MUSKRAT FALLS CORPORATION

and

ANDRITZ HYDRO CANADA INC.

SUPPLY AND INSTALL AGREEMENT

Supply and Install Powerhouse and Spillway Hydro-Mechanical Equipment

Agreement No. CH0032-001

DATED AS OF DECEMBER 18, 2013

TABLE OF CONTENTS

THIS AGREEMENT MADE as of the 18th day of December, 2013

BETWEEN:

MUSKRAT FALLS CORPORATION, a body corporate constituted pursuant to the *Corporations Act*, RSNL 1990, c. C-36, as amended, solely in its own right and not as agent of the Crown in right of the Province of Newfoundland and Labrador, and having its head office at the City of St. John's, Province of Newfoundland and Labrador (hereinafter referred to as **"Company"**)

- and -

Andritz Hydro Canada Inc. a corporation duly incorporated pursuant to the laws of New Brunswick (hereinafter called **"Contractor"**).

WHEREAS, Company is retaining the Contractor for the supply and installation of spillway and powerhouse hydro-mechanical equipment as more fully described in this Agreement;

WHEREAS, Contractor is engaged in the business of performing such Work and will provide all expertise, equipment, material and personnel to perform the Work;

WHEREAS Company and Contractor wish to set out all the terms and conditions on which Contractor shall carry out the Work;

NOW THEREFORE, the Parties, each in consideration of the promises and agreements of the other, hereby agree as follows:

ARTICLE 1
INTERPRETATION

1.1 The following Exhibits are attached hereto and shall form and be read and construed as an integral part of this Agreement:

Exhibit	Description
1	Scope of Work
2	Compensation
3	Coordination Procedures
4	Supplier Document Requirement List
5	Health and Safety Requirements
6	Environment and Regulatory Compliance Requirements
7	Quality Requirements
8	Subcontractors, Manufacturers and Material Sources
9	Interface and Milestone Schedule
10	Declaration of Residency

Exhibit	Description
11	Company Supplied Documents
12	Site Conditions
13	Provincial Benefits
14	Performance Security

1.2 For the purpose of this Agreement, except as is otherwise expressly provided or unless the context otherwise requires, the terms defined in this Article shall have the meanings assigned to them in this Article.

(a) **"Acceptance"** means express acceptance, concurrence or consent in writing by Engineer and **"Accepted"**, **"Acceptable"** and **"Accept"** shall be construed accordingly.

(b) **"Aconex"** means a cloud based computer software program for communication that can be accessed via an internet connection and a web browser.

(c) **"Affiliate"** or **"Affiliate(s)"** has the meaning given to affiliate in the *Canada Business Corporations Act*, R.S.C. 1985, c. C-44 and includes any limited partnership whose general partner is an affiliate of Company under that Act.

(d) **"Affiliate Assignee"** has the meaning ascribed thereto in **Article 30.1(a)**.

(e) **"Affiliate Assignment"** has the meaning ascribed thereto in **Article 30.1(a)**.

(f) **"Agent Party"** means initially the Security Trustee, and from time to time any agent or other person designated by the Security Trustee to enforce the Security Interests, or any receiver of the Affiliate Assignee or any person appointed as a receiver by the Security Trustee for the assets of the Affiliate Assignee. At any point in time there shall only be one Agent Party and the Security Trustee shall inform the Contractor each time there is a change in the designation of the Agent Party.

(g) **"Agreement"** means this document, including the Exhibits as referenced in **Article 1.1**, originally executed or as they may from time to time be supplemented, amended, revised or otherwise modified in accordance with the applicable provisions of this document and the Exhibits.

(h) **"Applicable Laws"** means any laws, statutes, regulations, standards, codes, orders, directives or other rules enacted or issued from time to time by any Authority having jurisdiction over Contractor or Company or the activities carried out under this Agreement, including safety, occupational health, customs and excise, taxation, workers compensation, labour and environmental protection laws, statutes, regulations, standards, codes, orders, directives and other rules.

(i) **"Approval"** means express acceptance, concurrence or consent in writing and **"Approve"** and **"Approved"** shall be construed accordingly.

(j) **"Authority"** means any:

(i) government or government department or agency;

(ii) municipality, local government authority or council;

(iii) other statutory authority;

(iv) fiscal or judicial body, commission, board, tribunal or agency; or

(v) other regulatory person or body;

(excluding Company) having jurisdiction or authority in any way over Contractor or Company or the subject matter of the Agreement, including a right to impose a requirement or whose Approval is required with respect to the LCP or the Work.

(k) **"Billing Information"** has the meaning ascribed thereto in **Article 12.6**.

(l) **"Breach"** has the meaning ascribed thereto in **Article 30.2**.

(m) **"Business Day"** means a day that is not a Saturday, Sunday or any other day which is a statutory holiday in the Province of Newfoundland and Labrador.

(n) **"Change"** means any of the following:

(i) An addition to the Work;

(ii) A significant increase or decrease in quantities of items forming part or all of the Work;

(iii) A deletion of any part of the Work;

(iv) A revision or modification to any part of the Work already completed;

(v) A variation to the schedule for the completion of a Milestone including a delay in the performance of the Work resulting from an act or omission by Company Group;

(vi) A modification in, variation to or deviation from the requirements set out in this Agreement that impacts Contractor's costs and/or schedule, including presence of hazardous substance as stated in **Article 15.12** and **Article 15.13**;

but for greater certainty, a Change shall not include:

(A) modifications, revisions or deviations to the requirements of the Agreement that are necessary to make the Work satisfy the performance requirements set out in Exhibit 1 – Scope of Work;

(B) any items that can reasonably be inferred as being included in the Work, including the advancement and development of the design of any element of the Work within the Contactor's responsibility under the Agreement;

(C) modifications, revisions or deviations to the requirements of Exhibit 1 – Scope of Work or any additional services that are requested by Company that are necessary because of delays attributable to Contractor Group;

(D) corrections or additional services that are required because of Contractor's breach of any of its representations, covenants, warranties, guarantees or other obligations under this Agreement, including corrections or additional services made necessary due to noncompliance with the Agreement, Applicable laws or the requirements of Authorities;

(E) the supply of any services, materials or equipment required to rectify any omissions, defects or deficiencies in the Work; or

(F) matters that might otherwise be grounds for alteration of a date for a completion of a Milestone but which coincide with any concurrent delay or other matter within Contractor's responsibility under this Agreement.

(o) **"Change Order"** means an order or directive for a Change issued in the form set out in Exhibit 3 – Coordination Procedures and signed by Company.

(p) **"Change Request"** means a request for a Change issued in the form set out in Exhibit 3 – Coordination Procedures.

(q) **"Claim"** means damages (including punitive and exemplary damages), expenses, costs, losses, injuries, liabilities, claims, liens, judgments, settlements, awards, remedies, debts, expenses, causes of action, demands, court costs, legal fees or disbursements.

(r) **"Commissioning"** means the checks, inspections, activities and tests required by the Technical Specifications to verify that the portion of Work performs in accordance with the requirements of this Agreement and is safe for use and/or occupation.

(s) **"Company"** means Muskrat Falls Corporation and its successors and permitted assigns.

(t) **"Company Group"** means collectively Company and Company's Other Contractors (including Engineer), and the respective Affiliates and Personnel of each of the foregoing, and any independent engineer, and its Personnel, retained by or on behalf of an entity that provides financing to Company or any of its Affiliates for the LCP or any part thereof.

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(u) **"Company's Other Contractors"** means all contractors and subcontractors of Company or its Affiliates, including all of their contractors and consultants (including any warranty surveyor or inspector) except Contractor and Subcontractors.

(v) **"Company Representative"** means the person designated in accordance with **Article 10.4**.

(w) **"Company Supplied Data"** means those documents listed in Exhibit 11 – Company Supplied Documents, together with such other documents to be provided by Company as shall be designated by Company in writing from time to time.

(x) **"Confidential Information"** has the meaning ascribed thereto in **Article 28.1**.

(y) **"Contract Price"** means:

(i) for all purposes other than those described in paragraphs (ii) and (iii) below, the two (2) fixed lump sums in the amounts and currencies set out in Appendix A to Exhibit 2- Compensation, as the same may be adjusted from time to time by agreement between the Parties or in accordance with the terms of the Agreement, being the consideration for the satisfactory performance of the Work by Contractor in accordance with the Agreement.

(ii) for the purposes of the performance security requirements in **Article 7** and project insurance requirements in **Article 20**, the Contract Price shall be the single lump sum in Canadian dollars specified in Section 12.2 of Exhibit 2-Compensation;

(iii) for the purposes of the limitation of liability in **Article 21.14,** and limits on liquidated damages in **Article 36**, the Contract Price shall be greater of the amount referenced in paragraph (b) above or the sum of the amounts referenced in paragraph (a) above converted to Canadian dollars using the exchange rates specified in Section 12.2 of Exhibit 2 - Compensation;

(z) **"Contractor"** means the Person identified as Contractor on the first page of this Agreement and its successors and permitted assigns.

(aa) **"Contractor Group"** means Contractor and Subcontractors (including Subcontractor's subcontractors of every tier) and their vendors and suppliers and their respective Affiliates which are Subcontractors and Affiliates which have a direct or indirect involvement in the performance of the Work and respective Personnel of each of the foregoing.

(bb) **"Contractor's Items"** means all machinery, systems, fittings, parts, spare parts, apparatus, tools, materials, supplies and any other equipment or items which are necessary to be supplied by Contractor Group at their cost to perform the Work but excluding such things that are permanently installed or Delivered as part of the completed Work.

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(cc) **"Contractor's Personnel"** means the Personnel to be provided by Contractor Group from time to time to perform the Work.

(dd) **"Contractor's Proprietary Information"** means information of a scientific or technical nature, including patented inventions, designs or trade secrets which Contractor employs in the course of performing the Work and is not otherwise required to be disclosed or delivered in accordance with other provisions in this Agreement.

(ee) **"Contractor's Representative"** is the person nominated as such in accordance with **Article 5.5**.

(ff) **"Court"** means a court of competent jurisdiction and includes the Supreme Court of Canada.

(gg) **"Cure Period"** has the meaning ascribed thereto in **Article 30.2**.

(hh) **"Defect"** means any error, omission, deficiency, defect and/or failure in design, materials, engineering, workmanship, manufacture and/or installation.

(ii) **"Deliver"**, **"Delivered"** or **"Delivery"** means that point in time at which Contractor provides and Company takes physical possession of the Work (or any part), in accordance with **Article 24**.

(jj) **"Dispute"** has the meaning ascribed thereto in **Article 39.1**.

(kk) **"Drawings"** means the drawings set out in Exhibit 1 - Scope of Work.

(ll) **"Effective Date"** means the date this Agreement is made as set out on page 1.

(mm) **"Engineer"** means Lower Churchill Management Corporation, or such other Person designated by Company in writing from time to time by giving Notice to Contractor, and any successors or assigns.

(nn) **"Exhibits"** means the Exhibits forming part of this Agreement and identified in **Article 1.1**.

(oo) **"Final Completion"** means that point in time when the Contractor has completed all the Work except for Warranty obligations.

(pp) **"Final Completion Certificate"** has the meaning ascribed thereto in **Article 25.6**.

(qq) **"Force Majeure"** has the meaning ascribed thereto in **Article 31.1**.

(rr) **"Interface"** means:

(i) the supply or delivery of products, components or materials by Company's Other Contractors for use or installation by Contractor in the performance of the Work; and

(ii) the supply, provision or construction of any erection, structure or opening by Company's Other Contractors necessary for Contractor's performance of the Work.

(ss) **"Good Utility Practice"** means the practices, methods and acts engaged in, or approved by, a significant portion of the electric utility industry in North America, or any of the practices, methods and acts which, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, are expected to accomplish the desired result at a reasonable cost consistent with good business, reliability, safety, environmental and expedition practices. Good Utility Practice is not intended to be limited to optimum practice, method or act to the exclusion of all others, but rather to include all practices, methods or acts generally accepted in North America.

(tt) **"HST"** means all amounts exigible pursuant to Part IX of the *Excise Tax Act* (Canada), R.S.C. 1985, c. E-15, including, for greater certainty, the taxes commonly referred to as the goods and services tax (GST) and the harmonized sales tax (HST).

(uu) **"LCP"** means lower Churchill projects which include hydroelectric power developments on the lower Churchill River located in the Labrador portion of the Province of Newfoundland and Labrador and associated power transmission facilities.

(vv) **"LEG2/96"** means the 1996 "Model 'Consequences' Defects Wording" published by the London Engineering Group.

(ww) **"Letter of Credit"** means the letter of credit described in **Article 7.3**.

(xx) **"Lower Churchill Construction Projects Benefits Strategy"** means the policy, strategy, obligations and procedures set out in the document located at www.NR.Gov.NL.CA/NR/Energy/LCP_Benefits_Strategy.pdf.

(yy) **"Milestone"** has the meaning ascribed thereto in Exhibit 3 – Coordination Procedures.

(zz) **"Milestone Completion Certificate"** means the certificate described in **Article 24.7**.

(aaa) **"Milestone Completion Date"** means for each Milestone and provided the Contractor has satisfied the criteria set forth in **Article 24.7** the date of Notice sent by Contractor to Company under **Article 24.7.**

(bbb) **"Milestone Schedule"** means the schedule for performance of the Work (or any part) as set out in Exhibit 9 – Interface and Milestone Schedule, as the same may be

7.2.9

amended from time to time by agreement of the Parties or otherwise in accordance with the provisions of the Agreement.

(ccc) **"Notice"** means a written communication that is required to be delivered in accordance with **Article 40**.

(ddd) **"Party"** means Company or Contractor, as the context requires, and **"Parties"** means Company and Contractor collectively.

(eee) **"Payment Certificate"** means the certificate for payment of all or any portion of the Contract Price that is issued by Contractor to Engineer for Approval by Company, all in accordance with **Article 12**.

(fff) **"Payment Milestone"** means a Milestone identified in Exhibit 2 – Compensation for which payment of a portion of the Contract Price is to be made by Company to Contractor.

(ggg) **"Performance Bond"** means the performance bond described in **Article 7.1**.

(hhh) **"Person"** means an individual, a partnership, a corporation, a trust, an unincorporated organization, a union, a government or any department or agency thereof and the heirs, executors, administrators, successors, assigns or other legal representatives of an individual, and words importing persons have a similar meaning.

(iii) **"Personnel"** means the directors, officers, employees, consultants, non-employed representatives and agents of a Person.

(jjj) **"Privacy Law"** means the *Access to Information and Protection of Privacy Act*, S.N.L. 2002 c. A 1.1, and all other applicable federal or provincial laws relating to disclosure of information, and the privacy, confidentiality or use of any information, about individuals and corporations.

(kkk) **"Punch List"** means a list of Defects and/or items or parts of the Work that are not complete as of the date of Substantial Completion Certificate.

(lll) **"Quality Plan"** means the plan described in Exhibit 7 – Quality Requirements.

(mmm) **"Security Interests"** means the following rights granted by Affiliate Assignee to the Security Trustee: (a) any right of set-off or combination of accounts intended to secure the payment or performance of an obligation; (b) any interest in property securing an obligation owed to, or a claim by, a Person other than the owner (which for the purposes hereof shall include a possessor under a title retention agreement and a lessee under a capital lease or in a sale and leaseback transaction), including by way of mortgage, pledge, charge, lien, assignment by way of security, hypothecation, security interest, hire purchase agreement, conditional sale agreement, deposit arrangement, deemed trust, title retention, capital lease,

discount, factoring or securitization arrangement deemed trust, on recourse terms; (c) any preference, priority, adverse claim, levy, execution, seizure, attachment, garnishment or other encumbrance which binds property; and (d) any agreement to grant any of the foregoing rights or interests.

(nnn) **"Security Trustee"** means the collateral trustee under a deed of trust and mortgage relating to senior secured bonds of the Affiliate Assignee, for and on behalf of the holders of such bonds from time to time, and any successor or assignee thereof.

(ooo) **"Site"** means the location for the performance of Work at the power plant, dam and/or immediate vicinity at Muskrat Falls, Labrador, as may be further described in Exhibit 1 – Scope of Work.

(ppp) **"Standard of a Prudent Contractor"** means good faith performance of contractual obligations and exercising that degree of care, skill, diligence, prudence, workmanship and foresight expected from a skilled and experienced contractor engaged in the same type of undertaking, in similar circumstances or conditions and in compliance with all Applicable Laws and to the satisfaction of Authorities.

(qqq) **"Subcontract"** means an agreement (including any supplement or amendment) entered into between Contractor and any Person in the manner and to the extent permitted under the terms of the Agreement by which Contractor engages such Person to perform any part of the Work.

(rrr) **"Subcontractor"** means any Person engaged by Contractor to perform any part of the Work pursuant to a Subcontract, and shall include the successors and permitted assigns of any such Person.

(sss) **"Substantial Completion"** means that the Work has been completed to the extent specified in **Article 25.1**.

(ttt) **"Substantial Completion Certificate"** means the certificate issued by Engineer in accordance with **Article 25.2**.

(uuu) **"Suspension Expenses"** has the meaning ascribed thereto in **Article 34.2**.

(vvv) **"Suspension Period"** has the meaning ascribed thereto in **Article 34.1**.

(www) **"Tax"** or **"Taxes"** means any tax, fee, levy, rental, duty (including, for greater certainty, all customs duties, anti-dumping duties and countervailing duties), charge, royalty or similar charge including, for greater certainty, any federal, state, provincial, municipal, local, aboriginal, foreign or any other assessment, governmental charge, imposition or tariff wherever imposed, assessed or collected, and whether based on or measured by gross receipts, income, profits, sales, use and occupation or otherwise, and including any income tax, capital gains tax, fuel tax, capital tax, goods and services tax, harmonized sales tax, value added tax, sales tax, withholding tax, property tax, business tax, ad valorem tax, transfer tax, franchise

tax, payroll tax, or excise tax, together with all interest, penalties, fines or additions imposed, assessed or collected with respect to any such amounts.

(xxx) **"Technical Assistance"** means the performance of technical assistance, advisory and/or other services as described in **Article 3.14**.

(yyy) **"Technical Requirements"** means specifications, drawings, plans or other documentation of a technical or scientific nature, and tests, set out or referenced in the Exhibits.

(zzz) **"Technical Specifications"** or **"Specifications"** means the document contained in Exhibit 1 – Scope of Work.

(aaaa) **"Term"** has the meaning ascribed thereto in **Article 1.18**.

(bbbb) **"Warranty"** means Contractor's obligations set out in **Article 17**.

(cccc) **"Warranty Period"** has the meaning ascribed thereto in **Article 17.1**.

(dddd) **"Warranty Work"** has the meaning ascribed thereto in **Article 17.5**.

(eeee) **"Work"** means all design, engineering, labour, services and obligations to be performed and materials, equipment and products to be supplied by Contractor under the terms of this Agreement, as more particularly described in **Article 3** and Exhibit 1 – Scope of Work, including Changes and the provision of all Personnel, plant, supplies, facilities, documentation, records and other items necessary to the performance of such design, engineering, labour, services and obligations.

(ffff) **"Worksite"** means any lands, waters and any other places on, under, over, in or through which the Work is to be performed, including design offices, workshops, onshore facilities, factories, fabrication facilities and places where Contractor Items are obtained, stored or used for the purposes of this Agreement.

1.3 The doctrine of *contra proferentem* shall not apply in the interpretation of this Agreement, meaning that if there is any ambiguous language in this Agreement it shall not be interpreted more strongly against the Party who prepared or drafted the ambiguous language.

1.4 Where reference is made to a direction, response, act, decision, determination, consent, waiver, approval, notice, request, or other communication of Company or to matters which must be satisfactory to Company, then, unless otherwise expressly stated, that matter is to be conducted or carried out at the sole discretion of Company.

1.5 Reference to any Party includes that Party's executors, administrators, substitutes (including persons taking by novation), successors and permitted assigns.

1.6 If an action pertaining to the administration of this Agreement, to Notices or to Disputes is required to be completed on a specified day which is not a Business Day, then the action shall be completed instead on the next Business Day.

1.7 Whenever in this Agreement the singular member or a masculine gender occurs the same shall be respectively construed as the plural, feminine or neuter and vice versa as the context or reference may require. Where a word is defined in this Agreement, a derivative of that word shall have a corresponding meaning.

1.8 Unless the context otherwise requires, reference to any Article is a reference to an Article or paragraph in this Agreement, and any reference to a Section is a reference to a Section or paragraph in an Exhibit.

1.9 The titles, headings, captions or indices shall not be used in any way in construing or interpreting any provisions of this Agreement.

1.10 Except as otherwise defined in this Agreement, words and abbreviations which have well known technical or trade meanings are used in the Agreement in accordance with such recognized meanings.

1.11 The recitals form part of and are incorporated into this Agreement.

1.12 The words "includes" and "including", whether or not used with the words "without limitation" or "but not limited to", shall not be construed to be limited by the specific enumeration of items but shall in all cases be without limitation and construed and interpreted to mean "includes without limitation" and "including without limitation".

1.13 Reference to any Act or legislation, or to a provision of an Act or legislation, is to the Act or legislation as amended and includes any statutory modification or re-enactment of it, a legislative provision substituted for it and any regulation, subordinate legislation or other statutory instrument issued under it.

1.14 If any provision in the Exhibits conflicts with a provision in the Articles of this Agreement, the provision in the Articles of this Agreement shall prevail. In the event that any provision in any of the Exhibits conflicts with any other provision in the Exhibits, priority shall be given in the order listed as follows:

(a) Exhibit 1 - Scope of Work

(b) Exhibit 9 – Interface and Milestone Schedule

(c) Exhibit 2 – Compensation

(d) Exhibit 7 - Quality Requirements

(e) Exhibit 3 - Coordination Procedures

(f) Exhibit 4 – Supplier Document Requirement List

(g) Exhibit 11 - Company Supplied Documents

(h) the remaining Exhibits in their numerical order by Exhibit number

except in respect of Technical Requirements, in which case the more stringent provision will prevail.

1.15 If the Standard of a Prudent Contractor conflicts with any other provision in this Agreement, the other provision in the Agreement shall prevail. Contractor shall give Notice to Company of any standard or requirement in this Agreement that Contractor considers is less stringent than the Standard of a Prudent Contractor.

1.16 The language of this Agreement shall be English and all communications and dealings under and the resolution of any disputes concerning this Agreement shall be conducted in the English language. All information, data or documentation of any nature that Contractor prepares in the performance of the Work, is required to submit to Company or is requested by Company to submit, shall be prepared in English.

1.17 Any Approval by Company or Acceptance by Engineer shall not waive Contractor's obligations under Applicable Laws or as outlined in this Agreement.

1.18 This Agreement shall be effective from the Effective Date and shall remain in full force and effect until the Work, and all Warranty obligations, is complete (the **"Term"**), unless earlier terminated in accordance with the provisions of this Agreement.

1.19 The illegality or unenforceability of any provision of this Agreement shall in no way affect the legality or enforceability of any other provision hereof. Any illegal or unenforceable provision shall be deemed severed from this Agreement and the remainder of this Agreement shall be construed and enforced as if this Agreement did not contain such illegal or unenforceable provision.

1.20 This Agreement shall be construed and the relations between the Parties determined in accordance with the Applicable Laws of Newfoundland and Labrador and Canada, including any limitation periods, and reference to such Applicable Laws shall not, by application of conflict of laws rules or otherwise, require the application of the Applicable Laws in force in any jurisdiction other than Newfoundland and Labrador. The Parties hereby irrevocably attorn to the Courts of the Province of Newfoundland and Labrador and Canada for the resolution of any dispute arising hereunder.

1.21 Except as expressly provided in the Agreement (including in the case of warranty and liquidated damages for delay) the rights and recourse of Company and Contractor contained in the Agreement are cumulative and not in the alternative unless otherwise provided. The exercise of any such rights or recourse shall not constitute a waiver or renunciation of any other rights or recourse. Except as expressly provided in the Agreement (including for the warranty and delay liquidated damages), the obligations imposed by the Agreement and the rights and remedies available thereunder are in addition to and not a limitation of any obligations, rights and remedies otherwise imposed or available by law.

1.22 Company is entering into this Agreement, and Contractor acknowledges that Company is entering into this Agreement, solely in its own right and not on behalf of or as agent of the Crown in right of the Province of Newfoundland and Labrador.

1.23 If Contractor is a joint venture or partnership of two or more Persons, all such Persons shall sign this Agreement and shall be jointly and severally liable to Company for all liabilities, indemnities and obligations of Contractor under, and relating to, this Agreement. Such Persons shall designate in writing one of them to act as a partner in charge with authority to bind the joint venture or partnership, as the case may be. The composition or the constitution of the joint venture or partnership, as the case may be, shall not be altered without the prior consent of Company. If requested by Company, Contractor shall provide to Company a copy of the joint venture agreement or partnership agreement, as applicable, excluding its financial terms, and such agreement shall be subject to the provisions of **Article 28**.

ARTICLE 2
CONTRACTOR'S STATUS

2.1 In the performance of its obligations under this Agreement, Contractor is an independent contractor and neither Contractor nor Contractor's Personnel shall be employees of Company. Contractor's Personnel shall be under the direct supervision and control of Contractor and not of Company. Contractor accepts complete responsibility as the principal for Contractor's Personnel.

2.2 Contractor is not an agent of Company or an agent of any Affiliate of Company. Contractor shall not represent or hold itself out as an agent of Company or an agent of any Affiliate of Company.

2.3 This Agreement shall not constitute a joint venture or partnership of Company and Contractor or of Company and any Subcontractor.

2.4 Contractor acknowledges that it shall be carrying on business in the Province of Newfoundland and Labrador during the performance of the Work and agrees to comply with the registration and other relevant provisions of the *Corporations Act*, RSNL 1990, c. C-36.

ARTICLE 3
CONTRACTOR'S OBLIGATIONS

3.1 Contractor shall carry out all of its obligations under this Agreement and shall perform the Work, including:

(a) any necessary design or engineering which is the responsibility of Contractor under this Agreement;

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(b) all work required for the procurement, fabrication, manufacturing, construction, testing, transport, delivery, maintenance, storage, documentation, preservation, installation, commissioning, repair and remediation of the Work;

(c) provision of all supervision, services, labour, trades, drafting, accounting, purchasing, expediting, inspection, testing, Personnel, Contractor's Items, transportation, mobilization and demobilization required for the compliance with and fulfillment of all Contractor's obligations under this Agreement;

(d) provision and installation of all equipment, products and materials required by this Agreement at the Site;

(e) ensuring the Work conforms strictly as to quality and description with the particulars stated in Exhibit 1 - Scope of Work and Company Supplied Data and complies with all Applicable Laws;

(f) satisfaction of the performance requirements set out in Exhibit 1 – Scope of Work;

(g) provision of all documents as required under, and in accordance with, the terms of this Agreement;

(h) provision of any work not expressly detailed in this Agreement or in Contractor's proposal, but which is necessary for the performance of the Work in accordance with this Agreement;

(i) rectification of any and all deficiencies as noted by Company, Engineer or any Authority before the start of the relevant Warranty Period and after such date as provided for in accordance with the Warranty; and

(j) completing the Work, and portions thereof, in accordance with Exhibit 9 - Interface and Milestone Schedule.

3.2 Contractor shall review and verify the details contained in the Exhibit 1 - Scope of Work, and Exhibit 11 - Company Supplied Documents and represents that it has a full knowledge and understanding of the nature and the scope of the Work, and including weather and all other conditions at Worksites, excluding subsurface, geological and hydrological conditions, Contractor should reasonably have discovered based on the Standard of Prudent Contractor. Contractor shall advise Company of any errors, omissions and inconsistencies in this Agreement which Contractor should reasonably discover based on the Standard of Prudent Contractor and shall not proceed with any part of the Work affected by such until resolved by Engineer.

3.3 Contractor shall ensure the work it performs is sufficient to encompass all matters necessary for the proper and efficient fulfillment of Contractor's obligations under this Agreement. Without limitation, Contractor shall undertake the Work in accordance with Applicable Laws, this Agreement and as required by any Authority.

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3.4 Contractor shall perform the Work to the Standard of a Prudent Contractor and shall ensure that Subcontractors shall perform to the same standard. Any material failure or any refusal or inability of Contractor to comply with the foregoing requirements shall constitute a breach of the terms and conditions of this Agreement. Contractor shall be solely responsible for any operations comprising the Work performed by Contractor Group.

3.5 Subject to **Article 10.3**, Contractor shall obtain and maintain all directions, guidelines, permits, certificates, authorizations, dispensations and licences of any type whatsoever necessary for the performance of the Work and shall comply with all Applicable Laws and requirements of Authorities. Contractor shall promptly notify Company in writing upon any discovery of a failure to adhere to the foregoing requirements in connection with the performance of the Work hereunder and shall defend, indemnify and hold Company Group harmless from and against all fines and penalties, as well as costs, expenses, rates and charges of Contractor Group and third parties, resulting from the failure of Contractor Group to comply with the foregoing requirements.

3.6 Contractor shall assist Company and provide necessary information and documents to support Company fulfilling Company's obligations set out in **Article 10.3**.

3.7 Contractor shall comply with all lawful instructions of Company pertaining to the performance of the Work, as communicated through the Company Representative, Engineer or otherwise in accordance with this Agreement. The absence of instructions from Company shall not permit Contractor to avoid its duty to perform its obligations under this Agreement. If Contractor fails to comply with a lawful instruction, then Company may at Contractor's sole risk and cost take whatever measures Company considers necessary to implement the instruction.

3.8 Contractor shall cooperate with Company's Other Contractors and Company Personnel working at the Worksites with a view to reducing interference with Company's Other Contractors and Company Personnel or with the operations of Company.

3.9 Contractor shall at all times promptly take all steps necessary to maintain good labour relations with Contractor Personnel to the extent that such requirement is consistent with sound business practice in accordance with the Standard of a Prudent Contractor. Subject to **Article 31.1(c)**, the existence of any labour disturbance relating to Contractor Personnel shall not relieve Contractor of its obligations hereunder.

3.10 Contractor shall transfer all unused excess materials, if any, to Company at the completion of the Work or, at Company's option, such excess materials shall be sold by Contractor and any amounts realized from such sales shall be credited to Company as a deduction from the Contract Price.

3.11 Contractor shall take such action as Company may specify to enable Company to comply with all Applicable Laws to be complied with by Company and in particular, Applicable Laws governing the use of local personnel, goods and services, which are in effect or which may come into effect during the Term.

3.12 Subject to **Article 6.2**, Contractor shall not change any location or place of origin identified in the Agreement for fabrication, manufacture or sourcing of equipment, materials or products without the prior Approval of Company.

3.13 Contractor shall be responsible, at its cost, for maintaining such inventories of Contractor's Items as necessary so as to avoid interruptions in the performance of the Work.

3.14 Contractor will provide Technical Assistance during installation and testing by Company's Other Contractors of the spillway, draft tube and intake primary anchors into first stage concrete. Technical Assistance will include:

(a) visually monitoring the installation and testing of such work for compliance with the requirements of the Contractor provided installation manual and inspection and test plans; and

(b) general Technical Assistance in accordance with the Agreement.

Contractor in performing Technical Assistance will not be required to complete or supply installation and testing quality control documents or ensure the orderly sequencing or accuracy of such quality control documentation. Company will be responsible for all matters pertaining to the quality of the installation and/or testing of such anchors, workmanship and progress of such work.

ARTICLE 4
CONTRACTOR'S DESIGN OBLIGATIONS

4.1 The provisions of this **Article 4** shall only apply to any design, engineering or architectural requirements that are the responsibility of Contractor under this Agreement.

4.2 All parts of the Work required by Applicable Laws to be performed by licensed or registered professional engineers or architects shall be performed by registered professional engineers and architects. In particular, any drawings, including design, installation and construction drawings, specific to the Province of Newfoundland and Labrador must be stamped by professional engineers registered to practice in the Province of Newfoundland and Labrador.

4.3 In the engineering and design of any equipment, products or materials to be incorporated into the Work and in the performance of the Work, Contractor shall exercise the standard of care normally exercised by licensed or registered professional engineers or architects having specialized knowledge, expertise and experience in the design of similar work.

4.4 For all engineering and design Contractor Group shall employ only engineering and design personnel who have the requisite knowledge and skills through education, training and experience to perform the engineering and design assigned to them.

4.5 Contractor shall design and engineer the Work for a useful life that is not less than the minimum stated in the Technical Requirements.

4.6 Before the start of the relevant Warranty Period, Contractor shall promptly remedy any error, omission, ambiguity, inconsistency or inadequacy in engineering or design identified by Engineer or Company in any Work and, after such date, as provided for in accordance with the Warranty.

4.7 Engineering and design review meetings will be scheduled and coordinated by Engineer in accordance with the provisions of Exhibit 3 – Coordination Procedures. Contractor shall attend all such engineering and design review meetings.

4.8 Contractor shall be solely responsible for all design and engineering for the Work for which it is responsible under this Agreement. Contractor shall not be relieved of its obligations under this Agreement by virtue of any Approval by Company or Acceptance by Engineer of Contractor's design and engineering or by virtue of a design and engineering review by Company Group.

ARTICLE 5
CONTRACTOR'S PERSONNEL

5.1 Contractor shall furnish and procure the numbers and classifications of Contractor's Personnel required to perform the Work. In the event Contractor fails to provide the numbers or classifications of Contractor's Personnel required in respect of the Work, Company may, at Contractor's sole expense, retain other contractors and deduct the costs associated with retaining such other contractors from the applicable compensation payable by Company to Contractor for the period such positions remain unfilled by Contractor. In such circumstances, Contractor shall assume, indemnify and save Company harmless for all liabilities associated with the retention of such other contractors.

5.2 Contractor shall ensure that throughout the Term each of Contractor's Personnel has the qualifications, training and experience, and holds the licenses and certifications necessary to carry out assigned duties in the performance of the Work. Contractor shall furnish records of competence for all of Contractor's Personnel when requested to do so by Company.

5.3 Contractor shall immediately remove and/or replace, at Contractor's own expense, any of Contractor's Personnel if, in the sole judgment of Company, any of Contractor's Personnel:

(a) ceases to carry out his or her duties in a manner satisfactory to Company or engages in misconduct, unsafe activities, or is incompetent or negligent;

(b) is certified by a medical practitioner as being medically unfit for the duties required of him or her; or

(c) risks impairing his or her usefulness in the performance of his or her duties through the use of alcohol or drugs.

5.4 Unless otherwise Approved by Company, Contractor shall replace, or cause to be replaced, at Contractor's own expense, any of Contractor's Personnel who is transferred or dismissed by Contractor or any Subcontractor, or leaves Contractor's or Subcontractor's employ.

5.5 Contractor shall nominate in writing one of Contractor's Personnel as Contractor's Representative. Contractor's Representative shall:

(a) be in charge of Contractor's Personnel and shall supervise Contractor's Personnel and maintain strict discipline in order to ensure the timely and efficient performance of the Work, and shall notify Company in writing of the occurrence of or threat of any labour dispute involving Contractor's Personnel;

(b) have full authority to act on behalf of and bind Contractor on all labour and Contractor's Personnel issues which arise between Company and Contractor;

(c) supervise the performance of the Work;

(d) have the authority to commit Contractor to any course of action within the bounds of its rights and obligations under this Agreement; and

(e) be authorized to receive on behalf of Contractor any Notices, information or decisions of Company made pursuant to this Agreement.

5.6 If positions of Contractor's Personnel of key importance to the performance of the Work are listed in Exhibit 3 – Coordination Procedures, Contractor shall not change any Personnel in such positions without the prior Approval of Company. In the event any such key Personnel leave the service of Contractor, Contractor shall promptly use all commercially reasonable efforts to retain suitably trained and experienced replacement key Personnel. In such circumstances, Company shall have the right, which shall be reasonably exercised by Company, to Approve such key Personnel. Contractor shall not retain such replacement key Personnel on a permanent basis without first obtaining Company's Approval, which shall not be unreasonably withheld or delayed.

5.7 Contractor shall be responsible for, and shall defend (and may settle with the Approval of Company, which Approval shall not be unreasonably withheld), protect, release, indemnify and hold Company Group harmless from and against all Claims of any nature incurred by Company Group in connection with the payment of Contractor's Personnel, including all compensation, medical costs, Taxes (including all Canadian and foreign payroll and withholding Taxes and remittances), unemployment insurance premiums, Canada pension plan contributions and other benefits of whatever nature or as may be applicable in any jurisdiction (including any jurisdiction where the Work is performed or where the Personnel reside or are employed) provided Contractor is given reasonable notice of any such Claim.

ARTICLE 6
SUBCONTRACTS

6.1 Subject to **Article 6.2** and **Article 6.3**, Contractor may employ Subcontractors to perform or support the performance of the Work or to furnish equipment to be provided by Contractor hereunder.

6.2 Contractor shall not Subcontract the whole of the Work. Subject to **Article 6.3**, Contractor may Subcontract for the supply of materials, services and minor fabrication for any single Subcontract up to a value of two hundred thousand dollars ($200,000.00), without Company's prior Approval. Contractor shall obtain Company's Approval for any Subcontract with a value in excess of two hundred thousand dollars ($200,000.00).

6.3 Subcontractors that are identified in Exhibit 8 – Subcontractors, Manufacturers and Material Sources are Approved by Company. Contractor shall not be entitled to replace Approved Subcontractors without the prior Approval of Company, which Approval shall not be unreasonably withheld.

6.4 Any Subcontract permitted under this **Article 6** shall not relieve Contractor of any of its duties, obligations, warranties, liabilities or responsibilities under this Agreement. Contractor shall be responsible for the acts, omissions and negligence of any delegate and any Subcontractors and any of their respective Personnel as fully as if they were the acts, omissions or negligence of Contractor's own Personnel.

6.5 Contractor shall oversee the performance of all Subcontractors and delegates and keep such records and accounts and furnish such reports and information relative to Subcontractors as Company may reasonably request. No Subcontract shall bind or purport to bind Company. All Subcontracts shall contain:

(a) a clear statement that Contractor is entering into such Subcontracts as principal and not as agent for any other Person; and

(b) a provision permitting the assignment of the Subcontract by Contractor to Company, at Company's option, without consent of Subcontractor.

6.6 Contractor shall ensure that any provisions of this Agreement which are required to be included in its Subcontracts have been so included. Contractor shall preserve and protect the rights of Company under this Agreement with respect to the Work to be performed by any Subcontractors so that the subcontracting thereof shall not prejudice such rights.

6.7 Contractor shall be responsible for, and shall defend (and may settle with the Approval of Company, which Approval shall not be unreasonably withheld), protect, release, indemnify and hold Company harmless from and against all Claims of any nature incurred by Company in connection with the payment of Subcontractor or Subcontractor's Personnel, including all compensation, medical costs, Taxes (including all Canadian and foreign payroll and withholding Taxes and remittances), unemployment insurance premiums, Canada pension plan contributions and other benefits of whatever nature or as may be applicable in any jurisdiction (including any jurisdiction where the Work is performed or where the Personnel reside or are employed) provided Contractor is given reasonable notice of any such Claim.

ARTICLE 7
PERFORMANCE SECURITY

7.1 Contractor shall deliver to Company within fifteen (15) Business Days of the Effective Date a performance bond in the form and with the content specified in Exhibit 14 which complies with **Article 7.2** (**"Performance Bond"**). Contractor shall maintain any such Performance Bond at all times until two years following the date shown for completion of the Work on the Final Completion Certificate issued pursuant to **Article 25**.

7.2 The Performance Bond required pursuant to **Article 7.1**, shall:

(a) be in effect as of the Effective Date;

(b) bond all of Contractor's obligations under this Agreement;

(c) strictly conform to the form of performance bond in Exhibit 14 – Performance Security;

(d) be in the face amount of fifty percent (50%) of the Contract Price, prepaid and non-cancellable by the surety;

(e) be issued by a surety which has a minimum credit rating of A- by Standard & Poor's, or equivalent rating by Moody's, DBRS or Fitch; and

(f) include a guarantee for correction of faulty workmanship and construction deficiencies for a period of two (2) years from the date shown for completion of the Work on the Final Completion Certificate issued pursuant to **Article 25**.

7.3 Contractor shall deliver to Company a letter of credit as security for the proper performance of Contractor's obligations under this Agreement, in the form and with the content specified in Exhibit 14 – Performance Security ("Letter of Credit"), as follows:

(a) within fifteen (15) Business Days of the Effective Date, a Letter of Credit equal to ten percent (10%) of the Contract Price valid until the date of Final Completion, which date shall be determined pursuant to **Article 25.6**;

(b) the bank issuing the Letter of Credit must be acceptable to Company and be set out in Schedule I of the Bank Act (Canada), S.C. 1991, c.46, as amended or replaced from time to time, and must have and maintain a senior, unsecured long-term credit rating of not less than A- or equivalent from any one of Standard & Poor's, or Fitch, or not less than A3 or equivalent from Moody's; and

(c) notwithstanding any term in this Agreement, Company is not obliged to make any payment to the Contractor under this Agreement until Contractor has delivered the Letter of Credit.

7.2.9.

7.4 All costs and expenses incurred in relation to the establishment and maintenance of the Performance Bond and Letter of Credit described in this **Article 7** shall be included in the Contract Price.

7.5 Company may claim and have recourse to the Performance Bond or to the Letter of Credit, or in any combination, if Contractor has not performed its obligations in accordance with the Agreement or if Company otherwise has a Claim against Contractor.

ARTICLE 8
POLICY ON ETHICS/CONFLICTS OF INTEREST

8.1 Contractor, in performing its obligations under this Agreement, shall establish and maintain appropriate business standards, procedures and controls including those necessary to avoid any real or apparent impropriety or adverse impact on the interests of Company and its Affiliates. Company reserves the right to review such standards and procedures at any time during the Term.

8.2 Contractor agrees to perform the Work and to conduct its operations in a manner which is in accordance with all Applicable Laws, consistent with the highest of ethical standards, including the Nalcor Code of Business Conduct and Ethics set out in Exhibit 11 – Company Supplied Documents, and to avoid any unlawful or unethical intervention in the political affairs of any country. Contractor agrees to cause all Subcontractors to adopt and enforce the foregoing policy.

8.3 Contractor shall not pay any commission or fee, or grant any rebate or make any loan to any Personnel of Company Group or government official, or favour any Personnel of Company Group or government official with any gift or entertainment of significant value or enter into any business arrangement with any Personnel of Company Group or government official. Contractor agrees to cause all Subcontractors engaged in the performance of the Work to adopt and enforce the foregoing policy.

ARTICLE 9
COMPLIANCE WITH LAWS

9.1 In performing the Work and carrying out the provisions of this Agreement, Contractor shall comply with all Applicable Laws.

9.2 Company may from time to time require Contractor to provide to Company, and Contractor shall promptly so provide, evidence acceptable to Company that Contractor has in all respects complied with the obligations set forth in **Article 9.1**.

9.3 Subject to **Article 21.4**, Contractor shall defend (and may settle with the Approval of Company, which Approval shall not be unreasonably withheld), protect, release, indemnify and hold Company harmless from and against all Claims whatsoever, whether direct or indirect, which may be brought against Company or which Company may sustain, pay or incur as a result of any failure by Contractor to comply with its obligations under **Article 9.1** and **Article 9.2** provided Contractor is given reasonable notice of any such Claim.

ARTICLE 10
COMPANY'S OBLIGATIONS

10.1 Subject to the provisions of this Agreement, Company agrees to engage Contractor to perform the Work in accordance with the terms of this Agreement.

10.2 Company, through the Company Representative or Engineer, shall provide to Contractor such instructions and information which can only be provided by Company. The provision of any such instructions or information shall not in any way relieve Contractor of any of its obligations under this Agreement.

10.3 Company shall obtain all authorizations, permits and licenses required by Applicable Laws for the performance of the Work and which are required to be and can only be obtained in Company's name.

10.4 Company shall designate a Company Representative who shall have authority to act on behalf of Company, commit Company regarding matters under the Agreement, receive and issue Notices and perform such other duties and acts reserved to the Company Representative under this Agreement.

10.5 Company Representative shall at all times during the Term have access to Contractor's Items and Worksites and may without limitation monitor the performance of the Work.

10.6 The Company Representative, by Notice to Contractor, may delegate any of their respective authority to any nominated deputy. Such Notice shall specify the precise authority of such deputy.

10.7 Company may change the Company Representative at any time at its sole discretion by Notice to Contractor.

10.8 Company is not obligated to supply any equipment, products or materials unless expressly stated in this Agreement that Company will supply specific equipment, products or materials. If any such equipment, products or materials are supplied by Company to Contractor, the equipment, products and materials shall be in the care and custody of Contractor but shall remain the property of Company. Contractor shall not use any such equipment, products and materials supplied by Company except for the purpose for which they were intended under this Agreement, and Contractor shall be responsible for the proper care, handling and maintenance of all such equipment and materials and shall indemnify Company against any loss or damage.

ARTICLE 11
ROLE AND RESPONSIBILITIES OF ENGINEER

11.1 Engineer has been retained by Company to provide procurement, construction management and contract administrations services. Engineer shall have such powers, discretions, functions and authorities as are specified in or as may be implied from this

Agreement and shall carry out such duties (including issuing instructions, decisions, orders and Acceptance).

11.2 Wherever Engineer is required to exercise its discretion by the giving of a decision, opinion or Acceptance, or to determine the cost or value of any matter which may affect the rights or obligations of a Party, Engineer shall exercise such discretion impartially within the terms of this Agreement, having regard to all circumstances.

11.3 Contractor shall comply with the decisions, orders and instructions given by Engineer in accordance with this Agreement.

11.4 Engineer shall confirm any decision, order or instruction in writing and any decision, order or instruction shall not be effective until such written confirmation has been received by Contractor.

11.5 Engineer shall be the interpreter of first instance of the Technical Requirements.

11.6 Contractor agrees that all Contractor's Items may be subject to inspection and Acceptance from time to time by Engineer or any Authority. Any Contractor Item which is rejected for not performing to standards set out in this Agreement or by Applicable Laws shall be immediately removed from the Worksite by Contractor and replaced with Contractor's Items Acceptable to Engineer at Contractor's cost.

11.7 Contractor shall not commence any Work involving permanent installation of any equipment, materials or products until Contractor has submitted to Engineer and Engineer has Accepted the health, safety and environmental plans required by **Article 15** and drawings marked "Issued for Construction" for the part of the Work to be performed.

11.8 Engineer shall notify Contractor when the Site is available for permanent installation of any equipment, materials or products as part of the Work, and Contractor shall not commence any Work at the Site until such notification has been given.

11.9 Where the Agreement calls for the Acceptance by Engineer or Approval by Company with respect to design, manufacture, installation, testing and commissioning of the Work, any such Acceptance or Approval is for general compliance with the Technical Requirements and does not relieve Contractor from satisfying all Technical Requirements. No inspection, review or Acceptance by Engineer or Approval by Company shall release Contractor from compliance with Contractor's obligations under this Agreement or Applicable Law.

11.10 Engineer or Company shall review and comment on Contractor's submittals required as per Exhibit 4 – Supplier Document Requirements, document no. 505573-3321-45EL-0002 and Exhibit 11 – Company Supplied Documents, document no. 505573-0000-37AG-I-0015, Rev 03 within fifteen (15) Business Days from the date Contractor submitted to Engineer or Company each of such submittals.

11.11 Company shall be responsible for the acts, omissions and negligence of Engineer as fully as if they were acts, omissions or negligence of Company.

ARTICLE 12
COMPENSATION AND TERMS OF PAYMENT

12.1 As full compensation for the performance by Contractor of all its obligations under this Agreement, Company shall pay Contractor the Contract Price in accordance with the terms of this Agreement including **Article 12**, Exhibit 2 – Compensation and Exhibit 3 – Coordination Procedures. Only those rates and prices specifically identified in Exhibit 2 – Compensation shall be paid by Company and any costs not specifically identified in Exhibit 2 - Compensation shall be deemed to be included in such rates and prices.

12.2 Within thirty (30) days of the Effective Date, Engineer, on behalf of Company, shall provide Contractor with a pro forma invoice that sets out all relevant Company cost codes and required information for billing. Contractor shall utilize said pro forma invoice and cost codes when billing Company.

12.3 Compensation to Contractor shall be paid:

(a) monthly based on progress, and/or

(b) upon achieving a Payment Milestone,

as further specified in Exhibit 2 – Compensation. Contractor shall be paid the portion of the Contract Price applicable to monthly progress or to a Payment Milestone following Approval by Company of a Payment Certificate and in accordance with the provisions of this **Article 12**.

12.4 Contractor shall provide, maintain and issue to Engineer, a detailed listing of the invoiced amounts of the Work and cash flow requirements regarding unbilled portions of the Work in accordance with the requirements set out in Exhibit 3 - Coordination Procedures. Contractor shall develop and present a format for the listing for Company Approval.

12.5 Contractor's invoices shall comply in all respects with Company's invoicing instructions as provided for in this Agreement, including Exhibit 2 – Compensation, Exhibit 3 – Coordination Procedures and Exhibit 13 - Provincial Benefits.

12.6 Invoices shall be accompanied by:

(a) all relevant supporting documentation as Company or Engineer may require to verify completion of the Work, the accuracy of the fees, charges and third party charges invoiced including copies of any relevant third party invoices, receipts and purchase orders;

(b) timesheets Accepted by Engineer for any Work performed on a time and materials basis;

(c) receiving reports and a summary page of all third party invoices, complete with summary sheet cross referring to all backup information; and

(d) a sworn declaration, in the form set out in Exhibit 3 – Coordination Procedures, that Contractor has paid Subcontractors, vendors and suppliers all amounts properly due for work, services, materials and equipment supplied or performed and billed by the Subcontractors, vendors and suppliers and included in Contractor's prior invoices for which Payment Certificates or Milestone Completion Certificates have been Approved by Company.

(All invoicing requirements, information and documentation described in this **Article 12** shall be referred to as the **"Billing Information".** Billing Information should always comprise a summary sheet with cross referencing to all backup information which demonstrates a clear audit trail substantiating all charges presented on the invoice.)

12.7 Company shall not be required to pay any invoice from Contractor until complete Billing Information has been provided to Company. Company shall not be responsible or liable for any Claim arising from delays in payment due to Contractor not providing complete Billing Information.

12.8 Contractor shall submit an application for payment as follows:

(a) For compensation based on monthly progress, Contractor shall issue to Engineer on the 25th day of each month during the performance of the Work, for Company's Approval, a Payment Certificate in the form set forth in Exhibit 3 – Coordination Procedures, that sets out:

(i) for Work items paid on a unit price basis, the number of units completed in that month together with the unit price and total claimed for each unit price item;

(ii) for Work items paid on a lump sum basis, the percentage completed as of the 25th of the month together with the amount claimed for each lump sum item based on the percentage completed less any amounts previously paid by Company for each such item;

(iii) for Work items paid on a reimbursable basis, Contractor will include such reimbursable items accompanied by appropriate references to the Agreement covering such items and a summary sheet cross referencing such items to all relevant Billing Information to demonstrate a clear audit trail substantiating all such items presented with the Payment Certificate;

and accompanied by all relevant supporting documentation as Engineer or Company may reasonably require to verify the progress achieved.

(b) For compensation based on Payment Milestones, when Contractor considers that a Payment Milestone has been completed and the criteria for completion of that particular Milestone have been achieved, it shall issue to Engineer, for Company's Approval, a Payment Certificate in the form set forth in Exhibit 3 – Coordination Procedures, together with a Milestone Completion Certificate and all relevant

supporting documentation as Engineer or Company may reasonably require to verify the successful completion of the relevant Milestone criteria and achievement of the Payment Milestone.

12.9 Where payment is made for Work items on a unit price basis, the quantities of unit priced items in Exhibit 1 – Scope of Work and Schedule of Unit Prices in Exhibit 2 - Compensation are estimated quantities only. Any increase or decrease in the quantities of Work performed in respect of those items listed in Exhibit 1 – Scope of Work and Schedule of Units Prices in Exhibit 2 – Compensation shall not result in a change in the unit price for those items.

12.10 On receipt of a Payment Certificate, Engineer shall review it and the supporting documentation to determine if the percentage completed is accurate and/or if the Milestone has been achieved as the case may be. Engineer shall render its decision within ten (10) Business Days from receipt of a Payment Certificate from Contractor. If Engineer determines that:

(a) For Work compensated on a monthly progress basis:

(i) the progress claimed in the Payment Certificate has been achieved, Engineer shall recommend to Company that the Payment Certificate may be Approved; or

(ii) the progress claimed has not been achieved, Engineer shall amend the Payment Certificate to reflect the progress actually achieved and advise Contractor in writing the reasons for the revision, and recommend to Company that the revised Payment Certificate may be Approved; and

(b) For Work compensated on a Payment Milestone basis:

(i) the Milestone has been achieved, Engineer shall recommend to Company that the Payment Certificate may be Approved; or

(ii) the Milestone has not been achieved, Engineer shall reject the Payment Certificate and advise Contractor in writing the reasons why the Milestone has not been achieved.

12.11 Upon receipt of a Payment Certificate Approved by Company, Contractor shall submit an invoice for the amount due as determined in accordance with Exhibit 2 – Compensation and the requirements of Exhibit 3 – Coordination Procedures. The invoice shall be supported by the Approved Payment Certificate and all Billing Information as Engineer or Company may reasonably require.

12.12 Contractor shall address invoices to:

Muskrat Falls Corporation
350 Torbay Road Plaza, Suite No. 2
St. John's, NL
A1A 4E1
Attention: Lower Churchill Project Accounts Payable

12.13 If any Change affects the Contract Price, Contractor may issue an invoice for the Work completed pursuant to the applicable Change Order, as follows:

(a) For Change Orders carried out on a lump sum or unit price basis, Contractor shall comply with the requirements outlined in **Articles 12.5** through **12.12** in the same manner as if the completion of the Change Order Work is payable by monthly progress or constitutes a Payment Milestone.

(b) For Change Orders carried out on a reimbursable basis, Contractor shall issue an invoice for that portion of the Change completed in the previous month, within ten (10) Business Days following the end of each month. Invoices in respect of such Changes shall be accompanied by all Billing Information including an executed copy of the relevant Change Order, a copy of time sheets Accepted by Engineer, daily progress reports and any other information as Engineer may require to verify the progress, completion and associated charges pertaining to the Change. The final invoice for reimbursable Changes shall also include any information as Engineer may reasonably require to verify the successful completion of the Change.

12.14 If Contractor fails to comply with the requirements of **Article 12.6**, the Work shall be deemed incomplete and Company may withhold monies otherwise payable to Contractor and/or return invoices to Contractor for resubmission until such information has been provided to the satisfaction of Company.

12.15 Within thirty (30) days following Engineer's receipt of a properly prepared invoice, accompanied by acceptable Billing Information in accordance with this **Article 12**, Company shall pay to Contractor the amount stated to be due, subject to all of the following:

(a) Company shall be entitled to withhold from such payment any amount(s) permitted pursuant to **Article 12.16**.

(b) If Engineer disputes any item charged in any invoice, Engineer shall notify Contractor of the disputed item specifying the reason therefor. Payment of such disputed item shall be withheld until settlement of the dispute, provided that payment shall be made on the undisputed portion.

(c) Company shall be entitled to set off amounts which it owes to Contractor under this Agreement against amounts which Contractor owes to Company under this Agreement or any other agreement

(d) For any payments made by Company to Contractor by electronic transfer, Contractor shall provide Company with the necessary banking information to facilitate

electronic transfer of funds to Contractor's bank. Any changes in Contractor's banking information or payment instructions shall be submitted in writing to the Company Representative. The Company shall not be held liable or responsible for errors or delays resulting from incorrect or delayed submission of changes in banking instructions.

12.16 Company shall be entitled to withhold payment, or to deduct from Contractor's compensation, any amounts associated with:

(a) invoiced items reasonably disputed by Company;

(b) Contractor's failure to make payments promptly to Subcontractors, agents, or suppliers;

(c) Contractor's failure to remit or pay any Tax or make any other payment required under Applicable Laws where Company, acting reasonably, determines that any such remittance or payment may be assessed against Company;

(d) Defects in the Work not remedied;

(e) liens or claims filed or registered against property, or reasonable evidence indicating to Company the probability of claims or liens being filed or registered, with respect to the Work; and

(f) any other matter as permitted or required by Applicable Laws or as expressly provided in Exhibit 2 – Compensation, or elsewhere in this Agreement.

12.17 If either Party fails to make payments as they become due under the terms of this Agreement or under an award by arbitration or Court, interest at the three (3) month Treasury Bill rate, as published by the Bank of Canada for the period in question, on unpaid amounts will also be due and payable until payment. Interest will apply at the rate and in the manner prescribed by **Article 12.17** on the amount of any claim settled pursuant to **Article 39** from the date the amount would have been due and payable under this Agreement, had it not been in dispute, until the date it is paid.

12.18 For greater certainty, Contractor and Company acknowledge that, notwithstanding any other provision of this Agreement, any amounts payable by Company to Contractor pursuant to this **Article 12** are exclusive of any HST as payable pursuant to section 165 of the *Excise Tax Act* (Canada), R.S.C. 1985, c. E-15. If Contractor is required to collect from Company an amount of HST with respect to the provision of any goods or services supplied pursuant to this Agreement, then Company, subject to compliance by Contractor with this **Article 12.21**, shall pay the amount of such HST to Contractor.

12.19 Contractor represents and warrants that it is now and shall remain registered for the purposes of the HST in accordance with Part IX of the *Excise Tax Act* (Canada), R.S.C. 1985, c. E-15, for the Term and that its HST Registration number is **801102153 RT 0001**.

12.20 Contractor shall provide, at all times when any HST is required to be collected, such documents and particulars relating to the supply as may be required by Company to substantiate a claim for any input tax credits as may be permitted pursuant to the *Excise Tax Act* (Canada), R.S.C. 1985, c. E-15, in respect of such HST. Without limiting the foregoing, Contractor shall include on all invoices issued pursuant to this **Article 12** all of the following particulars:

(a) HST registration number of Contractor;

(b) the subtotal of all taxable supplies;

(c) the applicable HST rate(s) and the amount of HST charged on such taxable supplies; and

(d) a subtotal of any amounts charged for any "exempt" or "zero-rated" supplies as defined in Part IX of the *Excise Tax Act* (Canada), R.S.C. 1985, c. E-15.

12.21 Notwithstanding any other provision in this Agreement, Company shall not be entitled to deduct nor retain from each payment a ten percent (10%) holdback pursuant to the *Mechanics' Lien Act*, R.S.N.L 1990, c.M-3. Contractor waives any and all rights and remedies it may have or obtain under the provisions of the *Mechanics' Lien Act*, RSNL 1990, c.M-3, arising from the performance of the Work, including lien rights against any property of the Company wherever situated. Contractor shall use its best effort to include a provision in its Subcontracts that the Subcontractor waives any right or benefits the Subcontractor may have or obtain under the *Mechanics' Lien Act*, RSNL 1990, c.M-3, arising out of any services, labour, materials, products or equipment supplied or delivered for the Work by the Subcontractor. Contractor shall indemnify and hold Company harmless for any losses and costs suffered or incurred by Company arising out of a failure by Contractor to include such a waiver in Subcontracts.

12.22 Company's obligation to pay any amounts to Contractor under this Agreement is subject to the following terms and conditions, which are inserted for the sole benefit of Company and may be waived by Company in whole or in part in respect of any payment, without prejudicing the rights of Company at any time to assert such terms or conditions in respect of any subsequent payment, namely:

(a) no notice of claim for lien shall have been given in connection with the Work or if a notice of such a claim for lien shall have been given, such claim shall have been released, vacated or, if applicable, removed from title or the claim shall have been secured through the delivery of a bond in respect of the full amount of the claim; and

(b) Company shall have received such other documents or satisfied such other conditions as Company or its project lenders may reasonably require and which are material to the Work.

12.23 The Parties agree that payments made by Nalcor Energy to Andritz Canada Inc. pursuant to a "Limited Notice to Proceed" agreement between Nalcor Energy and Andritz Canada Inc. dated September 6, 2013, shall be:

(a) included in and form a part of the Contract Price in this Agreement;

(b) credited against the Contract Price in this Agreement; and

(c) for greater certainty, the sum of the Contractor's compensation for performing Work under the "Limited Notice to Proceed" and for performing the Work under the Agreement shall not exceed the Contract Price.

12.24 The Parties agree that "Initial Work" which has been completed by Contractor and approved by Nalcor Energy pursuant to a "Limited Notice to Proceed" agreement between Nalcor Energy and Andritz Canada Inc. dated September 6, 2013, shall be included in and form a part of the Work under this Agreement. Such completed and approved "Initial Work" shall satisfy the obligation to perform that part of the Work under this Agreement to which the "Initial Work" relates.

ARTICLE 13
TAXES

13.1 Contractor acknowledges that it shall be carrying on business in the Province of Newfoundland and Labrador (and elsewhere as applicable) during the performance of the Work and agrees to prepare and to file in a timely manner all Tax returns or declarations required by any applicable Authority or Applicable Laws having jurisdiction over this Agreement or any portion thereof. Contractor shall lawfully discharge its Tax obligations.

13.2 Subject to the obligation of Company to pay HST pursuant to **Article 12.18**, Contractor shall pay all Tax and shall use its best efforts to ensure payment by Subcontractors of all Tax which may be lawfully assessed upon Contractor or any Subcontractor by any Authority having jurisdiction over Contractor, Subcontractor or this Agreement.

13.3 Contractor represents that Contractor's residence status for the purposes of Canadian income tax legislation is as set forth in Exhibit 10 – Declaration of Residency. Contractor shall advise Company of the country where Contractor is a resident for income tax purposes and shall give thirty (30) days Notice to Company and obtain its prior written consent before making or allowing any change to its tax residency status. If Contractor obtains, and provides to Company a copy of, an income tax waiver from the Canada Revenue Agency (CRA) waiving a non-resident tax source deduction as may be required by Canadian income tax legislation, Company agrees not to withhold any such income tax deduction to the extent waived so long as the waiver is and remains in force. In any event, Contractor further agrees to be liable for all such Taxes and shall indemnify Company in respect thereof pursuant to **Article 21.8** of this Agreement.

13.4 If required by the Applicable Laws of any country having jurisdiction, Company shall have the right to withhold amounts, at the withholding rate specified by such Applicable Laws,

from any compensation payable for the Work performed by Contractor Group, and any such amounts paid by Company to an Authority pursuant to such Applicable Laws shall, to the extent of such payment, be credited against and deducted from amounts otherwise owing to Contractor hereunder. Contractor shall note on each invoice whether any portion of the Work covered by such invoice was performed inside or outside of Canada for the purposes of Canadian income tax legislation or such other information requested or required by Company to properly assess withholding requirements. At the request of Contractor, Company shall deliver to Contractor properly documented evidence of all amounts so withheld which were paid to the proper Authority for the account of Contractor.

13.5 Contractor shall supply and arrange for all Contractor's Personnel to supply Company with all information relating to the activities under this Agreement that is necessary to enable Company or its Affiliates to comply with the lawful demand for information by any Authority. In the event Contractor does not supply or take all steps to arrange for any Subcontractor to supply such information and, as a result, an Authority imposes a Tax or fine upon Company or any of its Affiliates, Contractor shall forthwith pay or reimburse Company or any of its Affiliates for such Tax or fine.

13.6 Subject to the obligation of Company to pay HST pursuant to **Article 12.18**, the Contract Price shall include, and Contractor shall be responsible for, all Taxes which Contractor or Company is obliged pursuant to Applicable Laws to pay and does pay, for the purchase, sale, importation and exportation of the Work, or Contractor's Items, or personal property of any member of Contractor Group. Except as otherwise expressly provided herein, Contractor shall be the "importer of record" for the purpose of importing into Canada all Contractor's Items and the Work, or any part thereof, and shall pay all Taxes payable in respect of all such importations.

13.7 Contractor shall obtain for the benefit of Company all available exemptions from or recoveries of Taxes and shall employ all prudent mitigation strategies to minimize the amounts of Taxes required to be paid in accordance with Applicable Laws. In the event Contractor obtains any rebate, refund or recovery in respect of any such Taxes, it shall immediately be paid to Company to the extent that such amounts were paid by Company or reimbursed to Contractor by Company.

13.8 Notwithstanding any other provision of this Agreement, Contractor Group shall not make any statement, representation, filing, return or settlement regarding Taxes on behalf of Company to an Authority without the prior written consent of Company.

13.9 For greater certainty, Contractor and Company acknowledge that, notwithstanding any other provision of this Agreement, any amounts payable by Contractor to Company pursuant to this Agreement are exclusive of any HST payable pursuant to the *Excise Tax Act* (Canada), R.S.C. 1985, c. E-15 or any other Taxes exigible in respect of such amounts payable. If Company is required to collect from Contractor an amount of HST or other Taxes with respect to any such amounts payable pursuant to this Agreement, then Contractor shall pay the amount of such HST or other Taxes to Company. If the amounts payable by Contractor to the Company pursuant to this Agreement are deemed by any Applicable Law

7.13.9

to include an amount of HST or other Taxes, the amount otherwise payable pursuant to this Agreement shall be increased to the extent necessary so that the amount payable to the Company, net of such HST or other Taxes, is equal to the amount that would have been payable to the Company if such HST or other Taxes were not deemed to have been included in such amount.

13.10 For greater certainty, anti-dumping duties, countervailing duties and the like shall, in all cases, be borne by Contractor. Should any such duties become payable by Company, provided Contractor is notified promptly of such by Company, Contractor shall be liable for and defend (and may settle with Company's Approval, which Approval shall not be unreasonably withheld), protect, release, indemnify and hold Company harmless from and against any such duties, together will any interest, penalties and reasonable costs related thereto, and Contractor shall immediately provide Company with sufficient funds to pay such duties and other amounts in full.

ARTICLE 14
AUDIT AND RECORDS

14.1 Contractor shall maintain, and shall require each Subcontractor to maintain, in accordance with generally accepted accounting principles and practices satisfactory to Company, books, records, expense accounts and accounts pertaining to the provision of the Work, including Contractor's and Subcontractors' personnel records, correspondence, instructions, plans, drawings, receipts, vouchers, memoranda, tapes, data, models, data stored in computer libraries and such other documentation and related systems of controls.

14.2 Contractor and Subcontractors shall preserve the documents, records, registers and systems of control described in **Article 14.1** during the provision of the Work and for a period of not less than seven (7) years after expiration or any termination of this Agreement or for such longer period as may be required under Applicable Laws. Thereafter, Contractor shall give no less than sixty (60) days' notice to Company of Contractor's or Subcontractors' intention to destroy any of said documents and Company shall have the option to take possession of such records.

14.3 For Changes, Company shall, at all times, have access to and be authorized to examine and make copies, including electronic copies, of all documents, records and systems of control set forth in **Article 14.1** and such other documents and systems as may be related to such Changes and shall be authorized to interview Contractor's Personnel as may be necessary for an accurate audit and verification of costs of such Changes and general contract compliance relating thereto.

14.4 Notification of any claims made or discrepancies disclosed by an audit performed pursuant to this **Article 14** shall be made in writing to Contractor. Contractor and Company shall diligently attempt to resolve and agree upon such audit claims or discrepancies. Upon an audit claim or discrepancy being resolved and agreed upon, Contractor shall forthwith reimburse Company for any monies due as a result of such agreement or determination. Company may set off any amounts owed to it by Contractor for audit claim or discrepancies against any payments owed to Contractor by Company.

14.5 Contractor shall not be reimbursed for any costs it may incur as a result of Company conducting an audit pursuant to this **Article 14**. All such audits shall be conducted during normal business hours of Contractor and Company shall give reasonable notice to Contractor of the audit and shall specify the matters which are the subject of the audit.

14.6 Within five (5) Business Days of Notice by Company to Contractor, Contractor shall deliver to Company the most recent annual audited financial statements of Contractor.

ARTICLE 15
HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION

15.1 Contractor shall be responsible for ensuring the health and safety of all Contractor's Personnel who are engaged in the performance of the Work and also be responsible for environmental management. Without limiting the foregoing, Contractor shall:

(a) ensure that all Contractor's Items are maintained in safe, sound and proper condition and capable of performing the function for which each is intended and meets all industry standards and Applicable Laws;

(b) cease all activities in the area of any identified health, safety or environmental problem until such problem is resolved;

(c) immediately report to Engineer all health, safety and environmental problems and hazards;

(d) provide sufficient supervision, instruction and resources to ensure that Contractor Group's Work execution and Worksites comply with all Applicable Laws and good environmental practices;

(e) at its own expense and in accordance with Applicable Laws, supply and maintain Contractor's Personnel with personal protective equipment which shall be worn and used on all occasions as indicated by notices, instructions, good practice or as required by risk assessment;

(f) conduct such drills and tests of Contractor's Items, equipment, Personnel and procedures to ensure that they are available, trained and in place, respectively, for immediate and effective action in the event of emergency;

(g) comply with Company's emergency response requirements as described in Exhibit 11 – Company Supplied Documents;

(h) cooperate fully and comply with any directions given by Authorities, including the police, safety and environment regulatory officials and fire authorities; and

(i) report to Engineer monthly training compliance and safety statistics as identified by Engineer.

15.2 Contractor shall develop and submit to Engineer for Acceptance a detailed health and safety plan for the Work which demonstrates that, in connection with Contractor's performance of the Work, Contractor has identified risks pertaining to the health and safety of Contractor's Personnel, and that effective controls are implemented to prevent accidents and health and safety threats. Contractor's plan shall:

(a) satisfy the requirements of Exhibit 5 – Health and Safety Requirements;

(b) be structured in accordance with various elements within the Work such as fabrication, transportation, installation and commissioning;

(c) include measurable, achievable targets for health and safety performance, including: lost time frequency; total recordable frequency; injury severity data; and first aid cases;

(d) comply with Company's safety policies and procedures set out or described in Exhibit 11 – Company Supplied Documents; and

(e) comply with Applicable Laws and Exhibit 3 – Coordination Procedures.

15.3 Contractor shall develop and submit to Engineer for Acceptance a detailed environmental protection plan for the Work which demonstrates that, in connection with Contractor's performance of the Work at the Site, Contractor has identified risks pertaining to the environment and that effective controls are implemented to prevent threats and damage to the environment. Contractor's plan shall:

(a) satisfy the requirements of Exhibit 6 – Environmental and Regulatory Compliance Requirements;

(b) be structured in accordance with various elements within the Work such as fabrication, transportation, installation and commissioning;

(c) include measurable, achievable targets for performance, including: performance criteria for environmental emissions and waste, and hazardous materials; and

(d) include an environmental management plan that satisfies the Technical Requirements and Applicable Laws.

15.4 Engineer, on behalf of Company, shall Accept Contractor's plans required by **Article 15.2** and **Article 15.3** provided the plans comply with this Agreement, Applicable Laws and any ordinances, orders and decrees of any Authority having jurisdiction over health, safety and environmental compliance of the Work or the Worksite and any other requirements of Company.

15.5 Contractor shall comply with all such standards and the provisions of the plans required by **Article 15.2** and **Article 15.3**, along with any changes thereto as Contractor may be notified from time to time by Engineer, and all Applicable Laws relating to occupational health,

safety and environmental protection. Contractor shall ensure that all Contractor's Personnel involved in the performance of the Work comply with the provisions of Contractor's health, safety and environmental plans and all Applicable Laws relating to occupational health, safety, and environmental protection. Contractor shall appoint a safety officer who shall assist Contractor in safety matters relating to Contractor's Personnel.

15.6 Contractor shall promptly investigate and report to Engineer and Authorities having jurisdiction any near miss incidents or any accidents resulting in injury, death or illness to any of Contractor's Personnel engaged in the performance of the Work, any criminal acts, any damage to property or any adverse impact on the environment and any release of substances hazardous to the environment.

15.7 Contractor shall submit to Engineer for Acceptance Contractor's drug and alcohol policy which shall be in compliance with Applicable Laws. Contractor shall ensure that Contractor's Personnel who are engaged in the performance of the Work, are familiar with, and comply with, Contractor's drug and alcohol policy.

15.8 Company shall have the right to suspend performance of the Work for as long as necessary to prevent or stop any violation of this **Article 15**. During such period of suspension, Contractor shall not demobilize from the Worksite. No compensation shall be payable to Contractor by Company and Contractor shall not be entitled to compensation for any costs it incurs as a result of the suspension.

15.9 Company reserves the right to audit and inspect the Worksites to verify compliance with this Agreement, which audits and inspections may be performed by Engineer or such other third party as Company may direct.

15.10 Notwithstanding **Article 40.6**, in the event Company declares an emergency with respect to any matter affecting health, safety, the environment or potential damage to or loss of property, Contractor shall comply with verbal instructions issued by Company or Engineer with respect to such emergency. Company or Engineer shall confirm such instructions in writing at the first reasonable opportunity.

15.11 Subject to Section 2.6 of Exhibit 12 – Site Conditions, Contractor shall exercise all diligence to conduct operations under this Agreement in a manner that will prevent seepage, discharge or escape of debris. Contractor shall be responsible at its own costs to:

(a) handle, dispose and/or cleanup those hazardous substances included in Contractor's Items;

(b) handle, dispose and/or cleanup those hazardous substances disposed of or discharged on the Site by Contractor Group from Contractor's Items or other item used by Contractor in the performance of the Work;

(c) remediate any environmental damage arising from the Work occurring prior to Final Completion, including the removal and cleanup of any pollution, debris and hazardous substances from Contractor's Items;

(d) take such measures as are necessary in the circumstances to prevent or mitigate any environmental damage resulting from any pollution, seepage or discharge or escape of pollutants, debris and hazardous substances from the Work prior to Final Completion; and

(e) take such measures that Contractor or Company is under instructions to take from any Authority having jurisdiction to so instruct.

15.12 If Contractor:

(a) encounters hazardous substances at the Site; or

(b) has reasonable grounds to believe that hazardous substances are present in or on or under any of the Site which are not disclosed in the Exhibit 11 – Company Supplied Documents or are present in or on or under or migrating from any other sites;

Contractor shall:

(c) take all reasonable steps to secure such Site, including stopping the Work, to ensure that no individual suffers an injury, sickness or death and that no property is damaged or destroyed as a result of exposure to the presence of the hazardous substances;

(d) immediately report the circumstances to Engineer in writing; and

(e) report the circumstances to Authorities as required by Applicable Laws.

15.13 If hazardous substances are encountered during the Work, Contractor shall employ best practices and methods so as to minimize the costs of any work which may be required to handle and dispose of the hazardous substances and any environmental cleanup and to meet the requirements of Applicable Laws or Authorities.

ARTICLE 16
ACCESS AND QUALITY

16.1 Company shall, in accordance with this **Article 16**, have the right to send Company Group Personnel to the Worksites to monitor the progress of the Work, including to any manufacturing facility operated by any member of Contractor's Group where any materials, components, equipment or product is being manufactured, fabricated or assembled for the Work. At all times during the Term, Contractor Group Personnel shall provide all requisite assistance to Company Group Personnel.

16.2 Company Group Personnel shall, at all times during the Term, be granted unrestricted right of access to inspect the Work and monitor all the Work in progress or Contractor Items

utilized in connection with the creation or construction of the Work for the purpose of determining that the Work is being created or constructed in accordance with this Agreement.

16.3 Contractor, with the prior Acceptance of Engineer, shall permit representatives of Authorities to enter onto and inspect a Worksite, with reasonable advance notice and escorted access to the Work. Contractor may provide, and each such Person shall accept, reasonable safety and security measures implemented by Contractor. Contractor shall also promptly provide information reasonably requested by Company, Authorities or any of their representatives.

16.4 Contractor shall include appropriate provisions in all its Subcontracts and purchase orders to ensure the proper enforceability of the provisions of this **Article 16**.

16.5 No inspection, representation, responsibility or action of any Company Group Personnel hereunder shall relieve Contractor Group of any of its obligations or liabilities under this Agreement or operate as a waiver or release of the same.

16.6 Commencing on the Effective Date and throughout the Term, Contractor shall maintain a Quality Plan in respect of every aspect of the Work in accordance with Exhibit 7 – Quality Requirements.

16.7 Notwithstanding any Company, Engineer, Authority or other third party inspection, testing or witnessing, Contractor shall be responsible for quality control, quality surveillance/inspection, testing and quality assurance of the Work to verify and be able to demonstrate compliance with the requirements of this Agreement. Contractor shall carry out its quality management activities in accordance with Exhibit 7 – Quality Requirements.

16.8 Contractor shall conduct tests on the Work in accordance and in compliance with the provisions of Exhibit 1 - Scope of Work, Quality Plan, Contractor's quality management system, Company Supplied Data and Applicable Laws. Company and Engineer shall have the right at all times to request and witness any such test on the Work contemplated by this **Article 16.8**.

16.9 Contractor shall rectify, at Contractor's sole cost, any failure to comply with the requirements of Exhibit 1 – Scope of Work and Applicable Laws that are identified during testing, commissioning and inspection of the Work.

16.10 Upon completion of work necessary to satisfy **Article 16.9** and at the request of Company or Engineer, Contractor shall re-test the Work at Contractor's sole cost in order to confirm that the requirements of this Agreement are met. Company or Engineer may further require Contractor to re-test, at Contractor's cost, all the Work similar to that Work which originally failed any tests or inspection unless such similar Work was previously subjected to the same tests and found satisfactory.

16.11 Before the relevant Warranty period, Company and Engineer shall have the right to reject any Work, workmanship, equipment and documentation which do not conform to this

7.2.9.

Agreement. Contractor shall, at its sole expense, promptly remove any items so rejected and shall, in consultation with Company, immediately repair or replace the same at Contractor's option, providing such repair or replacement satisfies the Technical Requirements. Contractor shall carry out such further inspections or tests on other parts of the Work, as Company or Engineer may require, to ensure that there are no similar parts of the Work that fail to conform with this Agreement unless such similar Work was previously subjected to the same tests and found satisfactory.

ARTICLE 17
WARRANTY

17.1 The warranty periods in respect of the different portion of the Work are the periods of two (2) years from the dates set out below (the "**Warranty Periods**"):

(a) for the spillway electrical systems (including trash cleaner hoist and electrical building), when commissioned and ready for river diversion (Milestone M4 of the Milestone Schedule);

(b) for other spillway Work, when all stoplogs removed and ready for operation;

(c) for all powerhouse draft tube Work, when stoplogs are installed in units 1 & 2, bulkheads are installed in units 3 & 4, and when ready for water up of tailrace channel has been achieved (Milestone M22 of the Milestone Schedule);

(d) for all intake Work (including trash cleaner), when commissioned and ready for reservoir impoundment (Milestone M23 of the Milestone Schedule); and

(e) for all other Work, from the date of Substantial Completion, such date being determined pursuant to **Article25.2**.

17.2 Contractor shall perform all tests and take all measurements specified in Section 2 of the Technical Specifications to be made and taken during the Warranty Period.

17.3 For the duration of the Warranty Period, Contractor warrants:

(a) all of the Work and Warranty Work, against any and all Defects; and

(b) all of the Work and Warranty Work shall be fit for its intended use of controlling water flows (directly or indirectly).

17.4 For the avoidance of doubt, the provisions of this **Article 17** shall also extend to all portions of the Work and Warranty Work carried out by Subcontractors. Contractor shall cause to be extended to Company any applicable representations, warranties, guarantees and obligations with respect to design, engineering, materials, workmanship, equipment, tools and supplies furnished by its Subcontractors. All representations, warranties, guarantees and obligations of Subcontractors shall be:

(a) so written as to survive all Company and Contractor inspections, tests and Approvals; and

(b) extended to and be enforceable by Company, its successors and assigns.

If applicable, Contractor shall assign to Company all of Contractor's rights and interest in all extended warranties for periods exceeding the Warranty Period which were received by Contractor from any of its Subcontractors or vendors.

17.5 If, within the Warranty Period, any of the Work contains a Defect , Contractor, on receipt of Notice from Company, shall commence and diligently perform all services and work and supply all materials and equipment Contractor determines is required to remedy such Defect to the Standard of a Prudent Contractor at the times that Company directs so that it conforms to the requirements in the Agreement (**"Warranty Work"**). Company shall make that part of the Work containing the Defect available for repair by Contractor within 24 months from the date the Defect is discovered. If, for reasons outside Contractor's control, the Defect cannot be remedied at the times directed by Company and if Company Approves, Contractor shall provide a corrective action plan for review and Approval by Company. If Company rejects the corrective action plan, Contractor shall revise and re-submit the plan until the plan is Approved by Company. On Company's Approval of the corrective action plan, Contractor shall commence and diligently perform all Warranty Work as is necessary to remedy the Defect in accordance with the corrective action plan.

17.6 During the period that Warranty Work is being performed, Contractor shall continue to cooperate with Company's Other Contractors and Company Personnel in accordance with **Article 3.8**.

17.7 If Contractor does not fulfill its requirements under this **Article 17** or fails to fulfill its requirements within the period set by Company, such period to be fixed reasonably, within five (5) Business Days of Notice to Contractor by Company, Company may have the Work which is the subject of the Notice from Company corrected by a third party at the sole cost of Contractor. Such recourse shall in no way relieve Contractor from its Warranty obligations.

17.8 Contractor shall not substitute any materials in performing Warranty Work without the prior Approval of Company.

17.9 All work required to be performed in accordance with the terms of this **Article 17** shall be performed at the expense of Contractor and shall not give rise to any right of Contractor to remuneration.

17.10 Contractor shall consult Company prior to taking any action to re-design, re-build and replace any Work which, within the Warranty Period, fails to meet the requirements of this Agreement where such action may affect Company's commercial operation or maintenance of the Work.

17.11 This Warranty is subject to the following additional terms and conditions:

7.2.9

(a) Notwithstanding anything contained elsewhere in the Agreement, this Warranty shall apply to items manufactured and/or installed by Contractor, regardless of whether components or raw materials are supplied by Contractor or Subcontractors; and

(b) Subject to **Article 17.8** and **17.10**, Contractor shall have the option of repairing or replacing any Defects in the Work provided such repair or replacement meets all the requirements and specifications outlined in this Agreement.

17.12 Unless otherwise instructed by Company, Contractor shall remove from the Site and dispose of any parts or equipment that have been replaced, and Contractor shall be solely responsible for all costs associated with such removal and disposal. Company shall have the option, to be exercised at its discretion, to retain ownership of removed and replaced parts, and upon exercising such option Company may use or dispose of the parts as Company shall deem fit.

17.13 Company, itself or through Engineer, shall notify Contractor in writing with reasonable promptness after discovery of any Defect in respect of which Contractor shall be obliged pursuant to this **Article 17** to perform Warranty Work. Notice of any Defect discovered during the Warranty Period must be given to Contractor no more than sixty (60) days after the end of the Warranty Period.

17.14 Company, at its sole discretion, may retain independent third parties to inspect, test, review and/or observe the Work for compliance with this Agreement. Contractor, upon reasonable notice, shall provide such independent third parties access to the Work and to any facility in which any equipment or products are being manufactured for installation as part of the Work in order to permit the independent third parties to perform their duties.

17.15 The express warranties in this **Article 17** are the only warranties Contractor makes and there are no other warranties whether statutory, oral, express or implied. In particular, there are no implied warranties of merchantability or implied warranties of fitness for a particular purpose. Provided Contractor satisfies its obligations under this **Article 17**, the remedies available under this **Article 17** are Company's exclusive remedies for breach of Warranty.

17.16 Contractor shall have no Warranty obligations in respect of Defects in the Work caused by;

(a) errors in documents provided by Company;

(b) inadequacies in foundations or other work provided by or on behalf of Company;

(c) inadequate sub surface and hydrological conditions;

(d) Company's failure to operate or maintain the Work in accordance with Good Utility Practice or Contractor's written instructions delivered, to Company prior to the date of the Final Completion Certificate;

7.29.

(e) ordinary wear and tear or in respect of any parts that by their nature are subject to severe wear and tear and are considered expendable; and

(f) repairs performed by a Person other than Contractor except if such repair was made pursuant to **Article 17.7**.

ARTICLE 18
CONTRACTOR INSURANCE

18.1 Contractor will procure insurance policies in accordance with the requirements of **Article 18.3** from a financially sound insurance company and which is acceptable to Company, such acceptance not to be unreasonably withheld. If Contractor fails to procure such policies or fails to provide certificates of insurance confirming the coverage described in this **Article 18** in a form and with content acceptable to Company within the time specified in **Article 18.2**, or if any insurance is cancelled and not immediately replaced with comparable insurance to the satisfaction of Company, then Contractor shall be in default under **Article 32.2**.

18.2 Prior to commencing work at the Site or within thirty (30) Business Days following the Effective Date, whichever is earlier, Contractor shall submit to Company certificates of insurance evidencing the insurance required by **Article 18.3**. Failure of Company to advise Contractor of any insurance deficiencies shall not relieve Contractor of any liability related to its obligations under this **Article 18**.

18.3 Contractor shall at all times while conducting the Work carry at least the following insurance coverages with limits not less than those specified below, covering property and liability outside the scope of the insurance supplied by Company pursuant to **Article 20**. The cost of insurance procured by Contractor, including deductibles or self-insurance or policy retentions, shall be for the sole account of Contractor:

(a) Workers' Compensation

Workers' Compensation coverage for all of its Personnel engaged in the Work in accordance with the Applicable Laws of the jurisdictions in which the Work is performed. Contractor shall further ensure that non-residents working in Canada are fully covered by Workers' Compensation insurance and Employer's Liability insurance with such coverage including an extraterritorial benefits extension providing benefits at least equal to those provided by the jurisdiction in which the Work is performed.

(b) Employer's Liability

Employer's Liability insurance, with limits as required by Applicable Laws, but not less than Canadian five million dollars ($5,000,000.00) covering each employee engaged in the Work.

(c) Comprehensive General Liability

Comprehensive General Liability insurance written on an occurrence basis with limits of not less than Canadian five million dollars ($5,000,000.00) per occurrence for bodily injury (including death) and/or property damage including blanket contractual liability, sudden and accidental pollution liability for risks assumed by Contractor, broad form property damage, personal injury, contractor's protective liability, products and completed operations for a period of not less than twenty-four (24) months, contingent employer's liability and incidental medical malpractice.

(d) Automobile Liability Insurance

When not otherwise covered by Contractor's Comprehensive General Liability policy, Contractor shall obtain and maintain in effect automobile liability insurance covering all licensed vehicles whether owned, non-owned, leased or hired. Such insurance will provide a minimum combined single limit of liability for bodily injury and property damage of Canadian five million dollars ($5,000,000.00) per occurrence.

(e) Owned and Non-owned Aircraft

If applicable and to the extent that aircraft are used in the performance of the Work, owned and non-owned aircraft liability insurance with a combined single limit of not less than Canadian ten million dollars ($10,000,000.00). This insurance coverage may be provided by or through the owner or operator of aircraft used in the performance of the Work. Subject to **Article 21.13**, with respect to any claim arising from the use of owned or non-owned aircraft by Contractor in the performance of the Work, Contractors liability to Company is limited to the proceeds received from such owned and non-owned aircraft liability policy.

(f) Property

"All risks" property insurance covering all real and personal property which Contractor owns, leases or has in its care, custody or control and which is not otherwise insured by insurance obtained pursuant to **Article 20**, including all machinery and equipment to be used for the Work but not forming part of the Work.

(g) Property in Transit

If required by Exhibit 2 – Compensation, Contractor shall provide property in transit insurance coverage for the replacement cost of equipment, goods, products and materials to be incorporated into the Work with such coverage to apply during transportation from Contractor's plant, factory or distribution centre to the location for Delivery, with a maximum deductible of Canadian two hundred fifty thousand dollars ($250,000.00).

7.2.9.

(h) Subcontractors

Contractor is required to ensure that each of the Subcontractors provides insurance similar to the foregoing, as well as insurance which:

(i) is required by Applicable Laws; or

(ii) is reasonably appropriate in respect of the Work to be performed.

When requested to do so by Company, Contractor shall provide or cause to be provided to Company certificates of insurance confirming such Subcontractor insurance policies. Contractor Group shall not perform Work during any period when any required policy of insurance is not in effect.

(i) Other

In addition to the insurance coverage specified in this **Article 18**, Contractor shall carry such other insurance policies and in such amounts:

(i) as may be required in order to comply with Applicable Laws; and

(ii) with regard to liabilities assumed under the Agreement or in respect of specific activities performed for the Work.

18.4 Except for the policy which is the subject of **Article 18.3(g)**, all insurance policies required by this **Article 18** shall be endorsed to waive insurer's rights of subrogation against Company and Engineer and their Personnel, stockholders, successors, assigns and Affiliates. Except for this policy which is subject of **Article 18.3(d)**, liability policies required above shall name Company and Engineer and their Personnel, stockholders, successors, assigns and Affiliates as additional insureds and shall contain cross liability and severability of interest provisions. Except with respect to the insurance coverage to be procured by Company pursuant to **Article 20**, all of Contractor's insurance policies shall operate as primary to any insurance policies maintained by Company and their Personnel, stockholders, successors, assigns and Affiliates.

18.5 Contractor shall provide Company thirty (30) days prior Notice of any contemplated cancellation or any material change in the insurance coverages required by this **Article 18**.

18.6 Contractor shall give Company prompt notification of any claim involving the Work with respect to any of the insurance policies referred to in **Article 18.3**, accompanied by full details of the incident giving rise to such claim. Contractor agrees to do all acts, matters and things as may be reasonably necessary or required to expedite the adjustment of any loss or damage covered by insurance so as to expedite the release and disposition of such insurance in the manner and for the purposes contemplated in this Agreement. If requested by Company, Contractor shall advise Company in writing of the final resolution of any such insurance claims.

18.7 If requested by the other Party, a Party shall advise the other Party in writing of the final resolution of any insurance claims regarding the Work.

18.8 Company may reduce or waive all or any portion of these insurance requirements under circumstances where the Work to be performed does not require equivalent insurance coverage. Such reduction or waiver shall be obtained in writing and shall in no way reduce or waive Contractor's responsibility or liability for the Work.

18.9 Nothing in this **Article 18** shall or is intended to limit the liability of Contractor under any other provision of this Agreement. The provisions of this **Article 18** will not be interpreted as relieving Contractor of any of its obligations under this Agreement. Contractor may purchase, at its own expense, any additional insurance it deems necessary.

ARTICLE 19
WORKERS COMPENSATION

19.1 Prior to the performance of the Work at any Worksite within the Province of Newfoundland and Labrador, Contractor shall provide Company with Contractor's Workers' Compensation number and a letter of good standing in accordance with the Applicable Laws of the Province of Newfoundland and Labrador.

19.2 Contractor shall at all times pay, or cause to be paid, any assessment or contribution required to be paid pursuant to Applicable Laws relating to Workers' Compensation in respect of Contractor's Personnel and, upon failure to do so, authorizes Company, in addition to any other rights of Company under this Agreement, to withhold and remit on behalf of Contractor an amount equal to such assessment or contribution, including any interest and penalty assessed thereon.

19.3 Upon completion of Subcontract work, each Subcontractor who performed Work within the Province of Newfoundland and Labrador shall deliver to Engineer a clearance certificate from the Workplace Health, Safety and Compensation Commission of the Province of Newfoundland and Labrador.

19.4 Upon completion of the Work, Contractor and all Subcontractors who performed Work within the Province of Newfoundland and Labrador which have not previously provided evidence of compliance with **Article 19.3** above shall deliver to Engineer a clearance certificate from the Workplace Health, Safety and Compensation Commission of the Province of Newfoundland and Labrador.

ARTICLE 20
PROJECT INSURANCE

20.1 The following insurance coverages shall be procured by Company. The policies listed below will cover Company Group, Contractor and subcontractors of every tier (but not including vendors and suppliers except to the extent a vendor or supplier performs operations at the Site) as their interests and/or liabilities may appear:

(a) Construction All Risk (CAR) insurance, including design defect coverage to LEG2/96 or better, subject to a limit of not less than the total Contract Price, attaching on or in place and in effect as of the Effective Date.

(b) Wrap-up Liability insurance, with Company as the named insured and its Personnel, stockholders, successors, assigns and Affiliates as additional insureds, written on an occurrence basis with limits not less than Canadian fifty million dollars ($50,000,000.00) per occurrence for bodily injury and/or property damage including contractual liability, broad form property damage, personal injury, contractor's protective liability, completed operations for a period of not less than twenty-four (24) months, contingent employer's liability, incidental medical malpractice, cross liability and severability of interest provisions.

(c) Pollution Liability insurance, with Company as the named insured and its Personnel, stockholders, successors, assigns and Affiliates as additional insureds, written with limits not less than Canadian ten million dollars ($10,000,000.00) per occurrence and in the aggregate.

20.2 Insurance policies required by this **Article 20** shall be endorsed:

(a) to waive insurer's rights of subrogation against Contractor Group and subcontractors of every tier (but not including vendors and suppliers except to the extent a vendor or supplier performs operations at the Site) and their stockholders, successors, assigns and Affiliates; and

(b) include Contractor Group and subcontractors of every tier (but not including vendors and suppliers except to the extent a vendor or supplier performs operations at the Site) as additional insureds.

20.3 Contractor shall be responsible for deductibles under the Construction All Risk (CAR) policy of Canadian five hundred thousand dollars ($500,000.00), under the Wrap-up Liability policy of Canadian one hundred thousand dollars ($100,000.00), under the pollution liability policy of Canadian two hundred fifty thousand dollars ($250,000.00), provided that:

(i) Contractor shall not be responsible for deductibles arising from claims for damage or loss caused by earth quake or a Force Majeure event;

(ii) Contractor shall not be responsible for deductibles arising from claims for damage or loss caused by flood except Contractor shall be responsible for deductibles where the flood was caused or exacerbated by the acts or omissions of Contractor; and

(iii) to the extent a claim for damage or loss was caused by the negligence of Company Group, Company shall be responsible for that portion of the deductible which represents the proportion of fault attributable to Company.

20.4 The insurance policies required by **Articles 20.1** shall be in place and shall be maintained until a Final Completion Certificate has been issued, with any completed operations coverage to continue for twenty-four (24) months after the Final Completion Certificate has been issued as set out in the policy.

20.5 Contractor shall provide thirty (30) days prior Notice to Company of Contractor's intended date to commence Work at the Site, and ten (10) days prior to such date Company shall provide certificates of insurance to Contractor confirming that the policies of insurance required by this **Article 20** have been procured and are in effect. Upon written request from Contractor, Company shall provide a cover note summarizing insurance coverages and exclusions in the policies required by this **Article 20**.

20.6 Company shall provide thirty (30) days prior Notice to Contractor of any contemplated cancellation or any material change in the insurance coverages required by this **Article 20**.

ARTICLE 21
INDEMNIFICATION

21.1 The Parties hereby agree and acknowledge that if a provision in this **Article 21** conflicts with any other provision in this Agreement, the provision in this **Article 21** shall prevail.

21.2 For the purposes of this Agreement, any liability assumed or indemnity given by Contractor for the benefit of Company shall be deemed to be given by Contractor for the benefit of Company, its successors and assigns, Affiliates and Personnel.

21.3 Unless expressly otherwise limited or excluded herein, it is agreed and understood that the exculpatory clauses and indemnity obligations of each Party as provided in this Agreement shall apply to any and all Claims whatsoever incurred by the indemnified Party.

21.4 Subject to **Article 21.10** and **Article 23.6**, Company shall indemnify, keep indemnified and shall hold Contractor harmless from and against any and all Claims by a third party which Contractor may at any time sustain or incur by reason of or in consequence of a breach or non-performance by Company or any agent, employee or licensee for whom Company is in law responsible arising from the performance of any of the obligations of Company under this Agreement.

21.5 Contractor shall indemnify, keep indemnified and shall hold Company harmless from and against any and all Claims which Company may at any time sustain or incur by reason of or in consequence of any one or more of the following:

(a) any Claims by any third party in contract, tort, under any statute or otherwise at law or in equity with respect to any bodily injury, death or property damage or loss of such third party property arising out of a breach of contract or negligent actions or omissions or wilful misconduct of Contractor Group or any licensee, invitee or Person acting on behalf of any of them in connection with or incidental to the Work;

(b) any non-payment of amounts due and payable to Subcontractors, and Subcontractors' subcontractors, vendors and suppliers of every tier, resulting from furnishing of services, material, equipment, labour or otherwise in connection with the performance of Work;

(c) any Claim in respect of loss or damage to the property of Contractor Group however caused except to the extent the Claim was caused by the negligence or wilful act or omission by Company Group;

(d) any Claims in respect of personal injury or death of Contractor's Personnel except to the extent the Claim was caused by the negligence, or wilful act or omission of Company Group; or

(e) any representation or holding out by Contractor that it is an agent of Company.

21.6 Contractor shall include in all of its Subcontracts, a provision stating that Subcontractors shall defend, protect, release, indemnify and hold Company harmless from and against all Claims for the death of or bodily injury to Subcontractors and their respective Personnel, and for damage to or loss of the property of Subcontractors or their respective Personnel, except to the extent the Claims were caused by the negligence or wilful act or omission of Company Group.

21.7 Contractor shall be liable for and defend, protect, release, indemnify and hold Company harmless from and against all Claims (including any fine, penalty or demand of any Authority having jurisdiction) which may be brought against or suffered by Company or which Company may sustain, pay or incur, arising out of any failure by Contractor to comply with its obligations under **Article 15.11.**

21.8 Without limiting the generality of **Article 21.5**, and subject to the obligation of Company to pay HST pursuant to **Article 12.18**, Contractor shall be liable for and defend, protect, release, indemnify and hold Company harmless from and against:

(a) any and all Taxes imposed by any Authority on any of Contractor Group in respect of this Agreement, and any and all Claims including payment of Taxes which may be brought against or suffered by Company or which Company may sustain, pay or incur in conjunction with the foregoing as a result of the failure by Contractor to pay any and all Taxes imposed as stated herein;

(b) any and all Taxes imposed by any Authority in respect of the Work, or Contractor's Items, or any other items used by Contractor Group in the performance of the Work, or in respect of any services performed by Contractor Group in respect of this Agreement, and any and all Claims (including Taxes) which may be brought against or suffered by Company or which Company may sustain, pay or incur in conjunction with the foregoing as a result of the failure by any member of Contractor Group to pay any and all Taxes imposed as stated herein; and

21.9 Unless provided otherwise herein, the liability and indemnities specified in this **Article 21** shall apply:

(a) without regard to the characterization of any Claim, including the negligence or fault (whether sole, concurrent, gross (except when gross negligence or wilful misconduct is expressly provided as an exception to a specific provision hereof), active or passive negligence) or otherwise or wilful act or omission and including strict liability, breach of contract, breach of duty (statutory or otherwise) and including any pre-existing conditions, of either Party or any other Person (including the Party or Person seeking indemnity);

(b) whether or not any Claim is asserted to have arisen by virtue of tort, contract, quasi-contract, statutory duty, or any Applicable Laws;

(c) whether or not any Claim is made or enjoyed by the Person sustaining the injury or loss or by the dependents, heirs, claimants, executors, administrators, successors, survivors or assigns of such Person.

21.10 The indemnities given in this **Article 21** shall apply, notwithstanding that the indemnified Party may be entitled to contribution thereto from any third party and notwithstanding such liability may relate to the negligence of a third party, provided that in such case the indemnifying Party shall be fully subrogated to the rights of the indemnified Party against such third party.

21.11 If a Claim by a third party is asserted in circumstances which gives or may give rise to indemnification under this Article, the Party against whom the Claim is asserted (the "non-indemnifying Party") shall forthwith give Notice thereof to the other Party (the "indemnifying Party") and the indemnifying Party shall undertake the defence of such Claim. The indemnifying Party shall be entitled to retain legal counsel of its choice subject to the consent of the non-indemnifying Party, which consent shall not be unreasonably withheld. The Parties shall consult and cooperate in respect of such Claim and in determining whether such Claim and any legal proceedings relating thereto should be resisted, compromised or settled. Each Party shall make available to the other all information in its possession or to which it has access, and which it is legally entitled to disclose, which is or may be relevant to the particular Claim. The indemnifying Party shall provide the non-indemnifying Party with reasonable information as to the progress of such Claim on a regular basis. No such Claim shall be settled or compromised without the written consent of the indemnifying Party which consent shall not be unreasonably withheld. Notwithstanding the foregoing, if the indemnifying Party, within a reasonable time after Notice of any such Claim is given to it by the non-indemnifying Party, fails to defend such Claim, the non-indemnifying Party shall have the right to undertake the defence and compromise or settle such Claim on behalf of and for the account of the indemnifying Party.

21.12 Except for liquidated damages pursuant to **Article 36**, a Party has no responsibility and shall not be liable under this Agreement to the other Party for any Claim in respect of loss of profit, loss of revenue, business interruption, loss of business opportunity, loss of use, inability to operate at full capacity, cost of replacement power, whether foreseeable or not,

or any similar indirect or consequential damages or losses resulting from, arising out of or in connection with the Work or any obligation pursuant to this Agreement howsoever caused.

21.13 The aggregate liability of Contractor, Contractor Personnel, Subcontractors and Affiliate for all Claims of any kind for any loss, damage, expense resulting from, arising out of or connected with the Work or the performance or breach of this Agreement shall in no event exceed the sum of the Contract Price and actual insurance proceeds received from insurance to be maintained under this Agreement (to a maximum of Ten Million dollars ($10,000,000.00) of such proceeds per occurrence and in the aggregate), except that the foregoing limitation of liability shall not apply to Claims arising from Contractor's wilful, deliberate or intentional breach of this Agreement and Contractor's indemnity obligations under this Agreement resulting from or arising out of:

(a) Claims for personal injury (including death) suffered by third parties that are indemnified under **Articles 21.5(a)** and **21.5(d)**;

(b) Claims for property damage suffered by third parties that are indemnified under **Articles 21.5(a)** and **21.5(c)** with respect to Subcontractors only;

(c) fines and/or penalties imposed by any Authority but only and to the extent of amount of Taxes, fines and/or penalties imposed by any Authority that are indemnified under **Articles 3.5, 6.7, 9.3, 13.3** and **21.8**;

(d) Claims for infringement of patents and/or other intellectual property rights that are indemnified under **Article 29.3**; and

(e) Claims for any environmental damage or loss that are indemnified under **Article 21.7**.

21.14 The Contractor shall not be responsible for any damages caused by employees or representative of Company in relation to the Technical Assistance nor for any deficiencies or defective work performed by them under such Technical Assistance.

21.15 The limitations and exclusions of liability set forth in **Articles 21.12**, **21.13** and **21.14** shall take precedence over any other provision of this Agreement and shall apply whether the liability arises in contract, tort (including negligence), warranty, strict liability, indemnity or otherwise.

ARTICLE 22
SITE AND TRANSPORT ROUTE CONDITIONS

22.1 Contractor shall inform itself fully as to the risks and contingencies and all other data, matters and things, local or otherwise, respecting the Site, transportation routes and any other aspects of the Work necessary to satisfactorily perform Contractor's obligations under this Agreement.

22.2 Contractor acknowledges and agrees that utilities and service connections may not be located as exactly shown on drawings provided by Company or Engineer. Contractor shall satisfy itself fully as to the exact location of all utilities and service connections and shall, at no additional cost, make such alterations to the Work as may be required to avoid conflicts in or damage to utilities and connections.

22.3 Contractor shall be solely responsible for determining the transport route for shipment of all equipment, materials and products Contractor requires to perform and complete the Work. Contractor shall conduct its own tests or investigations to satisfy itself as to all transport route conditions, including obstructions, road conditions, weight restrictions, size limitations and utilities. Contractor accepts all risks and contingencies associated with the shipment of all equipment, materials and products for the Work.

22.4 Subject to **Article 31**, Contractor waives its right to any claim against Company for additional compensation or any extension to a date for completion of performance of any part of the Work set out in the Milestone Schedule based on, resulting from or arising out of any differences between transport route conditions that may exist and those conditions that may have been assumed or anticipated by Contractor, including resulting from any assumptions, anticipations, misunderstandings or misinterpretation by Contractor of port, bridge or road conditions or from any information provided by Company or Engineer.

22.5 Contractor shall bear all costs and charges for special and/or temporary rights which Contractor may require, including those for transport of components of the Work and access to a Worksite. Contractor shall also obtain, at Contractor's cost, any additional facilities outside a Worksite which Contractor may require for purposes of Work.

22.6 Subject to **Article 31**, Contractor shall be solely responsible for and assumes all risks associated with weather conditions at the Site, and the cost of performing the Work under all weather conditions experienced at the Site shall be included in the Contract Price.

ARTICLE 23
TITLE AND RISK

23.1 Contractor warrants good title to all Contractor's Items, consumables, goods and other items furnished by it under this Agreement and that they are free from any liens or encumbrances in favour of third parties. Risk of and in Contractor's Items shall remain with Contractor throughout the Term.

23.2 Subject to **Article 29**, title to the Work (or any part of the Work) performed, including all Contractor's documentation related to the Work, shall vest in Company as and when performed or prepared. Title to all equipment, materials and products to be supplied by Contractor or its Subcontractors for incorporation into the Work shall vest in Company as and when identified and designated for incorporation into the Work. Contractor shall identify, segregate in a secure area so far as possible and mark or otherwise identify all equipment, materials and products for incorporation into the Work as property of Company. Title to any items free issued to Contractor by Company shall always remain vested in Company.

23.3 Company shall have the right, without prejudice to any other right it may have under the Agreement, to decline to pay for any part of the Work if Contractor is unable to provide evidence reasonably satisfactory to Company that title to the same has passed to Contractor or shall pass unconditionally to Company as provided in the Agreement, free from any liens or encumbrances in favour of any third parties.

23.4 Contractor shall cause the inclusion of terms consistent with the terms of **Articles 23.1, 23.2** and **23.3** in all Subcontracts so that Company and Contractor shall have the rights herein set forth with respect to each Subcontractor involved in the performance of the Work.

23.5 Contractor warrants to Company that Applicable Laws do not prevent Company from obtaining title to the Work in accordance with this **Article 23**.

23.6 Subject to **Article 17**, risk of and in the Work shall be assumed by Company:

(a) for all Spillway electrical systems (including trash cleaner hoist and electrical building), when commissioned and ready for river diversion (Milestone M4 of Milestone Schedule);

(b) for other Spillway Work, when all stoplogs removed and ready for operation;

(c) for all Powerhouse Draft Tube Work, when stoplogs installed in units 1 & 2, bulkheads installed in units 3 & 4, and when ready for water up of tailrace channel (Milestone M22 of Milestone Schedule);

(d) for all Intake Work (including trash cleaner) when commissioned and ready for reservoir impoundment (Milestone M23 of Milestone Schedule);

(e) for all other Work, from the date of Substantial Completion, which date shall be determined pursuant to **Article 25.2**;

and Contractor shall assume the risk of and undertake the care and control of all other Work until Substantial Completion.

23.7 Contractor shall make available to Company all data relating to the operation and performance of the Work in electronic media for use by Company during the Term and during the operation of the Work. Contractor shall undertake all reasonable efforts to ensure data is provided in a form fully useable to Company with well recognized industry standard applications, including the requirements of Exhibit 3 - Coordination Procedures and Exhibit 11 - Company Supplied Documents. Where the software necessary to enable Company to fully utilize data is based in whole or in part on Contractor's proprietary information/software, Contractor shall grant Company and its Affiliates a non-exclusive, royalty free, irrevocable (except where Company or its Affiliate breaches the terms of this license and such breach cannot be rectified or remedied), and non-transferable license to such information/software for the purpose of the operation, maintenance, repair and refurbishment of the Work. Where such information/software is not proprietary to Contractor and obtained through usage of information/software leased or purchased from

third parties, Contractor shall, subject to Company's Approval, arrange for and obtain for the benefit of Company and its Affiliates a non-exclusive, royalty free, irrevocable (except where Company or its Affiliate breaches the terms of this license and such breach cannot be rectified or remedied), and non-transferable license to use such information/software for the purpose of the operation, maintenance, repair and refurbishment of the Work to enable Company and its Affiliates to fully utilize data in accordance with the terms of this Agreement. All Contractor's costs associated with such provision are deemed to be included in the Contract Price and are not separately reimbursable.

23.8 Company, at its discretion and upon Notice to Contractor, may take possession of or use Work, and/or any part of the Work, at any time prior to Substantial Completion of such Work. If Company takes possession of or uses the Work following such Notice:

(a) Company shall not be deemed to have Approved the Work or that part possessed or used;

(b) the Warranty obligations in **Article 17** shall apply except that the Warranty Periods for the Warranties in **Article 17.1** shall commence upon use of the part of the Work to which the Notice applies, notwithstanding the time for commencement in those Articles, and continue for the period specified in **Article 17**;

(c) Contactor shall not be relieved of its responsibilities and obligations under this Agreement;

(d) risk of loss of that part of the Work so possessed or used shall be assumed by Company on possession or use;

23.9 For the purpose of liquidated damages pursuant to **Article 36** and set out in Exhibit 2 – Compensation, Section 11.1, if Company takes possession or use of Work pursuant to **Article 23.8**:

(a) the spillway hydro-mechanical and electrical systems (including trash cleaner hoist and electrical building) shall be deemed commissioned and ready for river diversion (Milestone M4 of Milestone Schedule) as of the date of such possession or use of the relevant part of the Work; and

(b) all intake hydro-mechanical work (including trash cleaner) shall be deemed commissioned and ready for reservoir impoundment (Milestone M23 of Milestone Schedule) as of the date of such possession or use of the relevant part of the Work.

23.10 For the purpose of the performance incentives pursuant to **Article 36** and set out in Exhibit 2 – Compensation, Section 11.2, if Company takes possession or use of Work pursuant to **Article 23.8**:

(a) the spillway hydro-mechanical and electrical systems (including trash cleaner hoist and electrical building) shall be deemed commissioned and ready for river diversion

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(Milestone M4 of Milestone Schedule) as of the date of such possession or use of the relevant part of the Work; and

(b) all intake hydro-mechanical work (including trash cleaner) shall be deemed commissioned and ready for reservoir impoundment (Milestone M23 of Milestone Schedule) as of the date of such possession or use of the relevant part of the Work.

ARTICLE 24
COMPLETION AND DELIVERY

24.1 The Work shall be completed and Delivered to Company in accordance with the Milestone Schedule. In the event the Work (or any part) shall be tendered for Delivery before the applicable date in the Milestone Schedule, Company may, but shall not be obliged to, take Delivery of such Work. Any part of the Work ready for Delivery before the applicable date in the Milestone Schedule shall be stored and maintained by and at the expense of Contractor until Delivered to Company.

24.2 If Contractor fails to commence performance of the Work on the Effective Date or diligently proceed to complete the Work (or any part) for Delivery by the applicable date in the Milestone Schedule, Company may terminate the Agreement in accordance with **Article 32.1(c)** or may elect to continue with the Agreement if Contactor, in accordance with the provisions of **Article 24.3**, proposes an amended Milestone Schedule which is Approved by Company in a Change Order. Any changes to the Milestone Schedule pursuant to this **Article 24.2** and **Article 31** shall not result in an increase to the Contract Price or otherwise affect Company's rights to liquidated damages if a Milestone has not been achieved in accordance with the changed Milestone Schedule.

24.3 If Contractor has not or considers that it will not achieve a Milestone by the date specified in Exhibit 9 – Interface and Milestone Schedule:

(a) Contractor shall, within ten (10) Business Days of determining that a Milestone will not be achieved, submit for review and comment by Engineer a written completion plan detailing steps Contractor shall take to complete all necessary Work to meet the requirements of the Milestone, and Engineer shall provide written comment to Contractor within ten (10) Business Days of receipt;

(b) Contractor shall then resubmit to Engineer within five (5) Business Days a revised completion plan addressing any comments provided by Engineer, and Engineer shall provide written comment within five (5) Business Days of receipt;

(c) Contractor shall revise or resubmit the completion plan within the time limits in paragraphs (a) and (b) above until Contractor has addressed all comments of Engineer; and

(d) Contractor shall then promptly provide the necessary services, labour, materials and equipment as may be required under the completion plan.

24.4 The preparation, review and revision of a completion plan and provision of services, labour, materials and equipment as required by the completion plan shall not relieve Contractor of its obligations to achieve a Milestone by the date specified in Exhibit 9 – Interface and Milestone Schedule or be the basis for an increase in compensation.

24.5 Delivery of the Work shall be performed in the manner specified in the Agreement. Except as specified otherwise in the Agreement, Contractor shall be responsible for and shall bear the cost of packaging, loading and/or carriage of the Work to the location for Delivery specified in the Agreement.

24.6 Contractor shall ensure that provisions corresponding to those contained in this **Article 24** are included in all Subcontracts.

24.7 When Contractor has completed all the Work required to achieve a Milestone of the Milestone Schedule and/or a Payment Milestone, Contractor may by Notice to Company request written confirmation that Contractor has satisfied all the requirements to achieve such Milestone (the "Milestone Completion Certificate").

24.8 In the event Contractor has satisfied the criteria set forth in **Article 24.7**, Company shall provide Contractor with the corresponding Milestone Completion Certificate in the form set forth in Exhibit 3 – Coordination Procedures, within thirty (30) days of Contractor's Notice under **Article 24.7**.

ARTICLE 25
SUBSTANTIAL AND FINAL COMPLETION

25.1 Substantial Completion of the Work shall have occurred if and only if all of the items in paragraphs (a) to (g), inclusive, of this **Article 25.1** have occurred to the satisfaction of Engineer in accordance with this Agreement:

(a) the Work is ready for use or is being used for the purpose intended and is capable of achieving Final Completion at a cost of not more than two percent (2%) of the Contract Price;

(b) Contractor has delivered to Engineer all drawings, specifications, calculations, test data, performance data, equipment descriptions, equipment and system installation instruction manuals, integrated and coordinated operation and maintenance manuals, data, training aids required by this Agreement and, subject to **Article 26**, other technical documentation and information reasonably required by Company to use and maintain the Work;

(c) Engineer has prepared and delivered an updated Punch List to Contractor, which includes any minor items with respect to which Engineer has notified Contractor are incomplete or have Defects;

(d) Contractor has delivered to Engineer a Notice:

(i) detailing all outstanding Claims of Contractor under this Agreement with documentation sufficient in the opinion of Engineer to support such Claims, and Company shall not be liable to Contractor for any Claim under this Agreement which is not identified within that Notice; or

(ii) certifying that there are no other outstanding Claims;

(e) Contractor has delivered to Engineer the latest available clearance certificate from the Workers' Compensation Board of Newfoundland and Labrador that no assessments or other amounts are owing to the date therein specified;

(f) Contractor has removed all Contractor Group's Personnel, supplies, equipment, materials, rubbish and temporary facilities, except those reasonably required for completion of outstanding Punch List items, from the Worksite so that the Worksite is neat, clean and safe;

(g) there being no liens filed or registered pursuant to the *Mechanics' Lien Act*, RSNL 1990, c.M-3, with respect to or arising from the Work at that time.

25.2 When Contractor believes the requirements of Substantial Completion have been met, Contractor shall request from Engineer a Substantial Completion Certificate. Such request shall contain a declaration by Contractor that all the requirements of Substantial Completion have been met and a report of the results of any required tests for the Work with sufficient detail to enable Engineer to determine whether Substantial Completion has been achieved. If all requirements of Substantial Completion have been met to the satisfaction of Engineer, the date of Substantial Completion shall be the later of (i) the date specified in Contractor's request, and (ii) the date when the requirements of Substantial Completion were met to the satisfaction of Engineer. Within 30 days after Substantial Completion has been achieved as provided above, Engineer shall issue a Substantial Completion Certificate to Contractor, which states the date of Substantial Completion and Contractor shall turn over control and operation of the Work to Company.

25.3 If Contractor fails to rectify any items on the Punch List as soon as practicable, Engineer may notify Contractor and 30 days after such Engineer's notice, Company may employ others to carry out the rectification, the cost thereof being for the account of Contractor, without affecting any Warranties.

25.4 If any item of Work on the Punch List is not completed by the date specified on the Punch List for such item, Engineer may notify Contractor and 30 days after such Engineer's notice, Company may complete or employ others to complete the item and deduct one hundred ten percent (110%) of the cost to complete such item from the holdback shown on the Punch List, without affecting any Warranty.

25.5 Contractor's access to and continued presence at the Worksite after the date of Substantial Completion shall be for the sole purpose of achieving Final Completion. In performing such work Contractor will use its best efforts not to inconvenience or interfere with Company and Company's Other Contractors.

25.6 When Contractor has completed all the Work in accordance with the terms of this Agreement, except Warranty obligations, Contractor may by Notice to Company request written confirmation that Contractor has fully performed all of the Work hereunder (the "**Final Completion Certificate**"). If all requirements of Final Completion have been met to the satisfaction of Engineer, the date of Final Completion shall be the later of (i) the date specified in Contractor's request, and (ii) the date when the requirements of Final Completion were met to the satisfaction of Engineer.

25.7 By submission of the Notice to Company for confirmation that Contractor has fully performed all of the Work pursuant to **Article 25.6**, Contractor agrees that, as of the date of the issuance of the Notice, Contractor waives, remises, releases and discharges Company of any and all Claims as of the date of the Notice that are known, ought to have been known or discoverable by reasonable means by Contractor, which Contractor has or may have relating to or arising out of this Agreement and the subject matter of this Agreement, and all facts and circumstances related to the Work, save and except:

(a) any Claims previously submitted in writing prior to the date of the Notice, and remaining unresolved; and

(b) the balance of the Contract Price payable, if any, upon the issuance of the Final Completion Certificate.

25.8 Company shall not be obliged to issue the Final Completion Certificate until Contractor has fulfilled all of its Work obligations, including:

(a) satisfied any liens, claims or encumbrances affecting Company's property in connection with the Work or Warranty Work in accordance with **Article 41**; and

(b) paid in full any and all outstanding obligations against the Work.

25.9 Upon Contractor satisfying the criteria set forth in **Article 25.8**, Company shall provide Contractor with the Final Completion Certificate in the form set forth in Exhibit 3 – Coordination Procedures within fifteen (15) days of Contractor's Notice under **Article 25.6** or Contractor demonstrating that it has satisfied the criteria set forth in **Article 25.8**, whichever is later.

25.10 The issuance of the Final Completion Certificate shall not release Contractor from the provisions of this Agreement which expressly or by their nature extend beyond the expiration or any termination of this Agreement.

25.11 Within thirty (30) Business Days after issuance of the Final Completion Certificate, Company shall pay Contractor the balance of the Contract Price for the Work less:

(a) an amount to satisfy any liens registered against the property of Company arising out of Contractor Group's performance of the Work;

(b) any amount Company is entitled to set off against payment to Contractor;

(c) any amount payable by Contractor to Company under this Agreement; and

(d) any amounts required or permitted to be withheld by Company by Applicable Laws or this Agreement.

ARTICLE 26
CHANGES IN THE WORK

26.1 Company has the right to make a Change at any time and from time to time prior to the issuance of a Final Completion Certificate by issuing a Change Order. Compensation for a Change shall be determined in accordance with Exhibit 2 – Compensation and Exhibit 3 – Coordination Procedures.

26.2 Contractor shall not perform and shall not be entitled to any compensation for a Change without a Change Order issued by Company to Contractor for the Change.

26.3 Contractor will comply with the requirements of Exhibit 3 – Coordination Procedures in the development of the pricing, impacts on resources and schedule as it relates to such Change and present a comprehensive proposal covering the Change to Company for Approval.

26.4 Except to the extent expressly provided in a Change Order, no Changes shall vitiate or invalidate or be deemed to amend or be deemed to constitute a waiver of any provision of this Agreement. All Changes shall be governed by all the provisions of this Agreement. Changes will not result in any limitation of Contractor's Warranty under **Article 17**.

26.5 Contractor shall commence with and shall execute all Changes with all due diligence immediately upon receipt of a Change Order.

26.6 In the event the Parties fail to reach agreement on the pricing and impacts on resources and schedule with respect to a Change, Contractor shall perform the work specified in the Change Order as issued by Company and the Dispute will be handled in accordance with **Article 39.**

26.7 If Contractor considers that a Change is necessary or desirable, Contractor may request a Change Order by submitting a Change Request in writing to Engineer in accordance with the procedure set out in Exhibit 3 – Coordination Procedures.

26.8 If Contractor considers that an occurrence has taken place which constitutes a Change, then Contractor shall

(a) within five (5) Business Days of an occurrence that arises at the Site, give written notice to Engineer describing the occurrence and the reason Contractor considers that the occurrence constitutes a Change;

(b) within fifteen (15) Business Days of an occurrence that arises at a location other than at the Site, give written notice to Engineer describing the occurrence and the reason Contractor considers that the occurrence constitutes a Change; and

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(c) within thirty (30) days of the occurrence, request a Change Order

(i) quantifying the request by providing Engineer a Change Request in accordance with the procedure set out in Exhibit 3 – Coordination Procedures; or

(ii) if Contractor cannot complete the quantification of the request because the occurrence is ongoing as at the end of the thirty (30) day period, provide Engineer a reasonable estimate of the quantification of the request and shall provide the quantification promptly following the end of the occurrence.

(d) Company shall review such Change Request and notify Contractor of its decision within ten (10) Business Days. If Company:

(i) agrees that the occurrence constitutes a Change, then Company shall issue a Change Order in respect of the Change;

(ii) disagrees that the occurrence constitutes a Change, Contractor shall proceed with the Work without delay and such continuation of the Work shall be without prejudice to Contractor's rights to advance a Dispute under **Article 39**.

If Contractor fails to comply with the conditions of this **Article 26.8**, it will relinquish its right to request a Change Order and waives any claim it may have for additional compensation and for an extension of time to complete a Milestone arising from the occurrence.

26.9 Changes shall be invoiced and paid for in accordance with **Article 12**, Exhibit 2 – Compensation and Exhibit 3 – Coordination Procedures. Cost of the work carried out under a Change Order will reflect any discounts, rebates, refunds or free material credits earned with purchase of material or other goods and services charged under a Change.

26.10 If the quantity of the Work is decreased or any part of the Work is deleted Contractor shall not be entitled to claim any indirect or consequential damages, including loss of profits or loss of revenue.

26.11 If at any time after the start of the work directed by a Change Order for which there was no agreement on price, Company and Contractor reach agreement on the adjustment to the Contract Price and any adjustment to Exhibit 9 – Interface and Milestone Schedule, this agreement will be recorded in an amendment to the Change Order issued by Company.

26.12 If there is a change in Applicable Laws which makes modifications to the Work necessary or advisable and which impacts cost of the Work or the Milestone Schedule, Contractor shall be entitled to a Change Order in accordance with this **Article 26**. Upon becoming aware of the change in Applicable Laws, Contractor shall promptly present to Company a proposal for such modifications required as a result of the change in Applicable Law. Contractor shall prepare and provide to Company the following with its proposal:

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(a) details of the effect, if any, on the costs of the Work;

(b) details of the impact, if any, on dates for completion of Milestones and/or the Technical Requirements; and

(c) details of the impact on the Contract Price.

ARTICLE 27
PUBLICITY COMMUNICATIONS

27.1 Contractor agrees that all public relation matters arising out of or in connection with the Work shall be the sole responsibility of Company. Contractor shall obtain Company's Approval of the text of any announcement, publication or other type of communication concerning the Work.

27.2 Contractor shall not advertise or issue any information, publication, document or article (including photographs or film) for publication or media releases or other publicity relating to the Work, the Agreement, the LCP or Company's business and activities without Approval of Company except as may be required by Applicable Laws. Contractor shall promptly notify Company in advance of any such advertisement, issuance or publication that may be required by Applicable Laws.

27.3 Contractor shall refer to Company any enquiries from the media concerning the Work, the Agreement, the LCP or Company's business and activities.

27.4 Contractor shall include in each Subcontract a provision that incorporates the terms of **Article 27.1**, **27.2** and **27.3** such that those terms shall apply to each Subcontractor.

ARTICLE 28
CONFIDENTIALITY

28.1 The term "Confidential Information" shall mean all information and data, in whatever form, which a Party directly or indirectly acquires from the other Party or from the performance of the Work (including events witnessed by Contractor Group or Company Group and the Personnel of each of the foregoing in connection with the performance of the Work) and includes without limitation, Contractor's Proprietary Information. Confidential Information does not include information which:

(a) prior to the time of disclosure or acquisition is lawfully in the public domain;

(b) after disclosure or acquisition becomes part of the public domain, through no act or omission on the part of a Party;

(c) prior to disclosure or acquisition was already lawfully in a Party's possession without limitation on disclosure to others;

(d) was obtained by a Party from a third party who is lawfully in possession of such information and is not subject to a contractual or fiduciary relationship with the other Party with respect to such information; or

(e) was independently developed by the receiving Party without the use of Confidential Information.

28.2 Contractor shall not disclose Company's Confidential Information (including photographs of activities of Company) to any third party nor use any of Company's Confidential Information without the Approval of Company. Notwithstanding the foregoing, Contractor may disclose Company's Confidential Information to its Affiliates, Subcontractors and the directors, officers, employees, contractors, legal counsel, consultants and advisers to whom disclosure is required to enable Contractor to perform its obligations or if required by Applicable Laws provided Contractor has taken such reasonable and necessary precautions to prevent any of the foregoing parties from disclosing such information to any third party. Contractor shall adopt and follow precautionary measures with respect to Company's Confidential Information to ensure that it is not disclosed to third parties by any of Contractor Group, without the Approval of Company. Any Approval given by Company shall apply only to the specific request for Approval made by Contractor. If disclosure of Company's Confidential Information is required by Applicable Laws, Contractor shall promptly notify Company in advance of such disclosure unless prohibited by the Applicable Law.

28.3 Company shall not disclose Contractor's Confidential Information (including photographs of activities of Contractor) to any third party nor use any Contractor's Confidential Information without the Approval of Contractor. Notwithstanding the foregoing, Company may disclose Contractor's Confidential Information to its Affiliates, Engineer and the directors, officers, employees, contractors, subcontractors, legal counsel, consultants and advisors of the foregoing to whom disclosure is required to enable Company to perform its obligations hereunder or if required by Applicable Laws, provided Company has taken such reasonable and necessary precautions to prevent any of the foregoing parties from disclosing such information to any third party. Company may disclose such necessary Contractor's Confidential Information to Company's bankers and to financial institutions from whom Company may seek financing for the LCP. Company shall adopt and follow precautionary measures with respect to Contractor's Confidential Information to ensure that it is not disclosed to third parties by Company's Personnel or Engineer, or others, without the Approval of Contractor. Any Approval given by Contractor shall apply only to the specific request for Approval made by Company. If disclosure of Contractor's Confidential Information is required by Applicable Laws, Company shall promptly notify Contractor in advance of such disclosure unless prohibited by the Applicable Law.

28.4 To the extent a Party is subject to the provisions of the Privacy Law, all documents and other records in the custody of or under the control of that Party and its Affiliates, and in relation to the Work in the custody of or under the control of the other Party, will be subject to the Privacy Law. Subject to the limitations of the Privacy Law and to the extent it applies to each Party or its Affiliates, the confidentiality obligations contained in this Agreement shall apply.

7.2.9.

28.5 Each Party who discloses Confidential Information of another Party to its Personnel shall ensure that any such Personnel are informed of the confidential nature of the information disclosed and that such Personnel comply with the Party's obligations under this **Article 28**.

28.6 **Article 28** does not apply to the disclosure of information by a Party in order to comply with any Applicable Law or legally binding order of any Court or Authority, as long as prior to such disclosure the disclosing Party gives Notice to the other Party with full particulars of the proposed disclosure.

28.7 Contractor acknowledges that Company is subject to the access to information and Privacy Law pursuant to which the public may have access to Company's records.

28.8 If requested by the disclosing Party, whether prior to or after the expiry or earlier termination of the Agreement, the receiving Party shall promptly deliver to the disclosing Party all Confidential Information in the custody, possession or control of the receiving Party or any of its Personnel except for one archival copy to be kept in the legal department of the receiving Party and accessed only by legal counsel in the case of a dispute over the content of such Confidential Information disclosure.

28.9 The breach of any of the conditions contained in this **Article 28** will be deemed to be a material breach of the Agreement.

ARTICLE 29
PATENTS, TRADEMARKS, COPYRIGHTS

29.1 Contractor grants to Company and its respective Affiliates worldwide, a non-exclusive, royalty-free, irrevocable (except where Company breaches the terms of this license and such breach cannot be rectified or remedied), perpetual, non-transferable license to use any of its intellectual property rights for the purposes of performance of the Work, the use and operation of any property resulting from the performance of the Work, for the purposes of interfacing the Work with equipment supplied by third parties and for servicing and maintaining such property, including to have service and maintenance by third parties.

29.2 Contractor agrees to disclose promptly to Company, all inventions or concepts which it or its Personnel may make as a result of the performance of the Work or which are wholly or in part based on or derived from the Work and which are based mainly or wholly on technical information supplied by Company. Company hereby assigns all rights, title and interest in and to such inventions, and to any design, specification, or drawings produced in the course of the performance of the Work to Contractor. Company agrees to execute or have executed all documents and to perform or have performed all such lawful acts as may be necessary to perfect Contractor's title to such inventions and, subject to reimbursement of all reasonable costs incurred, to assist Contractor in obtaining and maintaining patent coverage, trademark or copyright thereon throughout the world.

29.3 Contractor shall not incorporate anything in the Work that violates copyrights, patents, and trademarks that were registered as of the date of incorporation into the Work. Provided that the part of the Work which is subject of a claim of patent, copyright or trademark

infringement and any uses of the Work associated therewith: 1) do not deviate from the Contractor's specifications; 2) have not been modified by Company or Company's Other Contractors; and 3) have not been designed in accordance with specifications provided or created by Company or Company's Other Contractors, Contractor agrees to indemnify and hold Company Group safe and harmless from and against any and all claims, losses, damages, costs (including legal costs), expenses and liabilities of every kind and nature arising out of or from any claims of alleged infringement of patents, copyright and trademark covering the Work or claims of Contractor's alleged misappropriation of proprietary or protected rights covering the Work and any property, methods or processes furnished by Contractor so long as Contractor is given reasonable notice of such claims. Contractor shall have the right and option to fulfill its obligations to Company hereunder by: (a) defending against and settling such claims; (b) obtaining for Company the right to continue using such Work or part thereof; (c) eliminating any infringement by replacing or modifying all or part of the Work. Contractor shall require its Subcontractors to provide the same rights and protections for Company Group that Contractor is required to provide pursuant to this **Article 29.3**.

29.4 Company agrees to indemnify and hold Contractor Group safe and harmless from and against any and all claims, losses, damages, costs (including legal costs), expenses and liabilities of every kind and nature arising out of or from any infringement or alleged infringement of patent or proprietary or protected rights covering property, methods or processes furnished by Company.

29.5 Subject to **Article 29.1**, **29.2** and **29.6** and except for any intellectual property rights included in any of the following documents, all drawings, assembly procedures, process specifications, computer programs, documents and information developed by Contractor Group for the purposes of the Agreement or which may arise out of the performance of the Agreement by Contractor shall be the property of Company.

29.6 If, as a result of the performance of the Work, Contractor Group develop any inventions or concepts, all rights, title and interest in and to such inventions and to any design specification or drawings produced therefrom shall belong to Contractor.

ARTICLE 30
ASSIGNMENT

30.1 Company may, without the Approval of Contractor, assign this Agreement, or any part thereof, to:

(a) any Affiliate of Muskrat Falls Corporation (an "**Affiliate Assignee**") provided, however, that notwithstanding any such assignment to an Affiliate Assignee (an "**Affiliate Assignment**"), Muskrat Falls Corporation shall remain jointly and severally liable for all obligations of the Affiliate Assignee under this Agreement until:

(i) Muskrat Falls Corporation has delivered a copy of a credit rating for the Affiliate Assignee to Contractor from any one of Standard & Poor's of BBB- or higher, Moody's of Baa3 or higher and DBRS of BBB low or higher;

(ii) the agent or Security Trustee of the lenders to the Affiliate Assignee has delivered a confirmation to Contractor that the Affiliate Assignee has credit facilities available to it to finance those costs of the LCP which include the Work in the form set out in Exhibit 3 – Coordination Procedures – Appendix M; and

(iii) Muskrat Falls Corporation has delivered to Contractor a confirmation in the form set out in Exhibit 3 – Coordination Procedures – Appendix N that Company's payment obligations to Contractor for the Work are included in the credit facilities available to Company referenced in paragraph (ii) above; or

(b) any successor to or replacement corporation of Company or similar entity in connection with any merger, consolidation or other reorganization of Company or transfer of all or any part of Company's assets other than as contemplated in paragraph (a) above; or

(c) any entity that has provided or provides financing for those costs of the LCP which includes the Work to Company, the Affiliate Assignee or their respective Affiliates, successors and replacements.

30.2 In the event of an assignment pursuant to **Article 30.1(c)**, Contractor agrees that:

(a) prior to the exercise by Contractor of any rights it may have under the Agreement arising by reason of any breach by Company of the Agreement (any such breach, a "**Breach**"), including cancellation or suspension of the Contractor's performance thereunder, Contractor shall give to the Agent Party at such time, written notice of the Breach at the time such notice is provided to Company. Upon receipt of such notice, such Agent Party shall be entitled, but shall in no way be obligated, to cure or cause to be cured such Breach and curable breaches which arose prior to such notice within sixty (60) days following the receipt by such Agent Party of such notice ("**Cure Period**"), provided that:

(i) such Cure Period will automatically be extended for the period of time the Contractor is precluded by Applicable Laws or by virtue of any debt reorganization, insolvency or bankruptcy proceedings, from cancelling the Agreement; and

(ii) during the Cure Period, Contractor will not be obligated to supply goods or services or otherwise perform prospective obligations under the Agreement unless Contractor receives immediate payment for such goods, services or obligations;

(b) it shall not exercise any rights of cancellation or suspension under the Agreement before the expiry of the Cure Period, unless the Agent Party at such time, expressly notifies the Contractor in writing that such Agent Party shall not:

(i) cure or cause to be cured the Breach specified in the relevant notice if such Breach is of a curable nature, or

(ii) observe and perform the obligations of Company under the Agreement, including curing curable breaches which arose prior to such notice.

30.3 Immediately and automatically upon delivery of the copy of the documents referenced in subparagraphs (i), (ii) and (iii) of **Article 30.1(a)** above, Muskrat Falls Corporation shall be fully and finally released and discharged from all liabilities, obligations, any and all actions, causes of action and covenants, whether expressed or implied, Claims or demands for damages, sums due, indemnity, costs (including without limitation legal fees and disbursements), expenses, interest, loss or injury of every nature and kind whatsoever and howsoever arising, which Contractor may heretofore have had, may now have, or may hereinafter have, in any way relating to or under this Agreement, both past and future, and Contractor acknowledges and agrees that the assignee shall thereupon be the sole obligor for all past and any future obligations under this Agreement in the same manner and to the same extent as if it was the sole obligor and original party hereto in the place and stead of Company under this Agreement, the whole without any further action, Approval, notice or document being taken, obtained, sent or executed by or to any of the Parties at any time. Any Affiliate Assignment pursuant to **Article 30.1(a)** shall become effective immediately upon delivery to Contractor of a Notice from Company and the Affiliate Assignee in the form set out in Exhibit 3 – Coordination Procedures – Appendix O.

30.4 Company shall not assign this Agreement or any of its benefits or obligations thereunder to any third party, other than those described in **Article 30.1**, without Contractor's Approval, which Approval shall not be unreasonably withheld, conditioned or delayed.

30.5 Following any assignment by Company pursuant to this **Article 30**, this Agreement may be re-assigned to Company without Contractor's Approval.

30.6 Contractor shall not assign any of its interest in this Agreement without the Approval of Company. Such Approval shall not release or relieve Contractor from any representation or warranty given by Contractor or any obligation to be performed on the part of Contractor under this Agreement. Notwithstanding the foregoing, Contractor may at any time assign its interest in this Agreement to an Affiliate, provided that:

(a) Contractor shall remain liable for any obligation to be performed on the part of Contractor under this Agreement, including Performance Guarantees, if the Affiliate fails to fulfill any such obligation;

(b) the Performance Bond, and letter of credit shall remain in place, remain effective and available to Company in the event the Affiliate fails to fulfill Contractor's obligation under this Agreement; and

(c) if the Affiliate has a tax residency status that is different than the tax residency status of Contractor as declared to Company in accordance with **Article 13.3** (or such subsequent tax residency Approved by Company in accordance with **Article**

13.3), Contractor has obtained the prior written approval of Company of the proposed assignment to the Affiliate.

30.7 In the event of a transfer by sale, assignment, amalgamation, merger, trust, operation of law or otherwise of any shares, interest or voting rights of Contractor which may result in the change of identity of the Person exercising *de facto* or *de jure* control over Contractor, the provisions of **Article 30.6** shall apply.

ARTICLE 31
FORCE MAJEURE

31.1 For the purposes of this Agreement, Force Majeure shall mean and be limited to the following:

(a) acts of God, riot, civil unrest, civil disturbance (including blockades to and from the Site), war, acts of civil or military authority, epidemics, quarantine restrictions, acts of terrorism, sabotage or destruction by a third party (other than any contractor retained by or on behalf of the Party suffering the Force Majeure);

(b) earthquake, fire, storms in excess of a one hundred (100) year storm or other natural physical disaster, but excluding other weather conditions as such regardless of severity;

(c) except for strikes caused or contributed to by Contractor, strikes at a national, provincial or Site level, industrial disputes at a national, provincial or Site level, which affect a substantial or essential portion of the Work; and

(d) maritime and aviation disasters.

31.2 Neither Contractor nor Company shall be responsible for any failure to fulfil any term or condition of this Agreement if and to the extent that such fulfilment has been delayed or rendered impossible by a Force Majeure occurrence of which the other Party has been notified in accordance with this **Article 31** and which is beyond the control and without the fault or negligence of the Party affected, and which by the exercise of reasonable diligence the said Party is unable to provide against. In the event of such a Force Majeure occurrence the Milestone Schedule shall be adjusted by the amount of the delay caused by the occurrence.

31.3 A Party may not rely upon the provisions of **Article 31.2**:

(a) unless within five (5) Business Days of being made aware of the Force Majeure occurrence it has given Notice to the other Party of such Force Majeure and of the obligations expected to be affected thereby;

(b) unless it shall immediately take all such steps as may be commercially reasonable in the circumstances to cause the discontinuance of, and to minimize the effect of, the

Force Majeure occurrence and resume performance of the obligation affected by the Force Majeure as soon as reasonably possible; and

(c) to the extent that and for so long as there would be concurrent delay to Work resulting from pre-existing matters within the responsibility or obligation of Contractor under this Agreement.

31.4 Where Company claims Force Majeure and is entitled to rely upon the provisions of **Article 31.2**, then no compensation shall be payable to Contractor during the period that the Force Majeure occurrence continues to prevent performance by Company. Where Contractor claims Force Majeure and is entitled to rely on the provisions of **Article 31.2**, then no compensation shall be payable to Contractor during the period that the Force Majeure occurrence continues to prevent performance by Contractor.

31.5 If Contractor is prevented from or delayed in performing any of its obligations as a result of an event of Force Majeure for a cumulative period of more than thirty (30) days or a consecutive period of more than fifteen (15) days during the Term, Company shall have the right thereafter to immediately terminate this Agreement upon giving Notice thereof to Contractor and Company shall have no further liability whatsoever to Contractor (except payment for Work performed prior to such termination and demobilization costs).

31.6 A Force Majeure occurrence shall in no circumstances entitle Contractor to an increase in the Contract Price.

31.7 During any period in which the performance of the Work is prevented because of Force Majeure, Contractor and Company shall mutually agree either (1) to continue maintaining Contractor's Items and Personnel at or near the Worksite, in which case Company will reimburse Contractor at the rates outlined in Exhibit 2 - Compensation which is intended to cover only those expenses incurred by Contractor as a direct result of such prevention of performance, or (2) to demobilize Contractor's Items and Personnel.

ARTICLE 32
DEFAULT AND TERMINATION

32.1 Company may, without prejudice to any other right or remedy that it may have against Contractor, by giving Notice to Contractor, immediately terminate this Agreement in the event that any of the following shall occur:

(a) Contractor breaches any of its obligations under **Article 15**;

(b) Contractor becomes or is, in Company's reasonable opinion, likely to become insolvent or to go into liquidation;

(c) Contractor fails to execute the Work in accordance with Exhibit 9 – Interface and Milestone Schedule and has failed to commence and diligently pursue actions reasonably necessary to mitigate or remedy such failure within ten (10) Business Days after the Notice from Company;

(d) the Work or any material part thereof becomes an actual or constructive total loss prior to Delivery notwithstanding that the loss may have been caused by an event of Force Majeure;

(e) Contractor fails to procure or maintain the Performance Bond and the letter of credit in accordance with **Article 7**; or

(f) Contractor is in breach of any other material obligations under this Agreement, including any terms, conditions, covenants, representations or warranties and has not commenced to rectify such breach within ten (10) Business Days after Notice thereof from Company or, after commencing to rectify such breach, is unable to rectify such breach within sixty (60) days of Company's Notice.

32.2 Notwithstanding **Article 32.1(f)**, if Company has provided ten (10) Business Days prior Notice to Contractor of the following applicable occurrence and Contractor has failed to remedy such occurrence within such ten (10) Business Day period, Company may, without prejudice to any other right or remedy that it may have against Contractor, by giving Notice to Contractor, immediately terminate this Agreement in the event that any of the following shall occur:

(a) Contractor fails to make prompt payment for labour, materials, financing, skill or other services provided to Contractor by third parties in the performance of the Work;

(b) Contractor subcontracts or delegates any portion of the Work, or its obligations hereunder, without Company's Approval in accordance with **Article 6.2**;

(c) Contractor assigns this Agreement without Company's Approval pursuant to **Article 30.6**;

(d) Contractor fails to obtain or maintain the insurance required in accordance with **Article 18**;

(e) Contractor disregards reasonable instructions of Company.

32.3 In the event Company terminates this Agreement pursuant to **Article 32.1** or **32.2**, Company may take title and possession of all Work and Company may complete the performance of the Work by whatever method it may deem expedient. In such case:

(a) Company shall have no liability whatsoever to Contractor, except for any amounts payable up to the date of termination of this Agreement (plus those amounts payable pursuant to **Article 32.6** when Company terminates pursuant to **Article 32.1(d)** due an event of Force Majeure), subject to Company's rights of set off; provided that Contractor shall be reimbursed for all Work performed by Contractor, to the satisfaction of Company, prior to such termination;

(b) subject always to considerations of health, safety and of the environment, Contractor shall discontinue performance of the Work and shall comply in full with Company's instructions regarding such termination;

(c) Contractor shall use its best efforts to assign to Company or its nominee any Subcontracts, including any contracts related to Contractor Personnel or any equipment required to complete the Work;

(d) subject to **Article 28** and **Article 29,** Contractor shall promptly deliver to Company all data, calculations and other materials associated with the Work, all on an appropriate medium, together with all drawings, specifications and other documents prepared or obtained by Contractor in connection with the Work and shall carry out Company's instructions concerning any cancellation or assignment of Subcontracts, purchase orders and any other matters arising out of this Agreement which Company decides are necessary or expedient; and

(e) Contractor shall allow Company, or its nominees, full right of access to the Worksites so as to remove or perform Work.

32.4 Notwithstanding any other provision of this Agreement:

(a) if Company does not anticipate receiving or has not received confirmation of financing for the LCP from Lenders by March 13, 2014, Company may terminate this Agreement in its sole and absolute discretion, effective immediately or effective at a future date specified in the Notice, provided that a future date shall not be later than fifteen (15) Business Days from delivery of the Notice, upon:

(i) giving Notice to Contractor, and

(ii) payment of the following amounts:

A. twelve million dollars ($12,000,000.00) plus 3 million five hundred thousand euros (€ 3,500,000) if the Notice to terminate is issued prior to or on January 13, 2014, less any payment made prior to the Notice described in subparagraph (i) above;

B. thirteen million dollars ($13,000,000.00) plus six million five hundred thousand euros (€ 6,500,000) if the Notice to terminate is issued after January 13, 2014 and prior to or on February 3 2014, less any payment made prior to the Notice described in subparagraph (i) above; or

C. fourteen million dollars ($14,000,000.00) plus eleven million euros (€ 11,000,000) if the Notice to terminate is issued after February 13, 2014 and prior to or on March 13, 2014, less any payment made prior to the Notice described in subparagraph (i) above;

and, subject to indemnity obligations pursuant to Article 21 and Claims previously submitted by Contractor in writing prior to the effective date specified on the Notice described in subparagraph (i) above, and remaining unresolved, upon the payment of the relevant amount described in subparagraph (ii) above, each Party and its Affiliates shall be released from, and the other Party waives, any and all Claims a Party may have against the other Party and/or its Affiliates arising from or relating to this Agreement;

(b) Company may in its sole and absolute discretion and for any reason, including convenience of Company and without any fault or default on the part of Contractor, terminate this Agreement effective immediately upon giving Notice to Contractor or effective at a future date specified in the Notice; and

(c) subject to Contractor complying with its obligations to protect persons and property from damage, Contractor shall cease the performance of the Work immediately upon receiving that Notice or upon any later date specified in that Notice.

32.5 Company may, without prejudice to any other right or remedy that it may have against Contractor, terminate this Agreement in the event that Contractor is prevented from or delayed in performing any of its obligations as a result of an event of Force Majeure pursuant to **Article 31.5** by giving Notice of termination to Contractor.

32.6 In the event Company terminates the Agreement pursuant to **Article 32.4(b)** or **Article 32.5**, Company may take title and possession of all Work and complete the performance of the Work by whatever method it may deem expedient. In such case:

(a) Company shall reimburse Contractor the aggregate value of all Work performed at the time of termination less the aggregate value of all amounts paid in relation to such Work. Company shall also pay Contractor a proportionate value of Work in progress or lump sum Change Orders by progress, wherein such proportionate value is determined by demonstrated Work progress, as agreed between the Parties, associated with the achievement of such Work in progress and lump sum Change Orders.

(b) For reimbursable Change Orders, Company shall reimburse Contractor for actual Work performed up to the date of termination, subject to Contractor compliance with **Article 12.13(b)**.

(c) Contractor shall clearly document and present to Company the costs incurred in the performance of the Agreement and the cancellation charges applicable to Subcontracts. In the event that costs incurred in the performance of the Agreement, together with the cancellation charges applicable to Subcontracts, are less than the amounts which have been previously paid to Contractor on account under the Agreement, Contractor shall reimburse Company in the amount of the difference within ten (10) Business Days of demand by Company following determination of the amount thereof.

(d) Contractor shall, prior to paying or agreeing to pay any cancellation charges pursuant to such Subcontracts, contracts and other agreements, submit to Company the amount of such charges for Approval. If and to the extent that Company does not Approve the amount of such charges, Contractor shall not pay the same and the Parties shall jointly negotiate with the relevant third party or parties in an attempt to reduce the amount thereof.

(e) In the event that the costs incurred in the performance of the Agreement are more than the amounts which have previously been paid to Contractor on account under the Agreement, Company shall reimburse Contractor in the amount of the difference within ten (10) Business Days of demand following determination of the amount thereof provided that Contractor has clearly documented the calculation resulting in such difference and has satisfied the requirements of paragraph (g) of this **Article 32.6**. In no event shall the aggregate of the amounts paid to Contractor under this Article exceed the Contract Price.

(f) Subject always to considerations of health, safety and of the environment, Contractor shall discontinue performance of the Work and shall comply in full with Company's instructions regarding such termination.

(g) Subject to **Article 28** and **Article 29,** Contractor shall promptly deliver to Company all data, calculations and other materials associated with the Work, all on an appropriate medium, together with all drawings, specifications and other documents prepared or obtained by Contractor in connection with the Work and shall carry out Company's instructions concerning any cancellation or assignment of Subcontracts, purchase orders and any other matters arising out of this Agreement which Company decides are necessary or expedient.

(h) Contractor shall allow Company, or its nominees, full right of access to the Worksites so as to remove or perform Work.

32.7 The Parties acknowledge and confirm their respective obligations to make commercially reasonable efforts to mitigate any damages or costs arising from any termination of this Agreement.

ARTICLE 33
BANKRUPTCY, INSOLVENCY AND RECEIVERSHIP

33.1 Company shall have the right, without limiting any of its other rights or remedies, to terminate this Agreement immediately by giving Notice of termination to Contractor if:

(a) Contractor or its assets becomes the subject of any proceeding (whether initiated by Contractor or another Person) under bankruptcy or insolvency laws, including proceedings under the *Companies' Creditors' Arrangement Act* (Canada), R.S.C. 1985, c. C-36; or

(b) Contractor becomes the subject of any proceeding for liquidation, reorganization or winding-up (whether initiated by Contractor or another Person); or

(c) a receiver or receiver-manager of all or any part of Contractor's assets is appointed by a Court or by any of its creditors; or

(d) Contractor commits an act of bankruptcy as defined in the *Bankruptcy and Insolvency Act* (Canada), R.S.C. 1985, c. B-3, or commits any other act or omission which would entitle any of Contractor's creditors to initiate a process or proceeding to take possession of any of Contractor's assets or to have any of Contractor's assets distributed among such creditors.

33.2 If this Agreement is terminated by Company under **Article 33.1**, Company shall be entitled to withhold further payments to Contractor and set-off those payments against any amounts which Contractor owes or will owe to Company under this Agreement or any other agreement and Company reserves to itself all other rights, remedies and counterclaims to which it may be entitled hereunder or at law or equity.

ARTICLE 34
SUSPENSION

34.1 Company may at any time during the Term, at Company's sole discretion for any reason, suspend performance of the Work, or any part thereof, by giving Notice to Contractor (such period of suspension hereinafter **"Suspension Period"**). The Work shall be resumed by Contractor on a date as may be specified by Company in a Notice to Contractor. During the Suspension Period, Contractor shall properly protect and secure the Work as Approved in advance by Company. The Milestone Schedule shall be adjusted by the duration of the Suspension Period.

34.2 Subject to **Article 34.3** and **Article 34.4**, Company shall reimburse Contractor its reasonable expenses (which Contractor shall use its best efforts to mitigate) incurred in compliance with any suspension order and associated reinstatement order (the **"Suspension Expenses"**). Any such Suspension Expenses are to be subject to audit in accordance with **Article 14**. In no event shall Contractor be entitled to any compensation for items covered in **Article 21.12** that may have resulted from such suspension or reinstatement order.

34.3 Company shall have the right to suspend performance of the Work for as long as necessary to prevent or stop any contravention of **Article 15**. During such period of suspension, no Suspension Expenses shall be payable to Contractor by Company.

34.4 In case of suspension due to Contractor's failure to perform the Work in accordance with **Article 3**, Contractor shall not be entitled to Suspension Expenses incurred from the moment the Notice of suspension was given until a reinstatement order (if any) is given by Company but shall remain liable, without prejudice to Company's other rights under this Agreement.

34.5 Contractor shall cause all terms of this Article to be inserted in all Subcontracts so that Company and Contractor shall have the rights herein set forth with respect to all Subcontractors.

34.6 Contractor shall have the right to suspend performance of the Work by giving fifteen (15) days prior written Notice to Company if Company fails to timely pay to Contractor any undisputed amount due under this Agreement. Contractor shall resume performance of the Work within ten (10) days after Company has paid to Contractor all such undisputed amounts.

34.7 Contractor shall have the right to suspend performance of the Work by giving fifteen (15) days prior written Notice to Engineer and Company if Engineer fails to make a recommendation pursuant to **Article 12.10** with respect to any undisputed Payment Certificate submitted by Contractor. Contractor shall resume performance of the Work within ten (10) days after Engineer has made a recommendation in respect of such Certificate.

34.8 Contractor shall have the right to suspend performance of the Work upon written Notice to Engineer and Company if Company fails to obtain or maintain the insurance required in accordance with **Article 20**.

ARTICLE 35
LABOUR RELATIONS

35.1 Contractor acknowledges that some or all of Company's Other Contractors and their Subcontractors at a Worksite may be union or non-union and that Company requires Contractor to ensure that labour peace shall be maintained. Contractor shall take all necessary precautions to avoid labour disputes and to minimize the disruption in the event of any dispute.

35.2 Contractor represents and warrants that no collective or other agreement with its Personnel or between its Subcontractors and their workers, and no expiry or termination of any such agreement, will adversely affect labour peace at the Worksites or delay Contractor's performance of the Work.

35.3 With respect to Work to be performed at the Site, Contractor represents and warrants that it and its Subcontractors, if unionized, have written agreements with the unions representing the workers employed by them that include provisions that non-affiliation rights in any collective agreement or pursuant to any statutory right will not be exercised in connection with the Work. Any and all such agreements shall be submitted to Engineer within five (5) Business Days of the Effective Date or of the date an agreement comes into effect.

35.4 With respect to Work to be performed at the Site, whenever Contractor has knowledge that any actual or potential labour dispute is delaying or threatening to delay the schedule and performance of the Work, Contractor shall immediately advise Engineer in writing, including

all relevant information with respect to such dispute or potential dispute and potential impact on the schedule and performance of the Work.

35.5 Without restricting the generality of Company's right to terminate the Agreement, Company may, but is not obligated to, give Notice to Contractor requiring Contractor to terminate any Subcontract for work at the Site by giving five (5) days notice to the Subcontractor if:

(a) the workers of the Subcontractor, or anyone employed by or through the Subcontractor:

(i) declare or engage in a strike, a work stoppage or a refusal to supply material; or

(ii) engage in a slowdown or other concerted activity which restricts or limits or, is likely to restrict or limit, the progress or performance of the Work; or

(iii) picket or cause picketing to occur or support picketing by the refusal to Work, or continue to Work at or in the Worksites whether in support of lawful strike or for any other reason; or

(iv) does not comply with **Article 8**;

or

(b) the Subcontractor, or anyone engaged by or through the Subcontractor, imposes a lockout, lawful or unlawful, against their workers engaged in performing the Work.

35.6 With respect to Work to be performed at the Site, Contractor shall ensure that all Subcontracts allow termination in each of the events set out in **Article 35.5**.

35.7 With respect to Work to be performed at the Site, the sole cost and expense of preventing, avoiding or removing any of the matters or events giving rise to a labour disruption caused by Contractor Group with respect to Work at the Site relating to Contractor Group Personnel shall be borne by Contractor, who shall prevent, avoid and remove any and all such labour disruptions within five (5) days of the commencement of such disruptions, including making any necessary applications for injunctive or other relief to the Court.

35.8 Except for strikes, labour disputes or industrial disputes referenced in **Article 31.1(c)**, delays in the performance of the Work as a result of any strike, industrial dispute, labour disruption or labour dispute involving Contractor Personnel are to be considered as a delay attributable to Contractor, and for which Contractor shall not be entitled to compensation or an extension to the date for completion of a Milestone.

ARTICLE 36
LIQUIDATED DAMAGES FOR DELAY AND PERFORMANCE INCENTIVES

36.1 For each Milestone specified in Section 11.1 of Exhibit 2 – Compensation as being subject to liquidated damages, if Contractor fails to Deliver that part of the Work to achieve the

Milestone by the date specified, Contractor shall pay Company as liquidated damages the full amount stipulated in Section 11.1 of Exhibit 2 – Compensation for each day, including any part thereof, of the delay of that Milestone, from thirty days after that Milestone Date to the date the Milestone is achieved, unless the failure to achieve the Milestone is due to an event of Force Majeure, a Change affecting the Milestone or a Suspension Period.

36.2 Contractor's limit of liability for liquidated damages for delay payable by Contractor to Company pursuant to this **Article 36** shall be a maximum of ten percent (10%) of Contract Price; provided that for any day for which Contractor is liable to pay liquidated damages to Company pursuant to **Article 36.1** for more than one (1) Milestone specified in Exhibit 2 – Compensation, Contractor shall only be liable to pay Company the largest liquidated damages rate applicable on that day.

36.3 The Parties agree that the liquidated damages determined in accordance with this **Article 36** are genuine pre-estimates of the likely damages that Company would incur as a result of Contractor's breach of contract for failure to complete the relevant portion of the Work on the dates specified in the Milestone Schedule. The Parties agree that the liquidated damages set out in this **Article 36** are not intended and shall not be deemed to be penalties.

36.4 Company shall have the right to payment by Contractor of liquidated damages from time to time by giving Notice to Contractor. Any such Notice shall specify the amount of such damages and Contractor shall pay the amount so specified within ten (10) Business Days of the date of such Notice. Failure by Company to give Contractor a Notice shall not constitute a waiver of Company's right to claim all liquidated damages under this **Article 36**.

36.5 Company has the right to set off any amount of liquidated damages, plus interest determined in accordance with **Article 12.17**, owed by Contractor to Company against any amount due or to become due from Company to Contractor under the Agreement.

36.6 Company will pay the specified performance incentives when Contractor achieves performance goals listed in Section 11.2 of Exhibit 2 - Compensation.

36.7 Notwithstanding anything to the contrary in this Agreement, but subject to **Article 32.1(c)**, the Parties agree that the payment of liquidated damages pursuant to **Article 36.1** constitutes the sole and exclusive remedy of Company for any delay in the performance of the Work including failure by Contractor to complete the Work or any part thereof by the dates for completion of the Milestones in Exhibit 2 – Compensation and Exhibit 9 – Work and Milestone Schedule.

ARTICLE 37
REPRESENTATIONS, WARRANTIES AND COVENANTS

37.1 Contractor represents and warrants that during the Term:

(a) it has the required skills, experience, facilities, equipment and capacity to perform the Work in a timely manner and in accordance with the terms of this Agreement,

Applicable Laws, the Standard of a Prudent Contractor and sound industry accepted practices;

(b) all Contractor's Personnel involved in carrying out any of the Work have the qualifications, training and experience, and hold such valid licences and certificates of competence, as are required to carry out their duties in relation to the Work (including visas and work permits);

(c) each of Contractor's Items is of good quality, in good working condition, is in compliance with all Applicable Laws and is fit for its intended use as contemplated in this Agreement; and

(d) the making and performance of this Agreement are within its powers, have been duly authorized by all necessary action and do not and will not violate any Applicable Law or any provision of its governing documents.

37.2 Contractor covenants that during the Term it shall:

(a) perform the Work in a diligent, safe, efficient and timely manner and in accordance with the Standard of a Prudent Contractor;

(b) perform the Work continuously and in accordance with this Agreement, using only Contractor's Personnel and for the portions of the Work listed in Exhibit 8 - Subcontractors, Manufacturers and Material Sources using only Subcontractors named in that Exhibit;

(c) use quality assurance programs in performing the Work which comply with the requirements of Exhibit 7 – Quality Requirements, all Applicable Laws and industry accepted practices;

(d) schedule all long lead time equipment or products for manufacture at the earliest possible date;

(e) not displace or set back in a manufacturing queue or production schedule the equipment or product to be manufactured for the Work in favour of another customer or client of Contractor following such equipment or product placement in a manufacturing queue or production schedule;

(f) supply materials, equipment and products for installation into the Work that are new and meet or exceed the standards specified in this Agreement ;

(g) maintain, at its sole risk, cost and expense, all Contractor's Items throughout the Term;

(h) comply with, and ensure Contractor's Personnel and Subcontractors comply with, all health and safety requirements set out in Exhibit 5 – Health and Safety Requirements and Applicable Laws;

(i) comply with, and ensure Contractor's Personnel and Subcontractors comply with, all environment and regulatory requirements set out in Exhibit 6 – Environment and Regulatory Compliance Requirements and Applicable Laws;

(j) take all steps necessary to maintain good labour relations with Contractor's Personnel to the extent that such requirement is consistent with sound business practice;

(k) comply, on a timely basis, with all instructions of Company consistent with the provisions of this Agreement, including health, safety and environmental instructions;

(l) provide such reports, records, and other information relating to the performance of the Work as Company may request from time to time, including copies of the qualifications and credentials of Contractor's Personnel and Subcontractors and information relating to quality assurance programs, and permit Company to inspect Contractor's Items and Worksites, to enable Company to satisfy itself that Contractor is complying with the terms of this Agreement;

(m) obtain for the benefit of Company all available exemptions and/or refunds from Taxes; and

(n) implement and maintain a cost effectiveness program ensuring all techniques proposed for the performance of the Work are or have been reviewed to ensure that they are cost effective.

37.3 Contractor warrants and acknowledges that it has reviewed and understands the Applicable Laws and Lower Churchill Construction Projects Benefits Strategy governing the use of personnel, goods and services in the Work. Contractor shall, throughout the Term, take such action as Company may specify to enable Company to comply with all Applicable Laws regarding the use of Canadian and Newfoundland and Labrador personnel, goods and services, including any Newfoundland and Labrador Benefits requirements and those requirements set forth in Exhibit 13 - Provincial Benefits of this Agreement. Where Contractor is permitted to subcontract, Contractor shall ensure that Subcontractors comply with such requirements. In addition, Contractor shall provide reports in the manner and format described in Exhibit 13 - Provincial Benefits of this Agreement throughout the term of this Agreement.

37.4 Company warrants that the information provided to Contractor by Company and Engineer is accurate and Contractor is entitled to rely on it. If such information:

(a) contains material errors or mistakes which Contractor acting within the Standard of Prudent Contractor may not have recognized as an obvious mistake or error, or

(b) describes conditions that are materially different than the actual conditions of the Site or conditions to perform the Work,

and such error, mistake or difference has an impact that constitutes a Change then Contractor shall be entitled to a Change Order for the additional costs and/or time to perform the Work arising as a result of the Change.

37.5 Contractor shall, maintain, at its sole risk, cost and expense, all Contractor's Items throughout the Term in the manner necessary to ensure that the warranties and covenants in **Article 37.1** and **Article 37.2** shall be true and accurate at all times during the Term. If any of Contractor's Items do not at any time conform to the warranties and covenants given in **Article 37.1** and **Article 37.2**, Contractor shall, at Contractor's sole expense, repair such Contractor's Items or replace with items which conform in all respects to such representations and warranties.

37.6 Contractor agrees that all of its representations, warranties and covenants contained in this Agreement are and shall be deemed to be material and shall be conditions of this Agreement.

ARTICLE 38
ENTIRETY OF AGREEMENT, NON WAIVER

38.1 This Agreement, as executed by authorized representatives of Company and Contractor, constitutes the entire agreement between the Parties with respect to the matters dealt with herein. This Agreement replaces and supersedes all prior agreements, documents, writings and verbal understandings between the Parties in respect of the Work and there are no oral or written understandings, representations or commitments of any kind, express or implied, which are not expressly set forth herein.

38.2 No modification of this Agreement by Contractor or Company, either before or after the execution of this Agreement, shall be of any force or effect unless such modification is in writing, is expressly stated to be a modification of this Agreement and is signed by duly authorized representatives of each of the Parties, with the exception of the following Exhibits where changes to same may be issued solely by Company:

(a) Exhibit 3 – Coordination Procedures;

(b) Exhibit 5 – Health and Safety Requirements;

(c) Exhibit 6 – Environment and Regulatory Compliance Requirements;

(d) Exhibit 10 – Declaration of Residency;

(e) Exhibit 11 – Company Supplied Documents;

(f) Exhibit 12 – Site Conditions;

(g) Exhibit 13 – Provincial Benefits.

38.3 No waiver of any provision of this Agreement shall be of any force unless such waiver is in writing, is expressly stated to be a waiver of a specified provision of this Agreement and is signed by the Party to be bound thereby. Either Party's waiver of any breach of, or failure to enforce, any of the covenants, conditions or other provisions of this Agreement, at any

time, shall not in any way affect or limit that Party's right thereafter to enforce or compel strict compliance with every covenant, condition or other provision hereof.

38.4 Each of the Parties shall, from time to time, at its own cost and expense, execute or cause to be executed all such further documents and do or cause to be done all things which are necessary to give effect to the provisions of this Agreement.

ARTICLE 39
DISPUTE RESOLUTION

39.1 If any dispute, controversy, claim, question or difference of opinion arises between the Parties under this Agreement including an interpretation, enforceability, performance, breach, termination or validity of this Agreement (**"Dispute"**), the Party raising the Dispute shall give Notice to the other Party in writing within thirty (30) days of the Dispute arising, and such Notice shall provide all relevant particulars of the Dispute.

39.2 Upon issuance of Notice of the Dispute, the Parties shall, acting in good faith and a commercially reasonable manner, attempt to resolve the Dispute in the following manner:

(a) Within fifteen (15) days of the Notice, the senior project managers for each of Company and Contractor shall meet to attempt to resolve the Dispute;

(b) If not resolved by senior project managers, the project sponsors or representative Vice Presidents for each of Company and Contractor will meet within thirty (30) days following the meeting of the project managers to attempt to resolve the Dispute; and

(c) If not resolved by project sponsors or representative Vice Presidents, the Chief Executive Officers for each of Company and Contractor will meet within thirty (30) days following the meeting of the project sponsors or representative Vice Presidents to attempt to resolve the Dispute.

39.3 If the Dispute is not resolved by the Parties within ninety (90) days from the date of delivery of the Notice of Dispute then a Party may take whatever action is deemed appropriate pursuant to this Agreement. For greater certainty, the Parties must comply with this **Article 39** before commencing any further action, legal or otherwise, with respect to a Dispute under this Agreement.

39.4 Notwithstanding the existence of a Dispute and the referral of the Dispute to the resolution procedures in this **Article 39**, Company and Contractor shall, to the extent reasonably possible or unless advised in writing by Company to suspend or discontinue work, continue to perform their obligations under this Agreement without interruption or delay. The continuation of such performance shall in no way amount to a waiver of, or in any way prejudice, the position that is taken by the Parties in the Dispute. There shall be no extension to the date for completion of a Milestone by reason that a Dispute has been referred to the dispute resolution process in this **Article 39**.

ARTICLE 40
NOTICES

40.1 Unless otherwise specified in the Agreement, any Notice given or made pursuant to the Agreement shall:

(a) be in writing;

(b) be marked to the attention of Contractor Representative, in the case of Contractor, or to Company Representative, in the case of Company;

(c) where given by Company, be signed or authorized by either Company Representative, an officer, a director or company secretary of Company, or a duly authorized representative of Company;

(d) where given by Contractor, be signed or authorized by either Contractor Representative, an officer, a director or company secretary of Contractor, or a duly authorized representative of Contractor; and

(e) be delivered by prepaid post, by hand, by Aconex or by facsimile to the Party to whom the Notice is addressed at its address specified in **Article 40.3** or such other address as that Party may have notified to the other Party.

40.2 A Notice will be taken to be duly given:

(a) in the case of delivery by hand, when delivered

(b) in the case of delivery by post, five (5) Business Days after the date of posting (if posted to an address in the same country) or twenty (20) Business Days after the date of posting (if posted to an address in another country);

(c) in the case of delivery by facsimile, on receipt by the sender of a transmission control report from the sending machine showing the relevant number of pages and the correct destination facsimile machine number or name of the recipient and indicating that the transmission has been made without error;

(d) in the case of delivery by Aconex, at the time and date recorded by Aconex for delivery to the recipient.

40.3 Any Notice given or made under the Agreement shall be delivered to the intended recipient by hand, post or facsimile to the address or facsimile number below or the address or facsimile number last notified by the intended recipient to the sender pursuant to **Article 40.7**:

(a) to Company:

Muskrat Falls Corporation
Re: Lower Churchill Project Muskrat Falls Corporation
350 Torbay Road Plaza, Suite No. 2
St. John's, NL
Canada A1A 4E1
Re: Lower Churchill Project
Attention: Scott O'Brien
Project Manager, Component I
Facsimile No.: (709) 754-0787
E-mail: ScottO'Brien@lowerchurchillproject.ca

(b) to Contractor:

Andritz Hydro Canada Inc.
6100 Aut. Transcanadienne
Pointe Claire, Quebec H9R 1B9
Attention: Mathieu Bertrand
Project Manager
Facsimile No.: 514 428 6726
E-mail: Mathieu.bertrand@andritz.com

40.4 Except where Notice is given using Aconex in accordance with **Articles 40.1, 40.2** and **40.3**, the Parties may use any other form of electronic mail for day to day communication but electronic mail shall not be used for and will not constitute Notice under the Agreement where the Agreement expressly requires that a Notice be given.

40.5 Any technical communications pertaining to the Work shall be between Engineer and Contractor Representative. Engineer shall, subject to the terms of this Agreement, be authorized to act on behalf of Company in all technical matters concerning the Work but not to commit or bind Company to a Change or an amendment of the Agreement.

40.6 Except where expressly provided otherwise in the Agreement, verbal communications will not constitute formal communication or Notice under the Agreement and neither Party has any obligation to act on any verbal communication or instruction unless and until it is confirmed in writing. Any action taken by a Party based on verbal communications, instructions or assurances will be at that Party's sole risk and will be without liability to or recourse against the other Party.

40.7 A Party may, from time to time, give Notice to the other Party of any change to its address or facsimile number.

ARTICLE 41
LIENS AND CLAIMS

41.1 Without prejudice to the provisions of this **Article 41**, Contractor shall prevent the imposition of any liens, claims, encumbrances or attachments by or on behalf of any third

party against Contractor's Items, the Work, and Company property wherever located, or any portion thereof and any liens or attachments which nevertheless are imposed shall be promptly vacated and removed from title by Contractor, at Contractor's sole cost, and Contractor shall indemnify, defend and hold Company Group harmless from and against the same.

41.2 Contractor shall defend, protect, release, indemnify and hold Company Group harmless from and against, and shall keep Contractor's Items, Company's property, Worksites and Work thereon free and clear of all liens, charges, claims, assessments, fines and levies suffered, created, or committed by Contractor Group, save only liens or encumbrances created with the prior written consent of Company voluntarily in favour of financial organizations in connection with Contractor's obtaining reasonable, prudent and necessary financing. Company may post on any of Contractor's property such notices as it may desire to protect itself against such liens, claims, assessments, fines and levies.

41.3 Notwithstanding the efforts of Contractor hereunder, if Company suffers costs or expenses or becomes liable for payment as a result of the imposition of such liens or attachments, then without prejudice to any other rights or remedies available to Company, Company shall have the right to withhold and set off an amount equal to any such costs, expenses or payments incurred or made by Company from any payments due to Contractor hereunder.

ARTICLE 42
ENUREMENT, TIME, SURVIVAL OF PROVISIONS

42.1 This Agreement shall be binding upon the Parties, their permitted assignees and successors.

42.2 Time is of utmost importance with respect to Milestones in the Milestone Schedule.

42.3 The following provisions of this Agreement shall survive the termination or expiration of this Agreement and remain in full force and effect: **Articles 1.19, 1.20, 5.1, 5.7, 6.7, 7.1, 7.3, 9.3, Article 12, Article 13, Article 14, Article 17, Article 21, Article 23, Article 24, Article 27, Article 28, Article 29, Article 32, Article 39, Article 41** and **Article 44**.

ARTICLE 43
COUNTERPARTS

43.1 This Agreement may be executed in any number of counterparts and any Party may transmit by facsimile or email in portable document format to the other Party a copy of this Agreement executed by that Party, the receipt of which shall have the same force and effect as if the original thereof had in fact been delivered at the same time.

43.2 Any original, facsimile copy, portable document format or photocopy of this Agreement bearing one or more signatures on behalf of a Party shall be admissible against that Party in any legal proceeding as evidence of the execution and delivery of this Agreement by that Party and without the requirement to produce an executed original of the Agreement.

43.3 Each person signing the Agreement as an authorized representative of a Party hereby represents and warrants that he or she is duly authorized to sign the Agreement for that Party and that the Agreement will, upon having been so executed, be binding on that Party in accordance with its terms.

ARTICLE 44
PERFORMANCE GUARANTEES

44.1 Notwithstanding any other provisions of this Agreement, if during the performance tests described in Exhibit 1 Scope of Work, Technical Specification, Section 48 13 20 Gates, Stoplogs and Trashracks, paragraph 2.8.8.4 performed immediately after Contractor achieves Milestones M4, M22 and M23 of the Milestone Schedule, as the case may be, the Work does not meet the seal leakage rate described in Exhibit 1 Scope of Work, Technical Specification, Section 48 13 20 Gates, Stoplogs and Trashracks, paragraph 2.8.8.4, Contractor shall immediately repair the relevant part of the Work to correct the leakage and bring it within the values specified in Exhibit 1 Scope of Work, Technical Specification, Section 48 13 20 Gates, Stoplogs and Trashracks, paragraph 2.8.8.4.

44.2 Repairs performed pursuant to **Article 44.1** shall be the sole and exclusive remedy available to Contractor for failure to reach the leakage rate specified in Exhibit 1 Scope of Work, Technical Specification, Section 48 13 20 Gates, Stoplogs and Trashracks, paragraph 2.8.8.4.

44.3 If the performance test described in Exhibit 1 Scope of Work, Technical Specification, Section 48 13 20 Gates, Stoplogs and Trashracks, paragraph 2.8.8.4 reveals the Work meets the seal leakage rate described in that paragraph 2.8.8.4, then Contractor shall not have any further responsibility concerning the seal leakage rate.

44.4 The express performance guarantee mentioned in this **Article 44** is the only performance guarantee Contractor makes for the Work. There is no other performance guarantee, whether statutory, oral, express or implied.

EXECUTED AS AN AGREEMENT:

For and on behalf of Muskrat Falls Corporation

Signature of Authorized Representative
President & CEO, Nalcor Energy

Edmund Martin

Name of Authorized Representative

Signature of Authorized Representative
Vice President, Lower Churchill Project, Nalcor Energy

Gilbert Bennett

Name of Authorized Representative

For and on behalf of ~~Andritz~~ Hydro Canada Inc.

Signature of Authorized Representative
Vice President

Daniel Carrier

Name of Authorized Representative

Signature of Authorized Representative
Vice President - Finance

Christoph Koeck

Name of Authorized Representative

EXHIBIT 1

SCOPE OF WORK

This Exhibit 1 Scope of Work incorporates the following documents:

1. Scope of Work
   Nalcor No: MFA-SN-CD-2000-ME-SP-0001-01, Rev D2

2. Preservation, Mechanical Completion & Commissioning Requirements
   Nalcor No: MFA-SN-CD-2000-ME-SP-0002-01, Rev D1

3. Technical Document List
   Nalcor No: MFA-SN-CD-2000-ME-LS-0003-01, Rev B4

4. Technical Specifications (See Volume 2)
   Nalcor No: MFA-SN-CD-2000-ME-TS-0001-01, Rev D2

5. Drawings.
   As per Technical Document List

LOWER CHURCHILL PROJECT
MUSKRAT FALLS HYDROELECTRIC DEVELOPMENT

CH0032

SUPPLY AND INSTALL POWERHOUSE AND SPILLWAY HYDRO-MECHANICAL EQUIPMENT

SCOPE OF WORK

Prepared by:
Adam Kavanagh, Eng.
Heavy Mechanical

Prepared by:
Gord Haines, P. Eng.
Lead Engineer - Electrical

Prepared by:
Steve Chorny, P. Eng.
Lead Engineer - Civil

Verified by:
Randolph Koob, P. Eng.
Lead Engineer - Mechanical

Verified by:
Greg Snyder, P. Eng.
Engineering Manager Hydro

REVISION LIST

Revision					
N°	By	Appr.	Date	Revised pages	Remarks
D2	RK	GS	27-Nov-2013	-	Update for Contract Award. See revision triangles.
D1	RK	GS	31-July-2013	-	Approved for Design
01/B2			01-Feb-2013	-	Issue for review
00	RL/ EC	RS/RK	07-11-2012	-	Issued for Bid.

Lower Churchill Project Muskrat Falls Hydroelectric Development	SCOPE OF WORK	Rev. D2
CH0032		EXHIBIT 1
SUPPLY AND INSTALL POWERHOUSE AND SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-SP-0001-01_D2		505573-3321-45EW-0001_02

TABLE OF CONTENTS
SCOPE OF WORK

1 GENERAL

1.1 PROJECT DESCRIPTION

1.1.1 The Lower Churchill Project (LCP), located on the Churchill River in the Province of Newfoundland and Labrador, Canada, consists of the Muskrat Falls Generating Station with a capacity of 824 MW (4 units of 206 MW), associated transmission lines, the Spillway, and Dams.

1.1.2 The project site of Muskrat Falls is located on the lower reaches of the Churchill River approximately 35 km west of the Town of Happy Valley – Goose Bay. Permanent access to the site is from the south shore, via a road extension from the existing Trans Labrador Highway. The Muskrat Falls Hydroelectric Development consists of the following main components:

.1 Main access road, including upgrading and construction of over 22 km of new road with several stream crossings;

.2 Approximately 20 km of site roads to be constructed to reach the main structures, laydown areas, accommodation complex, borrow areas and spoil disposal area;

.3 1,500 person accommodation complex;

.4 Contractor and Company's laydown areas;

.5 Reservoir preparation including some 130 km of forest access road, forest harvesting, and bank stabilization;

.6 Intake, Powerhouse, Spillway, Transition Dams, North RCC Dam and South Dam;

.7 North Spur stabilization works;

.8 Switchyards at Muskrat Falls and Churchill Falls;

.9 High voltage overhead transmission lines and associated infrastructure; and

.10 Environmental habitat (fish and terrestrial) protection, remediation and replacement.

1.2 GENERAL DESCRIPTION OF PACKAGE

1.2.1 General

.1 This Contract will be for the design, supply, installation, and commissioning of all Mechanical, Electrical and other associated Hydro-Mechanical equipment required for the Spillway, the Intake and the Draft Tube. The equipment and facilities will consist of fixed wheeled gates, bulkhead gates, trashracks, stoplogs, fixed and mobile wire rope hoists, hoist towers and buildings, trash cleaner, and electrical and mechanical auxiliaries in an electrical/control building on the dam crest with a backup diesel generator.

.2 To accommodate river diversion some of the work will be staged and involve a mix of permanent and temporary work and equipment.

.3 The work will also consist of supplying detailed documentation for design, quality control, and operation and maintenance for all work required by the Contract, and the provision for training of Company's personnel.

1.2.2 Spillway Equipment

.1 The Spillway will have five bays each with a Spillway Gate and hoist and in its initial configuration will be used for diversion of the entire river during the construction phase of the project. In its final configuration the Spillway, when combined with overflow discharge at the North RCC Dam, will be able to pass the Probable Maximum Flood for this project.

.2 In its initial configuration for river diversion each spillway bay will essentially be flat bottomed with the Spillway gate sill elevation at EL. 5.0 m. In its final configuration each spillway bay will have a parabolic rollway with the Spillway gate sill elevation at El. 18.0 m.

.3 Each Spillway Gate will be operated with a wire rope hoist located in a hoist house located above the Spillway on towers. The Spillway Gates will be capable of operating long-term at any gate opening.

.4 Each Spillway bay will have four sets of gate and stoplog guides. Starting from upstream guides are: stoplog guides for use after river diversion to enable the spillway rollway construction to be completed; another set of stoplog guides which will be used for the long-term maintenance of the Spillway after the rollways are constructed; guides for the Spillway Gates that will be used to regulate discharge through each bay; and a downstream set of stoplog guides that will be used both

for construction of the spillway rollways during diversion and for long-term maintenance.

.5 The stoplogs to be used in the upstream two guides will consist of a combination of permanent and temporary stoplogs. During the river diversion phase there will be sufficient stoplogs to isolate up to two Spillway bays at one time to construct the rollways and in the final permanent configuration there will be sufficient stoplogs available to isolate one Spillway bay for long-term maintenance.

.6 There will be sufficient downstream stoplogs to isolate two bays during the river diversion phase for construction of the rollways, and one set will be available for long-term maintenance.

.7 The Spillway upstream stoplogs will be handled by the trash cleaner hoist.

.8 Due to concerns about ice build-up during construction, and to facilitate installation and removal of the stoplogs in the winter, the upstream stoplogs are initially configured with upstream (water side) skinplate and seals, and after construction of the rollways, the permanent upstream stoplogs will have to be reconfigured to a downstream skinplate and seal arrangement.

.9 The Spillway Gates guides and hoists will require modifications to change from the initial river diversion phase configuration to the final in service configuration after construction of each rollway and the change in Spillway Gate sill elevation.

.10 Additional equipment to be provided includes dogging devices for the gates and permanent stoplogs, lifting beams for each type of stoplog, permanent and temporary heaters for ice control on the gates and stoplogs, lockout provisions for the Spillway Gates and Stoplogs, and access platforms, walkways and ladders.

1.2.3 Intake Equipment

.1 The powerhouse intake will have four turbine/generator units with three intake bays per unit. From upstream to downstream each intake bay will have trashracks and guides, bulkhead gate guides, and an Intake Gate and guides. One set of bulkhead gates will be provided to isolate one bay of one unit to permit maintenance to be performed on the Intake Gate in that bay.

.2 The Intake gates will be operated by a wire rope hoist and will be used for the isolation of the water passages to perform maintenance on the turbine/generator. The Intake Gates will also be capable of opening under maximum differential head to fill the water passages and to close under maximum head and maximum discharge as part of an emergency shutdown sequence to protect the turbine and generator.

.3 Additional equipment provided at the Intake includes dogging beams, lifting beams for the bulkhead gates and trashracks, heaters for ice control in the Intake Gate shaft, and lockout provisions for the Intake and Bulkhead gates. A concrete hoist house will be provided by Company's Other Contractor to house the Intake Gate hoists and all the necessary auxiliary equipment.

1.2.4 Draft Tube Equipment

.1 Each of the four turbine/generator units will have two Draft Tube outlets. Each outlet will have a set of guides for stoplogs that will permit isolating the water passages for maintenance. Sufficient Draft Tube stoplogs will be provided to isolate two turbine/generator units or four (4) Draft Tube water passages.

.2 A single Draft Tube Overhead Crane will be provided in the Draft Tube Gallery for handling of the stoplogs.

.3 Additional equipment to be provided includes a stoplog lifting beam, provisions for storage of the stoplogs, and provisions for lockout when the stoplogs are installed.

.4 A maintenance area will be provided in the Draft Tube Gallery to service the Draft Tube stoplogs, and a maintenance platform to service the Draft Tube Overhead Crane.

.5 As the tailrace water level can quickly rise for a short period of time, to near the height of the walkway during a plant load rejection, the provision for lockout at each stoplog slot will have to be engaged, locked, and disengaged from the walkway to eliminate danger to workers. A water stop gate will be provided in the Draft Tube Gallery to move the stoplogs in and out of the maintenance area, but minimize flooding of the maintenance area at high water level.

1.2.5 Trash Cleaner

.1 A Trash Cleaner will be provided to perform two functions. The Trash Cleaner will be used for cleaning the trashrack panels, removing debris from the sediment trap in front of the intakes, and for removing floating debris along the entire length of the dam crest. The Trash Cleaner will also be provided with a hoist that will be used for the handling of the Intake Bulkhead Gates, and the Spillway upstream Stoplogs.

.2 The Trash Cleaner will travel on rails, provided by Company's Other Contractor, on the intake deck, across the Centre Transition Dam which has a curved section, and across the Spillway, and will be provided with a power supply cable and reel located immediately downstream of the upstream guardrail.

1.2.6 Other Equipment and Facilities

.1 A Spillway Electrical Building will be provided to house a step down transformer, AC distribution for the Spillway equipment, Spillway gate controls, and a backup diesel generator. This work will proceed in phases to accommodate the various stages of construction and river diversion and will involve a combination of permanent and temporary facilities.

1.3 LANGUAGE AND UNITS

D1 **1.3.1** The language used for all equipment or control system displays, nameplates, submittals, and documentation shall be English.

1.3.2 All designs and drawings shall be prepared in accordance with the International System of Units (SI units) and the units of measurement shall be the International System of Units (SI).

D1 **1.3.3** All digital or analog displays, instrument's graduations and inscriptions shall comply with the SI system.

1.4 CLIMATIC DATA

1.4.1 The Climatological Data is included in Exhibit 11: Company Supplied Documents.

1.5 HYDROMETEOROLOGICAL DATA

1.5.1 Hydrometeorological data is summarized on Drawing MFA-SN-CD-2000-CV-DD-0003-01, in Exhibit 11: Company Supplied Documents.

2 SCOPE OF WORK

2.1 WORK INCLUDED

D2

2.1.1 The work shall comprise, but not be limited to: the design, supply, final sizing, fabrication drawings, fabrication, shipment, erection and installation, interface management, technical assistance of installation work performed by Company's Other Contractor, start-up, field-testing and commissioning, operation and maintenance manuals, training, warranty and all other services and items specified herein, as specified in Exhibit 1 – Appendix A Technical Specifications, as shown in Exhibit 1 – Appendix C Drawings, and/or as necessary for construction start-up, operation during diversion, and final operation of the facilities presented in this package.

2.1.2 The work included shall be as follows, and as described in the Technical Specifications and Drawings:

.1 Design, fabrication, supply, installation, and commissioning of all permanent and temporary Hydro-Mechanical Equipment for the Powerhouse draft tube gates, Intake and the Spillway as detailed below (Note: All equipment shall be considered permanent unless specifically identified as temporary.);

.2 Design, fabrication, supply, installation, and commissioning of all Electrical Equipment associated with the power supplies and control systems for all permanent and temporary Hydro-Mechanical equipment for the Powerhouse draft tube gates, Intake and Spillway as detailed below;

.3 Design, supply, fabrication and transportation of all anchors and steel templates embedded in the primary concrete, as well as the bolts, tie-rods, washers, and nuts necessary for the installation and attachment to the formwork for all items supplied under the Contract;

D2

.4 Technical assistance during installation of all supplied anchors installed by Company's Other Contractor including sign-off of Company's Other Contractors completion and quantity records related to the installation of embedded parts provided by Contractor;

.5 Supply, installation, and commissioning of electrical auxiliaries in the Spillway Electrical Building and temporary electrical installations for the Spillway;

.6 Design of all components, submission of all calculations and drawings for review and acceptance by Engineer, and the supply of all design notes, design criteria and drawings;

D1 .7 Final sizing of all supplied components, issue of manufacturing drawings for fabrication, and issue of installation drawings for construction;

D2 .8 Not Used;

.9 Operation and Maintenance Manuals for all supplied equipment;

.10 Supply of quality plans, quality procedures, Inspection and Test Plans (ITP's), and Record Sheets to cover all equipment during fabrication, assembly, and installation including complete documentation at the completion of all work;

.11 Supply of required Capital Spare Parts;

.12 Supply of test weights for load testing the hoists and cranes;

.13 Commissioning and Test Procedures and Record Sheets for the commissioning of all permanent and temporary equipment;

.14 Connections, accessories or equipment not specifically mentioned in these specifications but which are necessary for the proper installation and/or operation of the equipment are considered to be an integral part of the Work and shall be designed and supplied by Contractor;

.15 Onsite training of Engineer and Company staff, for forty (40) hours, for operators to be trained for operation and maintenance of the Spillway during the Diversion Phase;

.16 Onsite training of Company staff, for eighty (80) hours, for operators and maintenance staff to be trained for operation and maintenance of all equipment prior to hand-over;

D2 .17 Not Used;

D2 .18 Not Used;

D1 .19 Design, supply and installation of grounding connections to all metallic surfaces, structures, equipment and embedded parts supplied by Contractor;

D2

.20 Supply and installation of grout for drilled anchors and base plates.

2.1.3 Spillway Hydro-Mechanical Equipment

The work included shall be as follows, and as described in the Technical Specifications and Drawings:

.1 Design, supply and installation of five (5) sets of embedded parts for the Spillway gate guides and seal faces, with each set including: two (2) side guides with upstream seal faces; two (2) embedded sill beam assemblies (one for diversion phase and one for final rollway configuration); and three (3) embedded tubes per embedded side guide for side guide heaters;

.2 Design and supply of five (5) sets of side steel liners on the piers for installation with anchors in primary concrete, installed by Company's Other Contractor, downstream of each Spillway gate;

.3 Design, supply and installation of five (5) sets of steel rollway liners with anchors in the final rollways, downstream of each Spillway gate, with the installation of concrete anchors in the rollway first stage concrete by Company's Other Contractor;

.4 Design, supply and installation of five (5) sets of embedded parts for the permanent stoplog guides and seal faces immediately upstream of the Spillway gates, with each set including: two (2) side guides with downstream seal faces; one (1) embedded sill beam assembly; and three (3) embedded tubes per embedded side guide for side guide heaters;

.5 Design, supply and installation of five (5) sets of embedded parts for the temporary upstream stoplog guides and seal faces at the furthest upstream position, with each set including: two (2) side guides with upstream seal faces; one (1) embedded sill beam assembly; and three (3) embedded tubes per embedded side guide for side guide heaters. Although these guides are for temporary operation during construction, the guides will remain as part of the permanent installation;

.6 Design, supply and installation of five (5) sets of embedded parts for the downstream stoplog guides and seal faces, with each set including: two (2) side guides with upstream seal faces; one (1) embedded sill beam assembly; three (3) embedded tubes per embedded side guide for side guide heaters; and guide extensions above the concrete up to El. 20.0 m to facilitate stoplog installation and storage. In this case upstream seal refers to the watered up (wet) side of the stoplog;

.7 Design, supply and installation of a system for the storage/dogging of the ten (10) Spillway Type S1 Stoplogs in the five (5) stoplogs slots immediately upstream of the Spillway Gates;

.8 Design, supply and installation of a system for the storage/dogging of the permanent Spillway Type S4 Stoplogs in the five (5) downstream stoplog slots;

.9 Design, supply and installation of a temporary system for the storage/dogging of the temporary Spillway Type S4 Stoplogs adjacent to the Type S4 Stoplog permanent storage location;

.10 Design, supply and installation of isolation and lockout provisions for the Spillway stoplogs when the Spillway bays are isolated;

D2 .11 Design, supply, and technical assistance during installation performed by Company's Other Contractor, of all supplied anchors mounted on steel templates, downstream embedded angles, bolts, tie-rods, washers, nuts, etc., required for all the embedded parts in the primary concrete and attachment to the formwork;

D1 .12 Design, supply and installation of all anchors, steel templates, bolts, tie-rods, washers, nuts, etc., required for all the embedded parts in the second stage concrete;

D2 .13 Not Used;

D2 .14 Design and supply of one (1) set of Type S1 medium head stoplogs, consisting of ten (10) interchangeable sections, initially for temporary use in any two (2) of the furthest upstream stoplog guides, in combination with Types S2 and S3 Stoplogs, with the skin plate and seal on the upstream side; and for permanent use on their own in any one (1) of the stoplog guides immediately upstream of the Spillway Gates, with the skin plate and seals on the downstream side, with stoplog sections designed to be lifted with two (2) meters differential hydrostatic head;

D2 .15 Design and supply of two (2) sets of Type S2 low head temporary stoplogs, consisting of four (4) (estimated quantity - to be optimized by Contractor) interchangeable sections per set, with an upstream skin plate and seal, for combined use with Types S1 and S3 stoplogs in any two (2) of the furthest upstream stoplog guides, with stoplog sections designed to be lifted with two (2) meters differential hydrostatic load;

D2 .16 Design and supply of two (2) sets of Type S3 high head temporary stoplogs, consisting of eight (8) (estimated quantity: to be optimized by Contractor) interchangeable sections per set, with an upstream skin plate and seal, for combined use with Types S1 and S2 stoplogs in any two (2) of the furthest

upstream stoplog guides, with stoplog sections designed to be lifted with two (2) meters differential hydrostatic load;

D2 .17 Design and supply of one (1) set of Type S4 permanent stoplogs, consisting of five (5) interchangeable sections, with a upstream skin plate (on the downstream wet side) and seal, for use in any of the furthest downstream stoplog guides, with stoplog sections designed to be lifted with two (2) meters differential hydrostatic load;

D2 .18 Design and supply of one (1) set of Type S4 temporary stoplogs, consisting of five (5) interchangeable sections, with a upstream skin plate (on the downstream wet side) and seal, for use in any of the furthest downstream stoplog guides, with stoplog sections designed to be lifted with two (2) meters differential hydrostatic load;

.19 Design, supply and installation of one (1) lifting beam, for operation with the Trash Cleaner hoist, to install, remove, and store all of Types S1, S2, and S3 stoplogs when the Stoplogs are operating with upstream or downstream seals, including a lift beam storage stand;

.20 Design, supply and installation of one (1) lifting beam, for operation with a mobile crane, to install, remove, and store the Type S4 stoplogs, including a lift beam storage stand;

.21 Design, supply and installation of five (5) fixed wheel Spillway gates;

.22 Design, supply and installation of five (5) fixed wire rope hoists with controls for operating the Spillway gates before and after the rollways are constructed;

D2 .23 Design, supply, and technical assistance during installation performed by Company's Other Contractor, of all supplied anchors installed in primary concrete for hoist towers;

.24 Design, supply and installation of two (2) steel end towers to support the hoist bridge structures, each with enclosed stairways to access the hoists;

.25 Design, supply and installation of four (4) intermediate steel towers to support the hoist bridge structures;

.26 Design, supply and installation of five (5) fixed steel hoist bridge beam assemblies to support the Spillway gate hoists, auxiliary equipment, and hoist houses;

.27 Design, supply and installation of five (5) access walkways and ladders below the hoist bridge assemblies, with access from the hoist houses, to service the upper

sheaves, the upper mechanical stops, and the lower sheaves when the gates are raised to the upper maintenance position;

.28 Design, supply and installation of hoist houses for the Spillway gate hoists, complete with auxiliary electrical and mechanical services for the towers and enclosures;

.29 Design, supply and installation of five (5) sets of walkways with gates and handrails, with each set consisting of one (1) walkway upstream and (1) walkway downstream of the Spillway Gates, mounted on the primary concrete, designed for workers to safely access and service the Spillway Gates and seals, with provision for Company's Other Contractor to mount cable trays on the downstream walkway handrails;

D2 .30 Design, supply, and technical assistance during installation performed by Company's Other Contractor, of all supplied embedded anchors in primary concrete for the supplied walkways;

D2 .31 Design, supply and installation of handrails, and access gates, on the Spillway deck level at El. 45.5 m, downstream of the road guardrails supplied by Company's Other Contractor, along the tops of the piers for safe access to the stoplogs, gates, walkways between the piers, and gate access openings in the piers downstream of the towers, up to an interface point at the guardrails around the Spillway Electrical Building supplied by Company's Other Contractor;

.32 Design, supply and installation of steel ladders and lockable access gates in the concrete access ways in the piers that provide access to the tops of each of the Spillway gates;

.33 Design, supply and installation of Spillway Gate dogging devices, designed to dog the gate to service each set of wheels at a comfortable working level above deck level El. 45.5 m, to service the gate bottom seals, and to be capable of dogging the gate during construction of the rollways such that it does not interfere with construction;

.34 Design, supply and installation of isolation and lockout provisions for the Spillway Gates, hoists and power supplies when being serviced or maintained or for when the water passages are being isolated;

.35 Design, supply and installation of a general purpose electric hoist system, with power cord and pendant control, in the hoist house for maintenance purposes, designed to move equipment the full length of the hoist house, to the service zone and down to the level of the spillway deck at El. 45.5 m. The hoist system shall be single bridge type electric hoist that can access all equipment below 3000 kg;

.36 Design, supply and installation of five (5) sets of permanent heaters with controls, six (6) per Spillway gate, for the Spillway gate embedded guides;

.37 Design and supply, and installation as required, of one (1) set of temporary heaters, six (6) per set, for use in any one set of upstream stoplog embedded guides as required during construction;

.38 Design and supply, and installation as required, of one (1) set of portable heaters, six (6) per set, for use in any one downstream stoplog embedded guides;

.39 Design, supply and installation of electrical auxiliaries on the hoist towers, including interior stairway lighting, and exterior deck lighting, receptacles, cable trays, and cable mounted on the towers;

.40 Design, supply and installation of control system, power and control cables associated with the permanent heaters for the Spillway gate guides;

.41 Design, supply and installation of a temporary control system, including power and control cables and all associated equipment, for the upstream stoplog guides temporary heaters including cables and supports to serve all of the upstream stoplog heater locations, which may include cabling to each location or cabling and cable supports designed to allow cabling to be relocated as required;

.42 Design, supply and installation of a temporary control system, including power and control cables and all associated equipment, for the downstream stoplog guides temporary heaters including cables and supports to serve all of the downstream stoplog heater locations, which may include cabling to each location or cabling and cable supports designed to allow cabling to be relocated as required;

.43 Design, supply and installation of the heat relief ventilation system for the Spillway hoist house and stair towers;

D1 .44 Design, supply and installation of all electrical panels, electrical disconnects, MCC's, control equipment, power outlets, lighting, receptacles, and radiant heaters in the Spillway Gates hoist house and towers required for a fully operational Spillway;

.45 Design, supply and installation of feeder cables and control cables from Spillway Main MCC located in the Electrical Building, to the individual Spillway Gate MCCs located in the Spillway hoist houses;

.46 Design, supply and installation of control cables between the Spillway Electrical Building and the Spillway hoist houses;

.47 Design, supply, and installation of electrical cable trays, conduit, and cabling in the Spillway hoist houses, on the hoist towers to the Spillway Electrical Building, in the Spillway Gates, and to the embedded guide heaters;

D1 .48 Conversion of permanent Type S1 stoplogs from upstream seals to use in the permanent upstream stoplog slots with downstream seals after all rollway construction is completed;

.49 Transportation, installation, removal and storage of all Stoplogs required for isolating the Spillways for construction of the rollways and installation of the permanent sill beams and rollway steel plates;

.50 Transportation, installation, removal and storage of Stoplogs as required for testing and commissioning of the Spillway Equipment;

.51 Design, supply and installation of modification of the Spillway Gate Hoists for operation of the Spillway Gates at the higher elevation after each rollway has been constructed;

.52 Removal of the temporary stoplogs used for construction and transport to Company storage location;

.53 Final storage of the permanent upstream Stoplogs in the Stoplog storage system;

.54 Design and supply of all required slings for the operation of any of the Stoplogs with a mobile crane;

.55 Testing and commissioning of all supplied Spillway hydro-mechanical equipment, and electrical and mechanical auxiliaries, before and during the Diversion Phase, after each of the rollways are constructed, after final reservoir impoundment, and assistance during the commissioning of equipment supplied by Company's Other Contractor that interfaces with Contractors supplied equipment;

D1 .56 Design, supply and installation of the fire alarm system in the spillway hoist house and stair towers connected to the fire alarm control panel in the Electrical Building. Fire alarm system shall include automatic detectors, manual stations, audible and visual alerting devices, and cabling;

D1 .57 Design, supply, and installation of guards around each hoist to prevent worker access to the operating equipment including the hoist drums, drive shafts, and couplings.

2.1.4 Intake Hydro-Mechanical Equipment

The work included shall be as follows, and as described in the Technical Specifications and Drawings:

.1 Design, supply and installation of twelve (12) sets of embedded parts for the Powerhouse Intake Trashracks guides, with each set including: two (2) side guides; and one (1) sill assembly;

.2 Design, supply and installation of twelve (12) sets of embedded parts for the Intake Bulkhead Gates guides and seal faces, with each set including: two (2) side guide assemblies and one (1) lintel beam assembly with downstream seals; and one (1) sill beam assembly;

.3 Design, supply and installation of twelve (12) sets of embedded parts for the Intake Gates guides and seal faces, with each set including: two (2) side guide assemblies and one (1) lintel beam assembly with upstream seals; and one (1) sill beam assembly;

D2 .4 Design, supply, and technical assistance during installation performed by Company's Other Contractor, of all supplied anchors mounted on steel templates, bolts, tie-rods, washers, nuts, etc., required for all the embedded parts in the primary concrete installation and attachment to the formwork;

D1 .5 Design, supply and installation of all anchors, steel templates, bolts, tie-rods, washers, nuts, etc., required for all the embedded parts in the second stage concrete installation and attachment to the formwork;

D2 .6 Not Used;

.7 Design, supply and installation of twelve (12) sets of Intake Trashrack panels, one set for each water passage;

.8 Design, supply and installation of one (1) lift beam, for operation with a mobile crane, to install and remove the Trashrack panels;

D2 .9 Design, supply and installation of one (1) set of Bulkhead Gates for isolation of any one Intake Gate, with the top Bulkhead Gate section designed with Teflon coated seals, and to be lifted with two (2) metres differential hydrostatic head;

.10 Design, supply and installation of isolation and lockout provisions for the Bulkhead Gate slots when a water passage is isolated;

.11 Design, supply and installation of one (1) lifting beam, for operation with the Trash Cleaner hoist, to install, remove, and store the Bulkhead Gate sections;

.12 Design, supply and installation of dogging devices for the Bulkhead Gate sections and lift beam, designed to store the gates and lift beam below the Intake deck covers in the Bulkhead Gate slots;

.13 Design, supply and installation of twelve (12) sets of Intake Gates;

.14 Design, supply and installation of twelve (12) sets of wire rope hoists with controls for operating the Intake Gates;

D1 .15 Design, supply and installation of twelve (12) sets of dogging devices for the Intake Gates, designed to dog the gates to service each set of wheels at a comfortable working level from the maintenance platform in the gate inspection gallery, to service the gate seals, and to service the sheave blocks from the platform under the hoist deck;

.16 Design, supply and installation of isolation and lockout provisions for the Intake Gates, hoists and power supplies when the gates are being used to isolate the water passages or being serviced or maintained;

.17 Design, supply and installation of twelve (12) sets of heaters with controls, one set at each gate hoist, to blow heated air into the gate shafts to keep the water surface in the gate slot free of ice;

.18 Design, supply and installation of four (4) sets of motor control centres (MCC's) and control panels for each set of three intake gate hoists;

.19 Design, supply and installation of power and control cables associated with all Intake Hydro-Mechanical;

.20 Testing and commissioning of all supplied Intake hydro-mechanical equipment, and electrical and mechanical auxiliaries, and assistance during the commissioning of equipment supplied by Company's Other Contractor that interfaces with Contractors supplied equipment;

D1 .21 Design, supply and installation of twelve (12) sets of slot cover plates at each gate hoist, designed to protect personnel from suction pressure generated during gate emergency closure.

D1 .22 Design, supply, and installation of guards around each hoist to prevent worker access to the operating equipment including the hoist drums, drive shafts, and couplings.

2.1.5 Powerhouse Draft Tube Hydro-Mechanical Equipment

The work included shall be as follows, and as described in the Technical Specifications and Drawings:

.1 Design, supply and installation of eight (8) sets of embedded parts for the Draft Tube Stoplogs guides and seal faces, with each set including: two (2) side guide assemblies and one (1) lintel seal assembly with upstream seal faces; and one (1) sill beam assembly;

D2 .2 Design, supply and installation of four (4) sets of Draft Tube Stoplogs for the Powerhouse to isolate the draft tube water passages for two (2) turbine units, with the top stoplog sections designed with Teflon coated seals, and to be lifted with two (2) metres differential hydrostatic head;

.3 Design, supply and installation of one (1) Overhead Crane, with Lifting Beam, or equivalent, to install, remove, and store the Powerhouse Draft Tube Stoplogs sections;

.4 Design supply and installation of busbar conductors on the upstream wall of the Draft Tube Gallery, and a local disconnect, to provide power to the Draft Tube Crane;

.5 Design, supply and installation of sixteen (16) sets of storage supports for the Draft Tube Stoplogs;

.6 Design, supply and installation of a 2 m wide by 1 m high two door hinged water stop gate in the Draft Tube Gallery to allow movement of stoplogs to the Maintenance Area, and minimize flooding from a tailwater surge;

.7 Design, supply and installation of isolation and lockout provisions for the stoplog slots when the Draft Tube water passages are isolated, with the isolation and lockout of each bay engaged, locked out, and disengaged from the walkways;

D2 .8 Design, supply, and technical assistance during installation performed by Company's Other Contractor, of all supplied anchors mounted on steel templates, bolts, tie-rods, washers, nuts, etc., required for all the embedded parts in the primary concrete installation and attachment to the formwork;

D1 .9 Design, supply and installation of all anchors, steel templates, bolts, tie-rods, washers, nuts, etc., required for all the embedded parts in the second stage concrete installation and attachment to the formwork;

D2 .10 Not Used;

.11 Testing and commissioning of all supplied hydro-mechanical equipment for the Draft Tube Stoplogs and Hoist, and assistance during the commissioning of equipment supplied by Company's Other Contractor that interfaces with Contractors supplied equipment.

2.1.6 Trash Cleaning System

The work included shall be as follows, and as described in the Technical Specifications and Drawings:

.1 Design, supply and installation of one (1) combination Trash Cleaning System and Stoplog/Bulkhead Gate handling hoist;

D1 .2 Design, supply and installation of a cable guide for the power cable for the Trash Cleaner mounted on top of the upstream guard rail along the intake roadway decks;

.3 Delivery of Trash Cleaning System to site;

.4 Testing and commissioning of the Trash Cleaning System, and assistance during the commissioning of equipment supplied by Company's Other Contractor that interfaces with Contractors supplied equipment.

2.1.7 Spillway - Electrical Auxiliaries

The work included shall be as follows, and as described in the Technical Specifications and Drawings:

.1 Supply and installation of the complete electrical distribution system for the Spillway required for the temporary operation of the Spillway during the Diversion Phase. This electrical distribution system will remain as permanent;

.2 Supply and installation of temporary 25 kV feeder cable and cable supports from the termination pole for Construction Power 25 kV Distribution Line to the incoming 25 kV disconnect switch;

D1 .3 Supply and installation of two (2) 25 kV incoming load break disconnect switches;

.4 Supply and installation of dry type 1250 kVA, 25 kV -600/347 V transformer with off load tap changer;

D1 .5 Supply and installation of the Spillway 600 V switchgear, including incoming circuit breakers from the dry type transformer and from the emergency generator, complete with automatic transfer and load management controls;

.6 Supply and installation of 600 V Main Spillway MCC including the feeder units for the five (5) Spillway hoist house MCCs and motor starters and feeder units for auxiliary equipment, lighting and power distribution for the Spillway Electrical Building;

.7 Supply and installation of cable tray system for support of all power and control cables installed in the Spillway Electrical Building;

.8 Supply and installation of dry type distribution transformers, 600/347 V panelboards, and 208/120 V panelboards;

.9 Supply and installation of 125 V dc system including batteries, battery chargers, and panelboards;

.10 Supply and installation of lighting for the Spillway Electrical Building;

.11 Supply and installation of surface grounding system including ground bar, telecom ground bar, cable tray grounding, bonding of all electrical equipment, bonding of metal parts of non-electrical equipment and system and circuit grounding;

.12 Supply and installation of emergency lighting system for the Spillway Electrical Building including central emergency lighting equipment, remote heads and exit signs;

.13 Supply and installation of 600 kW emergency diesel generator;

.14 Supply and installation of emergency generator fuel tank (day tank);

D1 .15 Supply and installation of manual transfer switch;

D1 .16 Supply and installation of interlocked switch and power receptacle for connection of a mobile diesel generator;

.17 Supply and installation of safety switch in the Electrical Room for Trash Cleaning System power supply;

.18 Design, supply and installation of five (5) individual spillway gate controllers in the Electrical Room, and HMI (Human Machine Interfaces);

.19 Design, supply and installations of warning system, with outdoor horns to warn personnel of impending operation of Spillway gates;

D1 .20 Design, supply and installation of Spillway fire alarm system, including detectors, manual stations, audible and visual alerting devices, cabling and fire alarm control panel;

D1 .21 Supply and installation of power and signal cables and junction boxes, for connection of CCTV cameras, telephones and Security and Access Control System (SACS) by Company's other contractors;

.22 Design, supply and installation of fibre optic and communications cabling on the Spillway between the Spillway Electrical Building and the Spillway hoist houses for both Diversion and Operation Phases;

.23 Design, supply and installation of fiber optic cable from 25 kV Construction Power termination pole to telecom panel in Spillway Electrical Building;

.24 Design, supply and installation of temporary 600 V power supply cables from the main MCC in Spillway Electrical Room to the temporary power supply termination point for the Trash Cleaning System for use during construction;

.25 Design, supply and installation of permanent 600 V power supply termination points at the north end of the Intake Deck for the Trash Cleaning System permanent power supply;

.26 Testing and commissioning of all supplied Spillway Electrical Building electrical auxiliaries, and assistance during the commissioning of equipment supplied by Company's Other Contractors that interfaces with Contractor's supplied equipment.

D1 .27 Design supply and installation of 120 Vac UPS, including panelboard.

.28 Design supply and installation of 600 V copper busway between 25 kV / 600 V transformer and 600 V switchgear.

.29 Design supply and installation of cable trays between the outdoor installation near the diesel fuel tank (at elevation El. 15.00 m) and the spillway electrical building (at elevation El. 48.95 m).

.30 Design supply and installation of the buried conduits between 25 kV termination pole and the spillway steel structure including the trench for the conduits and buried cables, including concrete embedded conduit elbows.

.31 Design supply and installation of outdoor lighting at the diesel fuel tank area.

D1 .32 Design supply and installation of Spillway Electrical Building exterior lighting, and the poles and lighting on the Centre Transition Dam.

2.1.8 Spillway Electrical Building - Mechanical Auxiliaries

The work included shall be as follows, and as described in the Technical Specifications and Drawings:

.1 Supply and installation of the Diesel Generator Room ventilation and heating system;

.2 Supply and installation of the Electrical Room heat relief ventilation system;

.3 Supply and installation of the diesel generator engine exhaust system;

.4 Supply and installation of the diesel generator combustion air/heat relief intake system;

.5 Supply and installation of the diesel generator radiator exhaust/recirculation system;

.6 Supply and installation of the heating and ventilation control and monitoring system for the Spillway Electrical Building;

.7 Supply of one (1) portable motorized greasing unit and a cartridge grease gun:

.8 Testing and assistance with commissioning of all supplied Spillway Electrical Building mechanical auxiliaries, and assistance during the commissioning of equipment supplied by Company's Other Contractor that interfaces with Contractors supplied equipment.

2.1.9 Spillway Electrical Building – Structure

The work included shall be as follows, and as described in the Technical Specifications and Drawings:

.1 Supply and installation of the Spillway Electrical Building structure including all structural and miscellaneous steel;

D1

.2 Supply and installation of exterior and interior building finishes including concrete floor, cladding, flashing, insulation, sealants, doors, partitions, and building penetrations for equipment and cable trays in addition to other items for a complete building system.

2.1.10 Fuel Storage System

The work included shall be as follows, and as described in the Technical Specifications and Drawings;

D1 .1 Design, supply and installation of a diesel fuel storage system at the Spillway with a minimum 11,370 L concrete encased steel double wall above-ground fuel oil storage tank (ConVault 3000LP);

.2 Design, supply and installation of an automatic fuel pumping/return system to supply fuel from the fuel storage tank to the Spillway Diesel Generator fuel storage day tank;

D1 .3 Not used;

.4 Design, supply and installation of fuel supply and return lines from the fuel storage tank to the Spillway Diesel Generator fuel storage day tank;

D1 .5 Not used;

.6 Testing and commissioning of all supplied fuel storage system components, and assistance during the commissioning of equipment supplied by Others that interfaces with Contractors supplied equipment.

D1 .7 Supply and installation of access stairs and platform for safe access to the fuel tank fill connection.

2.1.11 Alternatives (to be confirmed by Company)

D2 .1 Not Used;

.2 Not Used;

D2 .3 Supply and installation of form work and second stage concrete for embedded parts. All references to and requirements for this alternative scope in this Exhibit 1 do not apply unless this alternative is selected by Company.

2.2 WORK PROVIDED BY COMPANY'S OTHER CONTRACTORS

2.2.1 As an option, the Company's Other Contractor can supply concrete to Contractors, including the delivery of concrete from the batch plant to the pour location, to be used at the discretion of Contractor at a set rate. If this option is retained by the Contractor,

the Company's Other Contractor will be acting as the Contractor's subcontractor for this specific work.

2.3 WORK EXCLUDED

2.3.1 General

.1 Excavation for the intake, powerhouse, spillway, intake approach channel and discharge channel;

.2 Upstream and downstream cofferdams;

.3 Access roads to the project location;

.4 Access roads into the worksite;

.5 Access ramps to upstream of the Spillway; to upstream of the Intake; and to downstream of the Draft Tube;

.6 Removal of access ramps and cofferdams;

.7 Dewatering of the excavation and site sediment control;

D2 .8 Survey of Company's Other Contractor's work.

2.3.2 Spillway and Centre Transition Dam

The following are excluded from the scope of work:

.1 Primary grounding;

.2 First stage (primary) concrete;

.3 Installation of the concrete anchors in first stage (primary) concrete for the embedded parts for the gate and stoplog side guides, sill seal beams, and lintel seal beams, and rollway plate anchors;

.4 Installation of the steel side plate liners and concrete anchors in first stage concrete;

.5 Installation of the primary anchors in first stage concrete for the Spillway hoist towers;

.6 Installation of the concrete anchors in first stage concrete for the supplied Spillway walkways;

.7 Embedded rail anchors and rails for the Trash Cleaning System;

.8 Guardrails mounted in primary concrete on the Spillway deck and piers;

.9 Supporting steel, platform and concrete deck topping below the Spillway Electrical Building;

.10 25 kV construction power supply up to the termination pole near the Spillway Electrical Building for operation of the Spillway for the Diversion Phase;

.11 25 kV permanent power supply to the Spillway Electrical Building for permanent operation of the Spillway;

.12 Cable trays for cable not supplied by this contract;

.13 600 V power supply cables, DC power supply cable, control cables, and communication cables from Powerhouse up to the Spillway Electrical Building.

D1 .14 Spillway permanent bridges and downstream temporary bridge.

2.3.3 Intake

The following are excluded from the scope:

.1 Main lighting, welding and convenience outlets;

.2 Primary grounding;

.3 First stage (primary) concrete;

.4 Installation of the concrete anchors in first stage (primary) concrete for the embedded parts for the gate, stoplog and trashrack side guides, sill seal beams, and lintel seal beams;

.5 Installation of the concrete anchors in first stage concrete for the Intake Gate hoists;

.6 Embedded rail anchors and rails for the Trash Cleaning System;

.7 Guardrails, handrails and ladders mounted in primary concrete on the Intake deck, Intake hoist house, and Intake Gate maintenance platforms;

.8 Associated electrical and mechanical systems including power outlets, cable trays, radiant heating, ventilation, and piping systems in the Intake Hoist House;

.9 600 V power supply cables from Powerhouse up to the Intake deck section for the Trash Cleaner power supply;

D1 .10 Trashrack head loss monitoring system.

2.3.4 Powerhouse Draft Tube

The following are excluded from the scope:

.1 Main lighting and convenience outlets;

.2 Primary grounding;

.3 First stage (primary) concrete;

.4 Installation of the concrete anchors in first stage (primary) concrete for the embedded parts;

.5 Walkways, guardrails, handrails and ladders in primary concrete in the Draft Tube Gallery;

.6 Associated electrical and mechanical systems including power outlets, cable trays, radiant heating, ventilation, and piping systems in the Draft Tube Gallery;

.7 Power supply cables: 600/347 Vac (3 wires, 60 Hz and 3 phases, four wires), 120/208 V (3 phases, four wires) and normal 120 V (1 phase, 60 Hz) and UPS.

2.3.5 Spillway Electrical Building

The following are excluded from the scope:

.1 Support plates and anchor bolts for the Spillway Electrical Building;

2.3.6 Spillway Electrical Auxiliaries

D1 The Supply and Installation of the following are excluded from the scope:

.1 Telecom panel in the Spillway Electrical Building;

.2 CCTV cameras and monitoring equipment;

.3 Telephones

.4 Security and Access Control System (SACS)

.5 Workstations for display of CCTV images in the Spillway Electrical Building;

.6 Connection and testing of the fibre optic cable between the 25 kV termination pole and the Spillway Electrical Building.

2.3.7 Spillway Electrical building – Mechanical Auxiliaries

The following are excluded from the scope:

.1 Telecom panel switch router for the heating and ventilation system.

2.3.8 Fuel Storage System

The following are excluded from the scope:

D2 D1 D1 D2

.1 Main fuel storage tank foundations, concrete slab, and bollards;

.2 Not used;

.3 Not used;

.4 Steel access stairway to centre transition dam drainage gallery.

3 SPECIAL REQUIREMENTS

3.1 GENERAL

3.1.1 Contractor shall coordinate primary anchor design including size, spacing, length and installation sequence in first stage concrete with the Engineer, concrete and reinforcing drawings, and concrete contractor before the first stage concrete anchor concept is finalized and Accepted by the Engineer.

D2

3.1.2 Site Information Drawings provided show general layout of the site and cofferdams around the work areas. Access ramps will be provided into the work areas by the Company's Other Contractors who are providing the site Excavation (CH0006) and the

primary (first stage) concrete structures (CH0007) that can be used by the Contractor to access the work areas.

3.1.3 The overall project schedule requires that some of the work be performed during the winter period. The Contractor shall take all necessary measures for winter installation, including the use of heated shelters and the Contractor shall design, supply, install and remove temporary shelters.

3.1.4 Where an area is used by the Contractor as shelter for the execution of its work before the area is completed, it is the responsibility of the Contractor to supply, install and subsequently remove any temporary walls and enclosure as may be required.

3.1.5 All temporary works shall be designed by a professional engineer member of the PEGNL. The professional engineer shall be approved by the Engineer prior to starting any work. All designs and drawings shall be submitted to the Engineer for review and approval before starting of any work.

3.1.6 The Contractor shall supply install, operate, dismantle and remove from the site at the end of the work construction cranes of a capacity to suit the Contractor's needs.

3.1.7 The Contractor shall submit the required documentation to the Engineer for review and approval in accordance with the Technical Specification and Supplier Document Requirement List (SDRL).

3.1.8 Where there are conflicts between or within the Technical Specification, Drawings, Codes, Standards or Acts, priority shall be given to the more stringent.

3.2 SITE CONDITIONS

3.2.1 This Scope of Work Specification shall be read in conjunction with Exhibit 12 Site Conditions.

3.2.2 CONCRETE SUPPLY AT MUSKRAT FALLS

D1 .1 A concrete batch plant will be installed at the Muskrat Falls work site by one of the Company's Other Contractor's, and Company will be negotiating a set price for this concrete supply to Company's Other Contractor. Contractor can choose to obtain concrete supply from this Company's Other Contractor's batch plant at the negotiated price or is free to seek alternative suppliers. Contractor shall indicate which option it chooses for the bid and provide details of alternate sources if that is the chosen option.

D2 .2 Not Used.

D2 .3 Not Used.

D1 .4 Contractor shall be fully responsible for making arrangements with and payments to, Company's Other Contractor for concrete supply, as well as ensuring quality of concrete supplied and schedule of concrete supply meets Contractor's construction requirements.

D1 **3.3 NOT USED**

3.4 ENVIRONMENTAL REQUIREMENTS

D2 **3.4.1** Contractor shall comply with the Technical Specification Section 01 35 43 – General Environmental Requirements and Environmental and Regulatory Compliance Requirements in Exhibit 6.

D1 **3.4.2** Prior to the start of site work, the Contractor shall prepare a Contract Specific Environmental Protection Plan (C-SEPP) for review and approval by the Engineer.

3.5 DOCUMENTS

3.5.1 Drawings Provided to the Contractor

.1 The Issued for Bid drawings issued with the Request for Proposal (RFP) are intended to indicate the location, type and scope of work to be carried out. They are not to be used for construction.

D1 .2 At Contract award, approved Company supplied Drawings will be provided to the Contractor for design. The Contractor shall proceed with final design, and shall notify the Engineer of all differences and/or discrepancies with the drawings Issued for Bid.

.3 With the Tender, and before the beginning of the work, the Contractor shall submit for the Engineer's acceptance, the drawings required as per Technical Specification and as provided in the SDRL (Exhibit 4- Supplier Document Requirement List).

D1

.4 The Contractor shall submit documentation as per approved supplier document register.

3.5.2 Drawings

.1 The Drawings are included in Exhibit 1, Attachment 2.

.2 The Drawings related to the work are Approved for Design.

.3 Contractor shall only execute Works based on Contractor's Issued for Construction Drawings that have been Accepted by the Engineer, or based on Company Supplied Approved for Construction (AFC) drawings.

3.5.3 Technical Specification

The Technical Specification and performance requirements related to the Work are provided in Exhibit 1, Attachment 1.

D1

3.5.4 Not used

3.6 PRESERVATION, MECHANICAL COMPLETION & COMMISSIONING REQUIREMENTS

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3.6.1 For preservation, mechanical completion and commissioning requirements see Section 11 08 00 – Preservation, Mechanical Completion & Commissioning Requirements.

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3.6.2 Records of preservation, mechanical completion, testing and commissioning requirements shall be provided for all electrical and mechanical equipment performed prior to delivery to site and at site.

3.6.3 Personnel shall be provided for Commissioning at site, and all labour, equipment and instrumentation necessary to operate, install/remove, and test all equipment supplied as part of this work to demonstrate that it meets the requirements of the contract.

3.7 INTERFACE WITH COMPANY'S OTHER CONTRACTORS

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3.7.1 Interfaces to be managed as per Exhibit 3, Coordination Procedure.

3.8 INSTALLATION

3.8.1 General

.1 Contractor shall be responsible for all activities necessary for installation of the Work including, activities required for:

.1 Transportation and offloading of all permanent equipment, spares, ancillary and installation equipment to Contractor's laydown area;

.2 Pre and post installation surveys;

.3 Installation of all components;

.4 Lifting operations;

D2

.5 Technical assistance during concreting of Contractor's supplied equipment by Company's Other Contractor;

.6 Inspection, testing and commissioning; and

.2 Cleaning and care of the facilities in its care, custody and control.

3.8.2 If any Contractor supplied equipment is unavailable, Contractor shall replace it with equipment Accepted by Engineer which shall be at least equivalent in quality and performance.

3.8.3 Contractor shall perform site reinstatement including, removal of all temporary works and debris dropped or discharged by Contractor including all installation aids and rigging.

3.8.4 Contractor shall perform constructability and hazard peer reviews with Engineer, Company's Other Contractors and Subcontractors prior to commencement of the Work.

3.8.5 Contractor shall operate and maintain construction services based on a twenty-four (24) hour day - seven (7) day week for the duration of the Work.

3.8.6 On completion of the Work, all services shall be dismantled by Contractor and removed from the Muskrat Falls Worksite as part of Contractor's demobilization unless directed otherwise by Engineer.

3.9 MOBILIZATION

3.9.1 Mobilization shall include:

.1 Provision of a pre-mobilization schedule covering all checking, testing and calibration activities;

.2 Checking, testing and calibration of major items of equipment;

.3 Submission of test and survey reports;

.4 Site preparation and readiness activities;

.5 Provision and Delivery of spares;

.6 Modification and repairs, as necessary, for all parts of the Contractor's Items to enable them to correctly and safely perform their function;

.7 Loadout of equipment from Contractor's loadout facilities or nominated ports;

D1

.8 Set-up of Contractor's temporary facilities as described in Section 3.10 of this Exhibit 1;

.9 Set-up and establish Contractor's offices at the Muskrat Falls Worksite.

3.9.2 Contractor is responsible for all mobilization of Contractor's Items and Personnel, required for the execution of the Work.

3.9.3 Engineer may, at its sole discretion, witness Contractor's mobilization and demobilization activities.

3.9.4 Contractor shall immediately advise Engineer of any change to the mobilization date.

3.9.5 Daily notice shall be given the Engineer for each of the last fourteen (14) days prior to the actual mobilization date.

3.10 CONTRACTOR'S TEMPORARY FACILITIES

3.10.1 Contractor shall erect its offices and other buildings to carry out the Work, subject to securing prior Approval from Engineer.

3.10.2 Contractor shall undertake the supply, installation, operation and disassembly, including work required for all services necessary beyond the connecting points indicated by Engineer and as further detailed in Exhibit 12 - Muskrat Falls Worksite Conditions.

3.10.3 Any grading required, beyond the original grading, shall be at Contractor's account.

3.10.4 Plans for construction of temporary facilities shall be submitted to Engineer for Approval.

3.10.5 The installation of the buildings shall conform to Applicable Laws and the requirements set by Engineer.

D1

3.10.6 Contractor shall submit to Engineer, for its Acceptance, all plans and specifications for all systems it shall require for the execution of the Work, and shall be submitted no later than fifteen (15) days before the start of installation Work.

3.10.7 Engineer has the right at all times, to inspect the temporary facilities of Contractor and at the Contractor's expense require any changes it deems necessary or not in accordance with plans Approved by Engineer.

3.10.8 From electrical connection points provided by Company as indicated in Exhibit 12 - Muskrat Falls Worksite Conditions, Contractor shall provide, install and maintain its own distribution network and provide circuit breakers, fuse holders and various required materials in order to protect the electric circuit and transformer for the power needs of its construction services and its facilities.

3.10.9 The electrical connection work shall be done in accordance to applicable electrical codes and coordinated and Accepted by Engineer prior to connecting to the Company's network.

3.10.10 Engineer has the right at all times to inspect all temporary electrical systems installed by Contractor and at the Contractor's expense require any changes it deems necessary or not in accordance with plans Approved by Engineer.

3.11 PREPARATORY WORK

3.11.1 Contractor shall perform, prior to commencement of installation activities, all survey and preparatory operations as necessary to allow completion of the Work.

3.12 DEMOBILIZATION AND CLEAN-UP

3.12.1 Contractor shall be responsible for the removal of its entire temporary works, failed components and tooling from the Muskrat Falls Worksite, excluding temporary power facilities or as directed by the Engineer.

3.12.2 Contractor shall restore all areas of the Muskrat Falls Worksite, put at its disposal, to its original state or in a condition acceptable to the Engineer.

3.12.3 Any remedial operation that Engineer deems necessary shall be performed by Contractor.

3.12.4 Upon completion and acceptance of the Work, Contractor shall demobilize Contractor Items and Personnel.

3.12.5 Demobilization and clean-up shall be completed in accordance with the Exhibit 6 - Environmental and Regulatory Compliance Requirements.

3.12.6 Upon completion of the Work and during the demobilization process, Contractor shall dismantle all temporary electrical services that it installed and make them available for inspection and approval by Engineer.

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D1

3.13 NOT USED

3.14 SURVEY REQUIREMENTS

3.14.1 Contractor shall be responsible for all survey equipment and Personnel necessary to complete the Work.

3.14.2 Contractor shall plan and perform the survey and measurements activities in an optimal manner and in accordance with the Agreement.

3.14.3 Contractor shall prepare detailed procedures for all survey activities prior to, during and post installation, and the procedures shall describe all aspects of the survey activities including planning of operations, calibration, description and operation of all systems, checklists, survey works, processing of data and reporting.

3.14.4 All survey procedures shall be issued to Engineer for Acceptance.

3.14.5 Contractor's equipment and systems shall be well maintained and tested and shall utilize current technology.

3.14.6 Contractor shall be responsible for supply, installation, calibration and operation of all positioning systems and aids necessary to perform the Work.

3.14.7 Calibrations shall be fully documented and such documentation shall be provided to Engineer on request.

3.14.8 In the event of replacement or repair of any equipment, calibration procedures shall be repeated in full.

3.15 PRE-INSTALLATION SURVEYS

3.15.1 Prior to commencing any installation activities, Contractor shall carry out pre-installation surveys of the Worksite(s).

3.15.2 Contractor shall be responsible for locating and confirming the position, configuration and status of the existing structures and items.

3.15.3 Contractor shall submit the results of the pre-installation survey(s) to Engineer for review and Acceptance.

3.16 INSTALLATION SURVEY

3.16.1 Contractor shall perform surveys during installation activities as required to ensure the correct installation of the Work in accordance with the requirements of the Agreement.

3.16.2 As-built Survey

.1 Contractor shall perform an as-built survey of the Work.

.2 Contractor shall provide Engineer with the results of the as-built survey and identify, for Engineer Acceptance, any remedial measures proposed.

.3 All components requiring remedial works shall be re-surveyed as necessary to establish the final as-built system condition.

D1

4 NOT USED

END OF SECTION

LOWER CHURCHILL PROJECT
MUSKRAT FALLS HYDROELECTRIC DEVELOPMENT

CH0032

PRESERVATION, MECHANICAL COMPLETION & COMMISSIONING REQUIREMENTS

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PRESERVATION, MECHANICAL COMPLETION & COMMISSIONING REQUIREMENTS

TABLE OF CONTENTS

PART 1 GENERAL

1.1 SCOPE

1.1.1 This section defines Contractors responsibilities and minimum technical requirements for mechanical completion, preservation and commissioning of the Powerhouse and Spillway Hydro-Mechanical Equipment D1

1.2 DEFINITIONS

1.2.1 Commissioning Check List (CCL) – the documentation approved by Engineer to record all Commissioning Static Checks and results carried out during commissioning.

1.2.2 Commissioning Procedure (CPR) – detailed step by step description of relevant multi-discipline, Dynamic Commissioning / System Commissioning activities carried out to prove the design and suitability for operation of a system or part system.

1.2.3 Commissioning Static Checks – shall mean all live / energized tests that are carried out after a section of Work has reached Mechanical Completion. These shall be completed in compliance with the specifications at Contractors / Suppliers facilities, factory tests and during installation and/or construction as soon as it is safe for commissioning Static Checks to commence initially on a single discipline basis.

1.2.4 Completions – shall mean all activities involved in Mechanical Completion, Preservation, and handover for commissioning, commissioning and turnover to Operations.

1.2.5 Dispatch Dossier – shall mean those documents required, as a minimum, to accompany goods released to Site from Contractors / Suppliers and fabricators. Procured Goods shall not be dispatched without Dispatch Dossier.

1.2.6 Dynamic Commissioning / Systems Commissioning – shall mean commissioning activities which simulate operations of a complete system or part system. These tests shall, as near as possible, be at full operating conditions in order to carry out operational performance tests to verify that the system / equipment performs in accordance with the design criteria, together with the recording of such tests. Such Dynamic Commissioning / Systems Commissioning shall be sufficient to allow systems, part system and/or equipment to be certified, turned over to Operations by the RFO team and rapidly brought into operational service by Operations, if not already operational.

1.2.7 Inspection Test Records (ITR) – the documentation approved by Engineer that defines all procedural checks and tests to be carried out by Contractor during Mechanical Completion. D1

1.2.8 Livening Up Notice (LUN) – a notification to all involved parties at Site that commissioning will start and that all further work on a particular system or part system shall be subject to permit to work procedures. The LUN shall contain descriptions and marked up drawings of which particular system or part system D1

that will become live during commissioning. The method of work permit shall be the WPC (Work Protection Code) established by Company or the Contractor's Project Safety Management Plan if its requirements exceed the WPC.

D1 1.2.9 MC Handover – the formal transfer of MC documentation and responsibility for part systems, systems, area / building or the complete facility defined on the MCC.

1.2.10 Mechanical Completion (MC) – shall reflect non-live / non-energized completion of specified systems and part systems in the specification for Work, while in storage and during installation or construction to the latest design drawings, specifications and Standards.

D1 1.2.11 Mechanical Completion Certificate (MCC) – Issued by Contractor upon successful MC of a single discipline within a system or part system, thus allowing commencement of Commissioning Static Checks.

1.2.12 Operations – Company or its nominated representative responsible for Operation of the plant.

1.2.13 Part System Limits – clearly defined stand-alone scopes of work, which can be single or multi-discipline.

1.2.14 Preservation – shall mean those activities that are necessary to preserve the systems, part systems or equipment described in the specification before, during or after delivery, during MC and commissioning.

D1 1.2.15 Project Completion System (PCS) is a computerized system for tracking status of MC and commissioning by individual tag, MC Pack or commissioning pack. This system is used to verify MC and commissioning of all equipment at Contractors /Suppliers facilities and /or Site. The PCS operating software shall be provided by Engineer and it shall be the responsibility of the Contractor / Supplier to input the requisite engineering and scope data to the database. This data shall be maintained and status updated by the Contractor on an on-going basis.

1.2.16 Punch List – a list of incomplete scope and / or deficiencies agreed between Contractor offering the equipment, system, or part system and RFO receiving the equipment, system, or part system.

1.2.17 Punch List A item – means that the deficiency noted is significant and is preventing the MC Handover or RFO Turnover process.

1.2.18 Punch list B item – means that the deficiency is minor in nature and is not preventing the MC Handover or RFO Turnover process.

D1 1.2.19 Ready for Operations (RFO) – a team, led by Company, consisting of qualified personnel from Company, Engineer, Contractors and Suppliers.

1.2.20 RFO Turnover – the formal transfer of documentation and responsibility for operations and maintenance of part systems, systems, equipment, area / building or complete facility defined on the Turnover Certificate, from RFO to Operations.

D1 1.2.21 Specification Compliance Sign-off List (SCL) - An itemized list prepared by Contractor, for each system or part system, highlighting all its technical design parameters and specifications needed for ease in verification and sign-off by Engineer and RFO.

1.2.22 Turnover and Commissioning Package (TCP) - Detailed document outlining all testing procedures and functional requirements for each system or part system, which are completed or near Completions, to verify its performance in accordance to design specifications.

1.2.23 Turnover Certificate (TOC) – Issued by RFO to Operations upon successful completion of system or part system commissioning activities, leaving the system or part system ready for Operations.

1.2.24 Work Protection Code (WPC) - A code of practice outlining principles and methods of safe work on electrical, mechanical and associated equipment that provides formal assurance that sources of hazardous electrical and/or mechanical energy on specified equipment has been removed. It is designed to constitute a set of minimal recommended procedural and safety requirements for a safe working environment for all workers authorized to perform work on electrical, mechanical and associated equipment.

PART 2 CONTRACTOR'S RESPONSIBILITIES

2.1 GENERAL RESPONSIBILITIES

2.1.1 For all physical items within the boundaries of the Contractors Scope of Work, Contractor shall prepare plans, procedures, manuals, check sheets and reports for all completions activities. Contractor shall provide technical support, tools, spares and labour for completions activities.

D1 2.1.2 Relevant documentation shall be submitted as per the agreed Supplier Document Register. Refer to Exhibit 3 section 12 Completions Coordination Procedure for full details.

2.1.3 Contractor's Completions activities include but are not limited to the following:

1. Prepare Commissioning Manuals
2. Prepare Preservation Manuals
3. Perform initial preservations and packaging for shipment
4. Perform preservation, Mechanical Completion, Specification Compliance Verification, and Commissioning activities at Contractor's/Supplier's Works and prepare Dispatch Dossier

D1 5. Prepare and complete a SCL for all supplied systems or part systems

D1 6. Establish preservation and maintenance routines up to Handover of systems or part system upon completion of commissioning activities

D1 7. Carry out Mechanical Completion, document on Project standard forms, prepare punch lists prior to MC handover

8. Resolve punch lists items to satisfaction of Engineer

D1 9. Provide spares recommendations and agreed spares as per agreed Supplier Document Register

D1 10. Specify and provide commissioning tools, test equipment, first fills and consumables

D1 11. Define commissioning pack test limits and mark up limits on drawings, system and part system limits to be provided by Engineer and agreed to by Contractor

D1 12. Input data for the PCS database in the agreed format with MC inspection & test records, Mechanical Completion and Commissioning Packs, tag numbers and Commissioning Checklists for Commissioning Static Checks

13. Provide Dynamic Commissioning procedures

D1 14. Provide supervision, labour and technical support for commissioning activities

15. Prepare Performance Test procedures and test limits

16. Conduct commissioning static/dynamic checks on equipment, systems or part systems and document on Project standard forms

17. Plan and conduct performance test and determine acceptability of systems performance

18. Rectify, at Contractor's expense, system deficiencies including those identified in performance testing

D1 19. Prepare as-built mark ups.

PART 3 MECHANICAL COMPLETION

3.1 GENERAL

3.1.1 Contractor shall be responsible to carry out the MC inspections and tests and document these on the standard forms.

3.2 MECHANICAL COMPLETION AT CONTRACTOR'S FACILITES

D1 3.2.1 Engineer shall check and verify that the MC forms, allocated by Contractor, have been completed correctly and the MC Work is carried out prior to a shipping release.

D1 3.2.2 Contractor shall be responsible to complete a Dispatch Dossier which would contain the MC documentation along with any handling and storage requirements. For full requirements refer to the SDRL.

3.2.3 MC at Contractor's or Suppliers' facilities is applicable, but not limited, to the following type of supply:

1. Supplier skid mounted packaged equipment, such as hoists, pumps, fans and electrical panels. These skids contain piping, instrument, electrical and mechanical equipment and in many cases have a local control cabinet which is wired and connected to the primary and final elements;
2. Control panels;
3. Switchgear and control centres;
4. Transformers and electrical equipment;
5. Electrical breakers, and disconnects;
6. Control monitoring and communication equipment;
7. Hydraulic gates, stop logs, trash racks, follower beams and embedded parts;
8. Trash Rack Cleaner;
9. Hydraulic Power Unit (HPU);
10. Cranes and hoisting machinery;
11. Pad-eyes and loose lifting equipment;
12. Diesel generators;
13. Rotating machinery skid mounted.

3.3 MECHANICAL COMPLETION AT SITE

D1

3.3.1 The MC requirement at the Site shall be completed in accordance with the installation drawings, Standards, codes and to good industry and construction practices. The MC activities shall be carried out in accordance with the MC procedures and documented on MC standard forms. The MC confirmations for the key disciplines shall include, but not limited to:

Structural Discipline

1. Visual inspection for complete and correct installation in accordance with the latest drawings.
2. Alignment checks.
3. Dimensional control inspections and tests.
4. Verification that the specified NDE/NDT checks have been performed.

Mechanical Discipline

1. Visual inspection of equipment for correct and completed installation in accordance with the latest drawings.
2. Internal inspections of tanks, exchangers, fans, ductwork, etc.
3. Inspections and verification of correct and complete installation of pipe work.
4. Verification of coatings.
5. Verification that the specified NDE/NDT checks on gates, stoplogs,hoists etc. have been performed
6. Verification of colour coding for pipes.
7. Numbering identification of all mechanical components.
8. Verification of embedded parts alignment and seals of hydraulic gates and stop logs.
9. Flushing of lube and hydraulic oil systems to a specified standard.
10. Assembly of trash cleaner

Electrical Discipline

1. Visual inspection of equipment for correct and completed installation in accordance with the latest drawings.

2. Verification of electrical cable pulling, glanding, termination and testing.
3. Numbering identification of all wiring and electrical equipment.
4. Insulation and continuity of cables.
5. Insulation and continuity testing of generators, transformers, motors, panels, distribution boards and other electrical equipment.
6. Grounding checks.
7. Motor rotation checks.
8. Lighting circuit testing and illumination checks.

Instrument Discipline (Includes telecommunication)

1. Calibration and testing of instruments and telecommunication devices.
2. Visual inspection of equipment for correct and completed installation in accordance with the latest drawings.
3. Verification of electrical cable pulling, glanding, termination and testing.
4. Insulation and continuity testing of instrument / telecommunications cabling.

Civil / Architectural Discipline

1. Visual inspection of concrete structures for correct and completed installation in accordance with the latest drawings.
2. Verification of functionality of structural and architectural features (such as gates, doors, windows).

PART 4 PRESERVATION

D1

Refer to exhibit 3 section 12 Completion Coordination Procedure for details

D1

4.1 PRESERVATION AT CONTRACTOR'S FACILITY

4.1.1 The Contractor's Preservation requirements shall include the following:

1. All equipment and devices shall be protected for shipment;
2. Contractor shall perform the initial Preservation and document the Preservation carried out;

D1

3. Not used;

D1 4. Not used;

5. The Preservation documentation shall be included in the Dispatch Dossier and shall accompany the shipment;

4.2 PRESERVATION AT SITE

D1 4.2.1 Contractor shall supply a long term preservation procedure detailing required storage location, preservation checks and maintenance for Contractor's scope of supply up until takeover by operations.

D1 4.2.2 Contractor's Preservation requirements shall include the following:

1. Contractor shall be responsible for the preservation and protection of all scope of supply, inclusive of free issue and Supplier provided skid packages, equipment, material and devices.

2. Preservation procedures provided by the Supplier and the preservation requirement in the specifications outlined by Engineer shall be included.

3. Preservation documentation and records of preservation maintenance carried out shall be kept by Contractor and submitted for review as per the agreed Supplier Document Register.

4. Contractor shall energize any space heaters on receipt of equipment.

5. Contractor shall establish a preservation team to carry out the preservation requirement and to establish the preservation program up to the MC Handover of the equipment or system to RFO.

6. An inspection / check of preservation, damage shall be carried out by Contractor on receipt of equipment, materials, skid packages, fabricated elements and subassemblies. Deficiencies shall be noted and brought to the attention of Engineer for resolution.

7. Contractor shall store the equipment and material in the stipulated facility until ready for installation.

PART 5 COMMISSIONING

5.1 GENERAL

5.1.1 The following describes general requirements for commissioning. Specific tests related to the hydro-mechanical equipment are outlined in Appendix A.

5.2 COMMISSIONING AT CONTRACTOR'S FACILITIES

5.2.1 The commissioning requirements at Contractor's facilities shall be in accordance with the Factory Acceptance Testing (FAT) procedures accepted by Engineer.

5.2.2 Commissioning or FAT at Contractor's /Supplier's facility shall not be considered to be the final system commissioning, which can only be carried out when the equipment being tested is installed at Site and is connected up to the rest of the facility as per the system design.

5.2.3 FAT shall provide assurance that the equipment meets the design requirements and can meet the performance requirements.

5.2.4 Engineer, RFO and / or Operations will attend the FAT of key pieces of equipment, such as hoists' stall tests, trash cleaner, diesel generator, electrical equipment, control and monitoring systems.

5.2.5 FAT and the inspections, tests and readings taken shall be documented and made available to Engineer/RFO as part of the Supplier documentation provided with the system and part system equipment. SCL for each system or part system prior to commissioning of such system and part systems shall be submitted to RFO for confirmation.

5.3 COMMISSIONING AT SITE

D1 5.3.1 The commissioning activities at Site shall be conducted by Contractor utilizing Contractor supervision, Labour, test equipment / materials and technical support. Commissioning shall be witnessed by Engineer /RFO.

5.3.2 Commissioning at site shall include:

1. Commissioning Static Checks.
2. Dynamic Commissioning / System Commissioning.

D1 5.3.3 Contractor shall complete Commissioning Static Checks and document on CCL. The CCLs shall be submitted as per the SDRL and shall be discipline based. Commissioning Static Checks shall include, but not be limited to:

1. High voltage injection test.
2. Power on tests.
3. Relay tests.
4. High potential tests.
5. Loop checks and logic function tests.

6. Load tests.
7. HVAC air flow tests.
8. Pump tests.
9. Battery system backup tests.
10. Alarm settings and verification.
11. Valve position verification.
12. Pressure safety valve testing.
13. Rotation tests.
14. Lube and hydraulic oil cleanliness checks.
15. Opening/closing gates and stoplogs tests using the follower beams.
16. Start/stop motor testing.
17. Shutdown logic tests.
18. Control and monitoring offline checks.
19. Verification of intake gates emergency closure.
20. Diesel generator testing
21. Trash cleaner dry tests

5.3.4 Contractor shall provide technical support and labour to provide troubleshooting and resolution of deficiencies that may become evident during Dynamic Commissioning / System Commissioning.

5.3.5 Dynamic Commissioning / System Commissioning shall be performed when the Commissioning Static Checks are complete and the systems are ready for operational testing. The Dynamic Commissioning / System Commissioning activities shall include, but not be limited, to:

1. Water up tests during reservoir/ tailrace water impoundment.
2. Gate / Stop-log tests.
3. Trash cleaning system tests.
4. Start-up/shutdown tests.

5. Trips and alarm tests.
6. Baseline data recording.
7. Electrical power distribution tests.
8. Verification of the functionality of the control and monitoring systems.

PART 6 MANUALS

6.1 GENERAL

6.1.1 For each piece of equipment supplied for the Project, and for all components, sub-systems and systems, a complete set of manuals for the start-up, testing, preservation and commissioning ("Commissioning Manuals") shall be submitted, describing the required procedures in step-by-step detail.

6.1.2 For equipment which is incorporated into a sub-system or system, a separate Commissioning Manual for that piece of equipment is not required if all information required for that piece of equipment is included in the Commissioning Manual for the sub-system or system of which it is a part.

D1 6.1.3 Commissioning Manuals shall be submitted as per the SDRL.

6.2 REQUIRED COMMISSIONING MANUAL CONTENTS:

6.2.1 A responsibility matrix covering every single action, process and procedure required to complete commissioning.

6.2.2 Name of commissioning coordinator and commissioning supervisor(s).

6.2.3 Settings, alignments, tolerances and all tests and checks required prior to first start-up, energization or rotation of a piece of equipment, sub-system or system.

6.2.4 Proposed commissioning schedules.

6.2.5 Checklists and record forms.

6.2.6 Where applicable, copies of the Commissioning Manuals from all equipment and systems suppliers providing their respective procedures for testing and commissioning shall all be integrated by the Contractor into the Commissioning Manual.

6.2.7 Visual inspections and checks.

6.2.8 Pre-start checks.

6.2.9 Start-up checks.

6.2.10 Where applicable, tests and inspections required prior to start-up of ancillary equipment.

6.2.11 Tests and inspections required prior to start-up of diesel generator .

6.2.12 Initial run, commissioning and test operation of the diesel generator.

6.2.13 Checks for conformity with the Contract documents and the approved design documents.

6.2.14 Tests and checks required for interconnection, in accordance with the Contract documents and in accordance with any requirements of the transmission system operator.

6.2.15 Calibrations or settings for instrumentation, including forms to be used for the recording of such measurements.

6.2.16 Safety procedures and instructions for all personnel involved in commissioning.

6.2.17 For commissioning of control systems instructions shall include: application of appropriate signals to verify the operation of each input; running of software; and verification of software, including diagnostics and interface modules.

6.2.18 Procedures and equipment for the measurement of station service load.

PART 7 REPORTS

7.1 GENERAL

7.1.1 Contractor shall prepare test reports for consolidating the results of each major test of phase of testing.

7.1.2 Test reports shall be submitted as per the agreed Supplier Document Register for site and factory tests.

7.2 MINIMUM REPORT CONTENTS

7.2.1 As a minimum, each of the final test reports shall include the following information:

1. As-builts of all testing documentation;
2. Detailed diary of all testing performed;
3. Final equipment and control settings;
4. Calibration data;
5. Detailed results of all field tests, test data, including dimensional checks etc. for both pre-commissioning and commissioning tests;

6. Summary of the test conditions for all tests including status of equipment, ambient conditions, water levels etc.;
7. Deficiencies prior to and at completion of the testing;
8. Photographic record of all tests

APPENDIX A

Minimum Commissioning Procedure Requirements For

Hydro Mechanical Equipment

TABLE OF CONTENTS

PRESERVATION, MECHANICAL, COMPLETION & COMMISSIONING REQUIREMENTS

APPENDIX A – MINIMUM COMMISSIONING PROCEDURE FOR HYDRO MECHANICAL EQUIPMENT

PART 1 SCOPE

1.2 GENERAL

D1 1.2.1 This Appendix is intended to provide minimum static and dynamic commissioning requirements for specialized Hydro Mechanical equipment.

D1 1.2.2 Part systems are to be certified Mechanically Complete prior to start of Commissioning.

PART 2 GATES AND STOPLOGS

2.1 DRY TEST FOR ALL ROLLER GATES AND EMBEDDED PARTS

2.1.1 Following field full assembly and completion of all adjustments of the Intake Gates and the Spillway Gates to the satisfaction of Engineer, and prior to filling the forebay, Contractor shall carry out operational Dry Tests. These Dry Tests shall be carried out in accordance with the procedures Accepted by Engineer and will include as a minimum the following operations:

.1 Lower the gate to the sill and raise it to its maximum height a minimum of three consecutive operations with stops and starts at certain intervals, and Contractor shall demonstrate that these operations can be carried out from all control points;

.2 Verify proper operation of the gate and its auxiliary systems;

.3 Verify proper operation of the embedded parts heating systems (Spillway Gate);

.4 With the gate completely closed, verify the proper alignment and embedded part path clearances for all wheels, guide rollers, bearing bars, side guides etc. (at both sill elevations for Spillway Gates);

.5 With the gate completely closed, verify the proper seal pre-compression every 0.6 m along every seal;

.6 Verify the gap between the gate lip and the sill beam is within specified tolerances;

.7 Verify gate is hanging vertically plumb when suspended;

.8 Verify gate is not skewed sideways when sitting on the sill.

2.2 DRY TESTS FOR INTAKE BULKHEAD GATES

2.2.1 Following installation of the Intake Bulkhead Gates, and prior to filling the forebay, Contractor shall carry out operational Dry Tests. These Dry Tests shall be carried out in accordance with the procedures Accepted by Engineer, and will include as a minimum the following operations:

.1 Prior to Bulkhead Gate Dry Tests, lower the lifting beam in each bay to near the sill level and rise it to its maximum height stopping at two successive intervals while travelling both up and down. Verify proper operation of the lifting beam;

.2 Use the lifting beam to engage a bottom Bulkhead Gate and lower it in each bay stopping at two successive intervals. Once supported over the sill beam; disengage the lifting beam hooks; raise the beam a few metres and lower it again; re engage the hooks; and hoist the Bulkhead Gate up to the maximum height stopping at two successive intervals. Verify proper operation of the lifting beam and the Bulkhead Gates during the test;

.3 Using the lifting beam, install the entire set of Bulkhead Gates in each Bulkhead Gate slot. Verify proper operation of the lifting beam and the Bulkhead Gates during the entire test sequence;

.4 With each set of Bulkhead Gates completely installed, verify in each slot the proper gate alignment and embedded parts clearances between the slide bars and their guide path; and that the clearances between the upstream, downstream and lateral shoes and their respective bearing paths. Verify that the Bulkhead Gate's leaf springs deflection is within specified tolerances;

.5 Verify that the gap between the bottom Bulkhead Gate lip and the sill beam, and between each section, is within specified tolerances;

.6 With the complete set of Bulkhead Gates installed, verify the proper seal pre-compression at every 0.6 m on each side of each Bulkhead Gate section, between each section, and along the lintel.

2.2.2 Store the Bulkhead Gates and lift beams on the dogging devices in each of the slots for verification.

2.3 DRY TESTS FOR SPILLWAY STOPLOGS

2.3.1 Following installation of the Spillway Stoplogs and prior to filling the forebay, Contractor shall carry out operational Dry Tests. These Dry Tests shall be carried out in accordance with the procedures Accepted by Engineer, and will include as a minimum the following operations:

.1 Prior to stoplog Dry Tests, lower the lifting beam in each bay to near the sill level and rise it to its maximum height stopping at two successive intervals while travelling both up and down. Verify proper operation of the lifting beam;

.2 Use the lifting beam and engage a bottom stoplog and lower it in each bay stopping at two successive intervals. Once supported over the sill beam; disengage the lifting beam hooks; raise the beam a few metres and lower it again; re engage the hooks; and hoist the stoplog up to the maximum height stopping at two successive intervals. Verify proper operation of the lifting beam and the stoplogs during the test;

.3 Using the lifting beam, install one full set of each type of stoplog in each stoplog slot. Verify proper operation of the lifting beam and the stoplogs during the entire manoeuvre;

.4 With one set of stoplogs completely installed, verify in each slot the proper stoplog alignment and embedded parts clearances between the slide bars and their guide path; and that the clearances between the upstream, downstream and lateral shoes and their respective bearing paths. Verify that the stoplog leaf springs deflection is within specified tolerances;

.5 Verify that the gap between the bottom stoplog lip and the sill beam, and between each section, is within specified tolerances;

.6 With all sections installed, verify the proper seal pre compression at every 0.6 m on each side of each set of stoplogs, and every 3m along the sill seal between each stoplog, and every 3m along the lintel.

2.4 DRY TESTS FOR DRAFT TUBE STOPLOGS

2.4.1 Following installation of the Draft Tube Stoplogs and prior to filling the tailrace, Contractor shall carry out operational Dry Tests. These Dry Tests shall be carried out in accordance with the procedures Accepted by Engineer, and will include as a minimum the following operations:

.1 Prior to stoplog Dry Tests, lower the lifting beam in each bay to near the sill level and rise it to its maximum height stopping at two successive intervals while travelling both up and down. Verify proper operation of the lifting beam;

.2 Use the lifting beam and engaged a bottom stoplog and lower the stoplog in each bay stopping at two successive intervals. Once supported over the sill beam; disengage the lifting beam hooks; raise the beam a few metres and lower it again; re engage the hooks; and hoist the stoplog up to the maximum height stopping at two successive intervals. Verify the proper operation of the lifting beam and the stoplogs during the manoeuvres;

.3 Using the lifting beam, install one full set of each type of stoplog in each stoplog slot. Verify proper operation of the lifting beam and the stoplogs during the entire manoeuvre;

.4 With one set of stoplogs completely installed, verify in each slot the proper stoplog alignment and embedded parts clearances between the slide bars and their guide path; and that the clearances between the upstream, downstream and lateral shoes and their respective bearing paths. Verify that the stoplog leaf springs deflection is within specified tolerances;

.5 Verify that the gap between the bottom stoplog lip and the sill beam, and between each section, is within specified tolerances;

.6 With the complete set of stoplogs installed in every draft tube slot ensuring that every set of stoplogs has been used at least once;

.7 Verify that the gap between the bottom stoplog lip and the sill beam, and between each section, is within specified tolerances;

.8 With all sections installed, for one combination of components, verify the proper seal pre compression at every 0.6 m on each side of each section, between each section, and along the lintel.

2.4.2 Using the overhead crane, store the stoplogs on the storage supports.

2.4.3 Verify operation of the lockout devices in each of the stoplog slots and check that the lifting beam cannot be inserted with the stoplog slot locked out.

2.4.4 At the completion of Dry Tests, as directed by Engineer, install all stoplogs in Draft Tubes of Units 1 and 2, and verify that all seals are seating correctly for tailrace water up.

PART 3 HOISTS AND CRANES

3.1 GENERAL

3.1.1 Prior to the start of any operational tests on the hoists and cranes, Contractor shall demonstrate that the tension in the wire ropes, for hoists that have independent wire ropes, is balanced, and that it may be necessary to have some load on the hoist to perform the verification.

3.1.2 Wire rope balance shall be checked again after the hoist has run through a full operation cycle, and after all operational testing.

3.2 DEFLECTION TESTS

3.2.1 The deflection of the cranes and hoist girders shall be measured with the rated load in the middle of the span. This load shall be applied at least three (3) successive times before the measurement.

3.2.2 For the Intake Gate and Spillway Gate hoists the deflection shall be measured in the middle of the longest unsupported load member on the hoist structure itself.

3.3 BRAKE TESTS

3.3.1 All brakes (travel and hoisting) shall be tested under full load conditions, from maximum speed to rest, three (3) times in quick succession without overheating.

3.3.2 Where there are multiple hoist brakes they shall be tested individually.

3.3.3 The manual release lever on the Intake Gate hoists shall be tested including interlocks.

3.4 BUMPER TESTS

3.4.1 The bridge and trolley bumpers shall be impact tested against the end stops without load and at 40% of rated speed.

3.5 LOAD CELL TESTING

3.5.1 The load cell calibrations shall verified at no load, rated load, 125% test load, and intermediate loads between zero and rated load.

3.5.2 During the load cell verification the effect of hysteresis shall be measured and recorded.

3.5.3 During commissioning all overload protection shall be verified.

3.6 SLACK ROPE DETECTION

3.6.1 The slack rope detection system shall be tested prior to all load testing and again after the completion of all load testing. As part of this test the effects of the lifting beam shall be included where applicable.

3.7 CONTROL TESTING

3.7.1 All controls functions shall be tested thoroughly including combinations of control function where they may reasonably occur.

3.7.2 Where there are redundant controls such as pendants and radio control all the testing shall be repeated for all duplicate functions.

3.7.3 Where there is redundancy, all interlocks shall be tested to ensure only one control position has control at any time.

3.8 TEST INSTRUMENTATION AND MONITORING

3.8.1 As a minimum during the operational and load testing the following shall be recorded:

.1 Motor currents all phases;

.2 Supply voltages and voltage drop during hoisting;

.3 Brake current and voltages;

.4 Travel speeds;

.5 Hoisting and lowering speeds.

.6 Depending on Contractor's design and proposed Test Plan, Engineer may require additional test measurements.

3.9 INSPECTIONS

3.9.1 Prior to the start of the No Load tests, after the No Load tests, after the Rated Load test and again after the 125% Rated Load test, the hoists shall be thoroughly inspected by both Contractor and Engineer.

3.9.2 Contractor shall document all findings, deficiencies, unusual wear etc.

3.9.3 After the completion of all tests Contractor shall verify the torque on all key fasteners such as wire rope dead ends, sheave blocks, all fasteners that are primarily in tension, bumpers and end stops, drop stops, critical structural connections etc.

3.10 LIFTING DEVICES LOAD TESTS

3.10.1 Loose lifting devices such as lifting beams shall be load tested to 125% of their rated load.

3.10.2 Test Loads shall be within +0%, -4% of the required load.

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3.11 STATIC COMMISSIONING TESTS

3.11.1 After erection and prior to proceeding with commissioning and operational tests, all hoisting equipment shall be operated under its own power and tests carried out to prove the following:

.1 All clearances and alignments are in order; gearing is sufficiently quiet; all equipment is operating smoothly; and lubrication is adequate;

.2 Operation of all control devices is satisfactory;

.3 All limit switches are set and operate correctly;

.4 All circuits, interlocks and sequences of operation are correct;

.5 All protective devices operate satisfactorily;

.6 Each movement of the crane is satisfactory;

.7 Brakes are operating satisfactory;

.8 Positioning markers and targets are correctly adjusted;

.9 Travel of the trolley over the full range;

.10 Travel of the bridge over the entire running length;

.11 Raising over the maximum lifting height;

.12 Lowering over the minimum lifting height at normal speed;

.13 Lowering over the minimum lifting height at emergency speed (with fan brake);

.14 Test that the hoist brakes individually;

.15 Measure of all hoisting and travelling speeds;

.16 Measure of hoisting speeds;

.17 Verifying all limit switches;

.18 Verifying all circuits, interlocks and sequences of operation are correct;

.19 Verifying all protective devices operate satisfactorily;

.20 Verifying alignment of the bumpers with the end stops;

.21 Measurement of motor voltage and amperage for all operating scenarios.

3.11.2 All deficiencies shall be recorded during pre-commissioning, and deficiencies shall be corrected to the satisfaction of Engineer prior to proceeding with further testing and commissioning.

3.12 100% RATED LOAD TESTS

3.12.1 The following tests shall be performed with the rated load:

.1 Hoisting of the load at normal speed;

.2 Lowering of the load at normal speed;

.3 Lowering of the load at emergency speed;

.4 Test that the hoist brakes individually support the load with loss of power to hoist motor;

.5 Travel of the trolley over the full range;

.6 Travel of the bridge over the available length;

.7 Measure all travelling speeds;

.8 Measure hoisting speeds;

.9 Verifying all limit switches at rated speed;

.10 Verifying all circuits, interlocks and sequences of operation are correct;

.11 Verifying all protective devices operate satisfactorily.

.12 Measurement of motor voltage and amperage for all operating scenarios.

3.12.2 During these tests the speeds shall be varied over their full range and maintained sufficiently long to demonstrate the adequacy of the system and that there are no unusual noises, over-heating or control problems. As part of these tests the load shall also be lifted, stopped, lifted again and stopped at least three times (3) in quick succession.

3.12.3 Contractor shall demonstrate that the Rated Load Test load is within +4%, -4% of the required weight.

3.13 125% RATED LOAD TESTS

3.13.1 The following tests shall be performed with the test load at 125% of the hoist rated capacity:

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.1 Hoisting of the load;

.2 Lowering of the load;

.3 Travel of the trolley over the full range;

.4 Travel of the bridge over the available length;

.5 Test that the hoist brakes individually support the load;

.6 Measurement of motor voltage and amperage for all operating scenarios.

3.13.2 Contractor shall demonstrate that the 125% Test Load is within +0%, -4% of the required weight.

PART 4 OPERATIONAL LOAD TESTING OF GATES

4.1 GENERAL

4.1.1 Operational load testing shall be performed by Contractor under the supervision of Engineer.

4.1.2 Contractor shall provide procedures for operation load testing of the gates, but control of the gates will be by Engineer who will instruct Contractor when to perform each testing sequence.

4.1.3 Contractor shall supply personnel and equipment for the operational load testing.

4.2 SPILLWAY OPERATIONAL TESTING

4.2.1 The Spillway Gates will be tested with the following sequence:

.1 Partial testing at available head after the spillway entrance channel is watered up and the cofferdams removed in preparation for river closure;

.2 The Spillway Gates will remain fully open while the river is diverted through the Spillway

.3 After the river closured is complete the Spillway Gates will be closed and operated to water up the reservoir to Diversion Headpond Level (DHL);

.4 The Spillway Gates shall then be operationally tested for the Diversion Phase;

.5 When each set of Rollways are completed, the Spillway Gates will be adjusted for the new sill elevation, the gates closed and watered up, and shall be operationally tested again at the DHL;

.6 When the last two Spillway bays have their Rollways installed, the forebay will increase to the forebay Full Supply Level (FSL) and all Spillway Gates adjusted for the new sill elevation;

.7 After the forebay is watered up to FSL, each Spillway Gate shall be operationally tested again for long term operation.

4.2.2 For the operational tests, the Spillway Gates shall be operated over their full opening to demonstrate that they are capable of operating and that there is no excessive vibration.

4.3 INTAKE GATES OPERATIONAL TESTING

4.3.1 All Intake Gates shall be closed and monitored during initial filling of the forebay for leakage, but will not be able to be operationally tested until Engineer schedules watering up of the downstream water passages.

4.3.2 For Operation testing, the Intake Gates shall be cracked to simulate filling of the water passages with full differential head.

4.3.3 The Intake Gates will be immediately closed against full head to simulate closure of the gates under full differential head.

4.3.4 The Intake Gates shall then be operated, closed, dewatered, and checked for leakage.

4.3.5 Emergency lowering test of a set of three intake gates shall be performed to shut in one unit against full turbine discharge. The set of gates are to be chosen by Engineer.

4.3.6 Operational load testing shall demonstrate during the testing that the load does not exceed the gate's and hoist's specifications.

PART 5 IMMERSION AND ACCEPTANCE TESTING

5.1 GENERAL

5.1.1 There will be a period of delay between Contractor completing the Dry Tests, and the commencing to water up by Company's other contractors. Contractor shall have a field representative available to witness the behaviour of all gates and stoplogs while being submerged during water up, and shall have crews available to deal with any deficiencies during water up.

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5.1.2 Acceptance testing shall be performed by Contractor. These tests shall be carried out in accordance with procedures developed by Contractor, and submitted to and Accepted by Engineer. Records of Acceptance testing to be submitted as per the SDRL.

5.1.3 Testing after water up shall wherever possible be based on actual operations conditions, equipment under full hydrostatic load, and where not practical be based on simulated operating conditions that may happen during normal and emergency operation.

5.1.4 Immersion and acceptance testing shall demonstrate that the equipment is operating normally and without excessive vibrations.

5.1.5 Immersion and acceptance testing shall include, but not be limited to, operation with and without flow where applicable, installation of components while watered up, de-watering water passages, operation of all ancillary equipment, testing of all hoisting equipment, testing of Trash Cleaner equipment, etc.

D1 5.1.6 Leakage will be measured and compared against the permissible values stipulated in Technical Specification section 48 13 20.

D1 5.1.7 Not used.

PART 6 TRASH RACK CLEANER

6.1 GENERAL

6.1.1 Contractor shall provide all personnel required to perform all testing and commissioning activities including operating, and perform any repairs or modifications necessary.

6.1.2 Contractor shall provide Site Technical Representation from the manufacturer, versed in all aspects of the equipment design and operation including hydraulic systems, controls etc.

D1 6.1.3 Engineer may at their discretion witness all aspects of the work being performed by Contractor and will require advance notice of all testing and commissioning activities.

6.1.4 Every aspect of the equipment's functional capability shall be tested and commissioned.

6.1.5 All testing and commissioning activities shall be documented and at the Company's and/or Engineer's discretion shall be witness signed.

6.1.6 All testing and commissioning documentation, including any as built mark-ups, shall be provided to Engineer immediately upon completion of the commissioning (in draft form if necessary).

6.1.7 Any defects/deficiencies found during any aspect of the testing and commissioning shall be brought to the immediate attention of Engineer and if any require changes to the design or documentation previously accepted they shall be documented and submitted to Engineer for Acceptance prior to proceeding with any remedial work. Remaining testing and commissioning activities may be suspended by Engineer until defects/deficiencies are corrected.

6.1.8 Sequence of all testing and commissioning shall be performed to ensure all possible functionality and all reasonable worst case operating modes expected have been tested;

6.1.9 Engineer at his discretion may require aspects of the testing and commissioning to be repeated if modifications/adjustments are made after testing and commissioning has been performed.

6.1.10 All as-built information known prior to commissioning shall be documented adequately for use during testing commissioning.

6.2 STATIC COMMISSIONING TESTS

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D1 6.2.1 Contractor shall define all static checks to be carried per equipment tag number and this shall form part of the commissioning procedure.

D1 6.2.2 As part of the pre-commissioning checks and testing the Contractor shall, as a minimum, perform the following work:

.1 Check of all wiring connections;

.2 Check all piping connections;

.3 Check/test/verify/calibrate all instrumentation, transducers, limit switches, position sensors, over load devices and all other electronic or indicating devices;

.4 Check fasteners/connections on all key components that were shipped to site pre-assembled;

.5 Check for leaks on all hydraulic equipment;

.6 Check/test functionality and settings on all hydraulic equipment including, but not limited to, relief valve settings, flow rates, operating pressures, unloaders, pressure switches;

.7 Check/test all safety and interlock devices;

.8 Check and test all ancillary mechanical and electrical equipment, such as heaters, fans, lighting, etc;

.9 Check/test all individual control and operating functions;

.10 Check/test/verify all control functions from all locations;

.11 Test installation and function in the dry of all cleaning heads and other attachments.

.12 During all testing and operation the following shall be monitored by the Contractor;

.13 Check for abnormal noise or vibration and overheating in machinery drive or hydraulic components;

.14 Check for proper operation, freedom of movement, binding in all components;

.15 Check electrical components for overheating;

.16 At completion of the testing and pre-commissioning inspect for abnormal wear, damage, or inadequate lubrication;

.17 Inspect and check cleanliness and levels of all fluids;

.18 All deficiencies noted during pre-commissioning shall be corrected to the satisfaction of Engineer prior to proceeding with further testing and commissioning.

6.3 COMMISSIONING TESTS

6.3.1 Final commissioning tests shall be performed after the reservoir is impounded to full supply level of El. 39.0 m, and shall include demonstration tests of all Trash Cleaning System functions, followed by a 60-day trial operating period.

6.3.2 Contractor shall perform the following tests on the Trash Cleaning System:

.1 The demonstration tests shall include two complete traverses of the full Powerhouse trashrack face, using first a shallow cleaning cycle across the face of the Powerhouse;

.2 In a) above the cleaning system shall be operated in both manual and semi-automatic modes;

.3 Operation shall include dumping of material into Company-supplied trash container. The second test cycle shall include a full-depth cleaning of the entire Powerhouse trashrack face, with alternating use of the manual and semi-automatic cleaning cycles;

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.4 Acceptance tests for the clam head operation shall be demonstration of the cleaner head removal, attachment of the clam head, clamming of the trench area upstream of the trashracks at elevation El. 39 m, for the full width of the Powerhouse Trashracks, followed by removal of the clam head and reattachment of the cleaner head;

D1 .5 Acceptance tests for the cleaning system storage function shall be a demonstration of a full traverse of the Powerhouse operating rails, operation of the end-of-travel limit controls on each end;

D1 .6 Acceptance tests for the stoplog hoist shall at the Spillway and at the Intake shall be a demonstration of the hoist at all stoplogs slots and Bulkhead Gates slots with their respective lift beams;

.7 Demonstration that the hoist hooks can be safely secured during operation of trash cleaning system.

D1 6.3.3 Any incorrect operation of control or limit devices during the Performance Acceptance tests will require that the subject test be repeated.

END OF SECTION

Document Front Sheet

nalcor energy
LOWER CHURCHILL PROJECT

SNC·LAVALIN EPCM consultant for Nalcor

NE-LCP Contractor/Supplier

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Comments:		Equipment Tag or Model Number:

NE-LCP or EPC(M)

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- ☐ 03 – REVIEWED - NOT ACCEPTED
- ☑ 04 – INFORMATION ONLY
- ☐ 05 – NOT REVIEWED

Lead Reviewer:	Date (dd-mmm-yyyy):	Project Manager:	Date (dd-mmm-yyyy):
NE-LCP or EPC(M) Management:	Date (dd-mmm-yyyy): 16-JAN-2014		

General Comments:

LOWER CHURCHILL PROJECT

CH0032

SUPPLY AND INSTALL POWERHOUSE AND SPILLWAY HYDRO-MECHANICAL EQUIPMENT

TECHNICAL DOCUMENT LIST

Prepared by:

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REVISION LIST

Revision					Remarks
N°	By	Verif.	Appr.	Date	
B4	AK	RK	GS	16-Jan-2014	Updated post Award - Contract Review
B3	AK	RK	GS	17-Dec-2013	Updated for Award
B2	AK	RK	GS	12-Dec-2013	For Award of full Contract
03	AK	RK	GS	09-Sep-2013	For Award
02	GD	RK	GS	05-Feb-2013	Addendum #4
01	JK	RK	GS	23-Jan-2013	Addendum #3
00	EC	RK	GS	15-Nov-2012	Issued for Bid.

TECHNICAL DOCUMENT LIST: TECHNICAL SPECIFICATION

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
AWARD	MFA-SN-CD-2000-ME-TS-0001-01	D2	N/A	N/A	POWERHOUSE AND SPILLWAY - HYDRO-MECHANICAL EQUIPMENT - TECHNICAL SPECIFICATION

TECHNICAL DOCUMENT LIST: SITE INFORMATION DRAWINGS

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
FOR INFORMATION	MFA-SN-CD-2000-CV-PL-0003-01	C2	0000-4G01	PLATE 01	MUSKRAT FALLS - GENERAL ARRANGEMENT OF WORKS - PLAN
FOR INFORMATION	MFA-SN-CD-0000-CV-PL-0004-01	C1	0000-4G01	PLATE 02	MUSKRAT FALLS - LOWER CHURCHILL RIVER - PLAN AND PROFILE
FOR INFORMATION	MFA-SN-CD-2000-CV-GA-0001-01	C2	0000-4G01	PLATE 03	MUSKRAT FALLS - ACCESS ROAD, ACCOMMODATIONS AND LAYDOWN AREAS
FOR INFORMATION	MFA-SN-CD-3000-GT-GA-0001-01	C1	0007-4G01	PLATE 01	MUSKRAT FALLS - INTAKE AND POWERHOUSE, SPILLWAY AND TRANSITION DAMS - GENERAL LAYOUT - PLAN
FOR INFORMATION	MFA-SN-CD-3000-GT-PL-0001-01	C1	0007-4G01	PLATE 02	INTAKE AND POWERHOUSE, SPILLWAY AND TRANSITION DAMS - LOCATION OF STRUCTURES - PLAN

TECHNICAL DOCUMENT LIST: SPILLWAY HYDRO-MECHANICAL EQUIPMENT

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
DESIGN	MFA-SN-CD-2400-ME-EL-0001-01	D1	0032-4501	PLATE 01	SPILLWAY - HYDRO-MECHANICAL - GENERAL ARRANGEMENT - ELEVATIONS AND SECTION
DESIGN	MFA-SN-CD-2400-ME-PL-0001-01	D1	0032-4501	PLATE 02	SPILLWAY - HYDRO-MECHANICAL - GENERAL ARRANGEMENT - PLAN AND SECTION
DESIGN	MFA-SN-CD-2400-ME-SE-0001-01	D1	0032-4501	PLATE 03	SPILLWAY - HYDRO-MECHANICAL - GENERAL ARRANGEMENT - SECTIONS
DESIGN	MFA-SN-CD-2420-ME-PL-0001-01	D1	0032-4501	PLATE 04	SPILLWAY - HYDRO-MECHANICAL - SPILLWAY GATES AND HOIST HOUSE - PLAN, ELEVATION AND DETAILS
DESIGN	MFA-SN-CD-2420-ME-EL-0001-01	D1	0032-4501	PLATE 05	SPILLWAY - HYDRO-MECHANICAL - UPSTREAM PERMANENT STOPLOGS - ELEVATION, SECTION AND DETAILS
DESIGN	MFA-SN-CD-2420-ME-EL-0002-01	D1	0032-4501	PLATE 06	SPILLWAY - HYDRO-MECHANICAL - UPSTREAM TEMPORARY STOPLOGS - ELEVATION, SECTIONS AND DETAILS
DESIGN	MFA-SN-CD-2420-ME-PL-0002-01	D1	0032-4501	PLATE 07	SPILLWAY - HYDRO-MECHANICAL - DOWNSTREAM STOPLOGS - PLAN, ELEVATION, SECTION AND DETAIL

TECHNICAL DOCUMENT LIST: INTAKE HYDRO-MECHANICAL EQUIPMENT

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
DESIGN	MFA-SN-CD-3200-ME-PL-0001-01	D1	0032-4502	PLATE 01	POWERHOUSE - HYDRO-MECHANICAL - GENERAL ARRANGEMENT - PLAN

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
DESIGN	MFA-SN-CD-3200-ME-SE-0001-01	D1	0032-4502	PLATE 02	POWERHOUSE - HYDRO-MECHANICAL - GENERAL ARRANGEMENT - ELEVATION AND SECTION
DESIGN	MFA-SN-CD-3240-ME-PL-0001-01	D1	0032-4502	PLATE 03	POWERHOUSE - HYDRO-MECHANICAL - INTAKE-TRASHRACKS - PLAN, ELEVATION, SECTION AND DETAIL
DESIGN	MFA-SN-CD-3240-ME-PL-0002-01	D1	0032-4502	PLATE 04	POWERHOUSE - HYDRO-MECHANICAL - INTAKE-TRASHRACKS - UNIT ARRANGEMENT - SECTIONS, ELEVATION AND DETAILS
DESIGN	MFA-SN-CD-3240-ME-PL-0003-01	D1	0032-4502	PLATE 05	POWERHOUSE - HYDRO-MECHANICAL - INTAKE-BULKHEAD GATES - PLAN, SECTIONS AND DETAIL
DESIGN	MFA-SN-CD-3240-ME-PL-0004-01	D1	0032-4502	PLATE 06	POWERHOUSE - HYDRO-MECHANICAL - INTAKE-BULKHEAD GATES - UNIT ARRANGEMENT - SECTIONS AND DETAIL
DESIGN	MFA-SN-CD-3240-ME-PL-0006-01	D1	0032-4502	PLATE 07	POWERHOUSE - HYDRO-MECHANICAL - INTAKE GATES - PLAN, SECTIONS AND DETAIL
DESIGN	MFA-SN-CD-3240-ME-PL-0007-01	D1	0032-4502	PLATE 08	POWERHOUSE - HYDRO-MECHANICAL - INTAKE GATES - UNIT ARRANGEMENT - PLAN, SECTIONS AND DETAILS

TECHNICAL DOCUMENT LIST: POWERHOUSE DRAFT TUBE HYDRO-MECHANICAL EQUIPMENT

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
DESIGN	MFA-SN-CD-3330-ME-PL-0001-01	D1	0032-4503	PLATE 01	POWERHOUSE - HYDRO-MECHANICAL - DRAFT TUBE STOPLOGS - ELEVATION, SECTIONS AND DETAILS
DESIGN	MFA-SN-CD-3330-ME-SE-0001-01	D1	0032-4503	PLATE 02	POWERHOUSE - HYDRO-MECHANICAL - DRAFT TUBE STOPLOGS - UNIT ARRANGEMENT - ELEVATION, SECTIONS AND DETAIL

TECHNICAL DOCUMENT LIST: TRASH CLEANING SYSTEM

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
DESIGN	MFA-SN-CD-2130-ME-GA-0002-01	D1	0032-4504	PLATE 01	SPILLWAY - HYDRO-MECHANICAL EQUIPMENT- TRASH CLEANER AND STOPLOG HANDLING - GENERAL ARRANGEMENT - PLAN, SECTIONS AND DETAIL

TECHNICAL DOCUMENT LIST: SPILLWAY – ELECTRICAL AUXILIARIES

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
DESIGN	MFA-SN-CD-3430-EL-SD-0002-01	C2	0000-4701	PLATE 01	ELECTRICAL SERVICES - IDENTIFICATION STANDARD
DESIGN	MFA-SN-CD-3430-EL-LS-0007-01	C1	0000-4701	PLATE 02	POWERHOUSE - ELECTRICAL SERVICES - LAYOUT LEGEND
DESIGN	MFA-SN-CD-3430-EL-LS-0006-01	C1	0000-4701	PLATE 03	POWERHOUSE - ELECTRICAL SERVICES DIAGRAM - LEGEND
DESIGN	MFA-SN-CD-2440-EL-SL-0004-01	D1	0032-4701	PLATE 01	SPILLWAY - DIVERSION PHASE - TEMPORARY POWER - SINGLE LINE DIAGRAM

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
DESIGN	MFA-SN-CD-2440-EL-SL-0001-01	D1	0032-4701	PLATE 02	SPILLWAY - 600 VAC AUXILIARY - SINGLE LINE DIAGRAM
DESIGN	MFA-SN-CD-2400-EL-LD-0002-01	D1	0032-4701	PLATE 03	SPILLWAY - DIVERSION PHASE - CONTROL SYSTEM INTERFACE DIAGRAM
DESIGN	MFA-SN-CD-2440-EL-DD-0005-01	D1	0032-4701	PLATE 04	SPILLWAY - DIVERSION PHASE - 25 kV INCOMING LINE - GENERAL LAYOUT
DESIGN	MFA-SN-CD-2440-EL-DD-0012-01	D1	0032-4701	PLATE 05	SPILLWAY - DIVERSION PHASE - TEMPORARY POWER - DETAILS
DESIGN	MFA-SN-CD-2440-EL-LT-0002-01	D1	0032-4701	PLATE 06	SPILLWAY - DIVERSION PHASE - ELECTRICAL ROOM EQUIPMENT LAYOUT
DESIGN	MFA-SN-CD-2440-EL-PL-0002-01	D1	0032-4701	PLATE 07	SPILLWAY - DIVERSION PHASE - CABLE TRAY AND CONDUIT BETWEEN ELECTRICAL BUILDING AND OUTDOOR INSTALLATIONS
DESIGN	MFA-SN-CD-2440-EL-DD-0006-01	D1	0032-4701	PLATE 08	SPILLWAY - DIVERSION PHASE - SURFACE GROUNDING
DESIGN	MFA-SN-CD-2440-EL-LT-0004-01	D1	0032-4701	PLATE 09	SPILLWAY - DIVERSION PHASE - LIGHTING - LAYOUT AND DETAILS
DESIGN	MFA-SN-CD-2440-EL-LT-0004-02	D1	0032-4701	PLATE 10	SPILLWAY - DIVERSION PHASE – LIGHTING - LAYOUT AND DETAILS
DESIGN	MFA-SN-CD-2400-EL-SL-0001-01	D1	0032-4701	PLATE 11	SPILLWAY - DIVERSION PHASE - UPS AND 125 VDC DISTRIBUTION - SINGLE LINE DIAGRAM
DESIGN	MFA-SN-CD-2440-EL-SL-0003-01	D1	0032-4701	PLATE 12	SPILLWAY- 600 VAC MOTOR CONTROL CENTER - SINGLE LINE DIAGRAM – SHEET 1 OF 2
DESIGN	MFA-SN-CD-2440-EL-SL-0003-02	D1	0032-4701	PLATE 13	SPILLWAY - 600 VAC MOTOR CONTROL CENTER - SINGLE LINE DIAGRAM – SHEET 2 OF 2
DESIGN	MFA-SN-CD-3290-EL-SL-0001-01	D2	0032-4701	PLATE 14	INTAKE - 600 VAC MOTOR CONTROL CENTER - SINGLE LINE DIAGRAM
DESIGN	MFA-SN-CD-2440-EL-DR-0002-01	D1	0032-4701	PLATE 15	SPILLWAY- 600/347 V DISTRIBUTION - PANELBOARD SCHEDULES
DESIGN	MFA-SN-CD-2440-EL-DR-0003-01	D1	0032-4701	PLATE 16	SPILLWAY - 208/120 V DISTRIBUTION - PANELBOARD SCHEDULES
DESIGN	MFA-SN-CD-2400-EL-LD-0001-01	D1	0032-4701	PLATE 17	SPILLWAY - FINAL PHASE - CONTROL SYSTEM INTERFACE DIAGRAM
DESIGN	MFA-SN-CD-2440-EL-LT-0006-01	D1	0032-4701	PLATE 18	SPILLWAY - ELECTRICAL AUXILIARIES - INSTALLATION LAYOUT
DESIGN	MFA-SN-CD-3340-EL-DD-0045-01	D1	0032-4701	PLATE 19	SPILLWAY - ELECTRICAL BUILDING - CCTV, TELEPHONE, COMMUNICATION, FIRE ALARM AND SECURITY SYSTEMS - EQUIPMENT LAYOUT AND DETAILS
DESIGN	MFA-SN-CD-2440-EL-DD-0004-01	D1	0032-4701	PLATE 20	SPILLWAY - CCTV SYSTEM, TELEPHONE, COMMUNICATION AND SECURITY SYSTEM EQUIPMENT LAYOUT AND INSTALLATION DETAILS
DESIGN	MFA-SN-CD-2440-EL-LT-0008-01	D1	0032-4701	PLATE 21	SPILLWAY - DIESEL FUEL TANK AREA - ELECTRICAL LAYOUT
DESIGN	MFA-SN-CD-2440-EL-RT-0001-01	C2	0032-4701	PLATE 22	SPILLWAY - ELECTRICAL BUILDING - CABLE TRAY AND CONDUIT LAYOUT
DESIGN	MFA-SN-CD-3340-EL-LT-0014-01	C1	0032-4701	PLATE 23	POWERHOUSE – INTAKE DECK PLAN EL 45.50 – ELECTRICAL EQUIPMENT LAYOUT – SHEET 1 OF 2
DESIGN	MFA-SN-CD-3340-EL-LT-0014-02	C1	0032-4701	PLATE 24	POWERHOUSE – INTAKE DECK PLAN EL 45.50 – ELECTRICAL EQUIPMENT LAYOUT – SHEET 2 OF 2
DESIGN	MFA-SN-CD-3340-EL-DD-0020-01	C1	0032-4701	PLATE 25	POWERHOUSE AND SPILLWAY - LUMINAIRE TYPES - LIGHTING AND RECEPTACLES
DESIGN	MFA-SN-CD-3340-EL-DD-0019-01	C1	0032-4701	PLATE 26	POWERHOUSE AND SPILLWAY - INSTALLATION DETAILS - LIGHTING AND RECEPTACLES
DESIGN	MFA-SN-CD-3340-EL-DD-0003-01	C1	0032-4701	PLATE 27	POWERHOUSE - INSTALLATION DETAILS - SURFACE GROUNDING

TECHNICAL DOCUMENT LIST: SPILLWAY ELECTRICAL BUILDING – MECHANICAL AUXILIARIES

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
DESIGN	MFA-SN-CD-2000-ME-SC-0001-01	D1	0000-4B01	PLATE 01	GENERAL WORKS - SCHEMATIC AND DRAWING SYMBOLS - HVAC
DESIGN	MFA-SN-CD-3350-ME-LS-0003-01	C2	0007-4601	PLATE 01	GENERAL WORKS - EQUIPMENT AND SYSTEM CODES - LEGEND
DESIGN	MFA-SN-CD-3350-ME-LS-0004-01	C2	0007-4601	PLATE 02	GENERAL WORKS - EQUIPMENT NUMBERING AND INSTRUMENTATION SYMBOLS
DESIGN	MFA-SN-CD-2440-ME-PL-0001-01	D1	0032-4B01	PLATE 01	SPILLWAY - ELECTRICAL BUILDING - PLAN AND SECTIONS - HVAC
DESIGN	MFA-SN-CD-2440-ME-SC-0001-01	D1	0032-4B01	PLATE 02	SPILLWAY - ELECTRICAL BUILDING - SYSTEM SCHEMATIC AND DETAILS - HVAC
DESIGN	MFA-SN-CD-2440-ME-DD-0001-01	D1	0032-4B01	PLATE 03	SPILLWAY - ELECTRICAL BUILDING - EXHAUST SYSTEM AND SUSPENSION DETAILS - HVAC
DESIGN	MFA-SN-CD-2440-ME-SC-0002-01	D1	0032-4B01	PLATE 04	SPILLWAY - ELECTRICAL BUILDING - CONTROL AND INSTRUMENTATION SCHEMATIC - HVAC
DESIGN	MFA-SN-CD-2440-ME-DD-0002-01	D1	0032-4B01	PLATE 05	SPILLWAY - ELECTRICAL BUILDING - CONTROL AND INSTRUMENTATION DETAILS - HVAC

TECHNICAL DOCUMENT LIST: FUEL STORAGE SYSTEM

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
DESIGN - Moved to Spillway - Electrical Auxiliaries section	~~MFA-SN-CD-2440-EL-PL-0002-01~~	~~D1~~	~~0032-4701~~	~~PLATE 24~~	~~SPILLWAY – DIVERSION PHASE - CABLE TRAY AND CONDUIT BETWEEN ELECTRICAL BUILDING AND OUTDOOR INSTALLATIONS~~
DESIGN - Moved to Spillway Electrical Auxiliaries section	~~MFA-SN-CD-2440-EL-LT-0008-01~~	~~D1~~	~~0032-4701~~	~~PLATE 25~~	~~SPILLWAY - DIESEL FUEL TANK AREA - ELECTRICAL LAYOUT~~
DESIGN – Moved to Spillway - Electrical Building – Structure section	~~MFA-SN-CD-2440-CV-PL-0001-01~~	~~C2~~	~~0032-4101~~	~~PLATE 08~~	~~SPILLWAY - DIESEL FUEL TANK - FOUNDATION PLAN AND DETAILS-CONCRETE~~

TECHNICAL DOCUMENT LIST: SPILLWAY ELECTRICAL BUILDING - STRUCTURE

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
DESIGN	MFA-SN-CD-2400-EN-LS-0001-01	D1	0032-4101	PLATE 01	POWERHOUSE, INTAKE AND SPILLWAY – GENERAL NOTES, LEGEND AND ABBREVIATIONS
DESIGN	MFA-SN-CD-2410-AR-PL-0001-01	D1	0032-4101	PLATE 02	SPILLWAY – ELECTRICAL BUILDING – PLANS AND ELEVATIONS - ARCHITECTURAL
DESIGN	MFA-SN-CD-2410-AR-SE-0001-01	D1	0032-4101	PLATE 03	SPILLWAY – ELECTRICAL BUILDING – SECTIONS - ARCHITECTURAL
DESIGN	MFA-SN-CD-2410-AR-DD-0001-01	D1	0032-4101	PLATE 04	SPILLWAY – ELECTRICAL BUILDING – DETAILS - ARCHITECTURAL
DESIGN	MFA-SN-CD-2410-ST-PL-0001-01	D1	0032-4101	PLATE 05	SPILLWAY – ELECTRICAL BUILDING – PLANS AND ELEVATIONS – STRUCTURAL STEEL
DESIGN	MFA-SN-CD-2410-ST-SN-0001-01	D1	0032-4101	PLATE 06	SPILLWAY – ELECTRICAL BUILDING – SECTIONS AND DETAILS – STRUCTURAL STEEL
DESIGN	MFA-SN-CD-2410-ST-DD-0001-01	D1	0032-4101	PLATE 07	MUSKRAT FALLS – SPILLWAY – HVAC BAFFLES – STRUCTURAL DETAILS – STRUCTURAL STEEL

REVISION ISSUED FOR	NALCOR DOCUMENT No.	NALCOR REVISION	SUB PKG	Plate No.	DOCUMENT TITLE
DESIGN	MFA-SN-CD-2440-CV-PL-0001-01	C2	0032-4101	PLATE 08	SPILLWAY - DIESEL FUEL TANK - FOUNDATION PLAN AND DETAILS-CONCRETE

Document Front Sheet

nalcor energy
LOWER CHURCHILL PROJECT

SNC·LAVALIN EPCM consultant for Nalcor

NE-LCP Contractor/Supplier

Contract or Purchase Number and Description:	Contractor/Supplier Name:
LC-G-0002 (Project 505573)	SNC-Lavalin Inc.
Document Title: Supply and Install Powerhouse and Spillway Hydro-Mechanical Equipment – Technical Specification	Total Number of Pages Incl. Front Sheet: 1190
Contractor/ Supplier Document Number:	Revision Number: 03
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MFA-SN-CD-2000-ME-TS-0001-01	D2

Approver's Signature:	Date (dd-mmm-yyyy):	Review Class:
	12 Dec '13	
Comments:		Equipment Tag or Model Number:

NE-LCP or EPC(M)

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Lead Reviewer:	Date (dd-mmm-yyyy):	Project Manager:	Date (dd-mmm-yyyy):
	16-Dec-2013		16-DEC-2013
NE-LCP or EPC(M) Management:	Date (dd-mmm-yyyy): 16-Dec-2013		

General Comments:

LOWER CHURCHILL PROJECT
MUSKRAT FALLS HYDROELECTRIC DEVELOPMENT

CH0032

SUPPLY AND INSTALL POWERHOUSE AND SPILLWAY HYDRO-MECHANICAL EQUIPMENT

TECHNICAL SPECIFICATION

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PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
RANDOLPH D. KOOB
12 DEC 2013
NEWFOUNDLAND & LABRADOR

Revision					
N°	By	Appr.	Date	Revised pages	Remarks
D2	RK RAC	GS	04-Dec-2013		Issued for Award. See Section Index for sections that have been changed. Changes identified throughout the document with D2 revision triangles.
D1	RK	GS	06-Sep-2013		Issued for Design.
B2	RK	GS	06-02-2013		Issued for Addendum.
00	EC /RL	RS/RK	07-11-2012	ALL	Issued for Bid.

STATUS	DISCIPLINE	SECTION	TITLE	PAGES
		DIVISION 1	**GENERAL REQUIREMENTS**	
Updated	Environmental	01 35 43	General Environmental Requirements	17
		DIVISION 3	**CONCRETE**	
No Changes	Concrete	03 11 00	Concrete Formwork	14
No Changes	Concrete	03 20 00	Concrete Reinforcement	9
Updated	Concrete	03 30 00	Cast-In-Place Concrete	54
No Changes	Concrete	03 60 40	Grout	14
		DIVISION 5	**METALS**	
No Changes	Structural & Miscellaneous Steel	05 12 00	Structural Steel	25
No Changes	Structural & Miscellaneous Steel	05 50 10	Miscellaneous Metals & Embedded Parts	22
		DIVISION 6	**WOODS AND PLASTICS**	
No Changes	Architecture	06 10 00	Rough Carpentry	9
		DIVISION 7	**THERMAL AND MOISTURE PROTECTION**	
Updated	Architecture	07 13 26	Self Adhered Sheet Waterproofing	6
Updated	Architecture	07 21 13	Board Insulation	7
No Changes	Architecture	07 21 16	Blanket Insulation	4
No Changes	Architecture	07 21 20	Low Expanding Foam Sealant	4
No Changes	Architecture	07 21 29	Sprayed Insulation – Polyurethane Foam	5
No Changes	Architecture	07 26 00	Vapour Retarders	5
Updated	Architecture	07 27 00	Air Barriers	7
No Changes	Architecture	07 46 13	Preformed Metal Siding	6
Updated	Architecture	07 52 00	Modified Bituminous Membrane Roofing	16
No Changes	Architecture	07 62 00	Sheet Metal Flashing and Trim	5
No Changes	Architecture	07 72 69	Roof Anchors and Safety Restraints	6
No Changes	Architecture	07 84 00	Fire Stopping	8

No Changes	Architecture	07 92 00	Joint Sealants	8
		DIVISION 8	**OPENINGS**	
Updated	Architecture	08 11 00	Metal Doors and Frames	10
No Changes	Architecture	08 31 00.01	Spillway Electrical BLDG - Access Doors – Mechanical	4
Updated	Architecture	08 51 00	Metal Windows	9
No Changes	Architecture	08 71 00	Door Hardware	14
Updated	Architecture	08 80 50	Glazing	7
		DIVISION 9	**FINISHES**	
No Changes	Architecture	09 21 16	Gypsum Board Assemblies	8
No Changes	Architecture	09 22 16	Non-Structural Metal Framing	4
No Changes	Structural & Miscellaneous Steel	09 90 00	Paint System For Structural Steel	11
No Changes	Architecture	09 91 23	Interior Panting	16
No Changes	Architecture	09 97 19	Painting Exterior Metal Surfaces	17
		DIVISION 11	**EQUIPMENT**	
~~No Changes~~	~~Commissioning~~	~~11 08 00~~	~~Preservation, Mechanical Completion & Commissioning Requirements~~ **(Removed from Technical Specification. Now a standalone document, MFA-SN-CD-2000-ME-SP-0002-01)**	~~30~~
		DIVISION 23	**HEATING, VENTILATING AND AIR CONDITIONING (HVAC)**	
No Changes	HVAC	23 01 31	Spillway Electrical BLDG - Air Duct Cleaning for HVAC Systems	8
No Changes	HVAC	23 05 00	Spillway Electrical BLDG - Common Work Results for HVAC	6
No Changes	HVAC	23 05 01	Spillway Electrical BLDG - Use of HVAC Systems During Construction	3
No Changes	Piping	23 05 05	Installation of Pipework	5
No Changes	HVAC	23 05 13	Common Motor Requirements for HVAC Equipment	5
No Changes	Piping	23 05 17	Pipe Welding	6
No Changes	HVAC	23 05 48	Spillway Electrical BLDG - Vibration and Seismic Controls for HVAC Piping	8

			and Equip.	
No Changes	HVAC	23 05 53.01	Spillway Electrical BLDG - Mechanical Identification	8
No Changes	HVAC	23 05 93	Spillway Electrical BLDG - Testing, Adjusting and Balancing for HVAC	12
No Changes	HVAC	23 05 94	Spillway Electrical BLDG - Pressure Testing of Ducted Air Systems	4
No Changes	HVAC	23 07 13	Spillway Electrical BLDG - Duct Insulation	8
No Changes	HVAC	23 07 14	Spillway Electrical BLDG - Thermal Insulation for Equipment	8
No Changes	Piping	23 08 01	Performance Verification Mechanical Piping System	2
No Changes	Piping	23 11 13	Facility Fuel-Oil Piping	19
Updated	Piping	23 11 14	Fuel Storage Tank Electronic Monitoring Systems	18
No Changes	HVAC	23 31 13.02	Spillway Electrical BLDG - Metal Ducts - High Pressure to 2500 Pa	10
No Changes	HVAC	23 33 00	Spillway Electrical BLDG - Air Duct Accessories	7
No Changes	HVAC	23 33 14	Spillway Electrical BLDG - Dampers – Balancing	5
No Changes	HVAC	23 33 15	Spillway Electrical BLDG - Dampers – Operating	8
No Changes	HVAC	23 33 16	Spillway Electrical BLDG - Dampers - Fire and Smoke	6
Updated	HVAC	23 34 00	Spillway Electrical BLDG - HVAC Fans	10
Updated	HVAC	23 34 25	Spillway Electrical BLDG - Packaged Roof and Wall Exhausters	10
No Changes	HVAC	23 35 16	Spillway Electrical BLDG - Engine Exhaust System	5
No Changes	HVAC	23 37 13	Spillway Electrical BLDG - Diffusers, Registers and Grilles	6
No Changes	HVAC	23 37 20	Spillway Electrical BLDG - Louvres, Intakes and Vents	9
No Changes	HVAC	23 44 00	Spillway Electrical BLDG - HVAC Air Filtration	8
No Changes	HVAC	23 55 01	Spillway Electrical BLDG - Duct Heaters	7
No Changes	HVAC	23 82 33.05	Gate Guide Heaters	5
No Changes	HVAC	23 82 39.01	Unit Heaters – Electric	4

		DIVISION 25	**INTEGRATED AUTOMATION**	
Updated	HVAC Controls	25 33 01	Spillway Electrical BLDG - HVAC Controls and Instrumentation	49
		DIVISION 26	**ELECTRICAL**	
No Changes	Electrical	26 05 00	General Electrical Requirements	30
No Changes	Electrical	26 05 14	Power Cable (25000 V and 28000 V)	4
No Changes	Electrical	26 05 20	Wire and Box Connectors (0-1000 V)	3
No Changes	Electrical	26 05 21	Wires and Cables (0-1000 V)	9
No Changes	Electrical	26 05 22	Connectors And Terminations	3
No Changes	Electrical	26 05 28	Grounding - Secondary	12
No Changes	Electrical	26 05 29	Hangers And Supports For Electrical Systems	3
No Changes	Electrical	26 05 31	Splitters, Junction, Pull Boxes and Cabinets	4
No Changes	Electrical	26 05 32	Outlet Boxes, Conduit Boxes and Fittings	4
No Changes	Electrical	26 05 34	Conduits, Conduit Fastenings And Conduit Fittings	5
No Changes	Electrical	26 05 36	Cable Trays For Electrical Systems	4
No Changes	Electrical	26 05 43.01	Installation of Cables in Trenches and in Ducts	5
No Changes	Electrical	26 05 80	Fractional Horsepower Motors	3
No Changes	Electrical	26 05 81	Motors- 1 to 250 hp	6
No Changes	Electrical	26 09 23.01	Metering and Switchboard Instruments	6
No Changes	Electrical	26 09 24	Lighting Control Devices - Low Voltage	4
No Changes	Electrical	26 12 16	Dry Type, Medium Voltage Transformers	8
No Changes	Electrical	26 12 16.01	Dry Type Transformers Up to 600 V Primary	7
Updated	Electrical	26 13 17	Full Load Interrupter Switches to 25 kV	4
No Changes	Electrical	26 13 18	Primary Switchgear Assembly to 25 kV	9
No Changes	Electrical	26 18 41	Interlock Systems	4
Updated	Electrical	26 23 00	Low Voltage Switchgear	7

No Changes	Electrical	26 24 16.01	Panelboards Breaker Type	5
Updated	Electrical	26 24 19	Motor Control Centres	8
No Changes	Electrical	26 25 00	Enclosed Bus Assemblies	4
Updated	Electrical	26 27 16	Electrical Cabinets and Enclosures	4
No Changes	Electrical	26 27 26	Wiring Devices	5
No Changes	Electrical	26 28 13.01	Fuses - Low Voltage	4
Updated	Electrical	26 28 16.01	Air Circuit Breakers	4
No Changes	Electrical	26 28 16.02	Moulded Case Circuit Breakers	4
No Changes	Electrical	26 28 20	Ground Fault Circuit Interrupters	4
No Changes	Electrical	26 28 23	Disconnect Switches - Fused and Non-fused	3
No Changes	Electrical	26 29 01	Contactors	3
No Changes	Electrical	26 29 03.01	Control Devices	6
Updated	Electrical	26 29 03.02	Control and Monitoring	10
No Changes	Electrical	26 29 03.03	Control and Monitoring - Hydro-Mechanical	32
Updated	Electrical	26 29 03.04	Spillway Automatic Transfer and Load Management System – Functional Description	6
No Changes	Electrical	26 29 10	Motor Starters to 600 V	8
No Changes	Electrical	26 29 23	Variable Frequency Drives	12
No Changes	Electrical	26 32 13.03	Installation of Power Generating Equipment	9
Updated	Electrical	26 32 13.04	Diesel Electric Generating Units (Liquid Cooled)	24
Updated	Electrical	26 33 16	Batteries and Battery Racks	6
No Changes	Electrical	26 33 43	Battery Chargers	5
No Changes	Electrical	26 33 53	Uninterruptible Power Systems Static (UPS)	12
No Changes	Electrical	26 50 00	Lighting	6
Updated	Electrical	26 52 00	Emergency Lighting	4
No Changes	Electrical	26 53 00	Exit Signs	5
No Changes	Electrical	26 56 19	Roadway Lighting	4

		DIVISION 28	**ELECTRONIC SAFETY AND SECURITY**	
No Changes	Security	28 16 00	Intrusion Detection	8
No Changes	Security	28 31 00.01	Multiplex Fire Alarm System	13
		DIVISION 33	**UTILITIES**	
No Changes	Fuel Storage Tank	33 56 13	Aboveground Fuel Storage Tanks	14
		DIVISION 48	**Hydro Mechanical**	
Updated	Hydro Mechanical	48 13 10	General Mechanical Requirements	39
Updated	Hydro Mechanical	48 13 20	Gates, Stoplogs and Trashracks	60
Updated	Hydro Mechanical	48 13 21	Hoists & Cranes	46
Updated	Hydro Mechanical	48 13 22	Trash Cleaning System	40

END OF SECTION

TABLE OF CONTENTS
SECTION 01 35 43
GENERAL ENVIRONMENTAL REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 The intent of the Environmental Requirements Specification is to detail the methods and procedures to be implemented during construction activities at the Lower Churchill Project to minimize any potential impacts on the environment.

1.2 CONTRACTOR'S RESPONSIBILITIES - REGULATORY AGENCIES

1.2.1 The Contractor shall refer to Exhibit 6 (Environmental and Regulatory Compliance Requirements). The Contractor is responsible for compliance with all applicable federal, provincial and municipal Regulations and By-Laws.

1.3 CONTRACT-SPECIFIC ENVIRONMENTAL PROTECTION PLAN (C-SEPP)

1.3.1 The Contractor shall refer to Exhibit 6 (Environmental and Regulatory Compliance Requirements) and documents provided in Exhibit 11, specifically the *Project-Wide Environmental Protection Plan* (P-WEPP) and *Contract-Specific Environmental Protection Plan Template*.

1.4 LIST OF ACRONYMS AND ABREVIATIONS

1.4.1	ACA	Ammoniacal Copper Arsenate
1.4.2	ACZA	Ammoniacal Copper Zinc Arsenate
1.4.3	C-SEPP	Contract-Specific Environmental Protection Plan
1.4.4	CAN/CGSB	Canadian General Standards Board
1.4.5	CCA	Chromated Copper Arsenate
1.4.6	CCME	Canadian Council of Ministers of the Environment
1.4.7	CuN	Copper Naphthenate
1.4.8	dB(A)	Decibels in A-Weighted Measurements
1.4.9	DFO	Fisheries and Oceans Canada
1.4.10	DNR	Newfoundland and Labrador Dept. of Natural Resources
1.4.11	DOEC	Newfoundland and Labrador Dept. of Environment and Conservation
1.4.12	ESCP	Erosion and Sedimentation Control Plan

1.4.13	GAP	Storage and Handling of Gasoline and Associated Product Regulations, 2003
1.4.14	GSC	Newfoundland and Labrador Government Services Centre
1.4.15	HOST	Heating Oil Storage Tank System Regulations NL Newfoundland and Labrador
1.4.16	OECD	Organization for Economic Co-operation and Development
1.4.17	PA	Pond Area
1.4.18	PCP	Pentachlorophenol
1.4.19	P-WEPP	Project-Wide Environmental Protection Plan
1.4.20	Qout	Outflow Capacity
1.4.21	Us	Sedimentation Velocity
1.4.22	TSS	Total Suspended Solids
1.4.23	UOC	Used Oil Control Regulations
1.4.24	WHMIS	Workplace Hazardous Materials Information System

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 ENVIRONMENTAL PROTECTION PROCEDURES

3.1.1 The Contractor shall install all environmental protection procedures illustrated on the Contract Drawings in accordance with the design, installation, maintenance and removal procedures detailed below. The Contractor shall also adhere to these requirements when preparing the C-SEPP. The Contractor shall use the P-WEPP in Exhibit 11 as a guide when preparing the C-SEPP.

D2

3.2 NOT USED

3.3 PROTECTION OF FISH HABITAT AND WATER QUALITY

3.3.1 Federal and Provincial Legislation requires prescribed methods and procedures to be employed when carrying out such work as culvert or bridge installations, watercourse diversions, fording, fill placement at watercourses, and any other work which may alter or impact any watercourse, or the quality of the water therein. These requirements are detailed in Exhibit # 6 – “Environmental Compliance Requirements”.

3.4 USE OF FRESH CONCRETE NEAR BODIES OF WATER

3.4.1 The Contractor shall implement the following environmental protection procedures.

3.4.1.1 The Contractor shall prepare concrete spill response plan. The Plan will outline steps to be taken to minimize the impact on the environment from an accidental spill or release of concrete and/or grout into the environment during the transportation, handling or placement, before the concrete or grout has cured.

D1

3.4.1.2 Not Used

3.4.1.3 Washwater from the cleaning of mixers, mixer trucks and concrete delivery systems shall be directed to a closed system aggregate rinsing sedimentation pond(s) in accordance with the referenced Codes of Practice.

3.4.1.4 In the event that water from the closed sedimentation system is intended for release, it shall first be tested for parameters related to any concrete additives used in the production of concrete (e.g. pH, total suspended solids). It shall also meet the limits specified by DOEC, and shall adhere to those portions of the Fisheries Act (SN1995 F12.1) that relate to fish habitat protection and pollution prevention.

3.4.1.5 When concrete is placed adjacent to a watercourse, all necessary precautions shall be taken to prevent the concrete from adversely affecting water quality. Whenever possible, fresh concrete shall not come in direct contact with the watercourse.

3.4.1.6 Standing water shall be removed prior to placing fresh concrete.

3.4.1.7 Formwork shall be made secure and tight to prevent leakage of fresh concrete into any adjacent waters.

3.4.1.8 Concrete delivery trucks or chutes shall not be washed within 100 m of any watercourse or watercourse.

3.4.1.9 All necessary precautions shall be taken when handling related substances such as form coatings and concrete admixtures to prevent any spill or leakage of these substances.

3.5 CONCRETE PRODUCTION

D1

3.5.1 Concrete production on site will be by Company's other contractor.

D2

3.6 NOT USED

3.7 STORAGE, HANDLING AND USE OF FUELS AND OTHER HAZARDOUS MATERIALS

3.7.1 The Contractor shall comply with the following procedures related to Storage, handling and use of fuels and other hazardous materials.

3.7.1.1 All storage tank systems shall be constructed, installed, and operated in compliance with the Storage and Handling of Gasoline and Associated Products Regulations, 2003 (GAP regulations); the Heating Oil Storage Tank System Regulations, 2003 (HOST Regulations); or the Used Oil Control Regulations.

3.7.1.2 The Contractor shall ensure drip trays be used where appropriate, examples may include portable generators, dewatering pumps and portable refuelling pumps.

3.7.1.3 Contractors shall supply verification of storage tank registration to the Engineer prior to the commencement of work.

3.7.1.4 Mobile fuel tanks shall comply with the Transportation of Dangerous Goods Regulations, SOR/2008-34 which requires intermediate size containers to comply with the requirements of CAN/CGSB-43.146-2002. Mobile tanks shall be properly secured.

3.7.1.5 GAP regulation controlled storage tank systems shall be operated as per Section 18 of the Storage and Handling of Gasoline and Associated Products Regulations, 2003. This involves, but is not limited to, gauging or dipping, reconciliation of records and the proper maintenance of reconciliation records for a period of two years. Records shall be maintained for inspection by the Engineer, ESO and/or Government Service Centre Inspectors.

3.7.1.6 The operator of a storage tank system shall, within 30 days of known abandonment, empty the system of all products, remove the tank and associated piping from the ground, remove any contaminated soil, clean the area and restore the site to the satisfaction of the Engineer and in accordance with the criteria of the Government Services Centre.

3.7.1.7 All HOST regulation controlled tanks shall be double walled construction.

3.7.2 The Contractor shall comply with the following Spill Reporting and Cleanup Procedures.

3.7.2.1 The Contractor, Sub-contractors, and their personnel shall take all necessary precautions to prevent the spillage, misplacement, or loss of fuels and other hazardous material.

3.7.2.2 The Contract shall prepare a Spill Response Plan.

3.7.2.3 The Contractor and Sub-contractors shall abide by the following measures in the event of a fuel or hazardous material spill:

3.7.2.3.1 Make every effort to stop leakage and contain contaminant flow.

3.7.2.3.2 Immediately notify the Engineer of all environmental incidents, including any loss of hazardous or controlled products. Any spill meeting the following criteria shall be reported immediately to the Canadian Coast Guard at 709-772-2083 or 1-800-563-9089:

3.7.2.3.2.1 Any spill on a natural water body (marine or freshwater); or

3.7.2.3.2.2 Any land-based spill:

3.7.2.3.2.2.1 Over 70 litres, or

3.7.2.3.2.2.2 Of any quantity that has the potential (e.g. by migrating through subsurface soil/bedrock/substructures, etc) to enter a natural water body, or

3.7.2.3.2.2.3 Of any quantity that has the potential to impact a privately owned property.

3.7.2.3.3 Report to the Engineer all releases to the environment of hazardous or controlled products, including those releases that are reportable to the Canadian Coast Guard. Once the spill is reported, the Engineer will liaise with other government agencies to provide additional information, as required.

3.7.2.3.4 Investigate and document in a written report, consistent with the format described in the Emergency Response Plan (which includes a spill response plan), all releases that require Canadian Coast Guard reporting. This report shall be prepared and submitted to the Engineer for distribution to applicable government agencies, including the Canadian Coast Guard and Government Service Centre. All other releases shall be investigated and documented.

3.7.2.3.5 Remove the contaminant from spill site by absorbent, pumping, or whatever method is appropriate and acceptable to the Engineer.

3.7.2.3.6 Clean up the affected area in accordance Government Services Centre's requirements, and as directed by the Engineer. All waste materials generated during cleanup operations shall be disposed of at an approved waste disposal site.

3.7.2.3.7 Take all necessary action to ensure the incident does not recur.

3.7.2.3.8 Describe in a written report the cause of the spill, actions taken to control and contain it, remedial action, damage or contamination estimate, and any further action to be taken.

3.7.2.4 The Contractor shall apply the following criteria in reaching decisions on contaminant and clean-up procedures.

3.7.2.4.1 Minimize danger to persons.

3.7.2.4.2 Minimize pollution to watercourses and wetlands.

3.7.2.4.3 Minimize the size of the area affected by a spill.

3.7.2.4.4 Minimize the degree of disturbance to the area and watercourses during clean-up.

3.7.2.5 The Contractor shall dispose of any soil contaminated by small leaks of oil or lubricating fluids from equipment in a manner approved by the Engineer, and in accordance with the criteria of the Government Services Centre.

3.7.2.6 The Contractor shall have on site a suitable quantity of absorbent material which can be accessed quickly and effectively in the event of any hydrocarbon spill.

3.7.2.7 The Contractor shall advise fuel handling staff of its location and application.

3.7.3 The Contractor shall implement all necessary precautions to prevent and reduce spillage, misplacement or loss of fuels and other hazardous materials. These precautions shall include, but are not limited to:

3.7.3.1 All fuel storage and handling shall be in accordance with the *Storage and Handling of Gasoline and Associated Products Regulations, 2003 (GAP Regulations).* Necessary approvals shall be obtained from the Newfoundland and Labrador Department of Government Services.

3.7.3.2 Bulk fuel storage (>2000 L) shall be established at least 100 m from any surface water. The storage of smaller quantities of fuel (i.e. 25 L or less) shall be permitted no closer than 15 m of a watercourse at approved sites.

3.7.3.3 Water pump use and refueling may take place within 15 m of a watercourse in certain instances. However, water pumps to be used within 50 m of a watercourse should be equipped with a drip pan and lined with absorbent material to collect any oil and fuel leaks, or spills which may occur.

3.7.3.4 Handling and fuelling procedures shall comply with the *Storage and Handling of Gasoline and Associated Products Regulations, 2003*, WHMIS, applicable Sections of the *National Fire Code and Fire Prevention Act*, and any additional requirements brought forth by the Newfoundland and Labrador Department of Environment and Conversation (NLDOEC) to limit potential contamination of soil or water.

3.7.3.5 Used oils shall be collected, stored, transported, and disposed of as per requirements outlined in the *Used Oil Control Regulations (UOC Regulations)*. Companies engaged in collecting, transporting, storing, using, selling, handling, and/or disposing of used oil shall hold a valid certificate of approval issued by GSC or DOEC. Approvals shall be requested and obtained prior to the handling and disposal of used oils and a copy kept on file. Used oil shall be stored in a used oil storage tank meeting the requirements outlined in Sections 18 and 21 of the UOC Regulations. Used oil can be stored in 205 L drums as long as the quantity does not exceed 205 L; the drums are clearly marked “used oil”; the drum is 18 gauge steel; the drum has secondary containment; the top of the drum is equipped with a sufficient opening to prevent spillage during filling or emptying; the drum is equipped with venting if it is intended to be vacuumed out and; it complies with CAN/CGSB – 43.150.95 if the drum is to be transported by road.

3.7.3.6 Fuels and other hazardous materials shall be handled by trained and qualified persons in accordance with the manufacturer’s instructions and government laws and regulations. Operators shall be in attendance for the duration of the refueling operation.

3.7.3.7 Fuel caches of helicopter fuels stored in 205 L drums shall be established within the Project area as required. All fuel caches shall be operated as per conditions of approvals from the Government Services Centre. All helicopter refueling shall be done at these locations if remote fuelling is required.

3.7.3.8 Gasoline for chainsaws and water pumps may be stored in approved 20 L metal storage containers.

3.7.3.9 Regular inspections of hydraulic and fuel systems on machinery shall be performed by Project personnel, and leaks shall be repaired immediately upon detection. Servicing of mobile equipment on land shall not be performed within 50 m of a watercourse.

3.7.3.10 Any above-ground container, with the exception of those exempted under the *Storage and Handling of Gasoline and Associated Products Regulation, 2003*, shall be placed on an impervious mat and shall be surrounded by an impervious dyke of sufficient height (minimum height 0.6 m) to contain a specified amount of fuel.

3.7.3.11 Fuel storage areas and non-potable transfer lines shall be clearly marked or barricaded so that they will not be damaged by moving vehicles. The markers shall be visible under all weather conditions and barriers shall be constructed in compliance with the *Storage and Handling of Gasoline and Associated Products Regulations, 2003*.

3.7.3.12 Waste oils, lubricants and other used oil shall be disposed of at an approved disposal site. Waste oil shall be shipped for disposal on a monthly basis.

3.7.3.13 All storage tank systems shall be inspected on a regular basis as per Sections 18, 20 and 21 of the *Storage and Handling of Gasoline and Associated Products Regulations, 2003.*

3.7.3.14 Any soil contaminated by leaks or spills of any petroleum product from equipment shall be excavated, stored in an approved container and disposed of off-site at a licensed disposal site.

3.7.3.15 Smoking shall be prohibited within 50 m of a fuel storage area.

3.7.3.16 The Contractor shall be required to verify personnel qualifications as they pertain to this item and provide written confirmation of same to the Engineer. The Contractor shall supply a copy of the Material Safety Data Sheets (in accordance with the *Workplace Hazardous Materials Information System (WHMIS) Regulations* under the *Occupational Health and Safety Act*) to the Engineer of all hazardous, toxic or dangerous materials or substances which will be used during the course of the Agreement. Refueling operations shall be supervised at all times. Under no circumstances shall any refueling procedure be left unattended by the operator.

3.7.4 The Contractor shall implement the following Equipment Servicing Procedures.

3.7.4.1 All heavy equipment maintenance shall be carried out using suitable fluid collection equipment and in a manner which ensures all waste material is collected and suitably disposed of.

3.7.4.2 The Contractor shall ensure that all equipment is mechanically sound to avoid leaks of grease, oil, diesel, gasoline, and hydraulic and transmission fluids.

3.7.4.3 The Contractor shall ensure that no servicing or washing of heavy equipment occurs adjacent to watercourses and designated wetlands. Fuelling, servicing or washing of equipment shall not be allowed within 100 m of a watercourse except within a refueling site approved by the Engineer.

3.7.4.4 The Contractor shall remove from the work area, and properly dispose of, all waste oil, filters, containers or other such debris at an approved waste disposal site.

3.7.5 Contractors shall at all times maintain in good condition at least one spill kit dedicated to each piece of fuel-powered equipment and absorbent material as required. Each spill kit shall be located on the equipment and stored in a weather-proof container. Each spill kit shall have an absorption capacity of no less than 23 litres. Examples of acceptable spill kits with various absorption capacities are as follows:

3.7.5.1 23 Litre Absorption Capacity

3.7.5.1.1 One (1) 10-litre bag Oclansorb®, or equivalent approved by Engineer;

3.7.5.1.2 Two (2) 4-mil heavy duty disposal plastic bag 30” * 48”;

3.7.5.1.3 One (1) steel hand spade;

3.7.5.1.4 Two (2) 100mm * 1200mm Sorb Sox®, or equivalent approved by Engineer; and

3.7.5.1.5 Five (5) sorbent pads 3/8” * 17” * 19”.

3.7.5.2 64 Litre Absorption Capacity

3.7.5.2.1 One (1) 13-litre bag Oclansorb®, or approved equivalent;

3.7.5.2.2 Ten (10) sorbent pads 3/8” * 17” * 19”, or approved equivalent;

3.7.5.2.3 Two (2) 4-mil yellow heavy duty disposal bag 30” * 48”;

3.7.5.2.4 One (1) steel hand spade;

3.7.5.2.5 Two (2) 4” * 4’ Sorb Sox®, or approved equivalent; and

3.7.5.2.6 Two (2) 4” * 8’ Sorb Sox®, or approved equivalent.

3.7.5.3 121 litre Absorption Capacity

3.7.5.3.1 Twenty five (25) sorbent pads 3/8” * 17” * 19”;

3.7.5.3.2 Ten (10) 4-mil yellow heavy duty disposal bag, 30” * 48”:

3.7.5.3.3 One (1) 44-litre bag Oclansorb®, or approved equivalent;

3.7.5.3.4 Eight (8) Sorb Sox® 4" * 4', or approved equivalent;

3.7.5.3.5 Five (5) Sorb Sox® 4" * 8', or approved equivalent;

3.7.5.3.6 Two (2) Spillows® 2" * 17" * 19", or approved equivalent;

3.7.5.3.7 One (1) spark resistant poly-shovel;

3.7.5.3.8 One (1) Sorb Sox® Boom 7" * 10', or approved equivalent; and

3.7.5.3.9 One (1) Pair of chemical resistant gloves.

3.8 USE OF HAZARDOUS, TOXIC, OR DANGEROUS MATERIAL

3.8.1 The Contractor shall implement the following procedures when working with hazardous, toxic or dangerous material.

3.8.1.1 The Contractor shall comply with all requirements of the Workplace Hazardous Material Information System (WHMIS), and shall provide Material Safety Data Sheets (MSDS) for all hazardous materials and waste dangerous good as defined by the federal *Transportation of Dangerous Goods Regulations*.

3.8.1.2 Hazardous material shall be stored at least 100 m away from all areas where drainage is directed into any watercourse or wetlands.

3.8.1.3 Toxic or dangerous substances such as form release agents, fuels, concrete additives (including superplasticizers), and other such substances, shall be transported, stored, and handled with all necessary precautions so as to prevent any spillage from occurring.

3.8.1.4 Drip pans shall be used at locations where such liquids are being drawn off in order to contain any minor spills, and as a safety measure for containment of a significant spillage.

3.8.1.5 Batteries shall be stored in secure dyked areas (with no drains), suitably protected to prevent infiltration of rainwater, snow and meltwater.

3.8.1.6 Any liquids, including acids, that drain into the dyked area shall be collected, handled and disposed of as a hazardous waste.

3.8.1.7 All equipment on the Project site shall use only hydraulic fluids that classify as "biodegradable", unless the Contractor justifies in writing to the Engineer's satisfaction that it is not feasible because of:

3.8.1.7.1 Technical or performance constraints,

3.8.1.7.2 Negative impacts on equipment warranties, and/or

3.8.1.7.3 Unavailability of biodegradable oils and lubricants.

3.8.1.8 The Contractor shall document the consideration of this issue in its bid documents providing, as a minimum, the following information:

3.8.1.8.1 Cost differential in using biodegradable and non-biodegradable oils and lubricants;

3.8.1.8.2 Life cycle cost differential for equipment maintenance and operation;

3.8.1.8.3 Product specifications indicating the product meets the definition of “biodegradable” when tested in accordance with the OECD 301B Ready Biodegradability Test procedure; and

3.8.1.8.4 Reasons (e.g. technical, market availability, equipment warranty provisions, etc) for not using biodegradable fluids, should that option be proposed.

3.8.1.9 The Contractor shall implement the following procedures when using hazardous materials near saltwater and freshwater areas (other than Protected Water Supply Areas).

3.8.1.9.1 In areas of low water hardness (i.e., 15-25 mg/L-1 CaCO3), pH 5.5 or less, and elevated background metals levels, or areas where metals-sensitive biota exist, ACA, ACZA and CCA shall not be used.

3.8.1.9.2 Pentachlorophenol shall not be used in salt water environments.

3.8.1.9.3 For temporary installation of wood structures (i.e. bridge abutments or wood poles) within 15 metres of a water body only untreated timber shall be used.

3.8.1.9.4 For permanent installations, non-invasive materials such as concrete or steel shall be used.

3.8.1.9.5 If use of untreated wood or alternative materials is not feasible or practical, approval by regulators is required prior to use of CCA, ACA, PCP and CuN.

3.8.1.9.6 Protective measures outlined above under Protected Water Supply Areas, such as pole wrapping and pipe installation, may be considered; however, using these alternatives requires preapproval by regulatory agencies.

3.9 WASTE MANAGEMENT

3.9.1 The Contractor shall implement the following Solid Waste Disposal procedures.

3.9.2 The Contractor shall review and comply with the provided Waste Management Plan (included in Exhibit # 11 of the Agreement) as required by the P-WEPP. The Waste Management Plan includes methods for the management, storage and disposal of both inert or non-hazardous wastes of various kinds (i.e. containers, filters, belts, scrap metals, domestic garbage, etc.), as well as hazardous wastes (i.e. used oils, solvents, paints, used/unused chemicals, old batteries, chemical based sludge, and contaminated soils and waters etc.).

3.9.2.1 Hazardous (waste oils, petroleum products, chemicals etc.) and non-hazardous waste materials.

3.9.2.2 The Contractor is responsible to collect and dispose of all waste produced by its employees and those of its Sub-contractors in a manner approved by the Engineer, and in accordance with the Newfoundland and Labrador Environmental Protection Act, Waste Management Regulations and Waste Diversion Regulations.

3.9.2.3 The Contractor shall implement the following waste management related environmental protection procedures:

3.9.2.3.1 Disposable wastes shall be stored in a leak proof container and disposed of at an existing approved municipal landfill site with the permission of the owner and/or operator.

3.9.2.3.2 Recyclable materials shall be collected separately and provided to an approved recycling facility.

3.9.2.3.3 Waste material shall not be deposited in any watercourse.

3.9.2.3.4 Waste types shall be separated and appropriate receptacles shall be provided for the collection of recyclable materials including; aluminum, glass, paper, cardboard and plastic.

3.9.2.3.5 Construction scrap and debris shall be separated into disposable and salvageable materials.

3.9.2.3.6 Waste accumulated on the site prior to disposal shall be confined in animal-resistant containers so that it does not pose an environmental or health hazard or cause conflict with wildlife.

3.9.2.3.7 Upon completion of the work, the Contractor shall, at its own expense, and to the satisfaction of the Engineer, dispose of, or remove from, the job site all construction plant, rubbish, unused material, including concrete forms, filter fabric material, sediment fencing, sand bags, and other equipment and materials belonging to it or used under its direction during the performance of the work. The site shall be left in a neat and clean condition.

3.10 MARSHALLING YARDS

3.10.1 Any site proposed for a marshalling yard should be of low value with respect to its potential for other uses when compared to other lands in the area. Abandoned gravel pits, abandoned commercial enterprises, or other previously disturbed areas are preferred locations.

3.10.2 Any site shall be located so as to minimize potential traffic hazards. Incoming and outgoing vehicles should be able to merge safely with other traffic. Prior to the commencement of construction the Contractor shall submit a list of candidate sites, which shall be reviewed and approved by the Engineer and any other relevant agency.

3.10.3 The Contractor shall implement the following general environmental protection procedures.

3.10.3.1 The marshalling yards and laydown areas used for equipment and material storage shall be located at least 30 m from any watercourse;

3.10.3.2 Plans shall be reviewed prior to the commencement of construction so that equipment or material storage yards shall be located at least 30 m from any watercourse or designated wetland.

3.10.3.3 Buffer zones are to be flagged prior to any disturbance activities.

3.10.3.4 Natural vegetation is to be left in place where possible.

3.10.3.5 Drainage from areas of exposed fill is controlled by grading or ditching and directed away from watercourses, whenever possible.

3.10.3.6 Surface water is to be directed away from work areas by ditching, the runoff from these areas may require silt to be removed by filtration or other suitable treatment.

3.10.3.7 The requirements for check dams or sediment traps to intercept runoff are determined in the field.

3.10.3.8 Check dams shall be used, as required, to reduce runoff velocity from work areas where there is exposed soil.

3.10.3.9 Areas to be exposed/disturbed shall be reduced to only what is required. Disturbed areas are to be graded to level grades and compacted. If required, erosion control matting may be required on exposed slopes prone to erosion.

3.10.3.10 In areas where natural vegetation is to be removed, the vegetation layer shall be stored for possible use as erosion control material on exposed slopes.

3.11 DUST CONTROL

3.11.1 The Contractor shall ensure that dust does not become a problem for adjacent property owners, construction site personnel, or create a hazard to vehicular traffic.

3.11.2 When required, or as directed by the Engineer, water or an acceptable dust suppressant such as calcium chloride shall be used by the Contractor on haul routes or other locations on the Project to control dust.

3.12 WILDLIFE PROTECTION

3.12.1 Work activities shall be undertaken in a manner that does not harass wildlife. Harassment is defined as any activity that would disrupt the normal behaviour of an animal. Any incidents that involve harassment of wildlife shall be reported to site management. Investigation of such incidents shall be completed and a report provided.

3.12.2 Firearms shall not be permitted on the construction site, unless authorized for use in control of nuisance animals. A policy of no hunting or fishing shall be in force for all personnel on the Project site.

3.13 NOISE CONTROL

3.13.1 The Contractor shall implement measures wherever possible to reduce potential effects arising from a variety of noise sources.

3.13.2 The Contractor shall regularly inspect exhaust systems on all vehicles and generators to ensure the equipment is in good operating condition.

3.13.3 The Contractor(s) shall also take measures so that workers are not exposed to noise levels above 85 dBA as per Occupational Health and Safety Guidelines.

3.13.4 The Contractor shall ensure that its workers shall wear proper personal protective equipment for hearing protection.

3.14 PROTECTION OF HISTORIC RESOURCES

3.14.1 The Contractor shall be aware that the *Historic Resources Act* (1985) requires the protection of archaeological sites and artefacts, and sets forth procedures to be followed in the event that either are found. The Contractor shall be aware of the following Sections of the Act:

3.14.1.1 Section 10(1) - A person who discovers an archaeological object in, on, or forming part of the land within the province shall report the discovery forthwith to the Minister stating the nature of the object, the location where it was discovered and the date of the discovery.

3.14.1.2 Section 10(2) - No person, other than the one to whom a permit has been issued under this Act, who discovers an archaeological object shall move, destroy, damage, deface or obliterate, alter, add to, mark or in any other way interfere with, remove or cause to be removed from the province that object.

3.14.1.3 Section 11(1) - The property in all archaeological objects found in, on or taken from the land within the province, whether or not these objects are in the possession of Her Majesty is vested in Her Majesty.

3.14.2 Should the Contractor encounter any archaeological remains, such as stone, bone or iron tools, concentrations of bone, fireplaces, house pits and/or foundations, work in the area of the find shall cease immediately. The Contractor shall immediately notify the Engineer, immediately upon discovery of any historic resources. The Engineer shall immediately notify The Company who in turn shall immediately notify the Historic Resources Division.

3.15 SITE REHABILITATION

3.15.1 The Contractor shall be aware that all areas of the construction sites shall require careful consideration of the landscape within which the work is taking place, to ensure that the correct rehabilitation approach is taken. The following general rehabilitation measures shall be implemented.

3.15.1.1 Rehabilitation shall be required for all temporary work;

3.15.1.2 No temporary buildings or structures associated with the work shall be left on site upon completion of the work;

3.15.1.3 All solid waste, including petroleum, oil and lubricant containers shall be removed from site;

3.15.1.4 Pre/Post occupation inspection shall be completed; and

3.15.1.5 The On-Site Environmental Monitor shall prepare a report for all sites documenting site conditions prior to disturbance and upon site abandonment and rehabilitation. Each report shall include a description of the condition of vegetation and other aspects of natural environment.

3.15.2 The Contractor shall implement the following rehabilitation measures specific to quarry and borrow areas:

3.15.2.1 Arrangements shall be made with the representatives of the Department of Natural Resources for an inspection to be conducted prior to abandonment of the site;

3.15.2.2 All equipment and material shall be removed from the site.

3.16 ENVIRONMENTAL COMPLIANCE MONITORING

3.16.1 Ongoing monitoring for compliance with regulatory requirements shall be conducted throughout the life of the Project by the Engineer. Dedicated on-site environmental monitors shall be present at the construction sites.

3.16.1.1 The Contractor shall not unduly restrict or impede the inspectors in the performance of their duties.

3.16.1.2 The Contractor shall be responsible for environmental performance and reporting, as required by provisions of any permits, authorizations or approvals.

3.16.1.3 The results of compliance monitoring shall be evaluated as part of the Project's environmental management system. Compliance instructions shall be issued by the Engineer, as required, ensuring compliance with all regulatory and contractual environmental requirements.

END OF SECTION

SECTION 03 11 00
CONCRETE FORMWORK
TABLE OF CONTENTS

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 03 11 00
CH0032	**CONCRETE FORMWORK**	**Rev. D2**
Powerhouse & Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 This specification describes the requirements for the design, supply, erection and dismantling of formwork, shoring and scaffolding, including all labour, material, equipment and supervision needed to execute the work for cast-in-place concrete as shown on the drawings and described in the specifications.

1.1.2 This specification shall be read conjointly with CSA A23.1/A23.2. However, the requirements of this Specification supersede the corresponding ones of CSA A23.1/A23.2.

1.2 WORK INCLUDED

1.2.1 The work covered by this specification includes, without being limited to, the following:

1.2.1.1 Design, supply, transportation to the site, unloading at the required locations, erection and dismantling of formwork and falsework;

1.2.1.2 Supply of all material, labour, equipment and supervision;

1.2.1.3 Production of formwork and shoring drawings and design calculations;

1.2.1.4 Make provision in the formwork, where required, for the installation of inserts, sleeves, anchor bolts, embedded items and waterstops;

1.2.1.5 Inspection and testing.

1.3 RELATED SECTIONS

1.3.1 Section: 03 20 00 Concrete Reinforcement

1.3.2 Section: 03 30 00 Cast-in-Place Concrete

1.3.3 Section: 03 60 40 Grout

1.3.4 Section: 05 50 10 Miscellaneous Metals and Embedded Parts

1.3.5 Section 48 13 10 General Mechanical Requirements

D1

1.3.6 Section 48 13 20 Gates, Stoplogs and Trashracks

1.4 DEFINITIONS

1.4.1 The following are used in this Specification:

1.4.1.1 SDRL: Supplier Documentation Requirements List

1.4.1.2 MSDS: Material Safety Data Sheets

1.4.1.3 OSHA: Occupational Safety and Health Administration

1.4.1.4 LEED: Leadership in Environmental Design

1.4.1.5 VOC: Volatile Organic Compounds

1.5 REFERENCES

1.5.1 The Contractor shall comply with the rules and provisions of the listed Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.5.2 All work shall be in accordance with this specification and the requirements of the following codes and standards:

1.5.3 Canadian Standard Association (CSA)

CSA A23.1-09/A23.2-09	Concrete Materials & Methods of Concrete Construction / Test Methods & Standard Practices for Concrete
CAN/CSA S269.1-1975(R2003)	Falsework for Construction Purpose
CAN/CSA S269.3-M92 (R2008)	Concrete Formwork
CSA W47.1-03 (R2008)	Certification of Companies for Fusion Welding of Steel
CSA W178.2-08	Certification of Welding Inspectors.

1.5.4 Canadian General Standards Board (CGSB)

CAN/CGSB 37-GP-9Ma	Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing

1.5.5 American Society for Testing and Materials (ASTM)

ASTM C309-11	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

1.5.6 Other Codes and References

NBC 2010	National Building Code of Canada 2010 and the Supplement to the National Building Code of Canada
ACI SP4 (2005)	Formwork for Concrete
ACI 347-04	Guide to Formwork for Concrete
OHSA	Occupational Health and Safety Act, Newfoundland and Labrador

1.6 SITE CONDITIONS

1.6.1 The Contractor is responsible for the verification of all dimensions, elevations and conditions on site prior to the execution of his shop drawings.

1.6.2 Any deviations, errors and site conditions which could adversely affect proper completion of the work shall be immediately reported to the Engineer for corrective action before preparing formwork drawings.

1.7 QUALITY ASSURANCE

1.7.1 The Contractor shall comply with an inspection program in conformance with ISO 9001:2008 requirements or equivalent.

1.7.2 The Contractor shall monitor the submitted quality control program, inspection and testing.

1.7.3 The Engineer reserves the right to inspect work at the fabrication plant at any time during the normal working hours. Provisions shall be made for such inspections, when requested.

1.7.4 Certifications

1.7.4.1 The Contractor shall be certified by the CWB according to the requirements of CSA W47.1 Division 1 or Division 2, in accordance with CSA S16.

1.7.5 Substitutions

1.7.5.1 Complete technical data as to type, composition, strength, quality, finish, capacity, performance characteristics and other pertinent details will be required to determine the acceptability of a substitute item.

1.7.5.2 Substitution for a specified element shall only be considered if the element is not available or if it results in an improved detail or easier erection.

1.7.5.3 Substitution shall receive written approval from the Engineer prior to being implemented.

1.8 SUBMITTALS

1.8.1 The Contractor shall submit the required documentation to the Engineer for review and approval, in accordance with the Supplier Document Requirement List (SDRL).

1.8.2 The Contractor shall submit the following to the Engineer for review, prior to start of fabrication:

1.8.2.1 Detailed schedule of fabrication and erection. The schedule shall amplify requirements of contract schedule and shall be updated on a regular basis. Schedule revisions shall be transmitted.

1.8.2.2 Copy of ISO 9001:2008 registration or equivalent and the Quality Assurance Program along with Quality Control (inspection and testing) Program.

1.8.2.3 CWB certificates of the welders, pointers and welding machine operators.

1.8.2.4 CWB certificates for the inspectors in conformance with CSA W178.2.

1.8.2.5 Welding procedures for shop welds. Procedures for field welding, if applicable, shall also be submitted.

1.8.2.6 Field-bolting checking procedure.

1.8.2.7 Design calculations of formwork, falsework:

1.8.2.7.1 Formwork drawings indicating materials, arrangements of joints, ties, shores, liners, locations of embedded parts, pattern and treatments of tie holes and rates of pour.

1.8.2.7.2 Formwork drawings and the associated design calculations shall bear the signature and seal of a qualified Professional Engineer registered in the Province of Newfoundland and Labrador.

1.8.2.8 Shop and erection drawings, and bills of material with bolt lists.

1.8.2.8.1 Shop drawings shall indicate the quantities, locations, top of steel elevations, spacing, sizes, profiles, steel grade, connections, including symbols and dimensions of welded joints, attachments, fasteners, galvanization or paint system and piece marks of members.

Any requirements for edge preparation for welds or machining requirements shall be clearly indicated.

1.8.2.8.2 Shop drawings shall include details of holes and fittings in components necessary for safety or to provide lifting and erection aids, as required.

1.8.2.8.3 Each shop drawing shall include a bill of material showing member piece marks, shape designations, number of pieces required, length, unit weight, total weight of each member, total weight of steel detailed on that drawing. It shall make reference to contract number, contract item number and related design drawing number.

1.8.2.8.4 Shop drawings shall be submitted only when their related design calculations have been reviewed.

1.8.2.8.5 Shop and erection drawings shall bear signature and seal of a qualified Professional Engineer registered in the Province of Newfoundland and Labrador. They shall also bear signature of a verifier.

1.8.2.8.6 Details of steelwork shall conform to the Canadian Institute of Steel Construction Handbook.

1.8.2.8.7 Engineer's drawings may be used as erection drawings, however the title block shall be replaced with a revised title block and the all professional seals shall be removed.

1.8.2.8.8 Erection drawings shall show piece marks, locations and details of field connections of members. They shall also indicate all A325 field bolts that need to be fully tensioned, in accordance with this Specification and the drawings.

1.8.2.8.9 In view of installation, shop drawings shall include details of all proposed additional reinforcement, bracing or otherwise stiffened metalwork.

1.8.2.9 Mill test certificates for all steel. The Contractor is responsible for the correlation between the material used and the mill test certificates.

1.8.2.10 Quality control and test reports, including radiographic films.

1.8.3 Submit Material Safety Data Sheets for each product required by OSHA to have an MSDS.

PART 2 PRODUCTS

2.1 FORMWORK MATERIALS

2.1.1 Formwork materials shall be as follows:

2.1.2 Wood Forms

2.1.2.1 Wood forms of sound and dressed lumber sheeting or plywood in good condition and free from defects. Forming wood shall be free of loose knots, warping, etc.

2.1.2.2 Forming wood shall be in new condition; i.e., all corners and edges shall be intact and the surface shall be smooth with no delaminating.

2.1.2.3 All formwork for exposed surfaces shall be made of plywood panels at least 16 mm thick. Such panels shall measure 2 400 mm long by at least 600 mm wide wherever the dimensions so allow.

2.1.2.4 Matchboard and tongue and groove board shall only be permitted for non-exposed surfaces.

2.1.3 Metal forms of prefabricated steel construction.

2.1.4 Materials for concrete formwork shall be suitable to achieve the finish requirements for formed surfaces as specified in the pertinent section of the specification.

2.2 FORM TIES

2.2.1 Form ties shall be metal rods or bolts of sufficient strength for intended service. Form ties that leave irregular holes or lead to repair marks that detract from specified finishes are prohibited.

2.3 FORM COATINGS, SEALERS AND RELEASE AGENTS

2.3.1 Sealtight Duogard as manufactured by W.R. Meadows, form oil or approved equivalent for form coatings, sealers, and release agents shall be used.

2.4 FORMWORK LINER

2.4.1 Unless indicated otherwise on the drawings, formwork shall be covered with a formwork liner type Drainaform as manufactured by Texel Inc. or approved equivalent, between elevations 37.50 m and 40.00 m for all upstream surfaces, including the bulkhead and intake gate shafts, and between elevations 0.50 m and 7.00 m for all downstream surfaces. The formwork liner is only required where the surface is normally in contact with water in the reservoir, tailrace and discharge channels. The formwork liner shall be installed as per the manufacturer's recommendations.

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PART 3 EXECUTION

3.1 FORMWORK DESIGN

3.1.1 Calculations and Drawings

3.1.1.1 Design of formwork shall take into account the following minimum criteria:

3.1.1.1.1 Weights of fresh concrete for walls and slabs (concrete density and pour rate);

3.1.1.1.2 Loads superimposed by equipment and scheduled placement methods;

3.1.1.1.3 Wind loading;

3.1.1.1.4 Cambers (whether specified on drawings or not) to remain within the allowable wall and slab deflections;

3.1.1.1.5 Resistance, deflection, water tightness.

3.1.1.1.6 Description of the material in the wood, steel or other type of forming system.

3.1.1.2 Detailed drawings showing all the information needed to fabricate and assemble formwork in compliance with CSA A23.1/A23.2. The drawings shall indicate:

3.1.1.2.1 Formwork construction details with proposed ties and type of spreaders and all other relevant details such as bracing, support;

3.1.1.2.2 Formwork construction methods;

3.1.1.2.3 Embedded items, such as piping and miscellaneous metalwork.

3.1.1.3 All formwork drawings and associated design calculations shall bear the signature and seal of a qualified Professional Engineer registered in the Province of Newfoundland and Labrador.

3.1.2 Rigidity and Water Tightness

3.1.2.1 Formwork shall be sufficiently strong and watertight to withstand concrete and wind loads as well as the forces applied by the construction method used, with special consideration given to the placement rate shown on the drawings, to ensure that the finished concrete conforms to the lines, shapes and dimensions of the members indicated on the drawings.

3.1.2.2 Formwork shall be sufficiently watertight to prevent mortar bleeding, and shall be appropriately tied and braced to maintain the desired shape during concrete placement and remain straight until the concrete has set.

3.1.2.3 Prefabricated steel or reinforced wood panel formwork shall conform to the rigidity, water tightness and quality requirements described herein.

3.1.2.4 Forms shall produce dense concrete surfaces free of honeycombing, depressions and bulging.

3.1.2.5 All bracing and supports shall be of adequate strength and appropriately anchored for the purposes for which they were designed.

3.1.2.6 Formwork shall be cambered, where necessary, to account for deflections in order to meet the final concrete formline geometry.

3.1.2.7 Braces shall be located in a way that will allow the formwork to be removed without impact or damage to the concrete.

3.1.2.8 Corners and shoring shall be checked and corrected horizontally and vertically during concrete placement. Provide a control wire parallel to the plane of the wall when concreting walls.

3.1.2.9 Competent manpower shall be assigned to continuously check formwork alignment and conformity with the tolerances and make adjustments as needed during concreting.

3.1.3 Formwork Classification

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3.1.3.1 Formwork is classified according to the finish and the quality of concrete surface required and the tolerances specified in this Specification. The various formwork classes shall conform to the drawings, specifications and stipulations to adequately provide finsh tolerances as described in Section 03 30 00 clause 3.15.5

3.1.3.1.1 Class F1

3.1.3.1.1.1 Used to create surfaces that will be backfilled or will never be exposed. Formwork may be built with minimal roughness treatment

3.1.3.1.2 Class F2

3.1.3.1.2.1 Used to create exposed surfaces other than those described in other classes. Formwork shall be made in a way that will result in a concrete surface with uniform texture and appearance. The same material for all form walls of this class shall be used. Patching of formwork surface openings is prohibited.

3.1.3.1.3 Class F3

3.1.3.1.3.1 Used to create hydraulic flow surfaces where uniformity and alignment accuracy are required. Wood formwork for straight and curved surfaces shall be made of sound wood free of knots and irregularities that can be cut and cambered with precision to the profiles required without splitting or twisting, and shall keep the shape it is given.

3.1.3.1.4 Class F4

3.1.3.1.4.1 Used for secondary concrete formed surfaces. Same characteristics as Class F3 but with more stringent tolerances.

3.1.4 Connectors and Separators

3.1.4.1 Connectors

3.1.4.1.1 Formwork vertical walls shall be connected to each other or to a solid mass of concrete or rock using metal fasteners. Using twisted wire for form ties is prohibited.

3.1.4.1.2 Use removable or snap-off metal ties, fixed or adjustable length, using devices which have holes no larger than 25 mm diameter in the concrete surface on exposed work.

3.1.4.1.3 Use only watertight types of form ties and spacers for all formwork provided for the works.

3.1.4.2 Separators

3.1.4.2.1 Wooden separators shall be removed as the concrete reaches their level. Concrete separators and separators comprising attachments shall be left in the concrete.

3.1.4.3 Ties shall be positioned so as not to impede concrete placement. They shall be installed in vertical planes with a reasonable horizontal distance between them. The ends of the attachments shall be cut 40 mm from the surface inside the concrete, even for concrete faces that are not exposed.

3.2 FORMWORK PREPARATION

3.2.1 Coatings, Sealers and Release Agents

3.2.1.1 To prevent concrete from adhering, the formwork surface shall be treated with a plastic material or swabbed with fresh, non-detergent mineral oil. Formwork shall be swabbed prior to erection. All necessary precautions to prevent the oil from coming in contact with the reinforcement shall be taken.

3.2.1.2 Coatings, sealers or release agents shall be applied according to manufacturers' directions to achieve specified cure and finish before erecting forms.

3.2.1.3 Forms shall be protected from dust and dirt.

3.2.2 Lift Limitation

3.2.2.1 Lift levels shall be horizontal and delimited by a moulding. Unless otherwise indicated on drawings, all corners shall be chamfered to 25 mm, whether or not the surfaces are exposed, unless otherwise indicated on the drawings.

3.2.2.2 When close tolerances are required for vertical walls constructed in more than one lift, the formwork shall be continuous between lifts to prevent mortar from bleeding out between the new formwork and the concrete from the previous lift.

3.2.3 Formwork Cleaning

3.2.3.1 Openings shall be provided for cleaning inaccessible parts of the formwork.

3.2.3.2 Narrow formwork shall have openings at their base arranged in a way to allow clearing of all debris prior to concrete placement. Openings shall have a cover that can be installed and held in place by the pressure of the concrete. Similar openings shall be provided on approximately 3.0 m centres at the base of very high walls and other structures.

3.2.3.3 The inside of the formwork shall be cleaned immediately before the concrete is placed.

3.3 ERECTION OF FORMWORK

3.3.1 General

3.3.1.1 Make forms tight to prevent leakage of mortar.

3.3.1.2 Make a 25 mm. x 25 mm chamfer on external corners and edges of concrete exposed to view unless otherwise specified.

3.3.1.3 At all unformed construction joints and at cold joints which may unavoidably arise during concrete placement, wooden strips of minimum section, 50 mm by 50 mm, shall be secured to the inside of the forms at the location of each joint to ensure a uniform finish to the outside edges of any lift of concrete. The upper layer of concrete shall be worked up to and under these strips so as to provide smooth edges.

3.3.1.4 Do not fasten form ties to reinforcing steel or embedded parts.

3.3.1.5 Prevent form oil from contacting steel reinforcement, or contacting concrete surfaces on which additional concrete or any bonded coating shall be placed. Apply form oil before placing reinforcing.

3.3.1.6 Place and secure inserts, boxes and sleeves in formwork as required. Set screens with true and straight top edges to proper elevation. Form openings for all services passing through concrete members.

3.3.1.7 Provide temporary openings in forms in order to facilitate cleaning and inspection. Immediately before placing concrete, remove all foreign materials such as shavings, chips and sawdust from the forms. After cleaning, plug holes flush with the inside surfaces of the forms.

3.3.1.8 Install back-up strips in formwork material joints to prevent offsets and maintain a continuous plane across adjacent panels.

3.3.1.9 All formwork shall be inspected by the Engineer before concreting.

3.4 REMOVAL OF FORMWORK AND FALSEWORK

3.4.1 General

3.4.1.1 Formwork and falsework shall not be removed until the concrete has developed sufficient strength to bear its dead weight and any construction or other loads that may be imposed.

3.4.1.2 Care shall be taken in dismantling of formwork and falsework to prevent any damage that may result from premature form stripping

3.4.1.3 Where required, the formwork lining, if used, may temporarily be left on the concrete so it can be used for water curing of concrete surfaces.

3.4.1.4 The Engineer shall be given advance notice of the intention to remove formwork and falsework in order to obtain his approval before proceeding. Unless otherwise authorized by the Engineer, the time prior to removal of formwork and falsework shall be as specified hereafter. Specific situations not covered in the articles hereafter shall be complemented by the requirements of ACI 347 – Clause 3.7.2.3.

3.4.1.5 Where the required concrete curing period is longer than the time for removal of formwork, continue curing method after form removal to complete the curing.

D1 3.4.1.6 After the formwork is removed, the concrete shall be cured and protected in compliance with the Specification Section 03 30 00 Cast in Place Concrete.

3.4.1.7 Protect all sharp edges of concrete and maintain the integrity of the design. Remove complete sections of forms without exerting stresses against corners of sets, reveals, or prying against exposed concrete surfaces with tools of any description.

3.4.2 Delays for Removal of Formwork and Falsework

3.4.2.1 The following delays shall apply to the removal of formwork (form stripping) and falsework:

3.4.2.1.1 For vertical surfaces, formwork may be removed as follows:

3.4.2.1.1.1 Thin cross-sections (< 1.0 m) after 48 hours for GU cement concrete and after 72 hours for LH-M cement concrete;

3.4.2.1.1.2 Thick cross-sections (≥ 1.0 m) after 24 hours for GU cement concrete and after 48 hours for LM-H cement concrete.

3.4.2.1.2 For beams, arches and structural slabs, the concrete strength shall have attained 70% of its specified compressive strength and with a minimum of 14 days before removal of formwork and falsework, unless shown otherwise on the drawings.

3.4.2.1.3 In all cases, the concrete shall have attained sufficient strength to prevent it from being damaged by the form stripping work and all superimposed loads that may be applied.

3.4.2.1.4 In all cases, the removal of formwork and falsework shall be authorized by the Engineer.

3.4.3 Repair of formed surfaces

3.4.3.1 Carry out repair of formed surfaces as required by the Engineer and in accordance with normal practice and CSA A23.1/A23.2.

3.5 RE-USE OF FORMS

3.5.1 Clean and repair forms, prior to re-use, to meet requirements for achieving specified concrete finishes. All holes for bolts and ties shall be plugged smooth and flush to the formwork surfaces. Lumber formwork may be reused as long as it is structurally sound and forming wood is in new condition, i.e. all corners and edges shall be intact and the surface shall be smooth with no delaminating. The formwork liner shall be used for only one (1) application, no reuse of forrmowk liners is permitted.

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3.6 CONTRACTION JOINTS

3.6.1 Contraction joints shall be constructed at the locations shown on the drawings.

3.6.2 For formed contraction joints, a bituminous coating conformed to CAN/CGSB 37-GP-9Ma shall be applied over the formed surfaces up to a distance of 500 mm from any concrete face, in accordance with the manufacturer's instructions.

3.7 SECONDARY CONCRETE FORMWORK

3.7.1 A complete set of drawings of the formwork together with a detailed description of the proposed methods of handling and placing of the secondary concrete shall be submitted to the Engineer before concreting.

D1 3.7.2 All secondary formwork shall be of Class F-4.

3.7.3 Formwork shall be firmly attached in place, braced and supported to resist the loads to which it is exposed, keeping its alignment and shape. Formwork shall be tight and shall not permit any leakage.

3.7.4 Formwork shall be fixed on primary concrete and not to the embedded parts.

3.8 TOLERANCES

3.8.1 Construction Tolerances

3.8.1.1 The Contractor is responsible for designing, executing, and maintaining the formwork within the required limits such that the structure, when completed, is in compliance with the tolerances specified in Specification Section: 03 30 00 Cast-in-Place Concrete.

3.8.1.2 As soon as a problem is detected, in order to prevent a recurrence of any non conformance, the Contractor shall submit to the Engineer, for approval, preventive and/or corrective measures with regard to materials, type of formwork, concrete placement methods, finishing methods, etc.

3.8.1.3 The Engineer reserves the right to place a hold on the work until such preventive and/or corrective measure proposals are reviewed and found to be satisfactory.

3.8.2 Survey Grid Point Tolerances

3.8.2.1 Unless identified elsewhere, the applicable tolerances are:

3.8.2.1.1 Planimetric: ± 2 mm;

3.8.2.1.2 Altimetric: ± 2 mm.

3.9 FIELD QUALITY CONTROL

3.9.1 The Engineer shall be notified on completion of formwork erection and fixing of the items specified herein. Approval shall be obtained before making final arrangements to place concrete.

3.9.2 The Contractor shall make inspections before and during concrete placements to ensure that formwork is correctly located, sufficiently rigid and tight, clean, surface treated, and free from snow, ice, and other foreign materials.

3.9.3 Formwork and fixed items shall be checked during placing of concrete to detect formwork movements and to verify that specified tolerances are not exceeded.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 03 20 00
CH0032	**CONCRETE REINFORCEMENT**	Rev: D2
Powerhouse & Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 03 20 00
CONCRETE REINFORCEMENT

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 03 20 00
CH0032	**CONCRETE REINFORCEMENT**	Rev: D2
Powerhouse & Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 This specification establishes the minimum requirements for materials, detailing, supply, fabrication, inspection, delivery to the work site and installation of reinforcing steel, welded wire fabric, steel fibre reinforcement and miscellaneous accessories for Concrete Reinforcement.

1.1.2 Work Included

1.1.2.1 This specification applies to all operations associated with, but not necessarily limited to, the following:

1.1.2.1.1 Supply, detailing, fabrication, delivery, storage and installation of reinforcing steel bars, welded wire fabric and miscellaneous accessories;

1.1.2.1.2 Preparation of placing drawings and bill of materials (bar bending schedules);

1.1.2.1.3 Furnish welding materials and perform field/shop welding, if required;

1.1.2.1.4 Inspection and testing.

1.1.2.2 The Contractor shall supply all necessary equipment and maintenance thereof to perform the work outlined in this Specification.

1.2 RELATED SECTIONS

1.2.1 Section: 03 30 00 Cast-in-Place Concrete

1.2.2 Section: 05 50 10 Miscellaneous Metals and Embedded Parts

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1.2.3 Section: 48 13 10 General Mechanical Requirements

1.3 DEFINITIONS

SDRL : Supplier Documentation Requirement List

MSDS : Material Safety Data Sheets

OSHA : Occupational Safety and Health Administration

1.4 REFERENCES

1.4.1 The Contractor shall comply with the rules and provisions of the listed Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.4.2 All work shall be in accordance with this specification and the requirements of the following codes and standards:

1.4.3 Canadian Standards Association (CSA):

CAN/CSA-G30.15-M92	Welded Deformed Steel Wire Fabric for Concrete Reinforcement
D1 CSA-G30.18-09	Carbon Steel Bars for Concrete Reinforcement
D1 CSA-A23.1-09/A23.2-09	Concrete Materials and Methods of Concrete Construction/ Test Methods and Standard Practices for Concrete
CAN/CSA-A23.3-04 (R2010)	Design of Concrete Structures
CSA W186-M1990 (R2007)	Welding of Reinforcing Bars in Reinforced Concrete Construction
Reinf Steel Institute of Canada:	
RSIC-2009	Reinforcing Steel Manual of Standard Practice

1.4.4 American Concrete Institute:

ACI SP-66-04	ACI Detailing Manual 2004
ACI 318-11	Building Code Requirement for Structural Concrete and Commentary.

1.4.5 American Society for Testing and Materials:

ASTM A 108-07	Standard Specification for Steel Bars, Carbon, Cold Finished
ASTM A 185/A 185M-07	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 497/A 497M-07	Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete

ASTM A 615/A 615M-12	Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
ASTM A 775/A775M-07	Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
ASTM A 820/A 820M-11	Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
ASTM A 934/934M-07	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
ASTM C 1116/C 1116M-10a	Standard Specification for Fiber Reinforced Concrete

1.4.6 American Welding Society

AWS A5.1/A5.1M-04	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
AWS D1.1/D1.1M-10	Structural Welding Code.
AWS D1.4/D1.4M-11	Structural Welding Code – Reinforcing Steel.

1.4.7 Other Codes and References:

OHSA	Occupational Health and Safety Act, Newfoundland and Labrador
ISO 1000	SI Units and Recommendations for the use of their multiples and of certain other units.
ISO 80000-1-09	Quantities and Units – Part 1: General Principles.

1.5 QUALITY ASSURANCE

1.5.1 Quality of work shall be controlled to meet the requirements of this Specification, referenced codes and standards, and other contract documents in effect on the date of contract.

1.5.2 The Contractor shall follow a Quality Control Program during execution of the work. The program for reinforcing steel shall include but not limited to dimensional checks and visual inspection for cracks at bends.

1.5.3 Certification

1.5.3.1 The Contractor shall obtain and retain Certificates of Compliance for all products listed in Part 2 for the Engineer's review, when requested.

1.5.3.2 Suppliers of reinforcing steel shall be certified to ISO 9001:2008 or equivalent.

1.5.4 Substitutions

1.5.4.1 Complete technical data as to type, composition, strength, quality, finish, capacity, performance characteristics, and other pertinent details will be required to determine the acceptability of a substitute item.

1.5.4.2 Substitution for a specified element shall only be considered if the element is not available or if it results in an improved detail or easier erection.

1.5.4.3 Substitutions shall receive written approval from the Engineer prior to being implemented.

1.6 SUBMITTALS

1.6.1 The Contractor shall submit the required documentation to the Engineer for review and approval, in accordance with the Supplier Document Requirement List (SDRL).

1.6.2 The Contractor shall submit Material Safety Data Sheets for each product required by OSHA to have an MSDS.

1.6.3 The Contractor shall submit a Quality Control Program that will be followed during execution of the work, to the Engineer for approval, prior to fabrication.

1.6.4 The detailed Quality Assurance Plan shall include inspection and testing of all materials and workmanship.

1.6.5 Submit certification from manufacturer indicating fibers meet the requirements of ASTM C1116.

PART 2 PRODUCTS

2.1 REINFORCING STEEL

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2.1.1 Materials and workmanship shall comply with CAN/CSA-A23.3.

2.1.2 Reinforcing bars shall be uncoated Grade 400R, with specified yield strength of 400 MPa conforming to CSA G30.18.

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2.1.2.1 Where welding is specified on the drawings, the reinforcing bars shall be uncoated Grade 400W, with specified yield strength of 400 MPa conforming to CSA G30.18.

2.1.3 All bars for the concrete reinforcement shall be deformed bars, unless noted otherwise.

2.1.4 With each shipment of reinforcing steel, the Contractor shall provide certified mill test reports showing chemical and physical analysis for each heat of each size of reinforcing steel delivered.

2.1.5 Procured reinforcing steel shall be separated and tagged according to mill test identification numbers.

2.2 STEEL FIBRES

2.2.1 Cold drawn deformed steel wire, minimum 60 mm long, conforms to ASTM A820, Type one (1).

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2.2.2 Acceptable products: Dramix 3D65/60BG or approved equal

2.3 WELDED WIRE FABRIC

2.3.1 Welded steel wire fabric shall be deformed, unless noted otherwise on the drawings, and shall have minimum yield strength of 450 MPa.

2.3.1.1 Welded wire fabric shall be provided in flat sheets only.

2.4 MISCELLANEOUS ACCESSORIES

2.4.1 Reinforcing steel bar supports shall be submitted for approval by the Engineer.

2.4.2 Bar supports, including chairs, bolsters, spacers, and tie wire shall be standard products from an approved manufacturer of such items. Properly sized supports shall provide adequate concrete cover and shall be furnished in sufficient quantity, manufactured to serve their intended purpose, and capable of carrying imposed loads without measurable deflection or displacement of the reinforcing steel.

2.4.3 Annealed tie wire size 1.6 mm diameter or heavier shall be used for tying reinforcing steel.

2.4.4 The size and shape of bar supports shall be selected so that the bar is maintained in proper position with minimal movement during concrete placement. Where concrete blocks are used for support, their compressive strength shall be 35 MPa.

2.4.5 Metal bar supports shall not be used to support reinforcing steel in concrete placed against earth.

2.5 MECHANICAL SPLICES

2.5.1 Mechanical splices, such as Dywidag, Lenton or Dextra Bartec shall conform to the requirements shown on the design drawings.

2.6 EPOXY COATING

2.6.1 Epoxy coating shall conform to ASTM A 775.

2.6.2 With each shipment of epoxy coated reinforcing steel, provide written certificates for the powder coating and the coated bars in accordance with ASTM A 775 and ASTM A934.

PART 3 EXECUTION

3.1 DETAILING

3.1.1 Reinforcing steel shall be detailed in accordance with RSIC-2009 and/or ACI SP-66, unless noted otherwise on the design drawings.

3.1.2 Bars shall be jointed, by laps, couplers or welding as per CAN/CSA-A23.3 and CSA W186 and shall conform to the requirements shown on the design drawings.

3.1.3 Reinforcing steel placing drawings and bills of material (bar bending schedules) shall be prepared in accordance with RSIC-2009.

3.1.4 Placing drawings for bills of material shall be submitted to the Engineer for approval. The Engineer's approval shall be obtained prior to fabrication. The total weight of each size of bar shall be shown on each placing drawing.

3.1.5 Placing drawings and bills of material shall indicate the quantities, grade, locations, spacing, sizes, and piece marks of each bar to be fabricated and placed. Bills of material shall indicate bar piece marks, shape designations, number of bars required, length, unit weight and total weight of each bar as well as the total weight of steel.

3.1.6 All welds shall be shown using welding symbols in accordance with CSA W186. Field welded connections shall not be used, unless specifically approved by the Engineer.

3.2 STORAGE AND HANDLING

3.2.1 Before and after fabrication, reinforcing steel shall be stored off the ground and protected from dirt, grease, oil or other deleterious materials.

3.2.2 Padded contact areas shall be provided on all systems used for handling epoxy coated reinforcing. Epoxy coated bars shall be banded with material that will not damage the coating

3.3 FABRICATION

3.3.1 Do not fabricate reinforcing steel until bar bending lists have been reviewed by the Engineer.

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3.3.2 Fabrication of reinforcing steel shall conform to the requirements of CSA-A23.1/A23.2 and RSIC.

3.3.3 Bars shall be bent cold to the dimensions shown on the design drawings and the approved bills of material.

3.3.4 Welded wire fabric shall be furnished in flat sheets, unless prior approval is obtained from the Engineer.

3.3.5 Reinforcing steel shall not be heated or flame-cut.

3.4 MARKING

3.4.1 Each bundle of reinforcing steel bars shall be tagged after fabrication. The tag shall show the quantity, grade, size, piece mark, and suitable identification to allow checking, sorting, and placing.

3.4.2 Each bundle of flat sheets of welded wire fabric shall be tagged after fabrication. Tags shall show the piece mark, quantity, style designation, width and length.

3.4.3 Weatherproof tags that will remain legible for one year (minimum) when stored outside shall be used.

3.5 WELDING

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3.5.1 Only reinforcing steel conforming to CSA-G30.18 Grade 400W shall be welded or tacked, when shown on the drawings. If welding or tacking is shown, the Contractor shall obtain prior approval from the Engineer of welding procedures, procedure qualification records, and inspection plan as per CSA-A23.1/A23.2 and CSA W186.

3.5.2 Welders shall be qualified in accordance with the requirements of CSA W186, or an approved equivalent. The Contractor shall maintain welder qualification records at the location where the work is being performed and make them available for review when requested.

3.6 FIELD QUALITY CONTROL

3.6.1 All reinforcing and other embedments for the pour are to be in place, checked and inspected by the Contractor prior to review by the Engineer. Completeness of reinforcing and embedments is the responsibility of the Contractor.

3.6.2 Advise the Engineer at least 48 hours in advance for review of the reinforcing steel.

3.6.3 The Engineer's review does not relieve the Contractor of its responsibility for correctly placing and adequately supporting the reinforcing steel and embedded parts. During placement, the Contractor may be required to provide additional support to the reinforcing steel and embedded parts. The Contractor may be required to stop a concrete placement until any inadequacy in steel support is corrected.

3.6.4 The concrete pour will only be authorized after the Engineer has reviewed the steel.

3.6.5 Remove loose rust, scale or any other materials from surfaces of reinforcement and accessories that would, in the opinion of the Engineer, reduce their bond effectiveness. After placing, maintain reinforcement in clean condition.

3.6.6 Adjust reinforcement and embedments immediately before concrete is poured to ensure that bars and embedments are in correct position and are securely tied or otherwise secured to maintain position.

3.6.7 Field bending of bars is not permitted unless authorized by the Engineer in which case bending shall be done with and approved procedure and without heat. Bars shall not be re-bent. Bars which develop cracks or splits shall be replaced.

3.6.8 Reinforcing steel shall not be flame-cut.

3.7 INSPECTION AND TESTING

3.7.1 The Contractor shall provide inspectors to inspect material and workmanship in the fabrication shop.

3.7.2 The Contractor shall visually inspect all welding in accordance with CSA W186.

3.7.3 The Engineer reserves the right to inspect work in the fabrication shop at any time. The Contractor shall make provisions for such inspection, when requested.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 03 30 00
CH0032	CAST-IN-PLACE CONCRETE	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 03 30 00
CAST-IN-PLACE CONCRETE
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGL Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
C. TODD SMITH
C. Todd Smith
SIGNATURE
9 Dec 2013
PROVINCE OF NEWFOUNDLAND & LABRADOR

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 This specification describes the requirements for the supply of all labour, material, equipment and supervision for concrete preparation, transportation and placement, needed to execute the work described on the drawings and in the specifications.

1.1.2 This Specification shall be read conjointly with CSA A23.1/A23.2. However, the requirements of this Specification supersede the corresponding ones of CSA A23.1/A23.2.

1.2 WORK INCLUDED

1.2.1 The work covered by this specification includes, without being limited to, the following:

1.2.1.1 Supply of all material, labour, equipment and supervision needed to prepare concrete of the type and strength required by the contract documents and as shown on the drawings, and also the delivery to the work site and unloading at the required locations.

1.2.1.2 In-plant and in-field testing of concrete strength and other properties, as applicable.

1.2.1.3 Protection of concrete up to the delivery point, in hot or cold weather.

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1.2.1.4 Scarification of concrete surfaces to receive new concrete, except surfaces of primary concrete place by Company's other contractor.

1.2.1.5 Not Used.

1.2.1.6 Not Used.

D1

1.2.1.7 Labour, materials and facilities needed to place, cure and protect secondary concrete in hot or cold weather.

1.2.1.8 Construction of required control and expansion joints.

1.2.1.9 Repairing of any defective work.

1.2.1.10 Cleaning of work areas.

1.3 RELATED SECTIONS

1.3.1 Section: 01 35 43 General Environmental Requirements

1.3.2 Section: 03 11 00 Concrete Formwork

1.3.3 Section: 03 20 00 Concrete Reinforcement

1.3.4 Section: 05 50 10 Miscellaneous Metals and Embedded Parts

D1 1.3.5 Section: 48 13 10 General Mechanical Requirements

D1 1.3.6 Section: 48 13 20 Gates and Trashracks

1.4 DEFINITIONS

1.4.1 Engineer: The consulting Engineer or its representative.

1.4.2 Contractor: The entity responsible for the execution of the work covered by this Specification either directly or through Subcontractors.

1.4.3 SDRL: Supplier Documentation Requirement List.

1.4.4 MSDS: Materials Safety Data Sheets

1.4.5 OSHA: Occupational Safety and Health Administration

1.4.6 Primary concrete is equivalent to first stage concrete

1.4.7 Secondary concrete is equivalent to second stage concrete

1.4.8 GU cement: General use cement as per CSA A3001-08.

1.5 REFERENCES

1.5.1 The Contractor shall comply with the rules and provisions of the latest editions and amendments of the *listed* Codes and Standards. The Contractor shall seek approval from the Engineer prior to using equivalent other codes and standards.

1.5.1.1 Codes and Standards

1.5.1.1.1 All work shall be in accordance with this specification and the requirements of the following.

1.5.1.1.2 A copy of the CAN/CSA A23.1/A23.2 standards shall be kept on site at all times.

1.5.2 Canadian Standard Association (CSA)

CSA A3000-08	Cementitious Materials Compendium
CSA A23.1-09/A23.2-09	Concrete Materials & Methods of Concrete Construction / Test Methods & Standard Practices for Concrete
CAN/CSA S269.1-1975(R2003)	Falsework for Construction Purpose
CAN/CSA S269.3-M92(R2008)	Concrete Formwork
CAN/CSA A23.3-04(R2010)	Design of Concrete Structures

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1.5.3 Canadian General Standards Board (CGSB)

CAN/CGSB 37-GP-9Ma	Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing
CAN/CGSB-25.20-95	Surface Sealer for Floors

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1.5.4 American Society for Testing and Materials (ASTM)

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ASTM C94/C94M-12	Standard Specifications for Ready-Mixed Concrete
ASTM C150-12	Standard Specification for Portland Cement
ASTM C227-10	Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar Bar Method)
ASTM C260-10	Specifications for Air-Entraining Admixtures for Concrete
ASTM C289-07	Standard Test Method for Alkali-Silica Reactivity of Aggregates (Chemical Method)
ASTM C309-07-11	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C457/C457M-11	Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete
ASTM C494/C494M-11	Standards Specification for Chemical Admixtures for Concrete
ASTM C685/C685M-11	Standard Specification for Concrete Made by Volumetric Batching for Continuous Mixing
ASTM C1017/C1017M-07	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1107-11	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
ASTM C1260-07	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)
ASTM D422-63 (2007)	Standard Test Method for Particle Size Analysis of Soils
ASTM C1293-8b	Standard Test Method for Determination of Length Change of Concrete due to Alkali-Silica Reaction.

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1.5.5 Other Codes and References

NBC 2010	National Building Code of Canada 2010 and the Supplement to the National Building Code of Canada
ISO 1000	SI Units and Recommendations for the use of their multiples and of certain other units.
ISO 31-0	Quantities and Units – Part 0: General Principles.
ACI 347	Guide to Formwork for Concrete
ACI 214	ACI Recommended Practice for Evaluation of Compression Test Results of Field Concrete

1.5.6 American Concrete Institute:

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ACI 347-04	Guide to Formwork for Concrete
ACI 214R-11	Guide to Evaluation of Strength Test Results of Concrete
ACI 305R-06	Guide to Hot Weather Concreting
ACI 306R-10	Guide to Cold Weather Concreting
ACI 318-11	Building Code Requirements for Structural Concrete and Commentary

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1.6 QUALITY ASSURANCE

1.6.1 Quality of work shall be controlled to meet the requirements of this Specification, referenced codes and standards, and other contract documents in effect on the date of contract.

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1.6.2 The Contractor shall prepare and submit a detailed statement of proposed quality control procedures for all aspects of the work. The Contractor shall follow a Quality Control Program during execution of the work. The program shall include inspection and testing of all materials as well as dimensional checks and visual inspection.

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1.6.2.1 The Engineer will audit the Contractor's quality control program and will make independent tests. These tests shall be at the Company's expense, to verify that the material meets its intended purpose.

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1.6.2.2 The Engineer may carry out additional construction audits during the progress of the Work. The Engineer's audit during construction shall in no way replace the Contractor's quality control program or relieve the Contractor from its contractual responsibility.

1.6.3 All chemicals used need to be accompanied by a ''Material Safety Data Sheet'' and recorded on a site hazardous record document to be kept at the facility offices. For a list of substances not to be used due to their toxicity and health risk, refer to Specification Section 01 35 43: General Environmental Requirements.

1.6.4 The Contractor shall obtain and retain Certificates of Compliance for all products listed in Part 2 for the Engineer's review, when requested.

1.6.5 Complete technical data as to type, composition, strength, quality, finish, capacity, performance characteristics, and other pertinent details will be required to determine the acceptability of a substitute item.

1.6.6 The Engineer reserves the right to accept or reject any proposed substitution.

D1 1.6.7 Substitution for a specified element shall only be considered if the element is not available or if it results in an improved detail or better construction. Substitutions shall receive written approval from the Engineer prior to being implemented.

D1 1.6.8 At each stage of preparation and construction, the Contractor's quality control representative shall complete the appropriate section of Concrete Placement Authorization Form and sign the appropriate section off when, but not before, he is satisfied that the portion of the work is satisfactorily completed. The Engineer shall be given the opportunity to audit each stage of the Work before commencement of the subsequent stage.

D1 1.6.9 If the Engineer finds any portion of the preparation is not in accordance with the specification and/or good workmanship, the Contractor shall rectify the deficiency and no concrete shall be done until the deficiency is rectified.

D1 1.6.10 The Contractor shall bring to the attention of the Engineer any defects in the work or departures from the Contract Documents that may occur during construction, provide recommended method to correct the defect and state recommendations in writing.

1.7 SUBMITTALS

D1 1.7.1 The Contractor shall submit to the Engineer for approval, the Quality Control program that will be followed during the execution of the work.

1.7.2 The Contractor shall submit the following documentation to the Engineer for review and approval, in accordance with the supplier document Requirements List (SDRL).

1.7.3 Concrete Materials

1.7.3.1 Sources of supply of all cementitious materials proposed for the works and test reports for all cementitious materials verifying that the materials conform to the standards and requirements specified herein.

1.7.3.2 Sources of supply of all coarse and fine aggregates proposed for the Works and test reports on each size of aggregate verifying that the materials conforms to the standards and requirements specified herein.

D1 1.7.3.3 Data sheets for all chemical admixtures proposed for the Work and certification that the admixtures conform to the standards and requirements specified herein.

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1.7.3.4 Certification that the air entraining admixtures are compatible with the water reducing admixtures and the high range water reducing admixtures (super-plasticizer).

1.7.3.5 Source of the water for the concrete proposed for the Work and verification that the water conforms to the standards and requirements specified herein.

1.7.4 Placement Method

1.7.4.1 The Contractor shall submit details of proposed methods of placing, consolidating, finishing, curing and protecting concrete and materials including measures to be taken during hot and cold weather and during precipitation, including proposed measures to control concrete temperatures and temperature differentials before, during and after placement. Submit details of proposed cooling measures to achieve required concrete delivery and curing temperatures in hot weather conditions and proposed measures to avoid bug holes in the concrete surface.

1.7.5 Equipment

1.7.5.1 The Contractor shall submit a list of all equipment to be used in batching, transporting, placing, consolidating and finishing the concrete and grout, together with a list of proposed standby equipment.

1.7.6 Test Results

1.7.6.1 Results for all testing to the Engineer within 24 hours of receipt.

1.7.7 Materials for Concrete Related Products

1.7.7.1 Manufacturer's Specifications for the selected product for sealant, curing compound, releasing agent and other proprietary concrete-related products.

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1.7.8 The Contractor shall provide a Material Safety Data Sheet for each product required by OSHA to have a MSDS.

PART 2 PRODUCTS

2.1 CEMENT

2.1.1 Cement shall be as defined in this Specification, conforming to the relevant referenced codes and standard specifications.

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2.1.2 Portland cements type LH-M and type GU shall be used. Other types consisting of a blend of 35 to 40% LH-M with 10 to 15% GU and 50% Slag may also be used.

2.1.3 The cements shall have low alkalies content (no more than 0.6%).

2.1.4 Unless noted otherwise on the drawings, cement type GU shall be used.

2.2 MIXING WATER

2.2.1 The water shall conform to Section 4.2.2 of CSA A23.1/A23.2.

2.2.2 Concrete mixing water shall be free of salts, alkalis, acids and suspended particulates in proportions that could adversely affect the quality of the concrete.

2.3 AGGREGATE

2.3.1 General

2.3.1.1 Normal-density fine and coarse aggregate shall be used exclusively.

2.3.2 Sampling and Testing Frequency

2.3.2.1 Aggregate shall be sampled in accordance with the CSA A23.2-1A test method. Supplements A1 and A2 of this method shall apply.

2.3.2.2 Aggregate samples shall be taken at the end of the conveyor when the aggregate materials are transported via a conveyor system (belt conveyor).

2.3.2.3 The test method, frequency and sampled location are indicated in Table 1.

2.3.2.4 When test results are non-conforming, the necessary corrective actions shall be taken, and conformance of the materials with the requirements shall be demonstrated by testing.

2.3.2.5 Individual tests shall be carried out on coarse aggregate and fine aggregate, and also on the combination of coarse and fine aggregate as used on the site.

2.3.3 Normal-density fine aggregate

2.3.3.1 Normal-density fine aggregate shall consist of natural sand.

2.3.3.2 The Engineer may authorize the use of manufactured sand or stone screening as a replacement for part of the natural sand if it can be shown through test results that doing so will have no deleterious effects on the concrete, such as an increased demand for water to achieve a given slump, an increase in the amount of air entraining admixture needed to maintain a given air content, etc. The Engineer shall determine the replacement material percentage.

2.3.3.3 The fine sand sieve analysis results shall fall within the limits specified in Table 2.

2.3.3.4 During sandpit or sieving operations, the daily average (i.e. computed from the samples tested each day) sieve analysis distribution will be considered one lot for quality control purposes; the sampling frequency shall be as shown in Table 1.

2.3.3.5 During concrete manufacturing, the average sieve analysis distribution representing the aggregate used daily will be considered one lot for quality control purposes; the sampling frequency shall be as shown in Table 1.

2.3.3.6 Deviation from the requirements of one or more sieves in an individual sieve analysis will not be considered non-conforming. However, the individual results shall be clearly identified “Acceptable”, easily traceable, and the Engineer shall be notified.

2.3.3.7 The material will be considered non-conforming if there is a deficiency or excess on one or more sieves with respect to the average result of a lot (i.e. daily average).

2.3.4 Normal-density coarse aggregate

2.3.4.1 Normal-density coarse aggregate shall consist of crushed rock or crushed natural gravel.

2.3.4.2 For crushed natural gravel, the percentage by weight of aggregate fragmented by crushing and retained on a 5 mm sieve shall be greater than 80%.

2.3.4.3 Coarse aggregate size shall be chosen based on the nominal dimensions given in Table 3, in conformance with the criteria of Sections 4.3.2.2 and 4.3.6 of CAN/CSA A23.1.

2.3.4.4 Prepare 40-5 mm aggregate using either the three coarse aggregate gradings 40-20 mm, 20-10 mm and 10-5 mm, or the two coarse aggregate gradings 40-20 mm and 20-5 mm, combined at the batching plant in proportions that will ensure the sieve requirements of 40-5 mm coarse aggregate are met.

2.3.4.5 Prepare 20-5 mm class aggregate directly or using two coarse aggregate classes, 20-10 mm and 10-5 mm, combined at the batching plant in proportions that will ensure the sieve requirements of 20-5 mm coarse aggregate are met.

2.3.4.6 During coarse aggregate manufacturing, the daily average (i.e. computed from the samples tested each day) sieve analysis distribution for each manufactured size will be considered one lot for quality control purposes; the sampling frequency shall be as shown in Table 1.

2.3.4.7 During concrete manufacturing, the combined average sieve analysis distribution determined by calculating the aggregates used daily will be considered one lot for quality control purposes; the sampling frequency shall be as shown in Table 1.

2.3.4.8 Deviation from the requirements of one or more sieves in an individual sieve analysis will not be considered non-conforming. However, the individual results shall be clearly identified “Acceptable”, easily traceable, and the Engineer shall be notified.

2.3.4.9 The material will be considered non-conforming if there is a deficiency or excess on one or more sieves with respect to the average result of a lot (i.e. daily average).

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2.3.4.10 Prepare 80-5 mm aggregate using either the four (4) coarse aggregate gradings 80-40 mm, 40-20 mm, 20-10 mm and 10-5 mm, or the three (3) coarse aggregate gradings 80-40 mm,

40-20 mm and 20-5 mm, combined at the batching plant in proportions that will ensure the sieve requirements of 80-5 mm coarse aggregate are met.

2.3.5 Deleterious substances and physical properties

2.3.5.1 The results of test performed on separate samples, in conformance with the grading requirements given in Tables 2 and 3, shall not exceed the limits prescribed in Table 4 of this Specification. Deleterious substances and physical properties shall be determined in accordance with the test methods indicated in Table 4.

Table 1 - Aggregate Test Frequency

Material	Test & Method	Minimum Frequency[5]	Location & Need
Fine aggregate	Petrographic examination CAN/CSA A23.2-15A	At least once per source[1]	Report less than 3 years old
	Qualitative tests[2]. See Table 4	Once per source	Report less than 1 year old
	Alkali-aggregate reactivity CAN/CSA A23.2-14A & 25A	Once a year for each source	Report less than 3 years old
	Absorption CAN/CSA A23.2-6A	Once a month	Batching plant
		At least 3 times per source[4]	Sandpit
	Organic impurities CAN/CSA A23.2-7A	Twice per shift[3]	Sandpit
		Once per shift	Batching plant
	Sieve analysis & fineness modulus. CAN/CSA A23.2-2A	Twice per shift and more often, if necessary	Sandpit
		Once per shift	Batching plant
	Specific gravity CAN/CSA A23.2-6A	Once a month	Batching plant
		At least 3 times per source[4]	Sandpit
	Moisture content CAN/CSA A23.2-11A	Continuously	Batching plant
	Bulk density CAN/CSA A23.2-10A	Once a month	Batching plant
		At least 3 times per source[4]	Sandpit

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Table 1 - Aggregate Test Frequency (continued)

Coarse aggregate	Petrographic examination CAN/CSA A23.2-15A	At least once per source(1)	Report less than 3 years old
	Alkali-aggregate reactivity CAN/CSA A23.2-14A & 25A	Once a year for each source	Report less than 3 years old
	Absorption CAN/CSA A23.2-12A	Once a month	Batching plant
		At least 3 times per source(4)	Crusher
	Sieve analysis CAN/CSA A23.2-2A Fines < 80 µm CAN/CSA A23.2-5A	Twice per shift	Crusher
	Sieve analysis CAN/CSA A23.2-2A	Once per shift	Batching Plant
	Sieve analysis(6) CAN/CSA A23.2-2A	Twice per week (to check automated dosing)	After washing concrete on 5 mm sieve
	Specific gravity CAN/CSA A23.2-12A	Once a month	Batching plant
		At least 3 times per source(4)	Crusher
	Bulk density CAN/CSA A23.2-10A	Once a month	Batching plant
		3 times at the beginning	Crusher
	Fines < 80 µm CAN/CSA A23.2-5A	Once a month	Batching plant
	Fragmentation (Test for natural gravel; not expected to be used. If natural gravel is used, refer to the Engineer for an appropriate test)	At least once per source	Natural gravel only (if used)

Notes: see next page

Notes:(1) Each quarry, warehouse or storage area is considered an independent source. A quarry, warehouse or storage area is considered a unique source of material if the contents of said quarry, warehouse, or storage area are of homogeneous composition. If the quarry, warehouse or storage area contents are heterogeneous in composition, i.e. composed of more than one type of rock or materials of different origin, said quarry, warehouse or storage area is considered a multiple source and each source must be checked.

(2) Qualitative tests are those described in Table 4 of this Specification.

(3) Shift: 10 hour period; night shift and day shift.

(4) Per period of continuous production.

(5) The minimum frequency may be changed with the Engineer's approval.

(6) The coarse aggregate sieve analysis obtained after washing the concrete mix on a 5 mm sieve shall not be used as a test for acceptance or rejection according to the requirements of Table 3. Such tests shall only be used to verify coarse aggregate automated dosing. One must take into account the fact that some of the particles in the stone will pass through the 5 mm sieve during washing, while some of the particles in the sand will be retained on the 5 mm sieve.

Table 2 – Fine Aggregate Grading Limits

D1

Sieve dimension	Total weight passing in %	
	Concrete sand	Mortar sand
10 mm	100	-
5 mm	95 - 100	-
2.5 mm	80 - 100	100
1.25 mm	50 - 90	95 - 100
0.630 mm	25 - 65	60 - 85
0.315 mm	10 - 35	30 - 50
0.160 mm	2 - 10	10 - 30
0.080 mm	0 - 3(1)	0 - 5

Notes: (1) This limit may be extended to 5% in conformance with the requirements indicated at the bottom of Table 4.

2.3.6 Petrographic examination

2.3.6.1 A petrographic examination of the aggregate is required for each source or type of rock at the start of operations for each borrow source or quarry.

2.3.7 Aggregate approval

2.3.7.1 All the equipment required to manufacture the coarse aggregate, including washing systems, in order to conform with the grading requirements indicated in Table 3 (40-20, 20-10, 20-5A, 10-5A and 10-2.5A) shall be provided. Non-conforming aggregate shall be re-screened or washed, or both, to meet the grading requirements and the Table 4 requirement with regard to cleanliness at the 80 µm sieve.

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Table 3– Coarse Aggregate Size

Nominal size of coarse aggregate (mm)	**Total % by weight passing each sieve in mm**										
	112	**80**	**56**	**40**	**28**	**20**	**14**	**10**	**5**	**2.5**	**1.25**
Group I	Group I grading requirements apply to the batching plant during concrete mixing										
40-5†	-	-	100	85 - 100	-	35 - 70	-	10 - 30	0 - 5	-	-
20-5††	-	-	-	-	100	85 - 100	50 - 90	25 - 60	0 - 10	0 - 5	-
10-5	-	-	-	-	-	-	100	85 - 100	0 - 20	0 - 5	-
10-2.5	-	-	-	-	-	-	100	85 - 100	10 - 30	0 - 10	0 - 5
Group II	Group II grading requirements apply to crushing										
40-20	-	-	100	90 - 100	25 - 60	0 - 15	-	0 - 5	-	-	-
20-10	-	-	-	-	100	85 - 100	40 - 60	0 - 20	0 - 5	-	-
20-5A	-	-	-	-	100	85 - 100	50 - 80	25 - 60	0 - 7	0 - 3	-
10-5A	-	-	-	-	-	-	100	85 - 100	0 - 12	0 - 3	-
10-2.5A	-	-	-	-	-	-	100	85 - 100	10 - 20	0 - 7	0 - 3

Notes: † To prevent segregation, aggregates that make up either of these grading shall be stockpiled and batched in two or more separate sizes selected from Group II.

†† Aggregates that make this grading shall be stockpiled and batched in either one size, or two separate sizes selected from Group II.

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Table 4 - Deleterious Substance Limits(1) & Physical Properties

Properties	Maximum % of total sample		Test method	Minimum frequency
1- Basic requirements	**Fine aggregate**	**Coarse aggregate**		
Clay lumps(2)	1.0	0.3	CAN/CSA A23.2-3A	Once per source(10)
Low density granular constituents(3)	0.5	0.5	CAN/CSA A23.2-4A	Once per source(10)
Fines passing the 80 µm sieve	3.0(4)	1.0(5)	CAN/CSA A23.2-5A	Once per sieve analysis during crushing Once a month at batching plant for coarse aggregate Once per sieve analysis for fine aggregate
Flat particles		25	CAN/CSA A23.2-13A, procedure B	Once per source(10)
Elongated particles	-	45	CAN/CSA A23.2-13A, procedure B	Once per source(10)
Flat & elongated particles	-	20	CAN/CSA A23.2-13A, procedure A	Once per source(10)
Micro-Deval test(6)	20	17	CAN/CSA A23.2-23A, CAN/CSA A23.2-29A	Once per source(10)
Unconfined aggregate freeze/thaw test(7)	-	6	CAN/CSA A23.2-24A	Once per source(10)
Los Angeles abrasion loss test(8)	N/A	50	CAN/CSA A23.2-16A, CAN/CSA A23.2-17A	Once per source(10)
2- Alternative requirements to Micro-Deval test				
$MgSO_4$ soundness losses(9)	16	12	CAN/CSA A23.2-9A	Once per source(10)

Notes: see next page

Notes: (1) The limits for deleterious substances not listed in this table, such as chert, schist, siltstone, sandstone or argillaceous limestone, will be specified by the Engineer so as to cover all deleterious substances known to exist in a given region. In the absence of such information, aggregate will be approved or rejected based on Section 4.2.3.9 of CAN/CSA A23.1.

(2) Lumps of clay mean fine sedimentary substances, consolidated with aluminosilicates in aqueous form. This test does not apply to quarries with rock that is igneous by nature.

(3) A liquid with a specific gravity of 2.0 is usually used to separate particles of coal or lignite. Liquids with specific gravities greater or less than 2.0 may be needed to identify other deleterious substances with a lower specific gravity.

(4) This limit may be extended to 5% if the clay particles of less than 2 µm do not comprise more than 1% of the total fine aggregate sample. The amount of clay particles less than 2 µm must be determined by hydrometric analysis using the ASTM D422 test method, on a washed sample, on an 80 µm sieve.

(5) In the case of crushed aggregate, if the particles passing the 80 µm sieve consist of crushing dust that is essentially free of clay or schist, the limit indicated above may be increased to 2.0% when used at the batching plant, and does not apply during crushing. Notwithstanding the limit of this requirement, when the aggregate is coated with an adherent substance and appears dirty, it shall be subjected to the following test to determine the adherence of the substance to the aggregate: Place a sample of the aggregate in calm water, shake the sample slightly, and remove it. If, after this test, 80% of the sample aggregate is clean, the aggregate is acceptable; otherwise, the aggregate will have to be washed.

(6) Test method CAN/CSA A23.2-23A for testing fine aggregate is quick and extremely accurate. It also correlates closely with the more complicated and more variable $MgSO_4$ disintegration resistance test. For more information, refer to the document entitled: Micro-Deval Test for Evaluating the Quality of Fine Aggregate for Concrete and Asphalt, by C.A. Rogers, M. Bailey & B. Price. Transportation Research Board, Record No. 1301, 1991, pp. 68-76.

(7) Test method CAN/CSA A23.2-24A for testing coarse aggregate provides good accuracy and an acceptable correlation with the $MgSO_4$ disintegration resistance test. For more information, refer to the document entitled: Development of an Unconfined Freeze-Thaw Test for Coarse Aggregate, by C.A. Rogers, S.A. Senior & D. Boothe, Ontario Ministry of Transportation, Engineering Materials Report EM-87, 1989.

(8) Losses due to abrasion must not exceed 35% when the aggregate is used for construction of concrete roadways or other surfaces exposed to significant wear and tear.

(9) The Micro-Deval test requirements for fine aggregate or the freeze-thaw requirements for coarse aggregate may be waived if the requirements of the $MgSO_4$ soundness losses are within limits.

(10) Provided the source is homogeneous - shall be otherwise increased.

2.4 ADMIXTURES

2.4.1 All admixtures shall be approved by the Engineer.

2.4.2 An authorization to use an admixture from a different manufacturer not previously approved shall be obtained from the Engineer.

2.4.3 The admixtures shall conform to CSA A23.1/A23.2 and shall be used in accordance with their manufacturer's instructions. They shall not contain calcium chloride, either by addition or via formation as the result of chemical reaction between the concrete components.

2.4.4 The use of an admixture shall not reduce the durability of the concrete or its resistance to freezing and thawing. The Supplier shall show, through appropriate tests, that none of the admixtures, used individually or in combination, have an adverse effect on the concrete final properties.

2.4.5 Workability admixtures shall conform to ASTM C494/C494M, and ASTM C1017.

2.4.6 Initial set retarding or accelerating admixtures shall conform to ASTM C494/C494M.

2.4.7 Air entraining admixtures shall conform to ASTM C260.

2.4.8 A viscosity admixture may be required for some classes of concrete. If so, it shall be approved by the Engineer.

D1 2.4.9 Water reducing admixtures shall conform to ASTM C 494, Type A.

2.4.10 Super-plasticizers or high range water reducer admixtures shall not be used without prior approval by the Engineer. Slump of high-slump (flowable) concrete must not exceed 150 mm in order to prevent segregation. Approval for use of super-plasticizers or high range water reducer admixtures shall be limited to concrete having a specified slump of 50 – 100 mm.

2.4.11 Super-plasticizers shall conform to ASTM C 1017 and high range water reducer admixtures to ASTM C 494. Type F.

2.4.12 Super-plasticizers or high range water reducer admixtures shall not react adversely with the air entraining agent.

2.4.13 All other chemical admixtures are not authorized, unless approved by the Engineer for a specific use.

2.4.14 If admixtures are specified or if the Contractor proposes their use, the concrete mix shall be designed or redesigned incorporating the admixture, subject to prior approval from the Engineer. If requested, the Contractor shall supply additional test results indicating the effect the admixture has on such things as durability, workability, and segregation. These tests are in addition to those required by this Specification. D1

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2.5 SEALING COMPOUNDS

2.5.1 Surface sealers shall conform to CAN/CGSB-25.20 and shall not be manufactured or formulated with formaldehyde, mercury, lead, cadmium, hexavalent chromium or their compounds.

2.5.2 Sealing compound application shall be executed as per Manufacturer's instructions.

2.5.3 Acceptable sealers are as follows:

2.5.3.1 Kure-N-Seal 30 ES by BASF;

2.5.3.2 Floreseal WB 18 & 25 by SIKA;

2.5.3.3 Decra-Seal Plus by W.R. Meadows;

2.5.3.4 Or approved equal.

2.6 CURING COMPOUNDS

2.6.1 Curing compounds shall meet ASTM C309 requirements and shall be approved by the Engineer.

2.6.2 The use of curing compounds containing linseed oil is prohibited.

2.6.3 Curing compounds shall have low volatile organic compound emissions.

2.7 FLOOR HARDENERS

2.7.1 Concrete floor hardener shall be Sodium silicate or Magnesium fluosilicate type.

2.7.2 Acceptable floor hardeners are:

2.7.2.1 Sikafloor 3S by SIKA;

2.7.2.2 Or approved equal.

2.8 SUPPLEMENTARY CEMENTITIOUS MATERIALS

2.8.1 Supplementary cementitious materials, if permitted by the Engineer, shall conform to the following:

2.8.1.1 Fly ash shall conform to Type F as defined in CSA A3001-08 Cementitious Materials for use in Concrete. Fly ash content, if used, shall not exceed 25% by weight of the total cementitious material.

2.8.1.2 For each shipment of fly ash, obtain and retain a certified mill test report on chemical and physical properties confirming compliance with this Specification. Test reports shall be submitted for the Engineer's review upon request.

2.8.1.3 Silica fume content, if used, shall not exceed 10% by weight of the total cementitious material.

D1 2.8.1.4 All approved supplementary cementitious materials shall comply with A3001-08. Cementitious Materials for use in Concrete.

PART 3 EXECUTION

3.1 CONCRETE MIXES

3.1.1 Submittals

3.1.1.1 The Contractor shall submit to the Engineer, for approval, tests reports certifying that the materials listed below meet the specified requirements:

3.1.1.1.1 portland cement;

3.1.1.1.2 slag;

3.1.1.1.3 admixtures;

3.1.1.1.4 aggregates;

D1 3.1.1.1.5 mixing water;

D1 3.1.1.1.6 supplementary cementitious materials.

3.1.1.2 The Contractor shall submit to the Engineer, for approval, a report to the effect that the mixing equipment, and other equipment and materials to be used in preparing the concrete, meet the requirements of CSA A23.1/A23.2.

3.1.2 Mix Design

D1 3.1.2.1 The Contractor shall submit to the Engineer, for approval, a report concerning the concrete mix formulas and the results of the Compliance Tests as per Section 3.1.9 of this Specification. The report shall include the following information:

3.1.2.1.1 water-cement ratio;

3.1.2.1.2 mix proportions with admixtures used;

3.1.2.1.3 order of mix ingredient incorporation (if important);

3.1.2.1.4 estimated average strength;

3.1.2.1.5 hardened concrete air void characteristics per CSA A23.1/A23.2.

3.1.2.2 The applicable acceptance criteria shall be those given in CSA A23.1/A23.2.

3.1.3 Mix Classes

3.1.3.1 Mixes shall conform to the classes given in the tables of Appendix A.

3.1.3.2 Each class is proportioned to produce the required concrete strength, plasticity and workability for the purposes for which it will be used.

3.1.3.3 Mixes shall meet the required standards throughout the course of the concreting work.

D1 3.1.3.4 New mix formula shall be submitted to the Engineer for approval, including the information requested in Compliance Tests as per Article 3.1.9 of this Section, at least three weeks prior to the start of its use.

3.1.4 Specified Strength

3.1.4.1 The strength of concrete is specified by a Class letter, as indicated in Appendix A.

D1 3.1.4.2 The compressive strength corresponds to the strength at 28 days of normal curing for cement type GU and at 91 days for cement type LH-M.

3.1.5 Maximum Nominal Aggregate Size

3.1.5.1 The maximum nominal aggregate size is specified by sub-classes, as indicated in Appendix A.

3.1.6 Slump

3.1.6.1 The necessary slump is specified by sub-classes, as indicated in Appendix A.

3.1.7 Air-Entraining Admixture

3.1.7.1 Unless otherwise stipulated by the Engineer, all mixes shall contain entrained air, as indicated in Appendix A.

3.1.7.2 The entrained air specified in Appendix A is a function of the maximum aggregate size and is for a severe exposure to freeze-thaw cycles.

3.1.8 Equipment

3.1.8.1 The mixing equipment and other equipment and material to be used in preparing the concrete shall meet the requirements of CAN/CSA A23.1.

3.1.8.2 The equipment and mixing method shall provide accurate control of the ratios of cement, aggregate and water incorporated into each mix to produce mixes that are uniform and consistent over time.

D1 3.1.9 Compliance Tests

D1 3.1.9.1 Compliance tests shall be performed in order to verify that the concrete produced at the plant complies with the required properties given in the tables of Appendix A.

3.1.9.2 The tests pertain to the cement powder, mix formula and the mixing method and equipment. A new series of tests shall be carried out if any change is made to these parameters.

3.1.9.3 The tests shall be conducted using the mixing equipment to be employed on site.

D1 3.1.9.4 The tests shall be performed prior to start of concreting operation.

3.1.9.5 Mix compliance with specification requirements shall be demonstrated through one test on each of the A2, B2 and B3 class concrete.

3.1.9.6 A test shall consist of at least 2 m3 of concrete mix.

3.1.9.7 Hardened concrete air voids shall be verified on a concrete sample of each test taken no sooner than 15 minutes after the super-plasticizer is added. The sample shall be taken after handling is completed with the mixing and placement method to be used in the planned concreting.

D1 3.1.9.8 For cement type LH-M, compressive strength shall be obtained for each test as follows: two cylinders at 3 days, two at 7 days, two at 28 days and two at 91 days.

3.1.9.9 For cement type GU, compressive strength shall be obtained for each test as follows: two cylinders at 3 days, two at 7 days and two at 28 days.

3.1.10 Mixes for Pre-Defined Usages

3.1.10.1 Bond Mix

3.1.10.1.1 Bond mix to be used as a start layer on rock or concrete shall be of Class « X-3 » for a mix of Class X, where « X » represents the specified mix class A, B, BC, C, or D.

3.1.10.2 Fill Concrete Mix

3.1.10.2.1 Fill concrete shall be of the same Class as the structural concrete with which it is in contact, unless noted otherwise by the Engineer.

3.1.10.3 Mud Slab Mix

3.1.10.3.1 Mud slab mix shall be of the same Class as the structural concrete with which it is in contact, unless noted otherwise by the Engineer.

3.1.10.4 Lean Concrete Mix

3.1.10.4.1 Lean concrete shall be of Class D, unless noted otherwise by the Engineer.

3.1.10.5 CLSM Mix

3.1.10.5.1 Controlled low strength material (CLSM) mix shall be of Class X-2, unless noted otherwise on the drawings.

D1 3.1.10.6 Concrete class mixed for pre-defined usages shall be supplied and placed as shown on the drawings.

3.2 PRODUCTION AND DELIVERY

3.2.1 General

3.2.1.1 Unless otherwise indicated herein, concrete shall be prepared and delivered in compliance with the requirements of CSA A23.1/A23.2.

3.2.2 Production

3.2.2.1 Mixing of Concrete

D1 3.2.2.1.1 Concrete shall be mixed and placed in accordance with ASTM C94 and CSA A23.1 requirements.

3.2.2.1.2 The concrete shall be mixed using a stationary mixer.

3.2.2.1.3 Partial pre-mixes and truck mixes are not accepted.

3.2.2.2 Mixing Time

3.2.2.2.1 Mixing time shall conform to Section 5.2.3 of CAN/CSA A23.1. Any batch that has lost part of its plasticity due to over mixing shall be rejected.

3.2.2.3 Concrete Temperature

D1 3.2.2.3.1 The temperature of the concrete at the time of placement shall be within the limits specified in Table 5 below.

D1 3.2.2.3.2 The Maximum differential temperature within any part of the concrete during hydration shall be 20ºC or less.

D1 3.2.2.3.3 The maximum temperature within any part of the concrete during hydration shall be 65ºC or less.

D1 **Table 5 – Concrete Temperature at Time of Placement**

Smallest Element Dimension	Min. Temp. in °C[1] [2]	Max. Temp. in °C[1]
Less than 0.3 m	10	32
From 0.3 to 1.0 m	5	28
From 1.0 to 2.0 m	5	20
More than 2.0 m	3	12[3]
More than 2.0 m and indicated on drawings	3	7[3]

Notes: [1] The temperatures given are the average of a pour.

[2] The minimum temperature shall be aimed at.

[3] May be exceeded when 100% of the water has been replaced by ice.

3.2.2.4 Cold Weather Concreting

3.2.2.4.1 It may be necessary to prepare concrete at a temperature slightly higher than the minimum limit specified in Table 5 to compensate for the temperature drop due to cooling of the concrete during transport.

3.2.2.4.2 In cold weather, the water may have to be heated. The water temperature shall not exceed 80°C.

3.2.2.4.3 The drum or bin of the trucks transporting the concrete shall be sufficiently insulated to minimize concrete temperature drop. Any concrete with a truck outlet temperature that is less than the lower limit specified in Table 5 shall be rejected.

3.2.2.5 Hot Weather Concreting

3.2.2.5.1 Unless otherwise indicated herein, concrete shall be prepared and transported in compliance with CSA A23.1.

3.2.2.5.2 Special attention shall be paid to ensure that the temperature of any concrete mixed in hot weather is kept as low as possible.

3.2.2.5.3 In hot weather, it may be necessary to prepare concrete at a temperature that is lower than the minimum limit specified to compensate for the rise in temperature due to heating of the concrete during transport.

3.2.3 Delivery

3.2.3.1 General

3.2.3.1.1 All concrete shall be delivered by a mixer truck or an agitator truck.

3.2.3.1.2 The delivery point for the freshly mixed concrete shall be as specified by the Contractor or as indicated on the drawings.

3.2.3.1.3 Any concrete found to be deficient upon delivery to the site shall be rejected.

3.2.3.1.4 Concrete shall be placed as soon as possible after mixing. The maximum time between initial mixing and placement shall be 120 minutes. Any concrete that has not been placed within this time frame or that has begun to set shall be rejected, unless set retardant admixtures are used in agreement with the Engineer.

3.2.3.2 Slump Adjustment

3.2.3.2.1 Refer to Section 3.3.2 of this Section for slump control.

D1 3.2.3.2.2 If the slump is less than the specified slump at the start of unloading, and no more than 60 minutes have elapsed between dosing and unloading, the slump may be adjusted as per the recommendation of CAN/CSA A23.1 and following the approval of the Engineer.

3.2.3.2.3 No slump adjustment is permitted when concrete is delivered by an agitator truck.

D1 3.2.3.2.4 Adding water or super-plasticizer to adjust the concrete characteristics is permitted as per the recommendation s of CAN/CSA A23.1 and following the approval of the Engineer.

3.2.3.2.5 The amount of water or super-plasticizer added shall be approved and carried out under the supervision of the Contractor or a designated Field Engineer. It shall be recorded.

3.2.3.2.6 After slump adjustment, the measured slump shall conform to the specified slump.

3.2.3.3 Air Adjustment

3.2.3.3.1 Refer to Section 3.3.3 of this Specification for air content control.

3.2.3.3.2 Concrete shall be rejected if the measured entrained air does not conform to the specified limits.

3.2.3.3.3 Adjustment of the entrained air is permitted only if the measured entrained air is less than the percentage specified.

3.2.3.3.4 After air content adjustment, the measured air content shall conform to the specified air content.

3.2.3.4 Delivery Receipt

3.2.3.4.1 A delivery receipt containing the following information shall be provided for each truck.

3.2.3.4.1.1 Concrete supplier's company name and concrete plant identification.

3.2.3.4.1.2 Date and the ID number of the delivery receipt.

3.2.3.4.1.3 Name of the ready mix truck operator.

3.2.3.4.1.4 Designation of the structure or part thereof.

3.2.3.4.1.5 Class of concrete and other relevant information (batch number, slump limits, air content, temperature, maximum nominal coarse aggregate size, admixtures).

3.2.3.4.1.6 Volume of concrete in cubic meters.

3.2.3.4.1.7 Truck number, cumulative volume for the on-going pour, the haul number, or all three.

3.2.3.4.1.8 Loading or start of constituent mixing time.

3.2.3.4.1.9 Time of arrival on site.

3.2.3.4.1.10 Time unloading begins.

3.2.3.4.1.11 Time unloading is complete.

D1 3.2.3.4.1.12 The amount of super-plasticizer added after dosing and the signature of the Contractor's representative or Engineer's representative, who authorized the addition.

3.3 CONCRETE QUALITY CONTROL

D1 3.3.1 Inspection and Testing

D1 3.3.1.1 Concrete shall be inspected and tested by an independent laboratory appointed and paid by the Engineer.

3.3.1.2 Tests shall be carried out in compliance with CSA A23.1/A23.2.

3.3.1.3 Testing frequency shall be as indicated in Table 6.

3.3.2 Slump

3.3.2.1 Concrete slump shall not exceed the allowable limits indicated in Appendix A.

3.3.2.2 When the measured concrete slump is lower than the inferior limit specified, concrete is considered acceptable if the placement and consolidation methods are promptly adapted.

3.3.2.3 For each pour, the slump shall be verified for the first two loads. If the slump conforms to the specified percentage for both loads, the verification may subsequently be spaced every three loads, or every five loads if the pour rate exceeds 75 m3/h.

3.3.2.4 If a load is later found non-conforming, the next one shall also be verified, and so on until two consecutive loads are conforming. Only then may the slump verification frequency be reduced again.

3.3.2.5 The above verification frequency shall be increased in case of lack of concrete uniformity or of doubt.

3.3.2.6 Slump verification shall also be made each time a concrete cylinder is taken for a strength test.

3.3.3 Air Content

3.3.3.1 Air shall be entrained using an agent that produces a satisfactory network of air bubbles in the hardened concrete.

3.3.3.2 Total air content at the time of concrete placement shall meet the requirements of Appendix A.

3.3.3.3 Concrete air content shall be determined using the CAN/CSA A23.2-4C standard method.

3.3.3.4 Entrained air concrete shall also meet the requirements of ASTM C457.

3.3.3.5 For each pour, the entrained air shall be verified for the first two loads. If the air content conforms to the specified percentage for both loads, the verification may subsequently be spaced every three loads, or every five loads if the pour rate exceeds 75 m3/h.

3.3.3.6 If a load is later found non-conforming, the next one shall also be verified, and so on until two consecutive loads are conforming. Only then may the air verification frequency be reduced again.

3.3.3.7 The above verification frequency shall be increased in case of lack of concrete uniformity or of doubt.

3.3.3.8 Entrained air verification shall also be made each time a concrete cylinder is taken for a strength test.

3.3.4 Temperature

3.3.4.1 Temperature shall be verified each time slump or air or both is checked and also when concrete cylinder is taken for a strength test.

3.3.4.2 Temperature measurement can be checked as often as required to insure compliance to standards.

3.3.5 Strength

D1 3.3.5.1 For cement type LH-M, two cylinders shall be taken for the 3-day tests, two for the 7-day tests, two for the 28-day tests and two for the 91-day tests.

3.3.5.2 For cement type GU, two cylinders shall be taken for the 3-day tests, two for the 7-day tests and two for the 28-day tests.

3.3.5.3 For control purposes, strength tests shall be carried out on test cylinders prepared in compliance with CSA A23.1/A23.2-3C and verified in compliance with CSA A23.1/A23.2-9C.

3.3.5.4 Concrete will be accepted if it meets the CSA A23.1/A23.2 Section 4.4.6.6.1 requirements.

3.3.6 Other Tests

3.3.6.1 Tests on cement, admixtures and curing products shall be carried out in compliance with standardized CSA or ASTM practices, or those of other recognized concrete associations, and at the frequency established by the Contractor.

3.3.6.2 The compressive strength of in-place concrete, when it is required, shall be verified in compliance with CSA A23.1/A23.2, Section 4.4.6.2. The testing method shall be approved by the Engineer.

3.3.7 Acceptable non-conformity

3.3.7.1 A load with either non-conforming slump, air content or temperature, may be considered “acceptable” if the following conditions are met.

3.3.7.1.1 Only one of these three conditions exists:

3.3.7.1.1.1 measured concrete slump is not more than 10 mm above the upper limit specified; air content and temperature characteristics are conforming;

3.3.7.1.1.2 measured entrained air is no more than 0.2% outside the specified limits; slump and temperature characteristics are conforming;

3.3.7.1.1.3 measured temperature does not exceed the maximum specified by more than 5 ºC; slump and air content characteristics are conforming; average temperature of the pour conforms to the requirements.

3.3.7.1.2 Total volume of “acceptable” concrete does not exceed 10% of the total pour volume. However, when the pour volume is less than 80 m3, total volume of “acceptable” concrete shall not exceed 8 m3 or a single load.

D1 3.3.7.2 A non-conforming but “acceptable” load may be poured. It shall be registered as “acceptable”.

D1 3.3.7.3 A non-conforming and “not acceptable” load shall not be used. A non-conformance report shall be issued to the Contractor.

D1 3.3.7.4 In both cases, the next load shall be verified until two consecutive loads are conforming.

Table 6 – Cast-in-Place Concrete Testing Frequency

Test	Frequency	Location and Need
Slump	Continuously; at each compressive strength test	At the delivery point
Entrained air at the concrete plastic state	Continuously; at each compressive strength test	At the delivery point
Entrained air at the concrete hardened state	2 per year for concrete classes A-2, B-2 and B3, and the most frequently used classes subjected to weather (freeze-thaw cycles).	Sample taken at the delivery point
Temperature	Continuously; at each compressive strength test.	At the delivery point
Compressive strength of 150 x 300 mm cylinders	Minimum one set of samples per shift, per 100 m^3, per day, per element type and per concrete class.	Samples taken at the delivery point. Others, according to structural needs, site needs, etc.
Density of fresh concrete (unit weight)	Each time a sample is taken for a compressive strength test.	At the delivery point

3.4 VERIFICATION PRIOR TO CONCRETING

D1 3.4.1 Concreting Placement Authorization Request

D1 3.4.1.1 The Concreting Placement Authorization Request, duly completed, shall be submitted to the Engineer, at least 24 hours prior to each placement, giving all relevant information concerning the placement.

D1 3.4.1.2 Before submitting the Authorization Request, the Contractor shall make the necessary verifications comprising the following items:

3.4.1.2.1 Characteristics of the concrete to be used.

3.4.1.2.2 Reference to any change notice, or change to drawings.

3.4.1.2.3 Concreting program, placement equipment (quantity and description) and hourly concreting rate.

3.4.1.2.4 Temperature allowed at the point of discharge of plastic concrete.

3.4.1.2.5 Presence on site of the equipment and material needed to place, consolidate, finish, cure and protect the concrete.

3.4.1.2.6 Condition and cleanliness of formwork, rebar, embedded parts and concrete and rock surfaces.

3.4.1.2.7 Waterstops condition: Refer to the “Quality Control” Section of the Waterstops specification.

3.4.1.2.8 Ambient air temperature in the formwork and temperature of the rock or concrete that will come in contact with the fresh concrete.

3.4.1.2.9 Installation compliance with formwork drawings, including shoring and scaffolding installed, with evidence that they were approved by an Engineer in accordance with relevant codes and standards.

3.4.1.2.10 Installation compliance with reinforcing steel drawings and embedded part drawings.

3.4.1.2.11 Condition of the soil under all foundations to ensure that the latter are resting on soil with satisfactory bearing capacity.

D2 3.4.1.2.12 Condition of the concrete against which the fresh concrete will be placed to ensure that all surfaces have been scarified in compliance with clause 3.8 Surface Finishes below.

3.4.1.2.13 Survey checks have been done prior to placement.

3.4.1.2.14 Weather protection, if required, is in place.

D1 3.4.1.3 The Engineer shall approve and return the duly signed Concrete Placement Authorization Request to the Contractor, if everything conforms to the drawings and the specifications. Otherwise, the Engineer shall indicate on the unapproved Authorization Request the corrective measures that must be taken, and the Engineer shall verify them before authorizing concreting.

3.4.2 Formwork

D1 3.4.2.1 Formwork shall conform to Specification Section: 03 11 00 Concrete Formwork.

D1 3.4.2.2 to 3.4.2.6 Not used.

3.4.3 Surface Preparation Prior to Concreting

3.4.3.1 The rock against which the fresh concrete will be placed shall be properly scaled and cleaned, and water seepage sources shall be adequately channelled.

3.4.3.2 The wire mesh screen shall not be embedded in the concrete. It shall be removed and scrapped as the concrete lifts progress. Removal shall be carried out without damaging the rock consolidation bolts.

3.4.3.3 After removing the wire mesh screen, the surface shall be scaled to remove any loose materials from the vaults and walls. Scaling shall be done manually, with a bar, by experienced personnel. All the material resulting from scaling shall be removed.

D1 3.4.3.4 Concrete surfaces (horizontal, vertical, inclined) against which concrete is to be placed shall have a surface finish as described in Clause 3.8 of this Specification.

3.4.3.5 Before placing concrete on rock, soil or hardened concrete, the surface shall be carefully cleaned to remove all loose materials and foreign bodies, as well as any standing water. If the concrete is to be placed on soil, the surface shall be compacted to the density specified on drawings.

3.4.3.6 The Contractor shall verify that the method of placing concrete on rock, or hardened concrete on a slope, has been reviewed.

3.4.3.7 Placing concrete on a frozen surface is strictly prohibited.

3.4.4 Reinforcement and Embedded Items

3.4.4.1 Concrete reinforcement and embedded or buried items shall be clean and free of dried concrete, oil and rust, and shall conform to the Specification Section: 03 20 00 and Section: 05 50 10 respectively.

3.4.4.2 The spacing shown on the drawings between the reinforcement and formwork or outer surfaces shall be strictly respected. Reinforcement and embedded or buried items shall be solidly supported to prevent them from moving during concreting.

D1 3.4.4.3 Embedded parts and assemblies shall be placed securely and with care by the Contractor so that their positions are according to the drawings and meet the tolerances, where applicable.

D1 3.4.4.4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from the Engineer before placing concrete.

3.5 CONCRETE HANDLING

3.5.1 General

3.5.1.1 Concrete shall be handled in a way that the properties of the fresh concrete delivered will not be altered at the time it is placed.

D1 3.5.1.2 For pumping and conveying, a compliance test shall verify that the properties of the concrete at the point of discharge meet the requirements of Appendix A. These compliance tests shall be performed a minimum of 12 weeks prior to the scheduled concreting date and whenever a new concreting setup/mix equipment is proposed, so that adjustments, if necessary, can be made prior to final date of pour.

3.5.2 Equipment

3.5.2.1 Handling equipment shall have the capacity and shape required to ensure a constant rate of concrete supply at its delivery point.

3.5.2.2 None of the handling equipment shall be supported on the formwork, unless the formwork design has taken such support into consideration.

3.5.2.3 None of the handling equipment shall be supported on the reinforcement or embedded parts.

3.5.2.4 All equipment shall have adequate capacity to prevent cold joints. Handling equipment shall be used in a way that will meet all the requirements of CAN/CSA A23.1 Section 7 and in compliance with the following sections.

3.5.3 Concrete Trucks

D1 3.5.3.1 Concrete trucks shall have chutes that are wide enough to allow concrete to be unloaded without clogging.

3.5.4 Chutes and Drops

D1 3.5.4.1 When the concrete drop is significant (lift > 1.5 m), provide chutes or hoses to conduct the concrete to the base of the formwork, thereby preventing it from segregating or “cascading” through the reinforcement.

3.5.4.2 Chutes shall be round and covered inside with a metal sheet. At the time of use, the slope shall be such that the concrete slides at low speed, without rolling, to prevent segregation.

3.5.4.3 Chutes or plastic or steel hoses shall have a diameter of at least 150 mm and shall be fitted with a collector funnel. The maximum allowable chute length is 9.0 m. When this length is exceeded, the concrete shall be received in another hopper.

3.5.5 Belt Conveyors

3.5.5.1 Belt conveyors shall be wide enough to prevent overflow and their slope shall be kept low enough to prevent the concrete from slipping on the belt surface.

3.5.5.2 The first conveyor shall have a loading hopper to prevent segregation and overflow. Conveyors shall be fitted with a scraper at the discharge point to prevent the loss of mortar. All conveyors, including the last one at the point of concrete discharge into the formwork, shall also have a small hopper at the discharge point. The hopper on the final conveyor shall be extended by a vertical hose long enough so that the concrete arrives vertically in the formwork with no segregation.

D1

3.5.5.3 Complex conveyor systems will only be authorized if the properties of the concrete at the outlet of the system conform to the requirements of Clause 3.5.1 of this Section.

3.5.6 Hoppers

3.5.6.1 Hoppers shall have diameters large enough to allow concrete to flow without using a vibrator.

3.5.6.2 Hoppers for concrete classes with aggregates of nominal size less than or equal to 80 mm shall be metal and shall have a nominal diameter of 300 mm.

3.5.6.3 If the total drop height inside the supply line is greater than 9.0 m, the concrete shall be received in another hopper with a capacity of 0.75 m3 more than the volume of the supply line.

3.5.7 Concrete Pumps

3.5.7.1 Unless otherwise indicated on the drawings, concrete pumps may be used.

3.5.7.2 All types of pumps shall pump the specified concrete at acceptable rates, through the lines of required length, without significantly altering the mix dose.

3.5.7.3 The use of aluminum alloy hoses in the concrete transport system is prohibited as they chemically react with cement.

3.5.7.4 The pump line primer grout shall be of the same Class as the specified concrete Class (e.g. B-5 for Class B concrete).

3.5.7.5 The primer grout may be used if it represents a small percentage of the concrete to be poured and if no doubt exists concerning its quality. The specified concrete shall be vibrated to mix with the primer grout.

3.6 CONCRETE PLACEMENT

3.6.1 Preparation

D1 3.6.1.1 In addition to the items listed in Clause 3.4, “Verification Prior to Concreting”, the following conditions shall also apply:

3.6.1.2 Surfaces shall be kept moistened for a minimum duration of three hours before concreting and shall be kept clean and free from dirt. This mainly applies to hardened concrete surfaces, rock and soil against which the concrete is to be placed.

3.6.1.3 Surfaces of niches and openings to be filled with concrete shall be cleaned out and washed before placing the secondary concrete.

3.6.1.4 Bonding agents shall only be used at the request of the Engineer.

3.6.2 Concreting

3.6.2.1 Concrete shall be placed as close as possible to its final position, in a way that will prevent any segregation or alteration of delivered concrete properties.

3.6.2.2 As a guiding rule, concrete should be placed at the lowest point first.

D1 3.6.2.3 When concrete is placed in a deep beam, a wall or a column, at the same time as the slab above, the vertical section, if deeper than 1.5 m shall be poured first and a delay between one and three hours shall be left for the concrete to settle before pouring the slab above. After this delay, the concrete must still be plastic enough to allow a complete mix with the slab concrete through re-vibration.

D1 3.6.2.4 Concreting on rock or on set concrete shall start with the use of a 150 mm layer of bond mix, as defined in Clause 3.1.10. Under the supervision of the Engineer, this first layer to be placed on the cleaned surface shall be of the concrete Class mix specified in Clause 3.1.10 and it shall be well-vibrated to achieve maximum bond.

3.6.2.5 Concreting shall continue in a non-stop manner and each layer shall be covered by concrete in a plastic state before its initial set commences.

3.6.2.6 Competent manpower shall be available on site during concreting to move and reinstall the bars, and make adjustments as needed.

3.6.2.7 Competent manpower shall be available during concreting to check formwork and make adjustments as needed.

3.7 CONCRETE CONSOLIDATION

3.7.1 Equipment

D1 3.7.1.1 Vibrator diameters and vibration frequency shall conform to Table 19 of CSA A23.1.

D1 3.7.1.2 There shall be a few vibrators on the concreting site in addition to the number needed t do the work. Vibrators shall be in good operating condition.

3.7.1.3 Vibration frequency of each vibrator shall be verified at the beginning of the work and at least once a year.

3.7.2 Vibration

3.7.2.1 Concrete shall be consolidated in compliance with CSA A23.1/A23.2, Clause 7.2.5.2.

3.7.2.2 At least two vibrators shall be used for walls and beams – one to level the concrete immediately after it is placed and the other to consolidate it.

3.7.2.3 The distance between vibration points in general shall be approximately one to one-and-a-half times the observed radius of action.

3.7.2.4 The vibrator shall penetrate at least 150 mm into the previous layer. It shall then be slowly withdrawn at a speed of less than 100 mm per second.

3.7.2.5 The vibrator shall not be used to move the concrete laterally.

D1 3.7.2.6 The vibrator shall not come in contact with reinforcing steel or embedded items in the concrete.

3.8 SURFACE FINISHES

D1 3.8.1 Concrete

3.8.1.1 Increasing surface concrete plasticity to facilitate finishing is prohibited. Rather, a lower slump class (e.g. B-3-A instead of B-3) shall be used to prevent bleeding and excess laitance.

3.8.1.2 Dusting freshly placed concrete surfaces with cement or a mixture of sand and cement before or during the finishing operations is prohibited.

3.8.2 Levelling

3.8.2.1 Regardless of the nature of the pour, the surface shall be compacted and levelled with a wooden or magnesium trowel to incorporate all the aggregate into the mass of concrete and remove any surface irregularities. After this initial levelling, the surface shall not be touched again before bleeding is complete.

3.8.3 Un-Formed Surface Classification

3.8.3.1 The finishes for un-formed surfaces are classified in accordance with the quality of the concrete surface required and the tolerances as specified in Clause 3.15 Construction Tolerances. The various classes shall confirm to the drawings, specifications and stipulations set forth below.

3.8.3.1.1 U1 (screeding, bull floating/darbying): refer also to CSA A23.1 Clause 7.5.3.

3.8.3.1.1.1 Obtained by levelling: serves as the first phase for U2 and U3 finishes or for concrete surfaces that will never be exposed. The concrete surface shall be levelled to remove all defects exceeding the specified tolerances.

3.8.3.1.2 U2 finish (Edging/grooving, floating): refer also to CSA A23.1 Clause 7.5.4.2.

3.8.3.1.2.1 Used to finish exposed surfaces or as a second phase for a U3 finish. After edging and grooving, the concrete surface shall be smoothed using a wooden or steel float, or a mechanical float, to provide a uniform surface meeting the specified tolerances. Floating shall not be excessive.

3.8.3.1.3 U3 finish (trowelling): refer also to CSA A23.1 Clause 7.5.4.3.

3.8.3.1.3.1 Used for concrete surfaces where a smooth and hard finish is required. The concrete surface shall be smoothed using a wooden or steel trowel, or a mechanical trowel, to provide a uniform surface meeting the specified tolerances. The first trowelling may produce the required uniform surface. In the case where the first trowelling is mechanical, at least another one shall be executed manually to eliminate the small defects. When the concrete surface is exposed to water current, the last trowelling shall be made with a wood trowel. A time interval shall separate each trowelling in order for the concrete to harden. As the surface hardens, the trowel size shall diminish while increasing progressively (applicable also to mechanical trowel) the tool angle and the pressure applied on it.

3.8.4 Scarification

3.8.4.1 Unless otherwise indicated no the drawings, all surfaces that are to be covered with concrete, formed or otherwise vertical, horizontal or sloped, shall be scarified after the concrete has set or after the forms are removed, using a jet of pressurized water, pressurized abrasive, water and air, or any other means approved by the Engineer, to remove laitance, expose coarse aggregate and obtain a roughness of at least 5 mm.

3.8.4.2 Non-formed surfaces to be scarified shall be wet with a surface retarder immediately after concreting in order to facilitate the scarification operation. The required time between concreting and scarification, as well as the jet pressure, shall be determined through tests and approved by the Engineer.

3.8.4.3 Formed surfaces to be scarified may be wetted with a surface retarder prior to concreting in order to facilitate the scarification operation. The surfaces shall have their forms stripped

after the required time between concreting and form removal. Scarification shall be carried out immediately after the forms are removed. The jet pressure shall be adjusted based on the concrete age hardness. For hardened concrete that has developed most of its strength, and depending on the type of nozzle used, this pressure could be as high as 70 MPa. The pressure to be used, based on the time after concreting, shall be determined through tests and shall be approved by the Engineer.

3.8.4.4 Application of surface retarder shall not be done close to embedded parts and reinforcing steel.

3.8.4.5 All dislodged aggregates shall be removed.

3.8.4.6 All surfaces to be scarified shall be inspected and approved by the Engineer after scarification is completed.

3.8.5 Floor Topping

3.8.5.1 Bonded or monolithic type topping shall be executed as per the requirements of CSA A23.1 Clause 7.6 but the mix formula, slump, and water/cement ratio shall conform to the requirements of Specification Section: 03 30 00: Cast-in-Place Concrete.

3.8.5.2 Bonded toppings shall be at least 75 mm thick.

3.8.5.3 Monolithic toppings shall be 50 m thick minimum and 150 mm maximum.

3.8.5.4 In the case of bonded toppings, any support surface contamination shall be removed, preferably immediately before the topping is placed, by scarification as per this Specification or by percussion drill, in accordance with the Engineer's instructions.

3.8.5.5 Concrete topping for trowel-finished interior concrete floors should not include an air-entraining admixture; the maximum air content for these concretes should normally be 3%. Higher air contents make the surface difficult to finish, and can lead to surface blistering and peeling during finishing.

3.8.6 Floor Hardener

3.8.6.1 Floor hardener application shall be executed, where indicated on the drawings, as per Manufacturer's instructions.

3.8.6.2 In the case of a non-metallic hardener, it may be required to reduce or remove air entrainment in the concrete.

3.8.6.3 Concrete floor hardener shall not be used where concrete is exposed to freeze-thaw cycles and/or to de-icing salt.

3.9 CONCRETE CURING AND PROTECTION

3.9.1 General

3.9.1.1 Curing shall confirm to CSA A23.1 Clause 7.4

3.9.1.2 Concrete shall be protected against premature dry-out, excessive heat or cold, and damage, immediately after it is placed, and shall be kept at a relatively constant temperature with minimal moisture loss during the time needed for the cement to hydrate.

3.9.1.3 Horizontal concrete surfaces and any vertical surface to which fresh concrete must bind shall be water-cured.

3.9.1.4 Vertical concrete surfaces to which fresh concrete must not bind may be cured with a curing compound.

3.9.1.5 Specific curing restrictions, if required, are shown on the drawings.

3.9.2 Curing Period

3.9.2.1 Curing period shall be seven (7) consecutive days for GU cement concrete and ten (10) consecutive days for LH-M cement concrete.

3.9.3 Water Curing

3.9.3.1 Curing water temperature shall not be below 10ºC.

3.9.3.2 The surface shall not be allowed to dry out during this time. Special care shall be taken in heated shelters.

3.9.4 Curing Compounds

3.9.4.1 All materials shall be approved prior to installation

3.9.4.2 In areas that are sheltered from inclement weather, resin and wax based products shall be used.

3.9.4.3 In areas exposed to inclement weather, chlorinated rubber-based products shall be used.

3.9.4.4 The product shall be applied immediately after the surface is finished or the formwork is removed, as the case may be.

3.9.5 Protection for Concrete in Place

3.9.5.1 Protect exposed members from staining due to rusting of reinforcement projecting beyond construction joints.

3.9.5.2 Take suitable measures to prevent spalling and cracking damage occurring to the structure due to water freezing in expansion joints, small holes, slots and depressions.

3.9.5.3 Keep area of completed concrete free from ice, water or snow throughout the duration of the Project.

3.9.5.4 Take measures as necessary to ensure that concrete temperatures and concrete temperature differential requirements are met.

3.9.5.5 Protect freshly placed concrete surfaces from wind and direct heat to minimize the possibility of plastic shrinkage cracking.

3.9.6 HOT AND COLD WEATHER PROTECTION

3.9.6.1 General

3.9.6.1.1 All freshly placed concrete shall be protected against dry-out, rain, cold or heat, in compliance with CSA A23.1 Clause 7.4.

3.9.6.2 Temperature Verification

3.9.6.2.1 Concrete Temperature shall be determined using thermocouples installed near the surface, at 50 mm from it, and also in the middle inside for mass concrete. Thermocouple and other data acquisition wires shall be inserted in conduits and end in a surface data acquisition box.

3.9.6.2.2 When formwork has been removed, concrete surface temperature may be determined using a surface thermometer or an infrared one.

3.9.6.2.3 Other temperature verification means may be employed, subjected to the Engineer's approval.

3.9.6.2.4 The Contractor shall submit to the Engineer, for approval, a follow-up plan per element type, per structure part and per structure type in order to determine and record the ambient and concrete temperature of thin and massive (surface and internal) elements so as to ensure conformance with this Specification. On a daily basis, temperature data shall be collected, graphed and submitted to the Engineer by the Contractor.

3.9.6.3 Cold Weather Protection

3.9.6.3.1 Duration of Protection

3.9.6.3.2 In cold weather (ambient temperature at or below 5ºC), measures shall be taken to maintain the concrete surface temperature above 5ºC for the duration of the curing period.

3.9.6.3.3 Mass concrete elements shall be protected to limit the internal and external concrete temperature differential to within 20ºC in order to minimize cracking.

3.9.6.3.4 Concrete and ambient temperatures shall be monitored and recorded to determine if the maximum 20ºC temperature differential is being met and to verify the compliance with the requirements of Table 21 of CSA A23.1-09.

3.9.6.3.5 A table and graph showing the temperature differential between the ambient and surface temperature of the concrete shall be prepared for each pour as well as the temperature differential between the core and the surface of concrete. Results shall be made available to the Engineer for review and approval.

3.9.6.3.6 Concrete shall be protected so that its temperature shall never fall below the freezing point before it has reached 10 MPa strength.

3.9.6.4 Frozen Surfaces

3.9.6.4.1 Frozen surfaces shall be thawed out. The use of calcium chloride to thaw the bottom of formwork is prohibited.

3.9.6.4.2 Concrete shall not be placed on or against any surface with a temperature below 5ºC or any surface that could lower the concrete temperature below the minimum limits specified in Clause 3.2 of this Specification.

3.9.6.5 Equipment

3.9.6.5.1 Heating equipment

3.9.6.5.1.1 Provide an adequate number of heaters (boilers, smudge-pots etc) of sufficient capacity to heat the shelter so as to maintain the concrete at the required temperature.

3.9.6.5.1.2 If equipment that emits carbon dioxide is used, the gas shall be exhausted outside the shelter; in no case shall carbon dioxide come in contact with the concrete.

3.9.6.5.2 Ad-hoc Shelters

3.9.6.5.2.1 Shelters of this type consist of canvas or tarpaulin covers on the surfaces of the structure. Such covers shall be fastened in place so that they will not be disturbed during the protection period.

3.9.6.5.2.2 Framed shelters shall be high enough and wide enough to allow concrete to be placed, consolidated and surface-finished inside the shelter. Vertical clearance above the finished surface shall be at least 2.0 m.

3.9.6.5.3 Insulating Materials

3.9.6.5.3.1 Insulating materials shall maintain their insulating properties when wet.

3.9.6.5.3.2 For equivalence purposed, 25 mm of insulation is the insulation produced by a 25 mm thickness of material with a thermal strength of at least 0.60 m² ºC/W.

3.9.6.5.4 Types of Protection for Concrete in Place

3.9.6.5.4.1 Type I

3.9.6.5.4.1.1 All concrete surfaces exposed to air shall completely and effectively cover with 25 mm of insulation material. This type of protection may be used when there is only overnight freezing.

3.9.6.5.4.2 Type II

3.9.6.5.4.2.1 An ad-hoc shelter covering the entire structure and circulate warm air in the shelter and over the concrete, shall be prepared. This type of protection may be used when the outside temperature stays below the freezing point, but is not likely to drop below -12ºC during the protection period.

3.9.6.5.4.3 Type III

3.9.6.5.4.3.1 All formwork and all surfaces exposed to air shall be covered with an effective insulating material so that the concrete retains its heat throughout the protection period. The insulating material shall be placed directly on the formwork and joints shall be effectively sealed. The insulation values shall be 75 mm. The inside surfaces of the formwork shall be at a temperature above 5ºC when the concrete is placed. This type of protection may be used for any temperature swings.

3.9.6.5.4.4 Type IV

3.9.6.5.4.4.1 A framed shelter enclosing the entire structure and the inside of the shelter at the required temperature throughout the protection period shall be built. This type of protection may be used for any temperature variation.

3.9.6.5.5 Cooling after Protection

3.9.6.5.5.1 When the protection period is over the temperature of the concrete shall be lowered gradually, in accordance with CAN/CSA A23.1. Clauses 7.4.1.3 and 7.4.1.5.3.4. The purpose of this is to prevent concrete cracking that could occur at the end of the curing period due to a sudden change in temperature (thermal shock).

3.9.6.6 Hot Weather Protection

3.9.6.6.1 The hot weather concreting requirements shall confirm to CSA A23.1 Clause 7.4.

3.9.6.6.1.1 In hot weather, the temperature of the concrete shall be as low as possible when it is placed. Placement temperatures shall meet the requirements of Clause 3.2 of this Specification. The temperature of the concrete mass shall then be kept at a relatively low level by continuous spraying.

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3.10 FORM STRIPPING

3.10.1 Form removal shall be performed as per Specification Section 03 11 00: Concrete Formwork.

3.11 SURFACE TREATMENT AFTER FORMWORK REMOVAL

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3.11.1 The Contractor shall inspect the concrete surfaces after formwork removal. Any damaged and non-confirming concrete shall be repaired in accordance with Clause 3.16.

3.11.2 Surface defects may consist of imperfections such as honeycombing, cracking, spalling of aggregate and exposure of reinforcing steel.

3.11.3 Metallic pieces shall be removed or cut at 40 mm inside the concrete surface.

3.11.4 Concrete surfaces that are non-visible and not exposed to water flow shall be left as is, except in the following cases:

3.11.4.1 Non-conforming concrete quality;

3.11.4.2 Tie-rod holes;

3.11.4.3 Depression deeper than 30 mm or more;

3.11.4.4 Exposure of reinforcing steel.

3.11.5 Other concrete surfaces shall be repaired in case of:

3.11.5.1 Non-confirming concrete quality;

3.11.5.2 Non-conforming surface finish tolerance due to abrupt surface defects (local irregularities of small length with respect to height or depth) such as offsets and fins exceeding 3 mm, caused by defective form lumber, loose knots in the forms or displaced form sheething or sections;

3.11.5.3 Bug holes;

3.11.5.4 Exposed aggregates;

3.11.5.5 Insufficient edge chamfer;

3.11.5.6 Air holes more than 25 mm in depth or diameter;

3.11.5.7 For Class F1, F2, F3 and F4 formworks, entrapped air bubbles exceeding respectively 3%, 2%, 1% and 1% of the surface, considering 1 m² areas at a time.

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3.11.6 Concrete surface repairs shall be made as soon as possible after the concrete has cured.

3.12 CONSTRUCTION JOINTS

3.12.1 Location

D1

3.12.1.1 Construction joints shall be permitted only at the locations shown on the drawings or approved by the Engineer. The Contractor may propose alternate locations for improving the schedule.

3.12.1.2 When the concrete has hardened to the point where a vibrator cannot be inserted (cold joints during concreting), the surface shall be considered as a construction joint. In such a case, the Engineer shall be informed immediately so as to permit him to take action and not delay subsequent work.

3.12.2 Execution

3.12.2.1 Construction joints shall be flared so that the surface of the concrete is inclined in a gentle slope towards the non-exposed side to prevent the build-up of laitance on the exposed side of the finished surface. The exposed edge of the joint shall be straight wherever it is visible.

D1

3.12.2.2 All construction joints shall be finished and prepared for placement of the next lift in compliance with Clause 3.8 of this Section.

3.13 CONTRACTION JOINTS

3.13.1 Location

3.13.1.1 Contraction joints shall be constructed only at the locations shown on the drawings.

3.13.2 Execution

D1

3.13.2.1 For unformed contraction joint, the joint shall be made using pre-shaped spacers installed in the fresh concrete or using a concrete saw. The upper portion of the joint shall be protected by sealing it with a sealing agent as shown on the Drawings. In all cases, the sealing agent shall be compatible with the joint fill material.

D1

3.13.2.2 Saw-cut joints shall be cut as soon as the concrete surface has hardened sufficiently and before shrinkage cracks form. The proper time for cutting, normally 6 to 12 hours after placement of concrete, but would vary with the concrete class and is subject to approval by the Engineer on a placement by placement basis.

D1

3.13.2.3 For treatment of formed contraction joints, refer to Specification Section: 03 11 00 Concrete Formwork.

3.14 SECONDARY CONCRETE

3.14.1 Formwork

3.14.1.1 A complete set of drawings of the formwork together with a detailed description of the proposed methods of handling and placing of the secondary concrete shall be submitted to the Engineer before concreting.

3.14.1.2 All formwork shall be as specified in Specification Section 03 11 00: Concrete Formwork.

3.14.1.3 Formwork shall be firmly attached in place, braced and supported to resist the loads to which it is exposed, keeping its alignment and shape. Formwork shall be tight and shall not permit any leakage.

3.14.1.4 Formwork shall be fixed on primary concrete and not to the embedded parts.

3.14.2 Concreting

D1 3.14.2.1 Concrete surfaces which will come in contact with the secondary concrete, except surfaces of concrete placed by Company's other contractor, shall be finished and prepared in compliance with Clause 3.8.4 of this Section.

D1 3.14.2.2 Secondary concrete supplied for concreting of the embedded parts and grooves shall be of Class A-3, unless specified otherwise on the drawings.

3.14.2.3 No admixtures shall be added to the concrete without prior authorization of the Engineer. The impact of admixtures on the embedded steel parts shall be considered.

3.14.2.4 Secondary concrete shall be placed in such a way as to avoid displacement of embedded parts.

3.14.2.5 Secondary concrete shall be placed in a continuous operation at a maximum rate of 350 mm/hour, unless indicated otherwise by the embedded parts Manufacturer.

3.14.2.6 The minimum delay before removal of the formwork shall be as per Specification Section 03 11 00: Concrete Formwork.

3.14.2.7 The dimension of vibrator shall be 50 mm. There shall be no contact between vibrator and embedded parts, supports and anchors.

D1 3.14.2.8 If there is an evidence or danger of displacement of the embedded parts, the Contractor shall stop the concreting or reduce the pouring rate and immediately advise the Engineer for further action.

D1 3.14.2.9 Secondary concrete shall be of Class A-3, unless specified otherwise on the Drawings.

3.15 CONSTRUCTION TOLERANCES

3.15.1 General

D1

3.15.1.1 Unless otherwise indicated on the drawings, the concrete structural tolerances upon completion of the works shall conform to the requirements of this section.

3.15.1.2 General tolerances for the placement of angle irons and embedded items, other than embedded equipment parts whose tolerances are specified in the manufacturer's technical specifications, shall be as prescribed in Clause 6.7.3 of CSA A23.1/A23.2.

3.15.1.3 The Contractor is responsible for designing, executing, and maintaining the formwork within the required limits such that the structure, when completed, is in compliance with the specified tolerances of this Section and CSA A23.1.

3.15.1.4 Any concrete work not in compliance with the specified tolerances shall immediately be reported to the Engineer for the approval of the corrective action which may require removal or replacement of the concrete, depending on the severity of the non compliance.

3.15.1.5 As soon as a problem is detected, in order to prevent a recurrence of any non conformance, the Contractor shall submit to the Engineer, for approval, preventive and/or corrective measures with regard to materials, type of formwork, concrete placement methods, finishing methods, etc.

3.15.1.6 The Engineer reserves the right to place a hold on the work until such preventive and/or corrective measure proposals are reviewed and found to be satisfactory.

D1

3.15.2 Survey Grid Point Tolerances

3.15.2.1 The applicable tolerances are:

3.15.2.1.1 planimetric: ± 2 mm;

3.15.2.1.2 altimetric: ± 2 mm.

3.15.3 Dimensional Tolerances

3.15.3.1 The applicable tolerances for dimensions or position are:

3.15.3.1.1 Dimension

3.15.3.1.1.1 The allowable deviation for a dimension equal to or less than 3 m is ± 3 mm. The allowable deviation for a dimension greater than 3 m is 0.1% of the dimension, up to a limit of 30 mm.

3.15.3.1.1.2 Elevation: ± 6 mm.

3.15.4 Orientational Tolerances

3.15.4.1 Parallelism or deviation with respect to a theoretical profile :

3.15.4.1.1 1:500 maximum, up to a limit of 30 mm.

3.15.4.2 Perpendicularity :

3.15.4.2.1 1:500 maximum, up to a limit of 30 mm.

3.15.4.3 Horizontality :

3.15.4.3.1 1:500 maximum, up to a limit of 12 mm.

3.15.4.4 Verticality :

3.15.4.4.1 1:500 maximum, up to a limit of 30 mm.

3.15.5 Shape Tolerances

3.15.5.1 Water Runoff Surfaces :

D1 3.15.5.1.1 The applicable tolerances for flatness (or waviness) of water runoff surfaces is 1:25.

D1 3.15.5.2 Formed concrete surfaces shall conform to Table 7.

Table 7 – Formed Concrete Surface tolerances

Surface finish	Flatness tolerance	Joint tolerance
F1	30 mm	30 mm
F2	12 mm	8 mm
F3	5 mm	5 mm (measured perpendicular to current) 3 mm (measured parallel to current)
F4	5 mm (measured perpendicular to current) 3 mm (measured parallel to current)	5 mm (measured perpendicular to current) 3 mm (measured parallel to current)

Note: The surfaces shall be verified using a 1.5 m straight edge or a 1.5 m template for curved surfaces. For secondary concrete, the surfaces shall be checked by the straight line of 1.1 m.

D1 3.15.5.3 Un-formed concrete surfaces shall conform to Table 8.

Table 8 – Un-formed Concrete Surface tolerances

Surface finish	Flatness tolerance	Joint tolerance
U1	20 mm	5 mm
U2	5 mm	0 mm
U3	5 mm	0 mm

Note: The surfaces shall be verified using a 3.0 m straight edge or a 3.0 m template for curved surfaces.

3.15.6 Verifications

3.15.6.1 Verifications include all inspections to be carried out to ensure that the established tolerances have been complied with.

3.15.6.2 Verifications shall be done following form removal, by the Contractor, and the results of these verifications shall be submitted to the Engineer.

3.15.7 Measuring instruments and conditions

D1

3.15.7.1 Standard CSA A23.1/A23.2 applies.

3.16 REPAIR OF DEFECTS

3.16.1 Non-Conforming Materials and Workmanship

3.16.1.1 When sufficient evidence exists that defective workmanship has occurred or that non-confirming materials have been incorporated in the work, the Engineer may require concrete coring tests, inspections, surveys or other tests performed in order to help determine whether the Work must be repaired or replaced. If the work is found to be non-conforming, tests, inspections or surveys carried out under these circumstances, and required remedial work, shall be done at the expense of the Contractor.

3.16.1.2 Materials or workmanship, which fail to meet the specified requirements, may be rejected by the Engineer whenever found regardless of previous inspection. If rejected, non-confirming materials or Work incorporating non-conforming materials or workmanships shall be removed and replaced, or repaired, at the expense of the Contractor.

3.16.1.3 All materials and methods of repairs shall be submitted to the Engineer for review and approval prior to execution of the repair work.

3.16.2 Patching and Repair

D1

D1

3.16.2.1 Patching and repair of defective areas of new concrete or where bolts, ties, nails or other similar metal inserts are present shall be repaired in accordance with Clause 7.7.3 of CSA-A23.1. All materials and methods of repair shall be submitted to the Engineer for review and approval prior to execution of the repair work.

APPENDIX A

TABLES OF CONCRETE CLASSES

CLASS A (35): Structural concrete heavily exposed to inclement weather (wetting and drying, freezing and thawing in a saturated state), water running at high speed, or de-icing salt

Designation	Specified compressive strength[1] (MPa)	Maximum W/C ratio[2] (E/C)	Maximum coarse aggregate nominal size (mm)	Entrained air (%)	Placement slump (mm)	Location and use
A-1 (35-80)[3]	35	0.45	80[5]	3-6	20-60	Walls, slabs and piers over 1.5 m thick in the spillway, control structure, etc.
A-2 (35-40)	35	0.45	40	4-7	50-100	Walls and piers from 0.3 to 1.5 m thick
A-2-A (35-40-A)	35	0.45	40	4-7	20-60	Slabs from 0.3 to 1.5 m thick
A-3 (35-20)	35	0.45	20	5-8	50-100	Walls less than 0.3 m in thickness
A-3-A (35-20-A)	35	0.45	20	5-8[4]	20-60	Slabs less than 0.3 m in thickness & toppings 50 mm or more in thickness
A-4 (35-10)	35	0.45	10	5-8	50-100	Special uses
A-4-A (35-10-A)	35	0.45	10	6-9	20-60	Floor toppings less than 50 mm in thickness
A-5 (35-5)	35	0.45	5	9-12	175-225	If required at cold joints

D1

D1

Notes:
(1) At 28 days for concrete with type GU cement.
At 91 days for concrete with type LH-M cement.
(2) In some cases, the technical specifications may prescribe a minimum cement content dosage.
(3) (35-80) means 35 MPa – 80 mm. The concrete classes indicated in this table may be modified, for example for thick elements, with the authorization of the Engineer, to obtain a higher early compressive strength with the same type of cement LH.
(4) Maximum of 3% for interior topping use.
(5) The 80 mm size aggregate is generally not planned to be used. However the Engineer may permit its use for specific conditions.

D1

CLASS B (30): Structural concrete moderately exposed to inclement weather (wetting and drying, freezing and thawing in a saturated state) or water running at moderate speed

Designation	Specified compressive strength[1] (MPa)	Maximum W/C ratio[2] (E/C)	Maximum coarse aggregate nominal size (mm)	Entrained air (%)	Placement slump (mm)	Location and use
B-1 (30-80)[3]	30	0.50	80[4]	3-6	20-60	Foundations, walls & slabs over 1.5 m thick
B-2 (30-40)	30	0.50	40	4-7	50-100	Foundations, walls from 0.3 to 1.5 m thick, penstocks
B-2-A (30-40-A)	30	0.50	40	4-7	20-60	Slabs from 0.3 to 1.5 m thick
B-3 (30-20)	30	0.50	20	5-8	50-100	Foundations, walls less than 0.3 m thick
B-3-A (30-20-A)	30	0.50	20	5-8	20-60	Slabs less than 0.3 m thick
B-4 (30-10)	30	0.50	10	6-9	50-100	Special uses
B-5 (30-5)	30	0.50	5	9-12	175-225	If required at cold joints

D1

D1

Notes: (1) At 28 days for concrete with type GU cement.
At 91 days for concrete with type LH-M cement.
(2) In some cases, the technical specifications may prescribe a minimum cement content dosage.
(3) (30-80) means 30 MPa – 80 mm.
(4) The 80 mm size aggregate is generally not planned to be used. However, the Engineer may permit its use for specific conditions.

D1

CLASS BC (25): Structural concrete slightly exposed to inclement weather (wetting and drying, freezing and thawing, not in a saturated state) or water running at low speed

Designation	Specified compressive strength[1] (MPa)	Maximum W/C ratio[2] (E/C)	Maximum coarse aggregate nominal size (mm)	Entrained air (%)	Placement slump (mm)	Location and use
BC-1 (25-80)[3]	25	0.55	80[4]	3-6	20-60	Foundations, walls & slabs over 1.5 m thick
BC-2 (25-40)	25	0.55	40	4-7	50-100	Foundations, walls from 0.3 to 1.5 m thick, penstocks
BC-2-A (25-40-A)	25	0.55	40	4-7	20-60	Slabs from 0.3 to 1.5 m thick
BC-3 (25-20)	25	0.55	20	5-8	50-100	Foundations, walls less than 0.3 m thick
BC-3-A (25-20-A)	25	0.55	20	5-8	20-60	Slabs less than 0.3 m thick
BC-5 (20-5)	25	0.55	5	9-12	175-225	If required at cold joints

D1

Notes: (1) At 28 days for concrete with type GU cement.
At 91 days for concrete with type LH-M cement.
(2) In some cases, the technical specifications may prescribe a minimum cement content dosage.
(3) (25-80) means 25 MPa – 80 mm.
(4) The 80 mm size aggregate in generally not planned to be used. However, the Engineer may permit its use for specific conditions.

D1

CLASS C (20): Structural concrete not exposed to inclement weather (wetting and drying, freezing and thawing) or running water

Designation	Specified compressive strength[1] (MPa)	Maximum W/C ratio[2] (E/C)	Maximum coarse aggregate nominal size (mm)	Entrained air (%)	Placement slump (mm)	Location and use
C-1 (20-80)[3]	20	0.60	80[4]	3-6	20-60	Foundations, walls & slabs over 1.5 m thick
C-2 (20-40)	20	0.60	40	4-7	50-100	Foundations, walls from 0.3 to 1.5 m thick, penstocks
C-2-A (20-40-A)	20	0.60	40	4-7	20-60	Slabs from 0.3 to 1.5 m thick
C-3 (20-20)	20	0.60	20	5-8	50-100	Foundations, walls less than 0.3 m thick
C-3-A (20-20-A)	20	0.60	20	5-8	20-60	Slabs less than 0.3 m thick
C-5 (20-5)	20	0.60	5	9-12	175-225	If required at cold joints

D1

Notes: (1) At 28 days for concrete with type GU cement.
At 91 days for concrete with type LH-M cement.
(2) In some cases, the technical specifications may prescribe a minimum cement content dosage.
(3) (20-80) means 20 MPa – 80 mm.
(4) The 80 MM size aggregate is generally not planned to be used. However, the Engineer may permit its use for specific conditions.

D1

CLASS D (15): Structural concrete not exposed to inclement weather (wetting and drying, freezing and thawing) or running water

Designation	Specified compressive strength[1] (MPa)	Maximum W/C ratio[2] (E/C)	Maximum coarse aggregate nominal size (mm)	Entrained air (%)	Placement slump (mm)	Location and use
D-1 (15-80)[3]	15	0.65	80	3-6	20-60	Very thick fill, over 1.5 m
D-2 (15-40)	15	0.65	40	4-7	50-100	Medium thick fill from 0.3 to 1.5 m
D-3 (15-20)	15	0.65	20	5-8	50-100	Thin layer fill for embedment of electrical conduits, etc.
D-5 (15-5)	15	0.65	5	9-12	175-225	If required at cold joints

D1

Notes: (1) At 28 days for concrete with type GU cement.
At 91 days for concrete with type LH-M cement.
(2) In some cases, the technical specifications may prescribe a minimum cement content dosage.
(3) (15-80) means 15 MPa – 80 mm.
(4) The 80 MM size aggregate is generally not planned to be used. However, the Engineer may permit its use for specific conditions.

D1

Undefined Class

Designation	Specified compressive strength(1) (MPa)	Maximum W/C ratio(2) (E/C)	Maximum coarse aggregate nominal size (mm)	Entrained air (%)	Placement slump (mm)	Location and use
Dry mortar	30	0.35	5	If required	-	As stipulated in the Specification or on the drawings
Mortar or grout	30	0.45	5	If required	-	As stipulated in the Specification or on the drawings, for injecting under beam and column support plates
X-2	8	1,15	40	4-7	100-150	As stipulated in the Specification or on the drawings

Notes: (1) At 28 days for concrete with type GU cement.
At 91 days for concrete with type LH-M cement.

D1

(2) Support plate, beam and column adjustment grout shall consist of Portland cement, sand, water and a non-ferrous expanding admixture as needed, approved by the Engineer.
Unless otherwise indicated by the Engineer, the sand/cement ratio shall not exceed 1.5/1.0. The admixture shall be used in compliance with the Manufacturer's recommendations

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 03 60 40
CH0032	**GROUT**	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 03 60 40
GROUT
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
C. TODD SMITH
C. Todd Smith
SIGNATURE
9 Dec 2013
DATE
NEWFOUNDLAND & LABRADOR

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 03 60 40
CH0032	**GROUT**	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 This specification establishes the minimum requirements of materials and workmanship for furnishing, delivering, placing, finishing, curing, and testing of sand-cement grout, non-shrink cement-based grout and non-shrink epoxy grout.

1.1.2 Work Included

1.1.2.1 This specification applies to all operations associated with, but not necessarily limited to, the following:

1.1.2.1.1 Supply, mixing, placing, finishing and curing of cementitious or epoxy grout;

1.1.2.1.2 Surface preparation to receive grout;

1.1.2.1.3 Control joints and expansion joints, as indicated on the drawings;

1.1.2.1.4 Inspection and testing.

1.1.2.1.5 The Contractor shall supply all necessary equipment and maintenance thereof to perform the work outlined in this Specification.

1.2 RELATED SECTIONS

1.2.1 Section: 03 30 00 Cast-in-Place Concrete

1.2.2 Section: 05 50 10 Miscellaneous Metals and Embedded Parts

1.2.3 Section: 01 35 43 General Environmental Requirements

D1 **1.2.4** Section: 05 12 00 Structural Steel

1.3 DEFINITIONS

1.3.1 SDRL: Supplier Documentation Requirement List.

1.3.2 MSDS: Materials Safety Data Sheets

1.3.3 OSHA: Occupational Safety and Health Administration

1.4 REFERENCES

1.4.1 The Contractor shall comply with the rules and provisions of the listed Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.4.2 All work shall be in accordance with this specification and the requirements of the following codes and standards:

1.4.3 Canadian Standard Association (CSA):

CAN/CSA A3000-08	Cementitious Materials Compendium
CSA A23.1-09/A23.2-09	Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete
CAN/CSA A23.3-04 (R2010)	Design of Concrete Structures

D1

1.4.4 American Concrete Institute:

ACI 305R-06	Guide to Hot Weather Concreting
ACI 306R-10	Guide to Cold Weather Concreting.
ACI 318-11	Building Code Requirement for Structural Concrete and Commentary.

1.4.5 American Society for Testing and Materials:

ASTM C33/C33M-11a	Standard Specification for Concrete Aggregates
ASTM C109/C109M-11b	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in; or 50-mm Cube Specimens)
ASTM C150/C150M-12	Standard Specification for Portland Cement
ASTM C494/C494M-11	Standard Specification for Chemical Admixtures for Concrete
ASTM C827/C827M-10	Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from

	Cementitious Mixtures
ASTM C 1107/C1107M-11	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
ASTM C1019-10	Standard Test Method for Sampling and Testing Grout

1.4.6 Other Codes and References:

U.S. Army Corps of Engineers

CRD C 621	Specification for Non-shrink Grout
ISO 80000-1 (2009)	Quantities and Units – Part 1: General

1.5 GROUTING APPLICATIONS

1.5.1 Unless indicated otherwise on the drawings, the following criteria shall apply:

1.5.1.1 Sand-Cement Grout

1.5.1.1.1 Sand-cement grout shall be used for grouting of lightly loaded column base plates for miscellaneous structural and equipment supports, such as stairs, guardrails, skid-mounted equipment, small pumps, lube oil consoles, etc.

1.5.1.2 Non-Shrink Cement-Based Grout

1.5.1.2.1 This type of grout shall be used for grouting structural column base plates with or without shear keys seated in companion keyways formed in foundation piers, for sleeved anchor bolts designed to resist high shear forces, and for static equipment.

1.5.1.3 Non-Shrink Epoxy Grout

1.5.1.3.1 Non-shrink epoxy grout shall be used for reciprocating machines and in cases where high allowable bearing pressures are required, where dynamic loads due to impact and/or vibration are transmitted through the grout, and/or where chemical attack is possible.

1.5.1.3.2 In addition, this grout shall typically be used for bed plates or bases of centrifugal compressors, turbines, pumps, blowers, and associated drivers.

1.5.2 Selection of Grout

1.5.2.1 Selection of type of grout shall be in accordance with the criteria given above, except as follows:

1.5.2.1.1 Grouting of all equipment supports shall be in accordance with manufacturer's recommendations.

1.5.2.1.2 It may be necessary to use non-shrink cement-based grout or non-shrink epoxy grout instead of sand-cement grout for certain applications where grout is subjected to temperatures above ambient, where vibrating loadings are encountered or when necessary to meet the required structural strength.

1.5.2.1.3 Non-shrink grout shall be selected based on the manufacturer's recommendations for the particular application.

1.5.2.1.4 Generally, epoxy grout shall not be exposed to temperatures exceeding 93°C (200°F) for general use or 65°C (150°F) for precision grouting of major mechanical equipment, unless the grout manufacturer recommends a lower value.

1.5.2.1.5 Proper grout details shall allow for expansion joints, grout cut backs, corner reinforcing or added epoxy depth at corners to prevent cracks. Expansion joints in epoxy grout shall be spaced at intervals less than or equal to 900 mm.

1.6 QUALITY ASSURANCE

1.6.1 Quality of work shall be controlled to meet the requirements of this Specification, referenced codes and standards, and other contract documents in effect on the date of contract.

1.6.2 The Contractor shall follow a Quality Control Program during execution of the work. The program shall include inspection and testing of all materials as well as dimensional checks and visual inspection.

1.6.3 All chemicals used need to be accompanied by a ''Material Safety Data Sheet'' and recorded on a site hazardous record document to be kept at the facility offices. For a list of substances not to be used due to their toxicity and health risk, refer to Specification Section 01 35 43: General Environmental Requirements.

1.6.4 The Contractor shall obtain and retain Certificates of Compliance for all products listed in Part 2 for the Engineer's review, when requested.

1.6.5 Substitutions

1.6.5.1 Complete technical data as to type, composition, strength, quality, finish, capacity, performance characteristics, and other pertinent details will be required to determine the acceptability of a substitute item.

1.6.5.2 Substitutions shall receive written approval from the Engineer prior to being implemented.

1.7 SUBMITTALS

1.7.1 The Contractor shall submit the required documentation to the Engineer for review and approval, in accordance with the Supplier Document Requirements List (SDRL).

1.7.2 The Contractor shall submit Material Safety Data Sheets for each product required by OSHA to have an MSDS.

1.7.3 The Contractor shall submit the Quality Control Program that will be followed during execution of the work, to the Engineer for approval.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 All materials shall be approved prior to installation.

2.1.2 Sand-cement grout may be proportioned on site or at the batch plant. Proprietary grout shall consist of pre-measured, pre-packaged materials supplied by the manufacturer, with the exception of water.

2.1.3 All grouts shall be non-corrosive, non-staining and resistant to effects of moisture.

2.1.4 Compressive strength of grout shall meet or exceed that of foundation concrete.

2.2 WATER, AGGREGATE, CEMENT AND CHEMICAL ADMIXTURES

2.2.1 Mixing Water

2.2.1.1 Water to be used in mixing grout shall conform to the requirements of CSA A23.1/A23.2.

2.2.1.2 Mixing water shall be free of salts, alkalis, acids, organic materials and contaminants in proportions that could adversely affect the quality of the grout.

2.2.2 Aggregate

2.2.2.1 Sand shall be as defined in CSA A23.1/A23.2 and shall conform to grading for fine aggregate 4.75 mm (No.4) to 150 mm (No. 100) sieve as per ASTM C 33.

2.2.3 Cement

2.2.3.1 Cement shall be Portland cement Type I or II conforming to ASTM C 150.

2.2.4 Chemical Admixtures

2.2.4.1 Chemical admixtures shall comply with ASTM C 494.

2.3 SAND-CEMENT GROUT

2.3.1 Sand-cement grout shall consist of two parts sand for one part cement, by weight. Minimum 28 day compressive strength shall match or exceed that of the supporting concrete but shall not be less than 30 MPa.

2.3.2 Sand-cement grout shall have a maximum water-cement ratio of 0.40, by weight.

2.3.3 Sand-cement dry pack grout shall consist of two parts sand to one part cement, by weight, with just sufficient water to produce a stiff consistency that can be efficiently pushed into place without sagging.

2.4 NON-SHRINK CEMENT-BASED GROUT

2.4.1 Non-shrink cement-based grout shall be Grade C Combination Volume-Adjusting in accordance with ASTM C 1107.

2.4.2 Plastic volume change: Grout shall show no shrinkage (0.0%) and a maximum of 4.0% expansion at any time before initial set when tested in accordance with ASTM C 827.

2.4.3 Hardened volume change: Grout shall show no shrinkage (0.0%) and a maximum 0.2% expansion in the hardened state when tested in accordance with CRD-C621.

2.4.4 Compressive strength: Grout shall have a minimum compressive strength at 28 days of 50 MPa.

2.4.5 Initial set time: Grout shall achieve initial set in not less than 45 minutes when tested in accordance with ASTM C 1019.

2.4.6 Soundness: Grout shall contain no staining substances, no aluminum powder, no more than 0.05% chloride ions, nor other materials known to increase drying shrinkage and/or compromise durability.

2.4.7 Cement based non-shrink grout products listed below or approved equal shall be used:

2.4.7.1 SikaGrout 212 or Sikagrout 212 HP by Sika Corporation;

2.4.7.2 ChemRex/Master Builders (Masterflow 928).

2.5 NON-SHRINK EPOXY GROUT

2.5.1 Volume Change: Epoxy grout shall exhibit no shrinkage (0.0%) and a maximum of 4.0% expansion when tested in accordance with ASTM C 827, modified to use an indicator ball with a specific gravity between 0.9 and 1.1.

2.5.2 Compressive strength: Epoxy grout shall have a minimum compressive strength at 7 days of 70 MPa.

2.5.3 Heat Development: The peak exotherm of a 50 mm diameter by 100 mm high cylinder of grout shall not exceed 35°C (95°F) when tested at 24°C (75°F) material and laboratory temperatures.

2.5.4 Thermal expansion: Epoxy grout shall not exceed a coefficient of thermal expansion of 1.65 X 10^{-5} mm/mm/°C (30 X 10^{-6} in/in/°F).

2.5.5 Irritants: The use of epoxy grout which gives off noxious fumes or volatiles shall be prohibited.

2.5.6 Creep resistance: Manufacturer shall provide information on creep resistance including a description of the test method used.

2.5.7 Non-shrink epoxy grout products listed below or approved equal shall be used:

2.5.7.1 Sikadur Hi-Mod 32 by Sika Corporation;

2.5.7.2 ChemRex/Master Builders (Masterflow 648 CP Plus Grout);

2.5.7.3 ChemRex/Master Builders (Masterflow 678 DP Plus Grout)

PART 3 EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

3.1.1 Non-shrink cement-based grout and epoxy grout aggregate shall be delivered to the site in sound, dry packages. Epoxy grout liquid components shall be delivered in sealed hardener and resin containers. Alternatively, epoxy grout shall be delivered as a pre-packaged, pre-measured system.

3.1.2 All materials and pre-mixed grout in manufacturer's sealed containers, with labels legible and intact, shall be stored in a dry, weatherproof area at temperatures between 5 degrees C to 38 degrees C or within the temperature range recommended by the manufacturer. It is preferred that the grout be stored in a dry warehouse. If the grout must be stored outside, it shall be placed on pallets off the ground surface and completely covered with durable plastic sheeting. Any material which becomes damp or otherwise defective shall be removed from the site.

3.1.3 Time of storage for non-shrink grout shall not exceed manufacturer's recommendation nor 10 months from the time of manufacture.

D1

3.1.4 Opened bags or containers not used must be discarded.

3.2 SURFACE PREPARATION

3.2.1 Concrete surface on which grout will bear shall have attained its design strength prior to grouting

3.2.2 Concrete shall be sound and surfaces to be in contact with grout shall be free of oil, grease, paint, ice, laitance and other coatings and other deleterious substances. Surface shall be roughened by chipping, abrasive blasting or other mechanical means in order to expose coarse aggregate and to create irregular surface to which the grout will bond.

3.2.3 Prepared surface shall be cleaned of all dust and loose particles. After cleaning, foundation surface shall be tightly covered to keep it free of dust and oil.

3.2.4 Before grouting, equipment bases and base plates shall be leveled and aligned in accordance with the drawings and equipment manufacturer's recommendations. Base plate surfaces in permanent contact with grout shall be free of dirt, grease, paint, or other deleterious substances. If applicable, base plate cleaning shall comply with the grout manufacturer's specifications. Vent holes may be necessary in the base plate to eliminate air pockets.

3.2.5 Unless otherwise specified or shown on the drawings, the entire top surface of the foundation shall be grouted. Areas not to be grouted, such as oil pans or air circulation spaces, must be sealed off before the equipment is lowered into place. This may be accomplished with oakum or hemp rope, expandable fabric hose (such as canvas fire hose), rigid polyurethane foam, styrofoam or other soft compressible material.

3.2.6 When using a canvas fire hose, the hose shall be pressurized to a maximum of approximately 0.03 MPa (5 PSI) to avoid moving the equipment and affecting its alignment. Also, for epoxy grout, the fire hose shall be wrapped with polyethylene tape and coated with a heavy paste wax for ease of removal.

3.2.7 When using rigid polyurethane foam or styrofoam (do not use styrofoam for epoxy grout), allow 6mm per 25 mm of height for crush. The foam shall be installed prior to setting the equipment. To ensure a leak-proof joint, apply a bead of caulking compound on the mating surfaces of the concrete where it attaches to the foam and on the rigid foam where it attaches to the equipment bed plate.

3.2.8 Anchor bolts, leveling screws and other metal surfaces for which bond to the grout is not desirable shall be coated with approved varnish or wax or otherwise protected prior to placing grout.

D1 **3.2.9** Equipment base plate surface shall be prepared in accordance with grout manufacturer's requirements in order to ensure bond of grout to base plate. For equipment purchased with a special coating on the base plate which is designed to bond to epoxy grout, confirmation from the grout manufacturer shall be obtained assuring that the grout will bond to the special coating.

3.2.10 When sand-cement grout is used, the roughened surface shall be thoroughly presoaked with clear, potable water and shall be damp for 24 hours prior to placement of grout. Covering concrete with continuously wet burlap and running a fine hose spray will generally yield satisfactory results. Excess water shall be removed from concrete surface and anchor bolt sleeves before grout is placed.

3.2.11 When using non-shrink cement-based grout, the roughened concrete surface shall be presoaked with clear, potable water in accordance with manufacturer's recommendations.

3.2.12 When non-shrink epoxy grout is used, all surfaces must be kept completely dry before grouting, unless otherwise specified by grout manufacturer.

3.3 FORMS

3.3.1 Where forms are required, they shall be designed for rapid, continuous and complete filling of the space to be grouted. Forms shall be of adequate strength to withstand the forces produced during placement of the grout.

3.3.2 Forms shall be caulked or sealed with tape to provide a water tight seal.

3.3.3 Forms shall extend a minimum of 25 mm above the bottom of the base plate being grouted and shall be placed no closer than 25 mm from the edge of the base plate. On the pouring side, the form shall extend at least 150 mm above the bottom of the base plate and shall be placed no closer than 50 mm from the edge of the base plate.

D1 **3.3.4** Forms for non-shrink cement-based grout shall be pre-treated with an acceptable mineral oil or coated with approved release agent such as Sealtight Duoguard manufactured by W.R. Meadows, to prevent grout adherence and absorption.

3.3.5 Forms for epoxy grout shall be lined with polyethylene or coated with heavy wax to prevent grout adherence and absorption.

3.3.6 All chamfered edges required in epoxy grouts shall be incorporated into the forms.

3.4 MIXING AND PLACING

D1 **3.4.1** Manufacturer's instructions shall be strictly followed for non-shrink cement-based-grout preparation, proportions, mixing, forming, and depth of pour, pouring, curing and protection.

3.4.2 Grouting shall preferably be accomplished when ambient and mix temperatures are between 4.5°C (40°F) and 32°C (90°F) for cement-based grouts and between 10°C (50°F) and 32°C (90°F) for epoxy grouts. When temperatures are outside this range, the recommendations contained in CSA A23.1/A23.2 shall be followed for normal sand-cement grout. For non-shrink cement-based and epoxy grouts, manufacturer's recommendations shall be followed.

3.4.3 During hot weather installation, grout materials shall be stored at temperatures less than or equal to 21°C (70°F) throughout the 24 hours prior to grout installation. Surfaces that will come in contact with grout shall be shaded throughout the 24 hours prior to grout installation. Surfaces that will come in contact with grout shall have their temperatures reduced to values less than or equal to 32°C (90°F) with a cold water spray throughout the 1-hour prior to grout installation.

3.4.4 During cold weather installation, grout materials and elements to be grouted shall be maintained at temperatures between 21 degrees C to 24 degrees C throughout its thickness during and 48 hours after grouting.

3.4.5 Sand-cement grout shall be mixed as close as possible to the equipment to be grouted using a mortar mixer (with slow moving blades) wherever possible. For small quantities of epoxy grout, a clean and dry concrete wheelbarrow and mortar hoe may be used.

3.4.6 Sufficient manpower and equipment shall be available for rapid and continuous mixing and placing of grout. Sand-cement grout shall be mixed for 3 to 5 minutes after charging mixer then placed immediately. Mixed grout that remains standing shall be mixed at 5 minute intervals and then remixed for one minute before placing. Bedding grout that shows signs of stiffening or which has not been placed 30 minutes from time of initial mixing shall be discarded. Do not add water to grout mix after initial mixing.

3.4.7 Grout shall be mixed in quantities no greater than can be placed in the manufacturer's specified working time for the temperature at which the grout is being placed. Working time specified shall be considered a maximum value and any grout remaining after the specified working time has elapsed shall be discarded. Do not re-mix or re-temper stiffening grout. Any grout which shows evidence of initial set or entrapped air shall be discarded.

3.4.8 Once grout is mixed, it shall be placed continuously and rapidly, preferably from one side only, to avoid cold joints and minimize the chance of air entrapment. The grout level shall not drop below the equipment base. The grout fill location shall be moved only after the grout has filled past the new fill location. Expansion joint dividers shall be used to section off the maximum areas to be poured and worked at one time.

3.4.9 For flat base plates, grout shall be placed across the small dimension of the equipment base, from one long edge to the other, in one direction only. The use of a head box with an inclined plane to direct the grout across the compartment is recommended.

3.4.10 For inverted "U" shaped base plates, such as pump base plates, the base shall contain a sufficient number of relief holes (one 3 mm minimum diameter hole per corner) or grout shall be poured from a 100 mm hole in the center of each compartment.

3.4.11 Use of a vibrator is not permitted. Also, grout shall not be placed when vibrations are being transmitted by the operation of other equipment. Such equipment must be shut down while grouting and kept idle for at least 24 hours or until the grout has set sufficiently.

3.4.12 Cement-based grout may be tamped or rodded to eliminate voids. Care shall be exercised, however, so that air is not introduced into the grout.

3.4.13 In making deep pours, epoxy grout shall generally be poured in thicknesses of 50 to 100 mm per layer. Minimum depth of pour is 50 mm. Depth of pour is dependent on the product selected and on ambient temperatures. Deeper or shallower pours may be made if permitted by the manufacturer's standards. The final layer, which is to adhere to the machine base, shall be limited to between 25 and 50 mm in thickness, measured from bottom of the machine base. Epoxy grout shall not be rodded.

3.4.14 Epoxy materials may be skin irritants or sensitizers. Avoid contact with eyes, skin, inhalation of vapours and ingestion.

3.5 FINISHING

3.5.1 Exposed surface of grout shall slope away from base plates.

3.5.2 After grout has set, apply finish coating, where required, over grout holes and vent holes.

3.5.3 Cement-based grouts shall be trimmed back to the lower edge of the base plate and tapered to the existing concrete at 45 degree angles once the grout has reached an initial set. Protruding edges shall also be cut back.

3.5.4 Epoxy grout cannot be trimmed after initial set. Top surfaces shall be finished to proper slope before initial set.

3.6 CURING

3.6.1 Grout shall be cured in accordance with the manufacturer's recommendations.

3.6.2 The temperature of the base plate, supporting concrete foundation and grout shall be maintained within the limits specified in article 3.4 of this Specification Section.

3.6.3 After placement, cement-based grout shall be protected from premature drying, excessively hot or cold temperatures and mechanical injury. Sand-cement grout shall be maintained with minimal moisture loss at relatively constant temperature for a minimum of 3 days. Following 36 hours of moist curing, a curing/sealing compound such as Sikaguard Clear Seal by Sika Canada Inc. or approved equivalent may be applied to all exposed surfaces. Curing of non-shrink cement-based grout shall be in accordance with manufacturer's instructions.

3.6.4 Since water interferes with proper curing of epoxy grouts, moist curing shall not be used. Curing for epoxy grout shall be in accordance with manufacturer's instructions.

3.6.5 Foundations shall be shaded from direct sunlight for at least 24 hours before and 48 hours after grouting.

3.6.6 Unless stated otherwise by the manufacturer, epoxy grouts shall be protected from sudden temperature change for 48 hours.

3.7 SHIMS AND WEDGES

3.7.1 Shims for machinery, where accessible, shall be blocked off and removed once the grout has hardened. The space left by the removal of shims shall be re-grouted with the specified grout. Shims for base plates for structural columns may be left in place.

3.7.2 If leveling screws are used to level equipment, the screws shall be coated and backed off after the grout has hardened so that machine loads are transmitted only through the grout.

3.8 ANCHOR BOLTS AND PIPE SLEEVES

3.8.1 For anchor bolt sleeves and pipe sleeves requiring grout, all surfaces shall be cleaned of oil, grease and foreign substances.

3.8.2 Where epoxy grout is used, anchor bolts shall be isolated from the grout by means of PVC pipe, rubber hose or polyethylene wrapped in several layers around the bolt. Annular space within anchor bolt sleeves shall be plugged with a sleeve seal to prevent epoxy grout entering the sleeved space.

3.8.3 Unless shown otherwise on the drawing, anchor bolts within sleeves and pipe sleeves which are to remain isolated shall be filled with a pliable material such as silicone rubber molding material.

3.9 INSPECTION AND TESTING

3.9.1 The following work shall be subject to the surveillance of the Contractor's inspector at all times:

3.9.1.1 Compliance of materials with requirements specified herein;

3.9.1.2 Preparation of existing surfaces to receive grout;

3.9.1.3 Placing of grouts.

D1 **3.9.2** Surveillance performed by the Contractor's inspector shall not relieve either the Contractor performing the work or a supplier of material of any responsibilities connected with the quality of materials and satisfactory installation and performance of installed grout.

D1 **3.10 GROUT QUALITY CONTROL**

3.10.1 Inspection and quality control sampling and testing of grout shall be performed by the Contractor through the use of the services of a third party retained and paid by the Company.

3.10.2 Inspection and quality control sampling and testing of grout through the use of the services of a third party retained and paid by the Company shall not relieve either the Contractor or a supplier of material of any responsibilities connected with the quality and performance of the grout.

3.10.3 The compression strength of grout shall be determined on sample cubes (three cubes at one (1) day, three cubes at three (3) days, three cubes at seven (7) days and three cubes at (28) days).

D1 **3.10.4** Grout shall be sampled for each mix and for each working day.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 05 12 00
CH0032	**STRUCTURAL STEEL**	Rev: D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 05 12 00
STRUCTURAL STEEL
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
C. TODD SMITH
C. Todd Smith
SIGNATURE
9 Dec 2013
DATE
NEWFOUNDLAND & LABRADOR

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 05 12 00
CH0032	**STRUCTURAL STEEL**	Rev: D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

PART 1 GENERAL

1.1 SCOPE OF WORK

D1 1.1.1 The work described in this Specification includes all labour, material, equipment, inspection and testing services for the connection design, shop drawings, supply, fabrication, galvanization, transportation to site and erection of the structural steel.

D1 1.1.2 The design, fabrication and installation of structural steel shall conform to this Specification and to CSA S16. However, if there are any discrepancies the requirements of this specification supersede the corresponding ones of Standard CSA S16.

1.1.3 Work included

1.1.3.1 The buildings and structures included are:

1.1.3.1.1 Spillway towers, hoist bridge structure, and hoist houses.

1.1.3.1.2 Walkway on the spillway.

1.1.3.1.3 Spillway Electrical Building.

1.1.3.2 The work includes but is not limited to the following:

1.1.3.2.1 Preparation and submittal of shop and erection drawings.

D1 1.1.3.2.2 Analysis and design of all structural systems and components including design of connections.

1.1.3.2.3 Fabrication and supply of structural steel members, gratings, floor and roof decking, plates, bolts, chemical and/or expansion anchor bolts, and all other accessories required to execute the work.

1.1.3.2.4 Surface preparation of steels

D1 1.1.3.2.5 Galvanizing.

1.1.3.2.6 On-site erection according to drawings and within the prescribed tolerances.

1.1.3.2.7 All shop and field welding and bolting.

1.1.3.2.8 All shims and adjustment pieces necessary for work execution.

1.1.3.2.9 Supply preparation and injection of non-shrink grout under base plates.

1.1.3.2.10 Pre-tensioning of the anchor bolts.

D1 1.1.3.2.11 Work related to shop-painting and on-site touch-up after the completion of erection, including the bolts and connections. Refer to Section 09 90 00.

1.1.3.2.12 All inspections, tests and controls necessary for the follow-up of the quality control program.

1.1.3.2.13 As-built drawings.

1.1.3.2.14 Final clean-up of the site.

1.2 RELATED SECTIONS

1.2.1 Section 05 50 10: Miscellaneous Steel & Embedded Parts.

1.2.2 Section 01 35 43: General Environmental Requirements.

1.2.3 Section 03 11 00: Concrete Formwork

1.2.4 Section 03 20 00: Cast-in-Place Concrete

1.2.5 Section 03 60 40: Grout.

D1 1.2.6 Section 48 13 10: General Mechanical Requirements.

1.2.7 Section 48 13 24 Hoists and Cranes

D1 1.2.8 Section 09 90 00: Paint System for Structural Steel.

1.3 DEFINITIONS

1.3.1.1 LEED: Leadership in Energy and Environmental Design.

1.3.1.2 VDR: Vendor Data Requirements Form.

1.3.1.3 SDRL: Supplier Document Requirements List.

1.3.1.4 OSHA: Occupational Safety and Health Administration

1.3.1.5 VOC: Volatile Organic Compound.

1.3.2 Structural components: Consists of rolled structural shapes, welded wide flange shapes, hollow structural sections, rods, bars and plates as described in CISC Handbook of Steel Construction.

1.3.3 Connecting material: Consists of welds, fasteners, splice plates, cleats, brackets, gussets, stiffeners, end connections, base plates, bearing plates, and other related items.

1.4 REFERENCES

1.4.1 The Contractor shall comply with the rules and provisions of the listed Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

D1 1.4.2 All work shall be accordance with this specification and the requirements of the following codes and standards:

D1 1.4.3 Canadian Standard Association (CSA)

CSA A23.1-09/A23.2-09	Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete
CSA G30.18-09	Carbon Steel Bars for Concrete Reinforcement
CSA G40.20-04/G40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
CSA G189-1966 (R2003)	Sprayed Metal Coatings for Atmospheric Corrosion Protection
CSA S16-09	Design of Steel Structures
CAN/CSA S136-07	North American Specification for the Design of Cold-Formed Steel Structural Members
CSA W59-03 (R2008)	Welded Steel Construction (Metal Arc Welding)
CSA W48-06	Filler Metal and Allied Materials for Metal Arc Welding
CSA W47.1-03 (R2008)	Certification of Companies for Fusion Welding of

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	Steel
CSA W55.3-08	Certification of Companies for Resistance Welding of Steel and Aluminum
CSA W178.1-08	Certification of Welding Inspection Organizations
CSA W178.2-08	Certification of Welding Inspectors

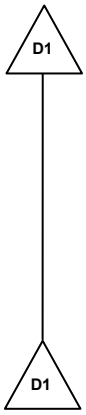
1.4.4 Canadian General Standard Board (CGSB)

CAN/CGSB-1.181-99	Ready-Mixed Organic Zinc-Rich Coating
CAN/CGSB-48.9712-2006	Non-destructive Testing - Qualification and Certification of Personnel

1.4.5 American Society for Testing and Materials (ASTM)

ASTM A108-07	Specification for Steel Bar, Carbon and Alloy, Cold Finished
ASTM A36-08	Standard Specification for Carbon Structural Steel
ASTM A123A/A123M-12	Standard Specification for Zinc (Hot Dipped Galvanized) Coatings On Iron and Steel Products
ASTM A153/A153M-09	Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM A194/A194M-11	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A325-09	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A384/A384M-07	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies

ASTM A490-12	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A500/A500M-10a	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563-07a	Standard Specification for Carbons and Alloy Steel Nuts
ASTM A653/A653M-11	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A759-10	Standard Specification for Carbon Steel Crane Rails
ASTM A780/A780M-09	Standard practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
ASTM C1107/C1107M-11	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
ASTM D695	Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic and Electrical Insulating Materials
ASTM D2240	Standard Test Method for Rubber Property-Durometer Hardness
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM E165-09	Standard Test Method for Liquid Penetrant Examination
ASTM E433-71(R2008)	Standard Reference Photographs for Liquid Penetrant Inspection
ASTM E709-08	Standard Guide for Magnetic Particle Testing



ASTM F436-11	Standard Specification for Hardened Steel Washers
ASTM F1554-07a	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

1.4.6 Other Codes, references and organizations

AISC Design Guide 7-2004	American Institute of Steel Construction, Steel Design Guide Industrial Buildings- Roofs to Anchor Rods, 2nd ed.
NBC 2010	National Building Code of Canada 2010 and the Supplement to the National Building Code of Canada
CISC Handbook	Handbook of Steel Construction, 10th edition, Canadian Institute of Steel Construction
CSSBI	Canadian Sheet Steel Building Institute
CWB	Canadian Welding Bureau
SSPC	Steel Structures Painting Council
OSHA	Occupational Safety and Health Administration
CISC/CPMA 1-73a	Colour, Pigments Manufacturers Association – “A Quick-drying One-coat Paint for Use on Structural Steel”
ISO 9001:2008	Quality Management Systems - Requirements

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1.4.7 Where there are conflicts between or within the Specifications, Drawings, Codes, Standards or Acts, the most stringent requirements shall be applied.

1.5 SITE CONDITIONS

1.5.1 The Contractor is responsible for verifying all dimensions, elevations and conditions on site prior to the execution of the work, including shop drawings and fabrication.

1.5.2 Any deviations, errors and site conditions which could adversely affect proper completion of the work shall be immediately reported to the Engineer for corrective action before preparing shop drawings.

1.5.3 Adequate provisions shall be made in order to protect existing structures, roads, utilities and other property against damage and to avoid interference with other contractors and plant operations.

1.6 QUALITY ASSURANCE

1.6.1 The Contractor shall comply with an inspection program in conformance with ISO 9001:2008 requirements or equivalent.

1.6.2 The Engineer shall monitor the submitted quality control program, inspection and testing.

1.6.3 The Engineer reserves the right to inspect work at the fabrication plant at any time during the normal working hours.

1.6.4 Quality of work shall be controlled to meet the requirements of this Specification the referenced codes and standards, and other contract documents in effect on the date of the contract.

1.6.5 The Contractor shall obtain and retain Certificates of Compliance for all products listed in Part 2 for the Engineer's review, when requested.

1.6.6 Certifications

1.6.6.1 The Contractor shall be certified by the CWB according to the requirements of CSA W47.1, Division 1 or Division 2, in accordance with CSA S16.

1.6.7 Substitutions

1.6.7.1 Substitution for a specified element shall only be considered if the element is not available or if it results in an improved detail or easier erection. The Engineer reserves the right to accept or reject any proposed substitution

1.6.7.2 Substitutions shall receive written approval from the Engineer prior to being enacted.

1.7 SUBMITTALS

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1.7.1 The Contractor shall submit the required documentation to the Engineer for review and approval, in accordance with the Supplier Document Requirement List (SDRL).

1.7.2 The Contractor shall submit the following to the Engineer for review and acceptance:

1.7.2.1 Not Used.

1.7.2.2 Not Used.

1.7.2.3 Certificates of the Contractor welders, pointers and welding machine operators.

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1.7.2.4 Certificates for the inspectors in conformance with CSA W178.2.

1.7.2.5 Welding procedures for shop welds. Procedures for field welding, if applicable, shall also be submitted.

1.7.2.6 Field-bolting inspection procedure.

1.7.2.7 Design calculations for all connections not detailed on the drawings.

1.7.2.7.1 Design calculations shall bear signature and seal of a qualified Professional Engineer registered in the Province of Newfoundland and Labrador.

1.7.2.7.2 Design calculations shall bear signature of a verifier who is a qualified Professional Engineer registered in the Province of Newfoundland and Labrador.

1.7.2.8 Shop and erection drawings including steel deck, placing drawings and bills of material with bolt lists.

1.7.2.8.1 Shop drawings shall indicate the quantities, locations, top of steel elevations, spacing, sizes, profiles, steel grade, connections, including symbols and dimensions of welded joints, attachments, fasteners, spacing of the fasteners for steel decking, paint system and piece marks of members. Any requirements for edge preparation for welds or machining requirements shall be clearly indicated.

1.7.2.8.2 Shop drawings shall include details of holes and fittings in components necessary for safety or to provide lifting and erection aids, as required.

1.7.2.8.3 Shop drawing shall include a bill of material showing member piece marks, shape designations, number of pieces required, length, unit weight, total weight of each member, total weight of steel detailed on that drawing. It shall make reference to contract number, contract item number and related design drawing number.

1.7.2.8.4 Shop drawings shall be submitted only when their related design calculations have been reviewed.

1.7.2.8.5 Shop and erection drawings shall bear signature and seal of a qualified Professional Engineer registered in the Province of Newfoundland and Labrador. They shall also bear signature of a verifier.

1.7.2.8.6 Detailing shall conform to the CISC Handbook.

D1 1.7.2.8.7 Not Used.

1.7.2.8.8 Erection drawings shall show piece marks, locations and details of field connections of members. They shall also indicate all A325 and A490 field bolts that need to be fully tensioned, in accordance with this specification and the drawings.

1.7.2.8.9 Shop drawings shall also include details of all additional reinforcing, bracing or stiffening members that may be required for erection purposes.

1.7.2.9 Mill test certificates for all steel components. The Contractor is responsible for the correlation between the actual material used and the corresponding mill test certificates.

1.7.2.10 Quality control and test reports, including radiographic films.

D1 1.7.3 Not Used.

1.7.4 The Contractor shall submit stamped as-built drawings to the Engineer, after the completion of the work.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 All materials to be supplied for the permanent works shall be new and be subject to Engineer's approval. Except as otherwise specified herein, shown on the drawings, or otherwise approved, the materials shall conform to the standards listed hereafter.

2.2 STEEL

Rolled W and WT sections, WWF, Built-up sections	CSA G40.20/G40.21, Grade 350W
Built-up sections for crane girders	CSA G40.20 / G40.21, Grade 350 WT, Category

including the stiffeners	2
Steels exposed to the weather	CSA G40.20/G40.21, Grade 350WT, Category 4
D1 Hollow structural steel section	ASTM A500, Grade C, f_y=345 MPa
Rolled plates	CSA G40.20/G40.21, Grade 350W, as indicated on the drawings
Rolled C, MC, S, L sections	CSA G40.20/G40.21, Grade 300W
Sag rods	CSA G40.20/G40.21, Grade 300W
Shear connectors (“Nelson” Type)	ASTM A108, Grade C-1010/Grade 60 ksi minimum
Rails	ASTM A759, type as shown on the drawings
Rail clips and links	Refer to drawings
Steel deck	ASTM A653-Grade 33 ksi with zinc thickness conforming to Z275
Welding materials	CSA W48, E49xx
Bolts	ASTM A325 or ASTM A490
Nuts	ASTM A563
Washers	ASTM F436
D1 Anchor bolts	ASTM F1554, Grade 55 ksi minimum. Unless otherwise noted (UNO)
D1 Rebar anchor bolts	Steel: CAN/CSA G30.18M Grade 400W. Threaded with Washer and Nuts
Concrete anchors	HILTI type hot dip galvanized, expansion or chemical adherence or as indicated on the drawings

Gratings	National Association of Architectural Metal Manufacturers (NAAMM) and CSA G40.20/G40.21, Grade 250W
Guardrails	ASTM A53, Grade 240 MPa

2.3 PROTECTIVE COATINGS

2.3.1 The Contractor shall submit documentation of proposed Materials to the Engineer. Materials shall be of first grade and used strictly in accordance with the Technical Conditions and the manufacturer's written directions.

D1

2.3.2 For protective coatings, refer to Section 09 90 00 – Paint System for Structural Steel, and Section 48 13 10 – General Mechanical Requirements.

2.4 GROUT

D1

2.4.1 Grout for column base plates and beam bearing plates shall be non-ferrous, non-shrink, with a minimum compressive strength of 50 MPa at 28 days, unless noted otherwise on the drawings as Specified in Section 03 60 40.

2.4.2 Structural steel shall be installed at the proper elevation by using packs of levelling steel shims. Typical installation details shall be submitted to the Engineer for approval.

2.4.3 The use of levelling nuts under the base plates is not an acceptable practice.

2.4.4 Prior to placing the grout, the space underside the base plates shall be cleaned. The Grout shall be prepared and installed following the instructions of the Manufacturer. The shear pockets shall be attentively inspected to ensure they are not filled with water or ice.

2.4.5 Not Used.

PART 3 EXECUTION

3.1 DESIGN

D1 3.1.1 Structural analysis, design, erection and related steelwork shall be in accordance with this Specification, CSA S16 and the CISC Handbook.

3.1.2 Shop fabrication drawings shall be made based on design structural drawings marked "Issued for Construction".

3.1.3 Steel shall be marked in compliance with CSA S16 and CSA G40.20/G40.21.

3.1.4 Connections not detailed or otherwise noted on the drawings shall be shop welded or field bolted.

3.1.5 No field welding is permitted unless specified on the drawings, or as approved by the Engineer.

D1 3.1.6 Design calculations and drawings shall bear the seal of a qualified Professional Engineer registered in the Province of Newfoundland and Labrador.

3.1.7 Eccentric connections shall not be used unless it is impossible to detail a concentric connection.

3.1.8 Welds shall be designed in accordance with CSA W59 using the electric arc-welding methods.

3.1.9 Connection design detail shall avoid lamellar tearing problems.

3.1.10 Steel plates subjected to tension perpendicular to the plate surface shall be verified for through thickness properties.

3.1.11 Bolted connections shall be, unless indicated otherwise on the drawings:

3.1.11.1 Designed of the bearing-type, assuming threads are included in shear planes;

3.1.11.2 Designed using high strength bolts, minimum diameter of ¾ inch, conforming to ASTM A325 or ASTM A490, using a minimum of 2 bolts per connection for angles and minimum 4 bolts for tees and HSS;

3.1.11.3 Tightened in accordance with CSA S16;

3.1.11.4 The bolts shall be black, excepted where indicated otherwise.

3.1.11.5 Bolts shall be touched-up using the paint system applied to the connected members.

D1 3.1.12 Slip-resistant-type connections shall be provided when required by the analysis, only for members or connections having alternate forces and shall be designed assuming Class A contact for surfaces, unless noted otherwise on the drawings. The bolts of slip-resistant connections shall be pre-tensioned in accordance with CSA S16.

D1 3.1.13 Connections shall be designed for actual load as determined by analysis, but shall meet the following minimum criteria:

D1 3.1.13.1 For the simply supported beams, the connections shall be designed for a shear equal or greater than 75% of the total uniform distributed load corresponding to the member capacity in bending, for the beam span shown and considering the beam laterally supported.

3.1.13.2 For fixed beams, the connection shall be designed for 100% of the member bending capacity, in addition to the shear required.

3.1.14 Beam connections shall be designed as shown on the drawings. When not shown on the drawings, the beam connections shall be designed using either end plate or a pair of clip angles. A minimum thickness of 7, 9 mm shall be used for angles, a minimum thickness of 12 mm for end plates with a minimum of 6 mm for filet welds. The connections shall be developed on minimum 75% of the beam depth.

3.1.15 In addition, the beam connections shall be designed also for the axial load shown on the drawings.

3.1.16 Struts and ties shall be connected for a minimum tension force of 100 kN, unless otherwise noted on the drawings.

D1 3.1.17 Bracing including strut and tie connections shall develop the forces indicated on the drawings but not less than the probable tensile resistance, probable compressive resistance or forces corresponding to $R_d.R_0 = 1.3$ (CSA S16-09, Sections 27.1.2 and 27.5.4.2).

3.1.18 Analysis and design of Hoist Towers and Hoist Support Beams include loads and loading combinations as described in Section 48 13 21 Hoists and Cranes.

3.2 FABRICATION

3.2.1 The start of fabrication shall be authorized by the Engineer. Authorization to proceed shall be interpreted as agreement of the Engineer with general conformity to specification and design drawings only and shall not imply verification of dimensions, sizes, or quantities.

3.2.2 Steelwork shall be fabricated in accordance with CSA S16 and the shop drawings. Provisions of CSA S16 Clause 28, “Shop and Field Fabrication and Coating”, shall apply unless otherwise specified.

3.2.3 Components shall be fabricated such as to result in pieces as large as practicable that satisfy transportation clearances. Special measures for road or naval transportation have to be considered.

3.2.4 The dimensions shown on the drawings for the structural steel members are for 23 ºC. The Contractor shall apply corrections for the steel dimensions depending on the effective temperatures at the fabrication time.

3.2.5 Members shall be cambered as shown on the drawings.

3.2.6 Built-up members shall be shop-fabricated within the tolerances of CSA S16, unless specified otherwise on the drawings.

3.2.7 Column splices and column base plate connections shall have a full bearing by milling and shall be in contact all over their intended contact surfaces, unless indicated otherwise on the drawings.

3.2.8 Splices not shown on drawings shall be submitted by the Contractor for review prior to fabrication.

3.2.9 Each steel member shall be marked and referenced on the erection drawings.

D1 3.2.10 Not used.

3.2.11 Provide weld preparation where required for field welded connections and supply clips for fit-up and erection.

3.2.12 Nelson studs shall be welded complete penetration at the shop, unless indicated otherwise on the drawings, in accordance with the requirements of CAN/CSA W59.

3.2.13 Open ends of HSS sections shall be sealed with 6 mm minimum cap plates, unless noted otherwise on drawings. 12 mm diameter venting holes shall be provided. These holes shall be at the member extremities and located in order to avoid any water entrapment inside the tubes.

3.2.14 Rough welds, sharp edges and corners shall be ground smooth and all weld spatters shall be removed.

3.2.15 Welds for galvanized steel shall be seal welded.

3.2.16 Hammer welding shall not be permitted.

3.2.17 Minimum cope radius shall be 20 mm, except where impracticable. Cope radius shall be ground to remove the visible heat affected zone and to create a smooth radius, free of nicks and notches.

3.2.18 Surface treatment shall be as follows:

3.2.18.1 Structural steel shall be painted, except as otherwise noted.

D1 3.2.18.2 Not Used.

3.2.18.3 Primed surfaces around connections shall be painted on site after final tightening of the bolts.

3.2.18.4 Bolts, nuts and washers shall be galvanized only for the connections of galvanized steels, unless noted otherwise.

D1 3.2.19 Refer to Section 09 90 00 Paint System for Structural Steel and Section 48 13 10 – General Mechanical Requirements for preparation of steel to be painted.

3.2.20 Refer to the “Galvanizing” article of this Section for preparation of steel to be galvanized.

D1 3.2.21 Refer to the “Quality Control” article of this Section for the inspection of bolting, welding and studs.

3.2.22 Unless noted otherwise, steel deck shall be:

3.2.22.1 of the type indicated on the drawings;

3.2.22.2 galvanized in accordance with ASTM A653, zinc thickness Z275;

3.2.22.3 in accordance with CAN/CSA S136 and the CSSBI recommendations;

3.2.22.4 supplied with mechanical connections, sheets, closure plates and pour stops.

3.2.23 The steel decking members shall span a minimum of 3 spans, unless noted otherwise on the drawings.

3.2.24 Each decking member shall be identified with a shipping mark as shown on the fabrication and erection drawings.

3.2.25 Final steelwork shall be free from distortion and defects detrimental to the appearance and/or the performance, to the Engineer's satisfaction.

3.3 PROTECTIVE COATINGS

D1 3.3.1 Steel painting shall be in accordance with Section 09 90 00, Section 48 13 10, CSA S16, the paint Manufacturer's instructions and the applicable SSPC requirements.

D1 3.3.2 to 3.3.17 Not used.

3.4 GALVANIZING

3.4.1 Steels specified to be galvanized, including bolts, nuts and washers, shall conform to ASTM A123/A123M and ASTM A153/A153M.

3.4.2 The galvanization of steels shall be done in one immersion.

3.4.3 In the event that steels specified to be galvanized exceed the dimensions of the immersion tanks available, those sections including their connecting bolts and washers, may be protected by metallization following prior approval of the Engineer. This procedure shall conform to CSA G189, with a minimum zinc protection thickness of 0.1 mm, which corresponds to 700 g/m ^{2}. The metallization using a protection with aluminum is not acceptable.

D1 3.4.4 All steels which are required to be galvanized shall have continuous seal welding all around their contact. The minimum welding dimension shall be 3 mm where capacity is not required for connection strength.

3.4.5 Before galvanizing, all weld spatter, rough welds, or sharp protrusion shall be removed by chipping and grinding. All welds shall then be sandblast cleaned in accordance with SSPC-SP10 "Near-white Blast Cleaning". The remaining surfaces shall be thoroughly

cleaned of all loose mill scale, rust, oil, grease and weld flux deposits in accordance with SSPC-SP6 “Commercial Blast Cleaning”.

3.4.6 Minimum quantity of galvanizing shall be 460 g/m^2 for nuts and bolts and 700 g/m^2 for all other parts, except steel wires.

3.4.7 Bolted connections for galvanized steels shall be made with galvanized bolts in accordance with ASTM A325. Washers and nuts shall have a compatible class and finish to the bolt finish as specified in ASTM A325.

D1 3.4.8 Nuts shall be re-tapped after being galvanized and the threads of nuts left bare in accordance with ASTM A153/A153M-09.

3.4.9 Bolts conforming to ASTM A490 shall not be galvanized, by any method.

3.4.10 Welded connections of already galvanized steel components are not accepted.

3.4.11 Material shall be galvanized after all the fabrication, machining and shop work is completed, except as otherwise specified herein.

3.4.12 Appropriate measures shall be taken in order to ensure that frames or similar items of steelwork are not distorted during the galvanizing process, in accordance with ASTM A384 requirements. In this regard, submit to the Engineer details of all proposed additional reinforcement, bracing or otherwise stiffened metalwork for approval prior to proceeding with the relevant work.

3.4.13 The coating shall be clean, smooth and free from defects. Bare spots, loosely attached spelter, unevenness of coating and globules which may be broken in handling, shall be cause for rejection. If more than 5 percent of material is rejected, manufacture shall be stopped and the process altered so that satisfactory work could be produced.

3.4.14 Galvanizing inspection shall be as described in the “Quality Control” section of this Specification. Galvanization work found to be defective shall be corrected.

D1 3.4.15 Galvanized surfaces damaged during transportation, handling and installation shall receive two coats of “Galvano Spray 70-45” by METAFLUX.

3.5 TRANSPORTATION, HANDLING AND STORAGE

3.5.1 The Engineer shall give a written approval for each delivery on site.

3.5.2 Federal, Provincial or Municipal transportation bylaws shall be respected.

3.5.3 Steelwork shall be handled and protected adequately for transportation and storage in order to avoid any damage. It shall be strengthened if needed.

3.5.4 Delivery slip shall have piece identification, description and dimensions.

3.5.5 Painted or galvanized surfaces shall not be stacked face to face. Wood blocks, polystyrene padding or other suitable materials shall be used as separator.

3.5.6 Nylon-type slings shall be used for lifting. Where it is necessary, lifting beams or cradles shall be used.

3.5.7 Steel shall be securely fastened with chains and blocking to transportation vehicle in order to prevent lateral movement. The edges of steelwork shall be protected with rubber, hessian or wood.

3.5.8 Small bundled sections shall not be loaded inside larger components.

3.5.9 Bolts, nuts and washers shall be shipped in metallic packaging and coated with protective oil. Bolts of different length or diameter shall be separated in several containers or bags, each one containing only identical type of pieces. All containers shall be properly labelled.

3.5.10 Wood blocks of convenient size shall be provided in order to ensure that the steel rests clear of ground, does not accumulate water and does not distort permanently.

3.5.11 Steel shall be unloaded at the designated location. Proper equipment and labour shall be employed to unload onto wood blocks without damage.

3.6 INSTALLATION

3.6.1 Stability

D1

3.6.1.1 It is the Contractor's responsibility to determine construction procedures and sequence to ensure the integrity of the structure and its components during erection. This includes the addition of necessary and adequate shoring, sheeting, temporary bracing and other temporary structures required to resist all construction loads and additionally to comply with the provisions of the OHSA.

3.6.1.2 Temporary bracings shall be maintained in place if the permanent stability of the structure depends on work of other trades, until that work is completed.

3.6.2 Erection

3.6.2.1 Unless otherwise noted herein, the structural steel shall be erected in accordance with this Specification, CSA S16, AISC-7, article 6.7.3 of CSA A23.1/A23.2, the CISC Code of Standard Practice and the approved erection drawings.

3.6.2.2 Alignment shall be in accordance with CSA S16 and as indicated on the drawings.

3.6.2.3 The Engineer shall approve any field cutting or altering of structural members not shown on the drawings.

3.6.2.4 Prior to final tightening of the bolted connections:

3.6.2.4.1 Each section of structure shall be plumbed and aligned;

3.6.2.4.2 Members shall be aligned and free of distortions and open joints.

3.6.2.5 Expansion and chemical anchors connecting loose steel to concrete work shall be installed where indicated on the drawings, according to Manufacturer's instructions.

3.6.2.6 No part of any new or existing structure shall be subject to erection loads which could in any way damage or cause permanent distortion to that part or any other part of the structure.

3.6.2.7 Any damage to the structural steel, including coating or errors in alignment or location shall be corrected.

3.6.2.8 Erection tolerance and inspection shall be as described in the "Quality Control" section of this Specification or as indicated on drawings.

3.6.3 Bolting

3.6.3.1 High-strength bolts shall be used for connections, unless indicated otherwise on the drawings.

3.6.3.2 For slip-resistant type connections, high strength bolts shall be pre-tensioned using turn-of-nut method in accordance with CSA S16 article 23.8.

3.6.3.3 Hardened washer shall be used under each nut.

3.6.3.4 All joint surfaces, including those adjacent to bolt heads and nuts, shall be free of burrs, dirt and other foreign material that inhabit solid seating of parts.

3.6.3.5 Do not drive drift pins with such force as to deform adjacent metal.

3.6.3.6 Drill any bolt holes missing from fabricated steel. Do not enlarge or make any hole by flame cutting.

3.6.3.7 Bolting inspection shall be as described in the “Quality Control” section of this Specification.

3.6.4 Field Welding

3.6.4.1 Field welding shall be:

3.6.4.1.1 Used only where shown on the drawings or as approved by the Engineer;

3.6.4.1.2 In accordance with CSA W59;

3.6.4.1.3 Executed by welders certified in accordance with CSA W59 and CSA W47.1.

3.6.4.2 Welding inspection shall be as described in the “Quality Control” section of this Specification.

3.6.5 Base Plates

3.6.5.1 Column base plates and beam bearing plates shall be set, shimmed levelled to correct positions and elevation shown on the drawings, subjected to the same quality control as described in the “Erection” section above.

3.6.5.2 The final position of the base plates shall be approved by the Engineer.

3.6.5.3 Any temporary support shall carry all construction loads imposed prior to base plate grouting.

3.6.5.4 The base plate grout shall:

3.6.5.4.1 Be placed after final alignment and levelling of the structure;

3.6.5.4.2 Be placed on and under surfaces thoroughly cleaned and free from grease, oil, laitance, sawdust and other deleterious matter;

3.6.5.4.3 Be mixed, placed, cured and finished in accordance with the grout Manufacturer’s instructions;

3.6.5.4.4 Be placed to cover the full area under base plates, completely surrounding anchor bolts, and filling cavities of shear pockets and sleeves;

3.6.5.4.5 Be sloped at 45° outside the perimeter of the base plate, or have an equivalent base dimension.

3.6.5.5 The anchor bolts of the columns shall be tightened to snug tight condition, after the grout has reached its full strength. After the completion of the structural steel erection, the anchor bolts shall be retightened in order to obtain the pretension in rods as required on the drawings.

3.6.6 Steel Deck

3.6.6.1 Steel deck shall be installed in accordance with CSSBI requirements and the approved shop drawings.

3.6.6.2 Closure plates shall be provided and fixed with screws.

3.6.6.3 Steel deck shall be cut in shop following the shop drawings. Minor cuts may be done on Site at small openings.

3.6.6.4 The roof deck shall be continuous on minimum 3 spans and the lapping in the longitudinal direction shall be of minimum 50 mm.

3.6.6.5 The connections of the deck on structural steel shall be using self-tapping screws 6 mm diameter, installed at 305 mm maximum interval, unless noted otherwise on the drawings.

3.6.6.6 For the ends of steel deck on the building perimeter, the maximum interval between the self-tapping screws shall be 152 mm.

3.6.6.7 The wind suction and pressure, as per NBC and Site conditions, will be given on drawings by the Engineer. On this basis the Contractor shall determine the required interval between connectors, depending on the connector capacity.

3.6.6.8 Steel deck connection on the structural steel by welding will be allowed only if it is specified on the drawings. In this case, the welding shall be in accordance with CSA W59.

3.6.6.9 The overlapping joints, on lateral sides, shall be mechanically fastened at 450 mm intervals, unless noted otherwise on the drawings.

3.6.6.10 Touch-up, wherever necessary, shall be done after the completion of work.

3.6.7 Errors and Misfit

3.6.7.1 Fabrication errors discovered during erection shall be reported to the Engineer along with proposed correction methods.

3.6.7.2 Minor misfit shall be corrected by reaming, cutting and chipping as part of work as approved by the Engineer.

3.6.7.3 Flame cutting shall only be allowed on secondary members with written approval from the Engineer.

3.6.7.4 Cut edges shall be ground and painted or galvanized to match the surrounding finish.

3.6.7.5 Fitting up bolts or drift pins shall not be used to bring improperly fabricated members together.

3.6.7.6 Shims, packing or wedging shall not be used to correct imperfect work without written approval of the Engineer.

3.6.8 Touch-ups

3.6.8.1 After installation, all field bolts, welds and any surface areas where the shop coat has been damaged during transportation, handling and installation, shall be cleaned, primed and repaired to its original state.

3.6.8.2 Refer to the article 3.3 “Protective Coating” of this Specification Section for touch-up of painted steel.

3.6.8.3 Refer to the article 3.4 “Galvanizing” of this Specification Section for touch-up of galvanized steel.

3.6.8.4 During touch-up on the work site, equipment and floors shall be protected against spray splash or drops of paint or zinc products. All stains or spilled products on equipment, floors and walls shall be cleaned.

D1

3.6.8.5 Refer to Section 09 90 00 – Paint System for Structural Steel for touch-up of the Structural Steel connections and areas next to the supports of steel beams.

3.6.9 Final Clean-up

3.6.9.1 Clean-up work site, remove all debris, shelters, equipment and surplus material prior to final acceptance of work.

3.7 QUALITY CONTROL, INSPECTION AND TESTING

3.7.1 Welds

3.7.1.1 Inspection and testing of welding shall conform to CSA W59 using non-destructive test methods.

3.7.1.2 Inspections and non-destructive tests shall be made by inspectors registered in conformance with CSA W178.2.

3.7.1.3 Inspection and testing of studs shall conform to CSA W59.

3.7.1.4 Test of welds shall be performed as indicated in the following table.

Weld Type	**Inspection**	**Level of Inspection**
Complete joint penetration groove welds in tension (Butt joint)	Radiographic	100% of the length of each weld
Complete joint penetration Groove Weld in compression or shear (Butt joints)	Radiographic	50% of the length of each weld
Fillet Welds in tension members	Magnetic	For each element, 100% of the length of each weld
Fillet Welds (others)	Magnetic	For each element, 25% of the length of each weld
Complete joint penetration groove welds in tension members	Ultrasonic	100% of the length of each weld
Complete joint penetration groove welds in compression or shear members	Ultrasonic	For each element, 50% of the length of the weld

3.7.1.5 Faulty welding shall be repaired as specified in CSA W59.

3.7.1.6 If faults exceeding the provision of CSA W59 are found, then 100% of the welding length shall be tested. Make repairs and retest repaired areas; if faults found in repaired areas, repair and retest until no faults occur.

3.7.2 Bolted Connections

3.7.2.1 Inspection of high-strength bolted connections shall conform to CSA S16.

3.7.3 Painting

D1 3.7.3.1 Refer to Section 09 90 00 – Paint System for Structural Steel.

D1 3.7.3.2 to 3.7.3.6 Not used.

3.7.4 Galvanizing

3.7.4.1 Testing shall conform to the requirements of ASTM A123A/A123M-12.

3.7.4.2 During galvanizing, the Engineer may carry out tests on the coating and analysis of the spelter, as considered necessary.

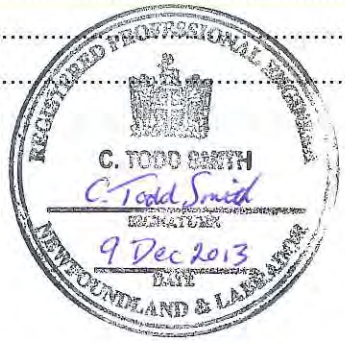
3.7.5 Erection

3.7.5.1 Tolerance, inspection and checking of structure for alignment, plumbness and elevation shall conform to the most stringent of CSA S16 and Chapter 19 of AISC-7, unless indicated otherwise on the drawings.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 05 50 10
CH0032	**MISCELLANEOUS METALS AND EMBEDDED PARTS**	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 05 50 10
MISCELLANEOUS METALS AND EMBEDDED PARTS
TABLE OF CONTENTS



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MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

PART 1 GENERAL

1.1 SCOPE OF WORK

D1

The work described in this Specification includes all labour, material, equipment, inspection and testing for the connection design, preparation of shop drawings, supply, fabrication, galvanizing, transportation to site and installation of the miscellaneous metals and embedded parts shown on the “Miscellaneous Steel” and/or Concrete drawings.

The design, fabrication and installation of miscellaneous steel shall conform to this Specification and to CSA S16. However, the requirements of this specification supersedes the corresponding ones of Standard CSA S16.

1.1.1 Work Included

.1 This specification applies to all operations associated with, but not necessarily limited to, the following:

.1 Supply, fabrication, delivery, storage and installation of miscellaneous metals, embedded items and anchor bolts;

.2 Preparation and submittal of detailed shop drawings and erection drawings;

.3 Furnish welding materials and perform field and shop welding;

.4 Preparation, painting and furnish coating materials including cleaning and touch-up after fabrication;

.5 Clean and shop galvanize all embedded steel and anchor bolts, if indicated on the drawings;

.6 Supply all necessary equipment and maintenance thereof to perform the work outlined in this specification;

.7 Inspection and testing.

1.2 RELATED SECTIONS

.1 Section: 01 35 43 General Environmental Requirements

.2 Section: 03 11 00 Concrete Formwork

.3 Section: 03 20 00 Concrete Reinforcement

.4 Section: 03 60 40 Grout

.5 Section: 03 30 00 Cast-In-Place Concrete

.6 Section 09 90 00 Paint System for Structural Steel

D1 .7 Section 48 13 10 General Mechanical Requirements

1.3 DEFINITIONS

SDRL: Supplier Documentation Requirement List

VDR: Vendor Documentation Requirement Form

MSDS: Material Safety Data Sheets

OSHA: Occupational Safety and Health Administration

1.4 REFERENCES

The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.4.1 All work shall be in accordance with this specification and the requirements of the following codes and standards:

1.4.2 Canadian Standard Association (CAN/CSA):

CSA A23.1-09/A23.2-09	Concrete Materials & Methods of Concrete Construction / Test Methods & Standard Practices for Concrete
CSA G30.18-09	Carbon Steel Bars for Concrete Reinforcement

CSA G40.20-04/G40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
CSA G189-1966 (R2003)	Sprayed Metal Coating for Atmospheric Corrosion Protection
CSA S16-09	Design of Steel Structures
CAN/CSA S136-07 (R2012)	North American Specification for the Design of Cold-Formed Steel Structural Members
CAN/CSA S157/S157.1-05 (R2010)	Strength Design in Aluminum and Commentary
CSA W59-03 (R2008)	Welded Steel Construction (Metal Arc Welding)
CSA W48-06	Filler Metal and Allied Materials for Metal Arc Welding
CSA W47.1-09	Certification of Companies for Fusion Welding of Steel
CSA W47.2--11	Certification of Companies for Fusion Welding of Aluminum
CSA W55.3-08	Certification of Companies for Resistance Welding of Steel and Aluminum
CSA W178.1-08	Certification of Welding Inspection Organizations
CSA W178.2-08	Certification of Welding Inspectors

1.4.3 Canadian General Standards Board (CGSB):

CAN/CGSB-1.132-M90	Zinc Chromate Primer, Low Moisture Sensitivity

1.4.4 American Society for Testing and Materials (ASTM):

ASTM A36-08/A36M-08	Standard Specification for Carbon Structural Steel
ASTM A53-10/A53M-12	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A108-07	Specification for Steel Bar, Carbon and Alloy, Cold finished
ASTM A123/A123M-12	Standard Specification for Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M-09	Standard Specification for Zinc Coating (Hot Dip) on Iron And Steel Hardware
ASTM A240-11/A240M-12	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A325-10/A325M-9	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength / Metric
ASTM A384/A384M-07	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A413/A413M-07	Standard Specification for Carbon Steel Chain
ASTM A500/A500M-10a	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563-07a	Standard Specification for Carbons and Alloy Steel Nuts
ASTM A572/A57-127	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A653/A653M-11	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780-09	Standard practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
ASTM B209/A209M-03(R07)	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221/B221M-12	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B308/B308M-10	Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles

ASTM B429/B429-10	Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM D1730–09	Standard Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting
ASTM E165-09	Standard Practice for Liquid Penetrant Examination for General Industry
ASTM E433-71(2008)	Standard Reference Photographs for Liquid Penetrant Inspection
ASTM E709-08	Standard Guide for Magnetic Particle Testing
ASTM F436/F436M-11	Standard Specification for Hardened Steel Washers
ASTM F1554-07a	Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength

1.4.5 Other Codes, references and organizations:

NBC 2010	National Building Code of Canada 2010 and the Supplement to the National Building Code of Canada
OHSA	Occupational Health and Safety Act, Newfoundland and Labrador
CISC Handbook	Handbook of Steel Construction, 9th edition, Canadian Institute of Steel Construction
CSSBI	Canadian Sheet Steel Building Institute
CWB	Canadian Welding Bureau
SSPC	Steel Structures Painting Council
ISO 9001:2008	Quality Management System Requirements

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1.5 SITE CONDITIONS

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1.5.1 The Contractor is responsible for verifying all dimensions, elevations and conditions on site prior to the execution of his shop drawings.

D1 **1.5.2** The Contractor is responsible to inspect and verify that finish of surfaces on primary concrete are satisfactory prior to installation of second stage embedments.

D1 **1.5.3** Any deviations, errors and site conditions which could adversely affect proper completion of the work shall be immediately reported to the Engineer for corrective action before preparing shop drawings.

1.6 QUALITY ASSURANCE

1.6.1 The Contractor shall comply with a quality assurance/quality control program in conformance with ISO 9001:2008 requirements or equivalent.

1.6.2 The Contractor shall monitor the submitted quality control program, inspection and testing.

1.6.3 The Engineer reserves the right to inspect work at the fabrication plant at any time during the normal working hours. Provisions shall be made for such inspection, when requested.

1.6.4 Quality of work shall be controlled to meet the requirements of this specification, referenced codes and standards and other contract document in effect on the date of contract

1.6.5 The Contractor shall obtain and retain Certificates of Compliance for all products listed in Part 2, for the Engineer's review, when requested.

1.6.6 Certifications

.1 The Contractor shall be certified by the CWB according to the requirements of CSA W47.1 Division 1 or Division 2, in accordance with CSA S16.

.2 Suppliers of all materials and products shall be certified to ISO 9001:2008 requirements or equivalent.

1.6.7 Substitutions

.1 Complete technical data as to type, composition, strength, quality, finish, capacity, performance characteristics, and other pertinent details will be required to determine the acceptability of a substitute item.

.2 Substitution for a specified element shall only be considered if the element is not available or if it results in an improved detail or easier erection.

D1 .3 Substitutions shall receive written approval from the Engineer prior to being implemented.

1.7 SUBMITTALS

1.7.1 The Contractor shall submit the required documentation to the Engineer for review and approval in accordance with the Supplier Documentation Requirements List (SDRL)

1.7.2 The Contractor shall submit the following to the Engineer, for review::

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.1 Not Used.

.2 Not Used.

.3 Certificates of the welders, pointers and welding machine operators.

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.4 Certificates for the inspectors in conformance with CSA W178.2.

.5 Welding procedures for shop welds. Procedures for field welding, if applicable, shall also be submitted.

.6 Field-bolting inspection procedure.

.7 Design calculations for moment connections and splices, if any, not detailed on the drawings.

.1 Design calculations shall bear signature and seal of a qualified Professional Engineer registered in the Province of Newfoundland and Labrador.

.2 Design calculations shall also bear signature of a verifier who is a qualified Professional Engineer registered in the Province of Newfoundland and Labrador.

.8 Shop and erection drawings, and bills of material with bolt lists.

.1 Shop drawings shall indicate the quantities, locations, top of steel elevations, spacings, sizes, profiles, steel grade, connections, including symbols and dimensions of welded joints, attachments, fasteners, galvanization or paint systems and piece marks of members. Requirements for joint preparation for welds or machining requirements shall be clearly indicated.

.2 Shop drawings shall include details of holes and fittings in components necessary for safety or to provide lifting and erection aids, as required.

.3 Each shop drawing shall include a bill of material showing member piece marks, shape designations, number of pieces required, length, unit weight, total weight of each member, total weight of steel detailed on that drawing. Shop drawings shall make reference to the contract number, contract item number and related design drawing number.

.4 Shop drawings shall be submitted only when their related design calculations have been reviewed and accepted.

.5 Shop and erection drawings shall bear signature and seal of a qualified Professional Engineer registered in the Province of Newfoundland and Labrador. They shall also bear signature of a verifier.

.6 Detailing of steelwork shall conform to the CISC Handbook.

.7 Engineer's drawings may be used as erection drawings, however the title block shall be replaced with a revised title block and the all professional seals shall be removed.

.8 Erection drawings shall show piece marks, locations and details of field connections of members. They shall also indicate all field bolts that need to be pretensioned in accordance with this Specification and the drawings as well as any field welding that may be required.

.9 Shop drawings shall include details of all proposed additional reinforcement, bracing or otherwise stiffened metalwork that may be required for erection purpose.

.9 Mill test certificate for all steel components. The Contractor is responsible for the correlation between the actual material used and the corresponding mill test certificates.

.10 Quality control and test report.

1.7.3 The Contractor shall submit stamped as-built drawings to the Engineer at completion of work.

1.7.4 The Contractor shall submit Material Safety Data Sheets for each product required by OSHA to have an MSDS.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 All materials to be supplied for the permanent works shall be new and be subject to approval.

2.1.2 Except as otherwise specified herein, shown on the drawings or otherwise approved, materials shall conform to the following standards.

2.2 METALS

Aluminum	ASTM B221, ASTM B209, ASTM B308 and ASTM B429. Alloy 6061-T6 temper, unless otherwise indicated on the drawings (reduced strength used for the design of welded parts)
Stainless steel	ASTM A-240, Types 304L or 316L, unless otherwise indicated on the drawings
Rolled W and WT sections	CSA G40.20/G40.21, Grade 350W
Rolled C, MC, S and L sections	CSA G40.2/G40.21, Grade 300W
Rolled plates	CSA G40.20/G40.21, Grade 350W
D1 Hollow structural steel sections	ASTM A500, Grade C,F_y = 345 mPa
Sag rods	CSA G40.20/G40.21, Grade 300W
Shear connectors (Nelson studs)	ASTM A108, Grade C-1010 / Grade 60 ksi minimum
Steel deck	ASTM A653-Grade 33 ksi with zinc thickness conforming to Z275
Grating	National Association of Architectural Metal Manufacturers (NAAMM) and CSA G40.20/G40.21, Grade 250W
D1 Checkered plates	ASTM A36 or CSA G40.21, Grade 300W (If indicated on the drawings)
Chains	ASTM A413, Grade 30 galvanized
Handrails/Guardrails	ASTM A53, Grade 240 MPa; Steel pipe size and schedule as indicated on the drawings
Welding materials	CSA W48, E49XX
Bolts	ASTM A325 Type 1
Nuts	ASTM A563

Washers	ASTM F436
Anchor bolts	As indicated on the drawings
Concrete anchors	HILTI type hot dip galvanized, expansion or chemical adherence or as indicated on the drawings

2.3 PROTECTIVE COATINGS

2.3.1 The Contractor shall submit documentation of proposed materials to the Engineer. Materials shall be of first grade and used strictly in accordance with the Technical Conditions and the manufacturer's written directions.

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2.3.2 For protective coatings, refer to Section 09 90 00 – Paint System for Structural Steel and Section 48 13 10 – General Mechanical Requirements.

PART 3 EXECUTION

3.1 DESIGN

3.1.1 General

.1 General steelwork shall be designed in accordance with this Specification, CSA S16 and the CISC Handbook.

.2 Aluminum handrails, if required, shall be designed in accordance with CAN/CSA S157.

.3 Shop fabrication drawings shall be made based on structural drawings marked "Issued for Construction".

.4 Connections not detailed on the Engineer's drawings shall be designed by a qualified Professional Engineer registered in the Province of Newfoundland and Labrador.

.5 Steel shall be marked in compliance with CSA S16 and CSA G40.20/G40.21.

.6 Connections not detailed or otherwise noted on the drawings shall be shop welded or field bolted.

.7 No field welding is permitted unless specified on the drawings, or as approved by the Engineer.

.8 Welds shall be designed in accordance with CSA W59 using the electric arc-welding methods.

.9 Eccentric connections shall not be used unless it is impossible to detail a concentric connection.

.10 Connection design detail shall avoid lamellar tearing problems, where possible. Steel plates subjected to tension perpendicular to the plate surface shall be verified for through thickness properties.

3.1.2 Bolted Connections

.1 Bolted connections shall be, unless indicated otherwise on the drawings:

.1 Designed of the bearing-type, assuming threads are included in shear planes;

.2 Designed using high strength bolts conforming to ASTM A325, using a minimum of two 5/8 inch diameter bolts per connection;

.3 Tightened in accordance with CSA S16.

.2 Bolts shall be touched-up using the paint system applied to the connected members.

3.1.3 Connection Design

.1 Beam connections shall be designed for the forces indicated on the drawings. However, the capacity of the connections shall be at least the greatest of 75% of the factored uniformly distributed load capacity in shear and 100% of the factored uniformly distributed load capacity in bending for a laterally supported beam of the span shown.

.2 The minimum depth of the connections shall be 75% of the beam depth.

.3 Bracing connections shall develop the forces indicated on the drawings. However, the capacity of the connections shall be at least the smallest of the net tension capacity of the member and 100% of its effective compression capacity.

.4 Minimum gusset plate thickness shall be 10 mm, unless shown otherwise on the drawings.

3.2 FABRICATION

3.2.1 General

.1 The start of fabrication shall be authorized by the Engineer. Authorization to proceed shall be interpreted as agreement of the Engineer, in conformity with the specification and design drawings only, and shall not imply verification of dimensions, sizes, or quantities.

.2 Steelwork shall be fabricated in accordance with CSA S16 and the shop drawings. Provisions of CSA S16 Clause 28, “Shop and Field Fabrication and Coating”, shall apply unless otherwise specified.

.3 Platforms, stairways and handrails shall be shop-assembled in the largest units suitable for shipping and handling. Ladder cages shall be shop-assembled on ladders.

.4 Aluminum handrails shall be fabricated in accordance with CAN/CSA S157 and the shop drawings.

.5 Measure fabrication dimensions assuming 18°C temperature.

.6 Provide weld preparation where required for field welded connections and supply clips for fit-up and erection.

.7 Nelson studs shall be welded at the shop, unless indicated otherwise on the drawings, in accordance with the requirements of CSA W59.

.8 Open ends of HSS sections shall be sealed with 6 mm minimum cap plates, unless noted otherwise on drawings. 12 mm diameter venting holes shall be provided.

.9 Rough welds, sharp edges and corners shall be ground smooth and all weld spatters shall be removed.

.10 Welds for steel to be galvanized shall be seal welded.

.11 Hammer welding shall not be permitted.

.12 Minimum cope radius shall be 20 mm, except where impracticable. Cope radius shall be ground to remove the visible heat affected zone and to create a smooth radius, free of nicks and notches.

.13 Shop splice of members shall not be permitted.

.14 Anchor bolts shall be threaded as indicated on the drawings.

.15 Checkered plate shall conform to ASTM A36 unless noted otherwise on the drawings with standard two-way raised pattern. The thickness shown on the drawings is nominal and does not include the height of the raised pattern.

.16 Openings greater than 150 mm diameter for pipes and ducts in floor plates shall be reinforced as directed with sleeves, plates or other steel members.

3.2.2 Surface Treatment

.1 Surface treatment shall be as follows.

.1 Miscellaneous steelwork, including bolts, nuts and washers, shall be galvanized, except otherwise noted.

.2 Non-galvanized pieces shall be painted, except where otherwise noted. Contact surfaces of connections shall be primed only over a surface extending 50 mm beyond the perimeter of the connection.

D1

.2 Refer to Section 09 90 00 – Paint System for Structural Steel for preparation of metalwork to be painted.

.3 Refer to the “Galvanizing” Article 3.4 of this Specification Section for preparation of steel to be galvanized.

3.2.3 Steel Deck

.1 Steel deck shall be:

.1 of the type indicated on the drawings;

.2 galvanized in accordance with ASTM A653, grade A;

.3 in accordance with CSA S136 and the CSSBI recommendations;

.4 supplied with mechanical connections, sheets, closure plates and pour stops.

3.2.4 Final metalwork shall be free from distortion and defects detrimental to the appearance, and performance and is subject to the Engineer’s approval.

3.3 PROTECTIVE COATINGS

3.3.1 General

D1 .1 Painting shall be in accordance with Section 09 90 00 – Paint System for Structural Steel, Section 48 13 10 – General Requirements, CAN/CSA S16, the paint Manufacturer's instructions and the applicable SSPC requirements.

D1 .2 Not used.

.3 Graphite paint shall be used under crane rails.

.4 Not used.

.5 Not used.

3.3.2 to 3.3.11.3 Not used.

3.4 GALVANIZING

3.4.1 Steel specified to be galvanized, including bolts, nuts and washers, shall conform to ASTM A123/ASTM A123M and ASTM A153/A153M.

3.4.2 The galvanization of steel members and assemblies shall be done in one immersion.

3.4.3 In the event that steels specified to be galvanized exceed the dimensions of the immersion tanks available, those sections including their connecting bolts, nuts and washers may be protected by metallization, following the prior approval of the Engineer. This procedure shall conform to CAN/CSA G 189, with a minimum zinc protection thickness of 0.1 mm, which corresponds to 700 g/m ^{2}. The metallization using a protection with aluminum is not acceptable.

3.4.4 All steels which are required to be galvanized shall have continuous seal welding all around their contact. The minimum welding dimension shall be 3 mm but this only where capacity is not required for connection strength.

3.4.5 Before galvanizing, all weld spatter, rough welds, or sharp protrusion shall be removed by chipping and grinding. All welds shall then be sandblast cleaned in accordance with SSPC-SP10 "Near-white Blast Cleaning". The remaining surfaces shall be thoroughly cleaned of all loose mill scale, rust, oil, grease and weld flux deposits in accordance with SSPC-SP6 "Commercial Blast Cleaning".

3.4.6 Minimum quantity of galvanizing shall be 460 g/m2 for nuts and bolts and 700 g/m2 for all other parts except steel wires.

3.4.7 Bolted connections for galvanized components shall be made with galvanized bolts in accordance with ASTM A325. Washers and nuts shall have a compatible class and finish to the bolt finish as specified in ASTM A325.

3.4.8 Nuts shall be re-tapped after being galvanized and the threads of nuts left bare in accordance with ASTM A153/A153M.

3.4.9 Welded connections of already galvanized steel components are not accepted.

3.4.10 Material shall be galvanized after all the fabrication, machining and shop work is completed, except as otherwise specified herein.

3.4.11 Appropriate measures shall be taken in order to ensure that frames or similar items of steelwork are not distorted during the galvanizing process, in accordance with ASTM A384 requirements. If preventive work is required, details of all proposed additional reinforcement, bracing or otherwise stiffened metalwork shall be submitted to the Engineer for approval prior to proceeding with the relevant work.

3.4.12 The coating shall be clean, smooth and free from defects. Bare spots, loosely attached spelter, unevenness of coating and globules which may be broken in handling, will be cause for rejection. If more than 5 percent of material is rejected, manufacture shall be stopped and the process altered so that satisfactory work could be produced.

3.4.13 Galvanizing inspection shall be as described in the “Quality Control” section of this Specification. Galvanization work found to be defective shall be corrected.

3.4.14 Galvanized surfaces damaged during transportation, handling and installation shall receive two 30 micrometer DFT layers of “Galvano Spray 70-45” by METAFLUX. Repairs shall be in accordance with ASTM A780-09.

3.5 TRANSPORTATION, HANDLING AND STORAGE

3.5.1 The Contractor shall give a written approval for each delivery on site.

3.5.2 Federal, Provincial or Municipal transportation bylaws shall be respected.

3.5.3 Metalwork shall be handled and protected adequately for transportation and storage in order to avoid any damage. It shall be strengthened if needed.

3.5.4 Delivery slip shall have piece identification, description and dimensions.

3.5.5 Metalwork shall be sent unassembled.

3.5.6 Each metalwork component shall be marked and referenced on the shop drawings.

3.5.7 Painted or galvanized surfaces shall not be stacked face to face. Wood blocks, Styrofoam padding or other suitable materials shall be used as separator.

3.5.8 Nylon-type slings shall be used for lifting, unless the packaging prevents the slings to get into contact with the metalwork. Where it is necessary, lifting beams or cradles shall be used.

3.5.9 Metalwork shall be securely fastened with chains and blocking to transportation vehicle in order to prevent lateral movement. The edges of metalwork shall be protected with rubber, hessian or wood.

3.5.10 Small bundled sections shall not be loaded inside larger components.

3.5.11 Bolts, nuts and washers shall be shipped in metallic packaging and coated with protective oil. Bolts of different length or diameter shall be separated in several containers or bags, each one containing only identical type of pieces. All containers shall be properly labelled.

3.5.12 Wood blocks of convenient size shall be provided in order to ensure that the steel rests clear of ground, does not accumulate water and does not distort permanently.

3.5.13 Metalwork shall be unloaded at the designated location. Proper equipment and labour shall be employed to unload onto wood blocks without damage.

3.6 INSTALLATION

3.6.1 Stability

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.1 It is the Contractor's responsibility to determine construction procedures and sequence to ensure the integrity of the structure and its components during erection. This includes the addition of necessary and adequate shoring, sheeting, temporary bracing and other temporary structures required to resist all construction loads and additionally to comply with the provisions of the OHSA.

.2 Temporary bracings shall be maintained in place if the permanent stability of the structure depends on work of other trades, until that work is completed.

3.6.2 Erection

.1 Unless otherwise noted herein, miscellaneous metalwork shall be erected in accordance with this Specification, CSA S16, clause 6.7.3 of CSA A23.1/A23.2, the CISC Code of Standard Practice and the approved shop drawings.

.2 Alignment shall be in accordance with CSA S16 and as indicated on the drawings.

.3 The Engineer shall approve any field cutting or altering of structural members not shown on the drawings.

.4 Anchor bolt threads shall be wrapped and protected from damage during construction.

.5 The embedded metalwork components shall be maintained in position, by means of temporary bracing, templates or otherwise, during concreting to avoid displacement. For embedded frames with covers, the method to keep the frame into place during concreting shall be submitted to the Engineer for review.

.6 Prior to final tightening of the bolted connections:

.1 each section of structure shall be plumbed and aligned;

.2 members shall be aligned and free of distortions and open joints.

D1

.7 Expansion and chemical anchors connecting loose steel to concrete work shall be installed where indicated on the drawings, according to Manufacturer's instructions. Special precautions shall be taken not to drill holes through the reinforcing bars. Post installed anchors shall be approved by the Engineer.

.8 No part of any new or existing structure shall be subject to erection loads which could in any way damage or cause permanent distortion to that part or any other part of the structure.

.9 Any damage to the miscellaneous metalwork, including coating or errors in alignment or location shall be corrected.

.10 Erection tolerance and inspection shall be as described in the "Quality Control" section of this Specification.

3.6.3 Bolting

.1 High-strength bolts shall be used for connections, unless indicated otherwise on the drawings.

.2 The high strength bolts in slip-critical type connections shall be pretensioned using the "Turn of the Nut" method, in accordance with CSA S16, clause 23.8.

.3 Hardened washer shall be used under each nut.

.4 All joint surfaces, including those adjacent to bolt heads and nuts, shall be free of burrs, dirt and other foreign material that inhabit solid seating of parts.

.5 Do not drive drift pins with such force as to deform adjacent metal.

.6 Drill any bolt holes missing from fabricated steel. Do not enlarge or make any hole by flame cutting.

.7 Bolting inspection shall be as described in the “Quality Control” section of this Specification.

3.6.4 Field Welding

.1 Field welding shall be:

.1 used only where shown on the drawings or as approved by the Engineer;

.2 in accordance with CSA W59;

.3 executed by welders certified in accordance with CSA W55.3 and CSA W47.1.

.2 Welding inspection shall be described in the “Quality Control” section of this specification.

3.6.5 Steel Deck

.1 Steel deck shall be installed in accordance with CSSBI requirements and the approved shop drawings.

.2 Closure plates shall be provided and fixed with screws.

.3 Steel deck shall be cut around the openings, columns, studs, etc.

.4 Longitudinal lap joints shall be over a minimum 50 mm and be mechanically fastened at minimum 300 mm intervals, unless noted otherwise on drawings

.5 Overlapping/Interlocking side joints shall be mechanically fastened at maximum 450 mm intervals, unless noted otherwise on the drawings.

.6 Ends of steel deck shall be mechanically fastened to supporting beams at maximum 300 mm intervals, unless noted otherwise on the drawings.

.7 Steel deck connection on the structural steel by welding will be allowed only if it is specified on the drawings. In this case the welding shall be in accordance with CSA W59.

.8 Touch-up, wherever necessary, shall be done after the completion of work.

3.6.6 Errors and Misfit

.1 Fabrication errors discovered during erection shall be reported to the Engineer along with proposed correction method.

.2 Minor misfit shall be corrected by reaming, cutting and chipping as part of work as approved by the Engineer.

.3 Flame cutting shall only be allowed on secondary members with written approval from the Engineer. Cut edges shall be ground and painted or galvanized to match the surrounding finish.

.4 Fitting up bolts or drift pins shall not be used to bring improperly fabricated members together.

.5 Shims, packing or wedging shall not be used to correct imperfect work without written approval of the Engineer.

3.6.7 Touch-ups

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.1 Refer to Section 09 90 00 – Paint System for Structural Steel for touch-up of painted steel.

.2 Refer to the “Galvanizing” Article 3.4 of this Specification Section for touch-up of galvanized steel.

.3 During touch-up on the work site, equipment and floors shall be protected against spray splash or drops of paint or zinc products. All stains or spilled products on equipment, floors and walls shall be cleaned.

3.6.8 Final Clean-up

.1 Clean-up work site, remove all debris, shelters, equipment and surplus material prior to final acceptance of work.

3.7 QUALITY CONTROL

3.7.1 Welds

.1 Inspection and testing of welding shall conform to CSA W59 using non destructive test methods.

.2 Inspections and non-destructive tests shall be made by inspectors registered in conformance with CSA W178.2.

.3 Testing of welds shall be performed as indicated in the following table.

Weld Type	Inspection	Level of Inspection
Complete joint penetration groove welds in tension (Butt joint)	Radiographic	100% of the length of each weld
Complete joint penetration Groove Weld in compression or shear (Butt joints)	Radiographic	50% of the length of each weld
Fillet Welds in tension members	Magnetic	For each element, 100% of the length of each weld
Fillet Welds (others)	Magnetic	For each element, 25% of the length of each weld
Complete joint penetration groove welds in tension members (“T” and “L” joints)	Ultrasonic	100% of the length of each weld
Complete joint penetration groove welds in compression or shear members (“T” and “L” joints)	Ultrasonic	For each element, 50% of the length of the weld

.4 Faulty welding shall be repaired as specified in CSA W59.

.5 If faults exceeding the provision of CSA W59 are found, then test complete weld length. Make repairs and retest repaired areas; if faults found in repaired areas, repair and retest until no faults occur.

3.7.2 Bolted Connections

.1 Inspection and checking of high-strength bolted connections shall conform to CSA S16.

3.7.3 Studs

.1 Inspection and testing of studs shall conform to CSA W59.

3.7.4 Painting

D1 .1 Refer to Section 09 90 00 – Paint System for Structural Steel.

D1 .2 3.7.4.2 to 3.7.4.6 Not used.

3.7.5 Galvanizing

.1 Testing shall conform to the requirements of ASTM A123/A123M-12.

.2 During galvanizing, the Engineer may carry out tests on the coating and analysis of the spelter, as deemed necessary.

3.7.6 Erection

.1 Inspection and checking of metalwork for alignment, plumbness and elevation shall conform to CSA S16, unless indicated otherwise on the drawings.

.2 Anchor bolts shall be positioned in accordance with the clause 6.7.3 of CSA A23.1/A23.2. Other embedded miscellaneous parts shall be positioned within a 6 mm tolerance, unless otherwise indicated on the drawings.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 06 10 00
CH0032	ROUGH CARPENTRY	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 06 10 00
ROUGH CARPENTRY
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

NEWFOUNDLAND AND LABRADOR
MEMBER
Nathaniel Saras, NLAA
Expires Dec 31 2013
Date Dec 2013
LICENSED TO PRACTICE
ASSOCIATION OF ARCHITECTS

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Wood Treatment: Materials and Applications for Wood Preservation

1.2 RELATED REQUIREMENTS

1.2.1 Section 07 52 00 – Modified Bituminous Membrane Roofing.

1.2.2 Section 07 92 00 – Joint Sealants.

1.3 REFERENCES

1.3.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.3.1.1 All work shall be in accordance with this specification and the requirements of the following.

1.3.2 American Standard for Testing and Materials (ASTM International)

1.3.2.1 ASTM C578-11b, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

1.3.2.2 ASTM C1289-12, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

1.3.2.3 ASTM C1396/C1396M-11, Standard Specification for Gypsum Board.

1.3.2.4 ASTM D1761-06, Standard Test Methods for Mechanical Fasteners in Wood.

1.3.2.5 ASTM F1667-11a, Standard Specification for Driven Fasteners: Nails, Spikes and Staples.

1.3.3 American Wood Preservers' Association (AWPA)

1.3.3.1 AWPA M2 - Standard for Inspection of Treated Wood Products.

1.3.3.2 AWPA M4 - Standard for the Care of Preservative Treated Wood Products.

1.3.4 Canadian General Standards Board (CGSB)

1.3.4.1 CAN/CGSB 11.3, Hardboard.

1.3.4.2 CAN/CGSB 51.32, Sheathing, Membrane, Breather Type.

1.3.4.3 CAN/CGSB 51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction and amendment.

1.3.5 Canadian Standards Association (CSA International)

1.3.5.1 CSA A123.2-03 (R2008), Asphalt Coated Roofing Sheets.

1.3.5.2 CSA A247-M86, Insulating Fiberboard.

1.3.5.3 CSA O80 Series, Wood Preservation.

1.3.5.4 CSA O80.20-1.1, This Standard applies to the fire-retardant treatment of lumber by pressure processes.

1.3.5.5 CSA O80.201, This Standard covers hydrocarbon solvents for preparing solutions of preservatives.

1.3.5.6 CSA O121, Douglas Fir Plywood.

1.3.5.7 CSA O141, Softwood Lumber.

1.3.5.8 CSA O325, Construction Sheathing.

1.3.6 National Lumber Grades Authority (NLGA)

1.3.6.1 Standard Grading Rules for Canadian Lumber.

1.3.7 Underwriters' Laboratories of Canada (ULC)

1.3.7.1 CAN/ULC-S706, Standard for Wood Fibre Insulating Boards for Buildings.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1.4.1 Product Data:

1.4.1.1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

1.4.2 Quality Assurance Submittals

1.4.2.1 Quality assurance submittals:

1.4.2.1.1 For products treated with preservative and fire-retardant by pressure impregnation submit following information certified by authorized signing officer of treatment plant:

1.4.2.2 Information listed in AWPA M2 and revisions specified in CSA O80 Series, Supplementary Requirement to AWPA M2 applicable to specified treatment.

1.4.2.2.1 Moisture content after drying following treatment.

1.4.2.2.2 Acceptable types of paint, stain, and clear finishes that may be used over treated materials to be finished after treatment.

1.5 QUALITY ASSURANCE

1.5.1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

1.5.2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.6.3 Storage and Handling Requirements:

1.6.3.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

1.6.3.2 Store and protect wood from nicks, scratches, and blemishes.

1.6.3.3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 FRAMING STRUCTURAL AND PANEL MATERIALS

2.1.1 Lumber: softwood, S4S (surfaced four sides), moisture content 19% (S-dry) or less in accordance with following standards:

2.1.1.1 CSA O141.

2.1.1.2 NLGA Standard Grading Rules for Canadian Lumber.

2.1.2 Framing and board lumber: in accordance with NBC

2.1.3 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:

2.1.3.1 Board sizes: "Standard" or better grade.

2.1.3.2 Dimension sizes: "Standard" light framing or better grade.

2.1.4 Plywood, OSB (oriented strandboard) and wood based composite panels: to CSA O325.

2.1.5 Douglas fir plywood (DFP): to CSA O121, standard construction.

2.1.6 Softwood Lumber: to CSA O141, standard construction.

2.1.7 Glass fibre board sheathing: non-structural, rigid, faced, fiberglass, insulating exterior sheathing board.

2.1.8 Gypsum sheathing: to ASTM C1396/C1396M.

2.2 ACCESSORIES

2.2.1 Exterior wall sheathing paper: to CAN/CGSB-51.32 single ply spunbonded olefin type impregnated as indicated.

2.2.2 Polyethylene film: to CAN/CGSB-51.34, Type 1, 0.15 mm thick.

2.2.3 Roll roofing: to CAN/CSA A123.2, Type S.

2.2.4 Air seal: closed cell polyurethane or polyethylene.

2.2.5 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

2.2.5.1 Sealants: VOC limit 250 g/L maximum.

2.2.6 General purpose adhesive: to CSA O112 Series.

2.2.6.1 VOC limit 200 g/L maximum.

2.2.7 Nails, spikes and staples: to ASTMF1667-11a.

2.2.8 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.

2.2.9 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.

2.2.10 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, sheet metal, formed to prevent dishing. Bell or cup shapes not acceptable.

2.2.11 Fastener Finishes:

2.2.11.1 Galvanizing: to ASTM A123/A123M or ASTM A653, use galvanized fasteners for exterior work, interior highly humid areas, pressure-preservative, and fire-retardant treated lumber.

2.2.11.2 Stainless steel: use stainless steel where recommended by material manufacturer.

2.2.12 Wood Preservative:

2.2.12.1 Preservative: to CSA-O80 Series, odourless, for stained finish.

2.2.12.2 Preservatives: maximum VOC limit 350g/L.

2.2.12.3 Fire Retardant: to CSA O80.20

2.2.12.4 Solvent: to CSA-O80.201

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.

3.1.1.1 Visually inspect substrate in presence of Engineer.

3.1.1.2 Inform Engineer of unacceptable conditions immediately upon discovery.

3.1.1.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Engineer.

3.2 PREPARATION

3.2.1 Application: Preservative

3.2.1.1 Treat lumber to CSA O80 Series.

3.2.1.2 Following water-borne preservative treatment, dry material to maximum moisture content of 19%.

3.2.2 Application: Field Treatment

3.2.2.1 Treat exposed surfaces of material with wood preservative, before insulation

3.2.2.2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.

3.2.2.3 Comply with AWPA M4 and revisions specified in CSA O80 Series, Supplementary Requirements to AWPA M2.

3.2.2.4 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.

3.2.2.5 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.

3.2.2.6 Remove chemical deposits on treated wood to receive applied finish.

3.2.2.7 Treat material as follows:

3.2.2.7.1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.

3.2.2.7.2 Wood furring for on outside surface of exterior masonry and concrete walls.

3.3 MATERIAL USAGE

3.3.1 Roof sheathing:

3.3.1.1 Plywood, DFP sheathing grade square edge, 19 mm thick.

3.3.2 Exterior wall sheathing:

3.3.2.1 Plywood, DFP sheathing grade square edge, 16 mm thick.

3.3.2.2 Insulating fiberboard, Type II-Sheathing, panel edge 16 mm thick.

3.3.2.3 Glass fibre sheathing, RSI indicated, 25 mm thick.

3.3.2.4 Polyisocyanurate sheathing, RSI indicated, 25 mm thick.

3.3.2.5 Gypsum sheathing, panel edge, 16 mm thick.

3.3.3 Underlay:

3.3.3.1 Plywood, DFP standard grade square edge, 16 mm thick.

3.3.4 Electrical equipment mounting boards:

3.3.4.1 Plywood, DFP standard grade, square edge 19 mm thick.

3.4 INSTALLATION

3.4.1 Install members true to line, levels and elevations, square and plumb.

3.4.2 Construct continuous members from pieces of longest practical length.

3.4.3 Install spanning members with "crown-edge" up.

3.4.4 Select exposed framing for appearance. Install lumber and panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.

3.4.5 Install wall sheathing in accordance with manufacturer's printed instructions.

3.4.6 Install roof sheathing in accordance with requirements of National Building Code of Canada (NBC).

3.4.7 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding, electrical equipment mounting boards, and other work as required.

3.4.8 Install furring to support siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing.

3.4.8.1 Align and plumb faces of furring and blocking to tolerance of 1:600.

3.4.9 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

3.4.10 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.

3.4.11 Install sleepers as indicated.

3.4.12 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

3.4.13 Countersink bolts where necessary to provide clearance for other work.

3.4.14 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.5 CLEANING

3.5.1 Progress Cleaning: clean in accordance with General Requirements. Leave Work area clean at end of each day.

3.5.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with General Requirements.

3.6 PROTECTION

3.6.1 Protect installed products and components from damage during construction.

3.6.2 Repair damage to adjacent materials caused by rough carpentry installation.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 07 13 26
CH0032	**SELF ADHERED SHEET WATERPROOFING**	**Rev. D2**
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 07 13 26
SELF ADHERED SHEET WATERPROOFING
TABLE OF CONTENTS

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PERMIT HOLDER
This Permit Allows
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Permit No. as issued by PEGNL N-0458
which is valid for the year 2013

NEWFOUNDLAND AND LABRADOR - ASSOCIATION OF ARCHITECTS - MEMBER
Nathaniel Salias, NLAA
Expires Dec 31 2013
Date: Nov 29, 2013
LICENSED TO PRACTICE

PART 1 GENERAL

1.1 RELATED WORK

1.1.1 Section 07 92 00– Joint Sealants.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.2.1.1 All work shall be in accordance with this specification and the requirements of the following.

1.2.1.1.1 Sealant and Waterproofer's Institute – Sealant and Caulking Guide Specification.

1.3 SUBMITTALS

1.3.1 Submit manufacturer's product data sheets.

1.3.2 Submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

1.4.1 Perform work in accordance with Sealant and Waterproofer's Institute – Sealant and Caulking Guide Assurance program and requirements for materials and installation.

1.4.2 Perform Work in accordance with National Air Barrier Association – Professional Contractor Quality Assurance program and requirements for materials and installation.

1.4.3 Manufacturer's Representative:

1.4.3.1 Inspect substrate prior to commencement of work, twice during application of membrane and at commissioning to ascertain that air/vapour barrier system is installed according to membrane manufacturer's most current published specifications and details.

1.4.3.2 Provide technical assistance to applicator and assist where required in correct installation of membrane.

1.4.3.3 Provide certificate of quality compliance upon satisfactory completion of installation.

1.4.4 Maintain one copy of documents on site.

1.5 QUALIFICATIONS

1.5.1 Applicator: Company specializing in performing work of this section with minimum 5 years documented experience with installation of air/vapour barrier system. Complete installation must be approved by the material manufacturer.

1.5.2 Applicator: Company who is currently licensed by certifying organization must maintain their license throughout the duration of the project.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Deliver, store and handle materials in accordance with manufacturer's written instructions. Deliver membrane materials in factory wrapped packaging indicating name of manufacturer and product.

1.6.2 Clean and leave area as it was prior to spill.

1.6.3 Store roll materials on end in original packaging.

1.6.4 Store primers at temperature of 5° C and above to facilitate handling.

1.6.5 Keep solvent away from open flame and excessive heat.

1.7 PROJECT ENVIRONMENTAL REQUIREMENTS

1.7.1 Do not install solvent curing sealants or vapour release adhesive materials in enclosed spaces without ventilation

1.7.2 Ventilate enclosed spaces in accordance with manufacturer's instructions.

1.7.3 Maintain temperature and humidity recommended by materials manufacturer before, during and after installation.

D2

1.8 NOT USED

PART 2 PRODUCTS

2.1 WATERPROOFING MATERIALS

2.1.1 Rolled, Self-Adhering, Waterproofing Membrane: Polymetric waterproofing membrane protected by release paper on cross-laminated polyethylene carrier film

with exposed polymetric membrane strips on both sides protected by pull-off release strips.

2.1.1.1 Membrane Physical properties

2.1.1.1.1 Thickness:

2.1.1.1.1.1 Carrier Film: 0.10 mm

2.1.1.1.1.2 Polymetric Membrane: 1.42 mm

2.1.1.1.2 Application: -5° and above

2.1.1.1.3 Elongation: min 300%

2.1.1.1.4 Tensile Strength:

2.1.1.1.4.1 Carrier Film: 40.7 MPa

2.1.1.1.4.2 Polymetric Membrane: 4.07 MPa

2.1.1.1.5 Puncture Resistance: 30 kg

2.1.1.1.6 Water vapour transmission: 5.72 ng/Pa.s.m^2

2.1.1.1.7 Moisture Absorption 0.1% max.

2.1.1.1.8 Hydrostatic head 73.1 m water

2.1.1.1.9 Acceptable manufacturers: MEL-ROL by W.R. Meadows of Canada or Blueskin WP 200 or Soprema Sopraseal Stick 1100, or approved substitute.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify that surfaces and conditions are ready to accept the work of this section.

3.1.2 Ensure all surfaces are clean, dry, sound, smooth, continuous and comply with membrane manufacturer's requirements.

3.1.3 Report any unsatisfactory conditions to the Engineer in writing.

3.1.4 Do not start work until deficiencies have been corrected.

3.2 PREPARATION

3.2.1 Remove loose or foreign matter which might impair adhesion of materials.

3.2.2 Ensure all substrates are clean of oil or excess dust; all concrete surfaces free of large voids, spilled areas or sharp protrusions.

3.2.3 Ensure all substrates are free of surface moisture prior to application of membrane and primer.

3.2.4 Ensure metal closures are free of sharp edges and burrs.

3.2.5 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.

3.3 INSTALLATION

3.3.1 Install materials in accordance with manufacturer's instructions.

3.3.2 Over the properly prepared substrate surface apply primer with a roller and allow drying to a tacky surface. Prime only area to be covered in a working day. Reprime area not covered with membrane within 24 hours.

3.3.3 After primer has dried, using a hand roller firmly press the entire membrane onto the primed surface in strict accordance with membrane manufacturer's written instructions.

3.3.4 Ensure complete coverage of and adhesion of all substrates to receive membrane, including wall penetrations. Co-operate with other trades to ensure continuity of the membrane.

3.3.5 Overlap membrane 50 mm and carefully smooth out with a roller to ensure full continuous bond throughout overlaps without fissures or fishmouthing.

3.3.6 It is important that a complete water seal be achieved. Be responsible for the completeness of the membrane wherever it is not specifically detailed. Consult with Engineer if there is any doubt as to the integrity of the membrane, whether detailed or not.

3.3.7 In order to ensure a complete seal, seal membrane to all penetrations in an approved manner.

3.3.8 Apply a trowelled bead of mastic to all terminations of the membrane at the end of a day's work.

3.3.9 Do not enclose membrane until it has been inspected and approved by Engineer. Inform Engineer 48 hours prior to required inspection.

3.4 PROTECTION OF WORK

3.4.1 Protect finished work in accordance with manufacturer's instructions.

3.4.2 Do not permit adjacent work to damage work of this section.

3.4.3 Ensure finished work is protected from climatic conditions.

3.5 INSPECTION

3.5.1 Carefully inspect for continuity of waterproofing prior to placement of drainage board.

3.5.2 Repair all deficient membrane areas.

3.5.3 Misaligned or inadequately lapped seams, punctures or other damage must be repaired with a patch of membrane extending 50 mm in all directions from edge of damaged areas.

3.5.4 Cover membrane immediately after Engineer's inspection to protect from damage by other trades.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 07 21 13
CH0032	**BOARD INSULATION**	**Rev. D2**
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 07 21 13
BOARD INSULATION
TABLE OF CONTENTS

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NEWFOUNDLAND AND LABRADOR
MEMBER
Nathaniel Salfas, NLAA
Expires Dec 31 2013
Date: Nov 20, 2013
LICENSED TO PRACTICE
ASSOCIATION OF ARCHITECTS

PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 03 30 00 – Cast-in-Place Concrete.

1.1.2 Section 07 27 00 – Air Barriers.

1.1.3 Section 07 46 13 – Preformed Metal Siding.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.2.1.1 All work shall be in accordance with this specification and the requirements of the following:

1.2.2 American Society for Testing and Materials International (ASTM)

1.2.2.1 ASTM C 578: Standard Specification for Rigid Cellular Polystyrene Thermal Insulation.

1.2.2.2 ASTM C591-12, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

1.2.2.3 ASTM C1289-12, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

1.2.2.4 ASTM E96/E96M-10, Standard Test Methods for Water Vapour Transmission of Materials.

1.2.3 Canadian General Standards Board (CGSB)

1.2.3.1 CGSB 71-GP-24M, Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.

1.2.4 Underwriters Laboratories of Canada (ULC)

1.2.4.1 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.

1.2.4.2 CAN/ULC-S704, Standard for Thermal Insulation Polyurethane and Polyisocyanurate, Boards, Faced.

1.2.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

1.2.5.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

1.3.1 Product Data:

1.3.1.1 Submit manufacturer's printed product literature, specifications and data sheets.

1.3.1.2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets. Indicate VOC's insulation products and adhesives.

1.3.2 Manufacturer's Instructions:

1.3.2.1 Submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

1.4.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.4.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Foam Plastic Board Insulation under Concrete Slab

2.1.1.1 Extruded Polystyrene Board Insulation: Comply with ASTM C 578.

2.1.1.2 Type VI.

2.1.1.3 Minimum compressive strength: 275 kPa (40 psi).

2.1.1.4 Density: 29 kg/m³ (1.80 lb/ft³).

2.1.1.5 Size: 610 x 2440 mm.

2.1.1.6 Edge condition: ship-lapped.

2.1.1.7 Thickness: 100 mm supplied in one layer only – multiple layers are not permitted.

2.1.1.8 RSI Value: 0.88 per 25 mm of thickness, with 90% lifetime limited warranty on thermal resistance (180 day real-time aging as mandated by ASTM C578, measured per ASTM C 518 at mean temperature of 75ºF.

2.1.1.9 Blowing agent formulation: Shall be zero ozone depleting.

2.1.1.10 Warranty: Limited lifetime warranty covering all ASTM C578 physical properties.

2.1.1.11 Acceptable Product: Dow Chemical company Foamular 400, or approved substitute.

2.1.2 Foam Plastic Board Insulation Not Under Concrete Slab

2.1.2.1 Extruded polystyrene foam plastic insulation, unfaced, complying with ASTM C578.

2.1.2.2 Type: X

2.1.2.3 Minimum compressive strength: 172 kPa (25 psi).

2.1.2.4 Size: 1220 x 2440 mm.

2.1.2.5 Edge condition: square

2.1.2.6 Thickness: 38 mm unless noted otherwise.

2.1.2.7 RSI Value: 0.88 per 25 mm with 90 percent lifetime limited warranty on thermal resistance (180 day real-time aging as mandated by ASTM C578, measured per ASTM C518 at mean temperature of 75ºF.

2.1.2.8 Water Absorption: Maximum 0.10 percent by volume per ASTM C272.

2.1.2.9 Surface Burning Characteristics (ASTM E84): Flame spread less than 25, smoke developed less than 450, certified by independent third party such as Underwriters Laboratories.

2.1.2.10 Blowing Agent Formulation: Shall be zero ozone depleting.

2.1.2.11 Fasteners: Provide preassembled screw/stress plate fasteners recommended by their manufacture for securing foam plastic insulating sheathing. Polymer or other corrosion-protected coated steel screw fasteners for anchoring sheathing to metal wall framing. Fastener length and size based on wall sheathing thickness and fastener manufacturer recommendation.

D2

2.1.2.12 Not used.

2.1.2.13 Acceptable Product: Dow Chemical Company Foamular 250 or approved substitute.

2.1.3 Rigid Cellular Polyisocyanurate:

2.1.3.1 Unfaced: to ASTM C591.

2.1.3.1.1 Type: 1.

2.1.3.1.2 Thickness: as indicated.

2.1.3.1.3 Size: 1200 x 2400 mm.

2.1.3.2 Faced: to ASTM C1289 and CAN/ULC C-S704.

2.1.3.2.1 Polyisocyanurate core: Type 1, facing 2.

2.1.3.2.2 RSI Value: 1.05 per 25 mm.

2.1.3.2.3 Shape: flat.

2.1.3.2.4 Thickness: as indicated.

2.1.3.2.5 Size: 1200 x 2400 mm.

2.1.3.2.6 Compressive Strength: 138 KPa.

2.1.3.2.7 Moisture Vapour Transmission: 1.5 ng/(Pa.s.m^2).

2.1.3.2.8 Water Absorption: max. 1.5%.

2.1.3.2.9 Acceptable Product: Johns Manville AP Foil-Faced Manville, or Atlas Energy Shield, or approved substitute.

2.2 ADHESIVE

2.2.1 Adhesive: suitable for bonding insulation boards to substrates as indicated on drawings.

2.3 ACCESSORIES

2.3.1 Insulation clips: impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.

2.3.2 Joint Sealing Tape: air resistant pressure sensitive adhesive tape as recommended by insulation manufacturer.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 WORKMANSHIP

3.2.1 Install insulation after building substrate materials are dry.

3.2.2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

3.2.3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.

3.2.4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from CAN/CGA-B149.1 and CAN/CGA-B149.2 type B and L vents.

3.2.5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

3.2.6 Offset both vertical and horizontal joints in multiple layer applications.

3.2.7 Do not enclose insulation until it has been inspected and approved by Engineer.

3.3 EXAMINATION

3.3.1 Examine substrates and immediately inform Engineer in writing of defects.

3.3.2 Prior to commencement of work, ensure:

3.3.2.1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

3.4 RIGID INSULATION INSTALLATION

3.4.1 Apply adhesive to polyisocyanurate insulation board in accordance with manufacturer's recommendations.

3.4.2 Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 150 mm wide 0.15 mm modified bituminous membrane over expansion and control joints using compatible adhesive and primer before application of insulation.

3.4.3 Carefully inspect for continuity of air barrier prior to placement of insulation.

3.4.4 Tape all insulation joints unless otherwise directed.

3.5 CLEANING

3.5.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

SECTION 07 21 16
BLANKET INSULATION
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 07 21 16
CH0032	**BLANKET INSULATION**	**Rev. D2**
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MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 06 10 00 - Rough Carpentry.

1.1.2 Section 07 26 00 – Vapour Retarders.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.2.1.1 All work shall be in accordance with this specification and the requirements of the following.

1.2.2 American Society for Testing and Materials International (ASTM)

1.2.2.1 ASTM C553-11, Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.

1.2.2.2 ASTM C665-12, Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

1.2.2.3 ASTM C1320-10, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.

1.2.2.4 ASTM F1667-11a, Standard Specification for Driven Fasteners: Nails, Spikes and Staples.

1.2.3 Canadian Gas Association (CGA)

1.2.3.1 CAN/CGA-B149.1, Natural Gas and Propane Installation Code Handbook.

1.2.3.2 CAN/CGA-B149.2, Propane Storage and Handling Code.

1.2.4 Underwriters Laboratories of Canada (ULC)

1.2.4.1 CAN/ULC-S702, Standard for Mineral Fibre Insulation.

1.3 SUBMITTALS

1.3.1 Product Data:

1.3.1.1 Submit manufacturer's printed product literature, specifications and data sheets.

1.3.2 Manufacturer's Instructions:

1.3.2.1 Submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

1.4.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.4.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Thermal batt and blanket mineral fibre:

2.1.1.1 Unfaced glass fiber thermal insulation to ASTM C665, Type 1, thickness and RSI value as indicated on drawings.

2.2 ACCESSORIES

2.2.1 Insulation clips: Impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.

2.2.2 Nails: galvanized steel, length to suit insulation plus 25 mm, to ASTM F1667-11a.

2.2.3 Staples: 12 mm minimum leg.

2.2.4 Tape: as recommended by manufacturer.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSULATION INSTALLATION

3.2.1 Install insulation to maintain continuity of thermal protection to building elements and spaces.

3.2.2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.

3.2.3 Do not compress insulation to fit into spaces.

3.2.4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls and CAN/CGA-B149.1 and CAN/CGA-B149.2 Type B and L vents.

3.2.5 Do not enclose insulation until it has been inspected and approved by Engineer.

3.3 CLEANING

3.3.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 07 21 20
CH0032	**LOW EXPANDING FOAM SEALANT**	**Rev. D2**
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 07 21 20
LOW EXPANDING FOAM SEALANT
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
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Nathaniel Salfas, NLAA
Expires Dec 31, 2013
Date: 01 Dec 13
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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 07 21 20
CH0032	**LOW EXPANDING FOAM SEALANT**	**Rev. D2**
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 07 26 00 – Vapour Retarders.

.2 Section 07 27 00 – Air Barriers - Descriptive or Proprietary.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

.1 All work shall be in accordance with this specification and the requirements of the following.

1.2.2 Canadian Urethane Foam Contractors' Association Inc. (CUFCA)

1.2.3 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S101, Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.3 CAN/ULC-S705.1, Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density, Material Specification.

.4 CAN/ULC-S705.2, Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density, Installer's Responsibilities-Specification.

1.3 SUBMITTALS

1.3.1 Submit test reports, verifying qualities of foam sealant meet or exceed requirements of this specification.

1.3.2 Submit test reports in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.

1.4 QUALITY ASSURANCE

1.4.1 Applicators to conform to CUFCA Quality Assurance Program.

1.5 SAFETY REQUIREMENTS

1.5.1 Protect workers as recommended by CAN/ULC-S705.2 and manufacturer's recommendations:

.1 Workers must wear gloves, respirators, dust masks, eye protection, protective clothing when applying foam sealant.

.2 Workers must not eat, drink or smoke while applying foam sealant.

1.6 PROTECTION

1.6.1 Ventilate area in accordance with manufacturer’s instructions.

1.6.2 Ventilate area to receive insulation by introducing fresh air and exhausting air continuously during and 24 hours after application to maintain non-toxic, unpolluted, safe working conditions.

1.6.3 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application area.

1.6.4 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.

1.6.5 Dispose of waste foam sealant daily in location designated by Engineer and decontaminate empty drums in accordance with foam sealant manufacturer’s instructions.

1.7 ENVIRONMENTAL REQUIREMENTS

1.7.1 Apply foam sealant only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Low expanding, one-component, polyurethane foam sealant, curing to a semi-rigid, closed cell urethane foam providing a RSI of 0.9 per 25.4 mm. To meet the following physical properties:

.1	Density:	25.7 kg/m^3
.2	Compressive Strength Parallel @ 10%:	0.48-0.66 MPa
.3	Tensile Strength:	0.71 MPa

.4 Water Vapour Transmission: 340 ng/Pa.m^2.5

.5 Flame Spread: 20

.6 Smoke Development: 70

.7 VOC Content: Low-emitting

PART 3 EXECUTION

3.1 APPLICATION

3.1.1 Apply foam sealant to clean surfaces in accordance manufacturer's printed instructions. Surfaces to be free of dust, dirt, oil and other foreign materials.

3.1.2 Cover surfaces not intended to be foamed.

3.1.3 Apply foam sealant to perimeter of openings indicated and to thickness as recommended by manufacturer. Trim excess cured foam from finished area.

3.1.4 Cover exposed urethane foam sealants to protect from adverse affects from ultraviolet light (sunlight).

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 07 21 29
CH0032 POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT	SPRAYED INSULATION – POLYURETHANE FOAM	Rev. D2
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 07 21 29
SPRAYED INSULATION – POLYURETHANE FOAM
TABLE OF CONTENTS

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MEMBER
Nathaniel Salfas, NLAA
Expires Dec 31 2013
Date: 5 DEC 2013
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ASSOCIATION OF ARCHITECTS

PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 07 26 00 –Vapour Retarders

1.1.2 Section 07 27 00 – Air Barriers - Descriptive or Proprietary.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.2.1.1 All work shall be in accordance with this specification and the requirements of the following.

1.2.2 Canadian Urethane Foam Contractors' Association Inc. (CUFCA)

1.2.3 Underwriters' Laboratories of Canada (ULC)

1.2.3.1 CAN/ULC-S101, Fire Endurance Tests of Building Construction and Materials.

1.2.3.2 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

1.2.3.3 CAN/ULC-S705.1, Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density, Material Specification.

1.2.3.4 CAN/ULC-S705.2, Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density, Installer's Responsibilities-Specification.

1.3 SUBMITTALS

1.3.1 Product Data:

1.3.1.1 Submit manufacturer’s printed product data literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.3.1.2 Submit two copies of WHMIS MSDS – Material Safety Data Sheets.

1.3.2 Test Reports

1.3.2.1 Submit certified test reports, from approved independent testing laboratories verifying qualities of insulation meet or exceed requirements of this specification.

1.3.2.2 Submit test reports in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.

1.3.2.3 Submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 QUALITY ASSURANCE

1.4.1 Applicators are to conform to CUFCA Quality Assurance Program.

1.4.2 Qualifications:

1.4.2.1 Installer: person specializing in sprayed insulation installations with minimum 5 years experience approved by manufacturer.

1.4.2.2 Manufacturer: company with minimum 5 years experience in producing of material used for work required for this project, with sufficient production capacity to produce and deliver required units without causing delay in work.

1.5 SAFETY REQUIREMENTS

1.5.1 Protect workers as recommended by CAN/ULC-S705.2 and manufacturer's recommendations:

1.5.1.1 Workers must wear gloves, respirators, dust masks, eye protection, protective clothing when applying foam insulation.

1.5.1.2 Workers must not eat, drink or smoke while applying foam insulation.

1.6 PROTECTION

1.6.1 Ventilate area in accordance with manufacturer's instructions.

1.6.2 Ventilate area to receive insulation by introducing fresh air and exhausting air continuously during and 24 hours after application to maintain non-toxic, unpolluted, safe working conditions.

1.6.3 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application area.

1.6.4 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.

1.6.5 Dispose of waste foam daily in location designated by Engineer and decontaminate empty drums in accordance with foam manufacturer's instructions.

1.7 ENVIRONMENTAL REQUIREMENTS

1.7.1 Apply insulation only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Insulation: spray polyurethane foam to CAN/ULC-S705.1, thickness and RSI value as indicated on drawings.

2.1.1.1 RSI: minimum 1.09 per 25 mm.

2.1.1.2 Density: 28 kg/m^3, to ASTM D-1622.

2.1.1.3 Air barrier properties: to ASTM E-28:

2.1.1.3.1 @75 Pa: < 0.05 L/s/m2

2.1.1.3.2 @300 Pa: < 0.05 L/s/m2

2.1.1.4 Perm rating: to ATSM E-96:

2.1.1.4.1 25 mm thick: 149.3 ng/(m^2.Pa.s)

2.1.1.4.2 75 mm thick: 72.1 ng/(m^2.Pa.s)

2.1.1.5 Tensile Strength: 310 kPa, to ASTM D-1623

2.1.1.6 Compressive Strength: 158 kPa, to ASTM D-162,

2.1.1.7 Flame Spread: 25, to ASTME-84

2.1.1.8 Smoke development: 200, to ASTM E-84

2.1.2 Primers: in accordance with manufacturer's recommendations for surface conditions.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 APPLICATION

3.2.1 Apply insulation to clean surfaces in accordance with CAN/ULC-S705.2 and manufacturer's printed instructions.

3.2.2 Use primer where recommended by manufacturer.

3.2.3 Apply sprayed foam insulation in thickness as indicated to seal all openings in exterior wall envelope to produce a continuous air/vapour barrier.

3.3 FIELD QUALITY CONTROL

3.3.1 Manufacturer's Field Services:

3.3.1.1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.4 CLEANING

3.4.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 07 26 00
CH0032	VAPOUR RETARDERS	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 07 26 00
VAPOUR RETARDERS
TABLE OF CONTENTS

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Nathaniel Salfas, NLAA
Expires Dec 31 2013
Date 12/22/13
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PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 03 30 00 – Cast-in-Place Concrete.

1.1.2 Section 06 10 00 – Rough Carpentry.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.2.1.1 All work shall be in accordance with this specification and the requirements of the following.

1.2.2 Canadian General Standards Board (CGSB)

1.2.2.1 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

1.2.3 Underwriters Laboratories Canada (ULC)

1.2.3.1 CAN/ULC S102, Method Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 SUBMITTALS

1.3.1 Product Data:

1.3.1.1 Submit manufacturer's printed product literature, specifications and datasheet and include:

1.3.1.1.1 Product characteristics.

1.3.1.1.2 Performance criteria.

1.3.1.1.3 Limitations.

1.3.2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

1.3.3 Quality assurance submittals:

1.3.3.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3.3.2 Instructions: submit manufacturer's installation instructions and comply with written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

PART 2 PRODUCTS

2.1 SHEET VAPOUR BARRIER

2.1.1 Polyethylene film: to CAN/CGSB-51.34, 0.15 mm thick, with a water vapour permeance of not greater than 4.5 ng/(P.s.m^2), and flame spread rating less than 150 to CAN/ULC S102.

2.2 ACCESSORIES

2.2.1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.

2.2.2 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer, to Section 07 92 00 - Joint Sealants.

2.2.3 Staples: minimum 6 mm leg.

2.2.4 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Ensure services are installed and inspected prior to installation of retarder.

3.1.2 Install sheet vapour retarder on warm side of exterior wall and ceiling assemblies prior to installation of gypsum board to form continuous retarder.

3.1.3 Use sheets of largest practical size to minimize joints.

3.1.4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

3.2 EXTERIOR SURFACE OPENINGS

3.2.1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

3.3 PERIMETER SEALS

3.3.1 Seal perimeter of sheet vapour barrier as follows:

3.3.1.1 Apply continuous bead of sealant to substrate at perimeter of sheets.

3.3.1.2 Lap sheet over sealant and press into sealant bead.

3.3.1.3 Install staples through lapped sheets at sealant bead into wood substrate.

3.3.1.4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.4 LAP JOINT SEALS

3.4.1 Seal lap joints of sheet vapour barrier as follows:

3.4.1.1 Attach first sheet to substrate.

3.4.1.2 Apply continuous bead of sealant over solid backing at joint.

3.4.1.3 Lap adjoining sheet minimum 150 mm and press into sealant bead.

3.4.1.4 Install staples through lapped sheets at sealant bead into wood substrate.

3.4.1.5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.5 ELECTRICAL BOXES

3.5.1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:

3.5.1.1 Install moulded box vapour barrier or wrap boxes with film sheet providing minimum 300 mm perimeter lap flange.

3.5.1.2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

3.6 CLEANING

3.6.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 07 27 00
CH0032	**AIR BARRIERS – DESCRIPTIVE OR PROPRIETARY**	**Rev. D2**
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 07 27 00
AIR BARRIERS – DESCRIPTIVE OR PROPRIETARY
TABLE OF CONTENTS

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 07 27 00
CH0032	**AIR BARRIERS – DESCRIPTIVE OR PROPRIETARY**	**Rev. D2**
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Section Includes:

1.1.1.1 Material and installation methods, providing primary air barrier materials and assemblies.

1.1.1.2 Air barrier materials to provide continuous seal between components of building envelope and building penetrations

1.2 RELATED SECTIONS

1.2.1.1 07 92 00 – Joint Sealants

1.3 REFERENCES

1.3.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.3.2 All work shall be in accordance with this specification and the requirements of the following.

1.3.3 Canadian General Standards Board (CGSB)

1.3.3.1 CAN/CGSB-19.13M, Sealing Compound, One Component, Elastomeric Chemical Curing.

1.3.3.2 CAN/CGSB–19.18M, Sealing Compound, One Component, Silicone Base Solvent Curing.

1.3.3.3 CAN/CGSB-19.24M, Multi-Component, Chemical Curing Sealing Compound.

1.3.3.4 CGSB 19-GP-14M, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.

1.3.4 Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification.

1.3.5 National Building Code of Canada (NBCC) – Part 5 – Environmental Separation.

1.4 SUBMITTALS

1.4.1 Product Data:

1.4.1.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.4.1.2 Submit WHMIS MSDS - Material Safety Data Sheets.

1.4.2 Quality Assurance Submittals: submit following in accordance with General Requirements.

1.4.2.1 Existing Substrate Condition: report deviations, as described in PART 3 - EXAMINATION in writing to Engineer.

1.4.2.2 Submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and maintenance instructions.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications:

1.5.1.1 Applicator: company specializing in performing work of this section with minimum 5 years documented experience with installation of air barrier systems.

1.5.1.1.1 Completed installation must be approved by the material manufacturer.

1.5.1.2 Applicator: company:

1.5.1.2.1 Currently licensed by National Air Barrier Association or certifying organization.

1.5.1.2.2 Must maintain their license throughout the duration of the project.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Deliver, store and handle materials in accordance with manufacturer's written instructions. Deliver membrane materials in factory wrapped packaging indicating name of manufacturer and product.

1.6.2 Avoid spillage: immediately notify Engineer if spillage occurs and start clean up procedures.

1.6.3 Clean spills and leave area as it was prior to spill.

1.6.4 Store roll materials on end in original packaging.

1.6.5 Store primers at temperatures of 5°C and above to facilitate handling. Keep Solvent away from flame and excessive heat.

1.7 AMBIENT CONDITIONS

1.7.1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.

1.7.2 Ventilate enclosed spaces in accordance with manufacturer's instructions.

1.7.3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

D2

1.8 NOT USED

PART 2 PRODUCTS

2.1 SHEET MATERIALS

2.1.1 Sheet Seal: self-adhesive bitumen laminated to high-density polyethylene film, nominal total thickness of 1.0 mm.

2.1.1.1 Membrane Physical Properties:

2.1.1.1.1 Application: min 5°C

2.1.1.1.2 Service temperature: -40°C to 70°C

2.1.1.1.3 Elongation: min 200%

2.1.1.1.4 Tensile strength: min 2.4 mPa

2.1.1.1.5 Puncture resistance: min 178 N

2.1.1.1.6 Water vapour transmission: 2.8 ng/Pa.s.m^2 (0.05 perms)

2.1.1.1.7 Moisture absorption: 0.1%

2.1.1.1.8 Air leakage at 75 Pa: 0.02 L/Sm^2

2.1.1.1.9 Air leakage of the 3000 Pa test: No change.

2.2 SEALANTS

2.2.1 Sealants are to be in accordance with Section 07 92 00 - Joint Sealants.

2.2.2 Primer: as recommended by sealant manufacturer.

2.2.3 Substrate Cleaner: non-corrosive type recommended by sealant manufacturer.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

3.2.1 Perform Work in accordance with Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification requirements for materials and installation.

3.2.2 Perform Work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program .

3.3 EXAMINATION

3.3.1 Verify that surfaces and conditions are ready to accept work of this section.

3.3.2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.

3.3.3 Report unsatisfactory conditions to Engineer in writing.

3.3.4 Do not start work until deficiencies have been corrected.

3.4 PREPARATION

3.4.1 Remove loose or foreign matter, which might impair adhesion of materials.

3.4.2 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas or sharp protrusions.

3.4.3 Ensure substrates are free of surface moisture prior to application of self-adhesive membrane and primer.

3.4.4 Ensure metal closures are free of sharp edges and burrs.

3.4.5 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.

3.5 INSTALLATION

3.5.1 Install materials in accordance with manufacturer's instructions.

3.5.2 Secure sheet seal to masonry, concrete and gypsum board materials with self-adhesive continuous metal bar with anchors.

3.5.2.1 Caulk with sealant to ensure complete seal.

3.5.2.2 Position lap seal over firm bearing

3.5.3 Install sheet seal between window and door frames and adjacent wall seal materials with sealant or adhesive as per manufacturer’s instructions.

3.5.3.1 Caulk to ensure complete seal.

3.5.3.2 Position lap seal over firm bearing.

3.5.4 Apply sealant within recommended application temperature ranges.

3.5.4.1 Consult manufacturer when sealant cannot be applied within these temperature ranges.

3.6 FIELD QUALITY CONTROL

3.6.1 Manufacturer's Field Services:

3.6.1.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.

3.6.1.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.7 CLEANING

3.7.1 Proceed in accordance with General Requirements

3.7.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.8 PROTECTION OF WORK

3.8.1 Protect finished work in accordance General Requirements.

3.8.2 Do not permit adjacent work to damage work of this section.

3.8.3 Ensure finished work is protected from climatic conditions.

3.9 SCHEDULES

3.9.1 Wall Air/Vapour Barrier Over Exterior Surface of Gypsum Sheathing:

3.9.1.1 Place sheet seal Type G over sheathing surfaces with Adhesive Type E.

3.9.1.2 Seal with Type Y sealant.

3.9.2 Window Frame Perimeter:

3.9.2.1 Lap sheet seal Type H from wall air seal surface with 75 mm of full contact over firm bearing to window frame with 25 mm of full contact.

3.9.2.2 Edge seal with Type Z sealant.

3.9.3 Wall and Roof Junction:

3.9.3.1 Lap sheet seal Type J from wall seal material with 150 mm of contact over firm bearing to roof air seal membrane with 100 mm of full contact.

3.9.3.2 Seal with Type X sealant.

3.9.4 Roof System Air/Vapour Barrier Over Steel Deck:

3.9.4.1 Gypsum sheathing, taped joints, apply membrane air seal Type K over sheathing surfaces with Adhesive Type D

3.9.4.2 Edge seal membrane with Type Y sealant.

END OF SECTION

SECTION 07 46 13
PREFORMED METAL SIDING
TABLE OF CONTENTS

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NEWFOUNDLAND AND LABRADOR
MEMBER
Nathaniel Salfas, NLAA
Expires Dec 31 2013
Date DEC 2013
LICENSED TO PRACTICE
ASSOCIATION OF ARCHITECTS

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Requirements for the installation of preformed metal cladding/siding.

1.2 RELATED SECTIONS

1.2.1 Section 06 10 00 – Rough Carpentry

1.2.2 Section 07 62 00 – Sheet Metal Flashing and Trim

1.2.3 Section 07 92 00 - Joint Sealants

D1

1.2.4 Section 07 84 00 - Fire Stopping

1.3 REFERENCES

1.3.1 The Contractor shall comply with the rules and provisions of the listed Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.3.1.1 All work shall be in accordance with this specification and the requirements of the following.

1.3.2 American National Standards Institute (ANSI).

1.3.2.1 ANSI B18.6.4, Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws.

1.3.3 American Society for Testing and Materials International, (ASTM).

1.3.3.1 ASTM D2369-10 (2011), Test Method for Volatile Content of Coatings.

1.3.3.2 ASTM D2832-92 (2011) – Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.

1.3.3.3 ASTM D5116-09 – Standard Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.

1.3.3.4 ASTM F1667-11A (2012) – Standard Specification for Driven Fasteners: Nails, Spikes and Staples.

1.4 SUBMITTALS

1.4.1 Product data: submit manufacturer's printed product literature, specifications and data sheets.

1.4.1.1 Submit two copies of WHMIS MSDS - Material Safety Data Sheets. Indicate VOCs for caulking materials during application and curing.

1.4.2 Shop Drawings:

1.4.2.1 Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, soffits, fascia, metal furring and related work.

1.4.3 Samples:

1.4.3.1 Submit duplicate 300 x 300 mm samples of siding material, of colour and profile specified.

1.4.4 Manufacturer's Instructions:

1.4.4.1 Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

1.5.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.5.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5.3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

1.6.1 Divert used metal cut-offs from landfill by disposal into the on-site metals recycling bin or removed for disposal at the nearest metal recycling facility.

1.6.2 Divert unused caulking, sealants, and adhesive materials from landfill through disposal at hazardous material depot.

PART 2 PRODUCTS

2.1 STEEL CLADDING AND COMPONENTS

2.1.1 Siding: to CGSB 93.4, Type A vertical, Class plain.

2.1.1.1 Finish coating: 10000 Series, two coat, polyvinylidene fluoride resin based system.

2.1.1.2 Colour: colour as selected by Engineer.

2.1.1.3 Gloss: medium.

2.1.1.4 Thickness: 0.65 mm base metal thickness.

2.1.1.5 Profile: preformed interlocking joints, profile CL 938 by Vic West, or approved equal.

2.1.2 Soffit: to CGSB 93.4, Class plain:

2.1.2.1 Finish coating: 10000 Series, two coat, polyvinylidene fluoride resin based system.

2.1.2.2 Colour: colour as selected by Engineer.

2.1.2.3 Gloss: medium.

2.1.2.4 Thickness: 0.65 mm base metal thickness.

2.1.2.5 Profile: flat sheet 'V' crimped for stiffness.

2.1.3 Fascia facings and exposed trim: to CGSB 93.4, Class plain:

2.1.3.1 Finish coating: 10000 Series, two coat, polyvinylidene fluoride resin based system.

2.1.3.2 Colour: colour selected Engineer.

2.1.3.3 Gloss: medium.

2.1.3.4 Thickness: 0.65 mm base metal thickness.

2.1.3.5 Profile: flat sheet “V” crimpod for stiffness, preformed with elongated slits and small perforations.

2.1.4 Alternative Finish Coating:

2.1.4.1 VicWest “Weather X and Baycoat Perspectra” are acceptable equals to 10000 coating series.

D1 **2.1.5** Liner Sheet: to ASTM A653, with Z275 zinc coating, structural quality:

2.1.5.1 Light duty modified silicone finish

D1 2.1.5.2 Factory formed flat or profiled, interlocking joints, shop installed seal material one side of joint. Profile CL508 by VicWest, or approved equal.

2.1.5.3 Thickness: 0.61 mm minimum base metal thickness

2.1.5.4 Color: color as selected by Engineer

2.2 ACCESSORIES

2.2.1 Exposed trim: inside corners, outside corners, cap strip, drip cap, undersill trim, starter strip and window/door trim of same material, colour and gloss as cladding.

2.3 FASTENERS

2.3.1 Nails to ASTM F1667-11a. Screws to ANSI B18.6.4. Purpose made aluminum alloy or stainless steel.

2.4 CAULKING

2.4.1 Sealants: Section 07 92 00 – Joint Sealants.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSTALLATION

3.2.1 Install cladding in accordance with CGSB 93.5, and manufacturer's written instructions

3.2.2 Install continuous starter strips, inside and outside corners, edgings, soffit, drip, cap, sill and window/door opening flashings as indicated.

3.2.3 Install outside corners, fillers and closure strips with carefully formed and profiled work.

3.2.4 Install soffit and fascia cladding as indicated.

3.2.5 Maintain joints in exterior cladding, true to line, tight fitting, hairline joints.

3.2.6 Attach components in manner not restricting thermal movement.

3.2.7 Caulk junctions with adjoining work with sealant. Do work in accordance with Section 07 92 00 - Joint Sealants.

3.2.8 Touch-up field welds and burnt or scratched surfaces after completion of erection, with paint or cold galvanizing materials depending on base coating.

3.3 CLEANING

3.3.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

SECTION 07 52 00
MODIFIED BITUMINOUS MEMBRANE ROOFING
TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 06 10 00 - Rough Carpentry.

1.1.2 Section 07 62 00 - Sheet Metal Flashing and Trim.

1.1.3 Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.2.1.1 All work shall be in accordance with this specification and the requirements of the following.

1.2.2 American Society for Testing and Materials (ASTM International)

1.2.2.1 ASTM C1177/C1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

1.2.2.2 ASTM D6162-00a (2008), Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.

1.2.2.3 ASTM D6164-11, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.

1.2.3 Canadian General Standards Board (CGSB)

1.2.3.1 CGSB 37.5, Cutback Asphalt Plastic Cement.

1.2.3.2 CGSB 37-GP-9Ma, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.

1.2.3.3 CGSB 37-GP-15M, Application.of Asphalt Primer for Asphalt Roofing, Dampproofing and Waterproofing.

1.2.3.4 CGSB 37-GP-19M, Cement, Plastic, Cutback Tar.

1.2.3.5 CAN/CGSB-37.29, Rubber- Asphalt Sealing Compound.

1.2.3.6 CGSB 37-GP-56M-80b (A1985)], Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

1.2.3.7 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

1.2.4 Canadian Roofing Contractors Association (CRCA)

1.2.4.1 CRCA Roofing Specifications Manual-1997.

1.2.5 Canadian Standards Association (CSA International)

1.2.5.1 CSA A123.21-04, Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems

1.2.6 Factory Mutual (FM Global)

1.2.6.1 FM Approvals - Roofing Products.

1.2.7 Underwriters Laboratories' of Canada (ULC)

1.2.7.1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2.7.2 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Compatibility between components of roofing system is essential.

1.3.2 Provide written declaration to Engineer stating that materials and components as assembled in system meet this requirement.

1.4 SUBMITTALS

1.4.1 Product Data:

1.4.1.1 Provide two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.

1.4.1.2 Provide two copies of WHMIS MSDS data sheets, and indicate VOC content for primers, asphalt, sealers, and filter fabric.

1.4.2 Provide Shop Drawings:

1.4.2.1 Indicate flashing, control joints, tapered insulation details, roof drains, and all required roofing materials.

1.4.2.2 Provide layout for tapered insulation.

1.4.3 Samples: submit two (2) sample 304.8 mm (12") long pieces of roofing insulation.

1.4.4 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

1.4.5 Test and Evaluation Reports: submit laboratory test reports certifying compliance of membrane with specification requirements.

1.4.6 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

1.4.7 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.

1.5 QUALITY ASSURANCE

1.5.1 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with 5 years documented experience approved by manufacturer.

1.6 FIRE PROTECTION

1.6.1 Fire Extinguishers: Maintain one stored pressure rechargeable type with hose and shut-off nozzle, ULC labelled for A, B and C class protection, size 9 kg on roof per torch applicator, 6 m of torch applicator.

1.6.2 Maintain fire watch for 2 hours after each day's roofing operations cease.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.7.2 Storage and Handling Requirements:

1.7.2.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.

1.7.2.2 Provide and maintain dry, off-ground weatherproof storage.

1.7.2.3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.

1.7.2.4 Remove only in quantities required for same day use.

1.7.2.5 Place plywood runways over completed Work to enable movement of material and other traffic.

1.7.2.6 Store sealants at +5 degrees C minimum.

1.7.2.7 Store insulation protected from daylight, weather and deleterious materials.

1.8 FIELD CONDITIONS

1.8.1 Ambient Conditions

1.8.1.1 Do not install roofing when temperature remains below -18 degrees C for torch application, or to manufacturers' recommendations for mop application.

1.8.1.2 Minimum temperature for solvent-based adhesive is -5 degrees C.

1.8.2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

D2

1.9 NOT USED

PART 2 PRODUCTS

2.1 PERFORMANCE CRITERIA

2.1.1 Compatibility between components of roofing system is essential.

2.1.2 Provide written declaration to Engineer stating that materials and components, as assembled in system, meet this requirement.

2.1.3 Roofing System: to CSA A123.21 for wind uplift resistance.

2.2 THERMALBARRIER AND AIR/VAPOUR BARRIER

2.2.1 Thermal Barrier: Pre-primed glass mat faced gypsum panel non-asphaltic, highly filled proprietary heat-cured coating on one side, to ASTM C1177, 16 mm thick.

2.2.2 Air/ Vapour Barrier: Self adhering peel and stick air/vapour barrier composed of Styrene-Butadiene-Styrene (SBS) modified bitumen reinforced with high density polyethylene film, anti slip surface, minimum thickness 1.0 mm.

2.3 INSULATION AND COVER BOARD COMPONENTS

2.3.1 For sloped roof decks or roof structures, provide uniform thickness rigid insulation.

2.3.2 For flat roof decks or roof structures, provide custom designed tapered insulation with minimum slope of 2.0 mm in 100 mm (2%). Taper insulation to drain, minimum RSI value at drain to be 4.0.

2.3.3 Expanded Polystyrene Insulation (EPS), Cover Board and Asphalt Recover Board:

2.3.3.1 Expanded Polystyrene Insulation (EPS):

2.3.3.1.1 To CAN/ULC-S701, Type 1, square edged.

2.3.3.1.2 Insulation value thickness per cm based on values listed in the latest edition of NRC - Evaluation Listings.

2.3.3.1.3 Provide two layers of insulation installed with staggered joints.

2.3.3.2 Cover Board: Non-structural, glass mat faced gypsum panel with water-resistant core to ASTM C1177, 6.35 mm thick.

2.3.3.3 Asphalt Recover Board: Semi-rigid asphalt roofing substrate composed of mineral core between glass fibre mats, 1200 x 1500mm sheets, minimum thickness 3.0 mm.

2.3.4 Extruded Polystyrene Insulation (XPS) and two layers of Asphalt Recover Board:

2.3.4.1 Extruded Polystyrene Insulation (XPS):

2.3.4.1.1 To CAN/ULC-S701, Type 2, square edged.

2.3.4.1.2 Insulation value thickness per cm based on values listed in the latest edition of NRC - Evaluation Listings.

2.3.4.1.3 Provide two layers of insulation installed with staggered joints.

2.3.4.2 Two layers of Asphalt Recover Board: Semi-rigid asphalt roofing substrate composed of mineral core between glass fibre mats, 1200 x 1500mm sheets, minimum thickness 3.0 mm each.

2.3.5 Polyisocyanurate Insulation and Asphalt Recover Board:

2.3.5.1 Polyisocyanurate Insulation:

2.3.5.1.1 To CAN/ULC-S704, glass reinforced felt facers, square edged and containing no CFC.

2.3.5.1.2 Insulation value thickness per cm based on values listed in the latest edition of NRC - Evaluation Listings.

2.3.5.1.3 Provide two layers of insulation installed with staggered joints.

2.3.5.2 Asphalt Recover Board: Semi-rigid asphalt roofing substrate composed of mineral core between glass fibre mats, 1200 x 1500mm sheets, minimum thickness 3.0 mm.

2.3.6 Total assembly RSI value:

2.3.6.1 Minimum average RSI value of assembly insulation components to be 7.0.

2.3.6.2 Insulation assembly components to consist of thermal barrier, insulation and cover board.

2.4 BASE SHEET

2.4.1 Base Sheet: to CGSB 37-GP-56M, polyester fibres to ASTM D6164, Styrene-Butadiene-Styrene (SBS) elastomeric polymer, prefabricated sheet, non-woven, polyester reinforcement, having nominal weight of 180 g/m^2.

2.4.1.1 Type 2, fully adhered.

2.4.1.2 Class C - plain surfaced.

2.4.1.3 Grade heavy duty service.

2.4.1.4 Top and bottom surfaces:

2.4.1.4.1 Polyethylene/ polyethylene.

2.4.1.5 Base sheet membrane properties:

2.4.1.5.1 Strain energy (longitudinal/transversal): 9.0/7.0 kN/m.

2.4.1.5.2 Breaking strength (longitudinal/transversal): 17.0/12.5 N/5 cm.

2.4.1.5.3 Ultimate elongation (longitudinal/transversal): 60/65 %.

2.4.1.5.4 Tear resistance: 60 N.

2.4.1.5.5 Cold bending at -30 degrees C: no cracking.

2.4.1.5.6 Softening point: ≥ 110 degrees C.

2.4.1.5.7 Static puncture resistance: > 400.

2.4.1.5.8 Dimensional Stability: -0.3 / 0.3 %.

2.5 CAP SHEET

2.5.1 Cap Sheet: to CGSB 37-GP-56M, combination of polyester and glass fibres to ASTM 6162, Styrene-Butadiene-Styrene(SBS) elastomeric polymer, prefabricated sheet, glass and polyester reinforcement, having nominal weight of 250 g/m^2.

2.5.1.1 Type 1, fully adhered.

2.5.1.2 Class A-granule surfaced.

2.5.1.2.1 Colour for granular surface: light gray.

2.5.1.3 Grade heavy duty service.

2.5.1.4 Bottom surface polyethylene.

2.5.1.5 Cap sheet membrane properties:

2.5.1.5.1 Strain energy (longitudinal/transversal): 13.0/10.0 kN/m.

2.5.1.5.2 Breaking strength (longitudinal/transversal): 25.0/16.0 kN/m.

2.5.1.5.3 Ultimate elongation (longitudinal/transversal): 60/65 %.

2.5.1.5.4 Tear resistance: 80 N.

2.5.1.5.5 Cold bending at -30 degrees C: No cracking.

2.5.1.5.6 Softening point: ≥ 110 degrees C.

2.5.1.5.7 Static puncture resistance: > 400.

2.5.1.5.8 Dimensional Stability: -0.2 / 0.2 %.

2.6 ADHESIVE

2.6.1 Adhesive for securing overlay board and insulation: a single component moisture cured polyurethane adhesive dispensed from a portable disposable pre-pressurized container requiring no external power source.

2.7 BASE SHEET FLASHING

2.7.1 To CGSB 37-GP-56M, Type 2, Class C, Grade 2, non-woven polyester reinforced 180g/m^2, self-adhesive membrane with polyethylene top face and release film under face.

2.8 SEALERS

2.8.1 Mastic made of synthetic rubbers, plasticized with bitumen and solvents with aluminum pigments to provide greater resistance to U.V.

2.9 PRIMERS

2.9.1 For self-adhesive membranes: A blend of elastomeric bitumen, volatile solvents and adhesive enhancing resins used to prime porous and non-porous substrates such as gypsum board, wood, concrete or metal to enhance the adhesion of self-adhesive membranes at temperatures above -10°C.

2.9.2 For heat welded membranes: A blend of elastomeric bitumen, volatile solvents and adhesive enhancing additives used to prime concrete or metal substrates to enhance the adhesion of torch-applied membranes.

2.10 FASTENERS

2.10.1 Fasteners: minimum #14 mechanical fasteners made of case-hardened carbon steel with corrosion resistance coating, complying with FM standards.

2.10.2 75 mm diameter round or hexagon stress plates complying with CSA B35.3 and FM 4470 approval standards, diameter and lengths as required to suit total assembly thickness.

2.10.3 Ensure fasteners have the following deck penetration:

2.10.3.1 For metal decks: minimum 19 mm and maximum 25 mm longer than assembly being secured. Fasteners to engage metal deck top flange.

2.11 WALKWAYS

2.11.1 Walkways to consist of one additional ply of cap sheet membrane. Colour to be different from field membrane as selected by Engineer.

2.12 CARPENTRY

2.12.1 Refer to Section 06 10 00 - Rough Carpentry.

2.13 CANT STRIPS

2.13.1 Cut from pressure-treated wood, 38 mm thick material, to measure 140 mm on slope.

2.14 ROOF DRAINS

2.14.1 As per mechanical specifications for Plumbing Specialties and Accessories.

2.14.2 Sump pan: 600 x 600 mm galvanized steel.

PART 3 EXECUTION

3.1 QUALITY OF WORK

3.1.1 Do examination, preparation and roofing work in accordance with Roofing Manufacturer's Specification Manual and CRCA Roofing Specification Manual, particularly for fire safety precautions.

3.1.2 Do priming in accordance with manufacturers written recommendations.

3.1.3 The interface of the walls and roof assemblies will be fitted with durable rigid material providing connection point for continuity of air barrier.

3.1.4 Assembly, component and material connections will be made in consideration of appropriate design loads.

3.2 PROTECTION

3.2.1 Cover walls and adjacent work where materials hoisted or used.

3.2.2 Use warning signs and barriers. Maintain in good order until completion of Work.

3.2.3 Clean off drips and smears of bituminous material immediately.

3.2.4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

3.2.5 Protect roof from traffic and damage.

3.2.6 At end of each day’s work or when stoppage occurs due to inclement weather, provide protection for completed work and materials out of storage.

3.2.7 Install insulation promptly to avoid possibility of condensation beneath vapour retarder.

3.2.8 Take necessary measures ensuring no penetration of the elements will occur to the building after commencement of work, including but not limited to water.

3.2.9 Only remove quantities of existing roofing material and install quantities of new roofing materials per day that can be covered with waterproofing membranes.

3.3 EXAMINATION ROOF DECKS

3.3.1 Inspect with Engineer deck condition including parapets, construction joints, roof drains, plumbing vents, and ventilation outlets to determine readiness to proceed.

3.3.2 Examine roof decks and immediately inform Engineer in writing of defects.

3.3.3 Prior to commencement of work ensure:

3.3.3.1 Decks are firm, straight, smooth, dry, and free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.

3.3.3.2 Curbs have been built. Coordinate height of roof curbs with Section 06 10 00 – Rough Carpentry.

3.3.3.3 Roof drains have been installed at proper elevations relative to finished roof surface.

3.3.3.4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.

3.3.4 Do not install roofing materials during rain or snowfall.

3.4 EXPOSED MEMBRANE ROOFING APPLICATION (METAL ROOF DECK)

3.4.1 Thermal Barrier and Air/Vapour Barrier:

3.4.1.1 Place thermal barrier with long axis of each sheet transverse to steel deck ribs, with end joints staggered and fully supported on ribs.

3.4.1.2 Secure thermal barrier to metal deck using one (1) fastener per board, located at the centre of the board, fasteners to be FMRC approved. **OR** , apply beads of roofing adhesive to metal deck in accordance with manufacturer's written instructions. Adhere thermal barrier in adhesive and walk-in thermal barrier to insure maximum contact with adhesive.

3.4.1.3 Fit butt edge joints in firm contact with one another.

3.4.1.4 Prime all surfaces of thermal barrier to receive self-adhering modified bituminous sheet air/vapour barrier as per manufacturer's instructions.

3.4.1.5 Apply self-adhering modified bituminous sheet air/vapour barrier to thermal barrier in an overlapping shingle fashion. Stagger all vertical joints.

3.4.1.6 Align modified bituminous sheet air/vapour barrier, remove protective film and press firmly into place. Ensure minimum 50 mm overlap at all ends and side laps. Roll membrane, including seams, with counter top roller to ensure full contact.

3.4.2 Insulation

3.4.2.1 Loosely lay layer of insulation over thermal barrier and air/vapour barrier. **OR** apply beads of roofing adhesive to air/vapour barrier in accordance with manufacturer's written instructions. Adhere insulation in adhesive and walk-in insulation boards to insure maximum contact with adhesive.

3.4.2.2 Place boards in parallel rows with ends staggered, and in firm contact with one another.

3.4.2.3 Cut end boards to suit.

3.4.2.4 Install tapered insulation in accordance with reviewed shop drawings.

3.4.3 Cover Board Components (Expanded Polystyrene (EPS):

3.4.3.1 Loosely lay cover board over EPS insulation. **OR,** apply beads of roofing adhesive to insulation in accordance with manufacturer's written instructions. Adhere cover board in adhesive and walk-in cover boards to insure maximum contact with adhesive.

3.4.3.2 Place boards in parallel rows with ends staggered and in firm contact with one another.

3.4.3.3 Cut end boards to suit.

3.4.3.4 Mechanically fasten asphalt recover board over cover board with plates and fasteners. **OR,** apply beads of roofing adhesive to cover board in accordance with manufacturer's written instructions. Adhere asphalt recover board in adhesive and walk-in asphalt recover boards to insure maximum contact with adhesive.

3.4.3.5 Fit boards tight together. Stagger joints between asphalt recover board and cover board. Install fasteners/adhesive based on design wind uplift securement requirements, for the building site location, for insulation and cover board, in accordance with manufacturer's recommendations.

3.4.3.6 OR

3.4.3.7 Cover Board Components (Extruded Polystyrene (XPS):

3.4.3.7.1 Cover XPS insulation with two layers of asphalt recover board.

3.4.3.7.2 Place boards in parallel rows with ends staggered and in firm contact with one another.

3.4.3.7.3 Cut end boards to suit.

3.4.3.7.4 Mechanically fasten asphalt recover board with plates and fasteners. **OR,** apply beads of roofing adhesive for each layer of asphalt recover board in accordance with manufacturer's written instructions. Adhere each layer of asphalt recover board in adhesive and walk-in asphalt recover boards to insure maximum contact with adhesive.

3.4.3.7.5 Fit boards tight together. Stagger joints between layers of asphalt recover board. Install fasteners/adhesive based on design wind uplift securement requirements, for the building site location, for insulation and cover board, in accordance with manufacturer's recommendations.

3.4.3.8 OR

3.4.3.9 Cover Board Components (Polyisocyanurate (Polyiso)):

3.4.3.9.1 Cover Polyiso insulation with one layer of asphalt recover board.

3.4.3.9.2 Place boards in parallel rows with ends staggered and in firm contact with one another.

3.4.3.9.3 Cut end boards to suit.

3.4.3.9.4 Mechanically fasten asphalt recover board with plates and fasteners. **OR,** apply beads of roofing adhesive to insulation in accordance with manufacturer's written instructions. Adhere asphalt recover board in adhesive and walk-in asphalt recover boards to insure maximum contact with adhesive.

3.4.3.9.5 Fit boards tight together. Install fasteners/adhesive based on design wind uplift securement requirements, for the building site location, for insulation and cover board, in accordance with manufacturer's recommendations.

3.4.4 Base Sheet Application:

3.4.4.1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.

3.4.4.2 Unroll and torch base sheet onto recover board taking care not to burn membrane or its reinforcement.

3.4.4.3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.

3.4.4.4 Application to be free of blisters, wrinkles and fishmouths.

3.4.5 Cap Sheet Application:

3.4.5.1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.

3.4.5.2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.

3.4.5.3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.

3.4.5.4 Application to be free of blisters, fishmouths and wrinkles.

3.4.5.5 Do membrane application in accordance with manufacturer's recommendations.

3.4.6 Flashings:

3.4.6.1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.

3.4.6.2 Torch, base and cap sheet onto substrate in 1 metre wide strips.

3.4.6.3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by torch welding.

3.4.6.4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.

3.4.6.5 Provide 75 mm minimum side lap and seal.

3.4.6.6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.

3.4.6.7 Do Work in accordance with manufacturer's recommendations.

3.5 ROOF PENETRATIONS

3.5.1 Install roof drain pans, vent stack covers and other roof penetration Flashings and seal to membrane in accordance with the manufacturer's recommendations and details.

3.5.2 All new roof drains to be installed by certified plumber. Coordinate installation of roof drains so that work can be inspected by Engineer prior to commencement of remaining roof work.

3.6 CLEANING

3.6.1 Perform in accordance with General Requirements.

3.6.2 Remove bituminous markings from finished surfaces.

3.6.3 Check drains to ensure cleanliness and proper function, and remove debris, equipment and excess material from site.

3.6.4 In areas where finished surfaces are soiled caused by work of this section, consult manufacturers of surfaces for cleaning advice and complying with their documented instructions.

3.6.5 Repair or replace defaced or disfigured finishes caused by work of this section.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 07 62 00
CH0032	SHEET METAL FLASHING AND TRIM	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

NEWFOUNDLAND AND LABRADOR
MEMBER
Nathaniel Salfas, NLAA
Expires Dec 31 2013
Date: 10-25-2012
LICENSED TO PRACTICE
ASSOCIATION OF ARCHITECTS

PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 06 10 00 – rough Carpentry.

1.1.2 Section 07 52 00 – Modified Bituminous Membrane Roofing.

1.1.3 Section 07 92 00 – Joint Sealants.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.2.2 All work shall be in accordance with this specification and the requirements of the following.

1.2.3 The Aluminum Association Inc. (AAI)

1.2.3.1 AAI-Aluminum Sheet Metal Work in Building Construction-2002.

1.2.3.2 AAI DAF45-03, Designation System for Aluminum Finishes.

1.2.4 American Society for Testing and Materials International (ASTM)

1.2.4.1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.2.4.2 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

1.2.4.3 ASTM D523-08, Standard Test Method for Specular Gloss.

1.2.4.4 ASTM D822-01(2006), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.

1.2.4.5 ASTM F1667-11a (2012), Standard Specification for Driven Fasteners: Nails, Spikes and Staples.

1.2.5 Canadian Roofing Contractors Association (CRCA)

1.2.5.1 Roofing Specifications Manual 1997.

1.2.6 Canadian General Standards Board (CGSB)

1.2.6.1 CAN/CGSB-37.5, Cutback Asphalt Plastic Cement.

1.2.6.2 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.

1.2.7 Canadian Standards Association (CSA International)

1.2.7.1 CSA A123.3-05, Asphalt Saturated Organic Roofing Felt.

1.3 SUBMITTALS

1.3.1 Product Data:

1.3.1.1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.3.1.2 Submit two copies WHMIS MSDS - Material Safety Data Sheets.

1.3.2 Samples:

1.3.2.1 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.

1.4 DELIVERY, STORAGE AND HANDLING

1.4.1 Deliver, store and handle materials in accordance with manufacturer’s instructions.

PART 2 PRODUCTS

2.1 SHEET METAL MATERIALS

2.1.1 Aluminum-zinc alloy coated steel sheet: to ASTM A792/A792M, commercial quality, grade 33 with AZ150 coating, regular spangle surface, 0.70 mm base metal thickness, pre-painted to CGSB-GP-71.

2.2 PREFINISHED STEEL SHEET

2.2.1 Prefinished steel with factory applied polyvinylidene fluoride.

2.2.1.1 Class F1S.

2.2.1.2 Colour as selected by Engineer from manufacturer's standard range.

2.2.1.3 Specular gloss: 30 units +/- 5 in accordance with ASTM D523.

2.2.1.4 Coating thickness: not less than 22 micrometres.

2.2.1.5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822 as follows:

2.2.1.5.1 Outdoor exposure period 2500 hours.

2.2.1.5.2 Humidity resistance exposure period 5000 hours.

2.3 ACCESSORIES

2.3.1 Isolation coating: alkali resistant bituminous paint.

2.3.2 Plastic cement: to CAN/CGSB 37.5. Maximum VOC limit 50 g/L.

2.3.3 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.

2.3.4 Sealants: Section 07 92 00 – Joint Sealants. Maximum VOC limit 50 g/L.

2.3.5 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.

2.3.6 Fasteners: of same material as sheet metal, to ASTM F1667-11a, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.

2.3.7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

2.3.8 Touch-up paint: as recommended by prefinished material manufacturer. Maximum VOC limit 50 g/L.

2.4 FABRICATION

2.4.1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details as indicated.

2.4.2 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.

2.4.3 Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints.

2.4.4 Hem exposed edges on underside 12 mm. Mitre and seal corners with sealant.

2.4.5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

2.4.6 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 **METAL FLASHINGS**

2.5.1 Form flashings, copings and fascias to profiles indicated of 0.70 mm thick prefinished steel.

PART 3 EXECUTION

3.1 **MANUFACTURER'S INSTRUCTIONS**

3.1.1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 **INSTALLATION**

3.2.1 Install sheet metal work in accordance with CRCA FL series details and as detailed.

3.2.2 Use concealed fastenings except where approved before installation.

3.2.3 Provide underlay under sheet metal. Secure in place and lap joints 100 mm.

3.2.4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips, as detailed.

3.2.5 Lock end joints and caulk with sealant.

3.3 **CLEANING**

3.3.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.3.2 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

SECTION 07 72 69
ROOF ANCHORS AND SAFETY RESTRAINTS
TABLE OF CONTENTS

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NEWFOUNDLAND AND LABRADOR
MEMBER
Nathaniel Salfas, NLAA
Expires Dec 31 2013
Date: 20 Dec 2013
LICENSED TO PRACTICE
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PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Shop fabricated roof mounted personal safety restraints.

1.2 RELATED SECTIONS

1.2.1 Section 07 52 00 - Modified Bituminous Membrane Roofing.

1.2.2 Section 07 62 00 - Sheet Metal Flashing and Trim

1.3 REFERENCES

1.3.1 American Society for Testing and Materials International, (ASTM).

1.3.1.1 ASTM A167-99 (2009), Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

1.3.1.2 ASTM A500/500M-10a, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

1.3.2 Canadian Standards Association (CSA International).

1.3.2.1 CAN/CSA-G40.20/G40.21-98, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

1.3.2.2 CAN/CSA-G164-M92(R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3.2.3 CSA-W47.1-92(R2001), Certification of Companies for Fusion Welding of Steel Structures.

1.3.2.4 CSA-W55.3-65(R1998), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

1.3.3 Master Painters Institute (MPI).

1.3.3.1 Architectural Painting Specification Manual.

1.3.4 The Society for Protective Coatings (SSPC).

1.3.4.1 SP -2, Hand-Tool Cleaning.

1.4 SYSTEM DESCRIPTION

1.4.1 Personal Restraint Assembly: Posts, steel rope loops, and attachments to resist lateral forces of 3 kN at any point and in all directions, without damage or permanent set.

1.5 SUBMITTALS

1.5.1 Submit WHMIS MSDS - Material Safety Data Sheets

1.6 SHOP DRAWINGS

1.6.1 Indicate component profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1.6.2 Indicate welded connections using standard welding symbols include net weld lengths.

1.7 QUALITY ASSURANCE

1.7.1 Submit design.

1.7.2 Submit Test Reports and substantiating engineering data and test results of previous tests by independent laboratory which purport to meet performance criteria, and other supportive data.

1.7.3 Design structural support framing components and site inspect the installation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed [at the place where the Project is located in the Province of Newfoundland and Labrador, Canada.

1.7.4 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.7.5 Co-ordinate the Work with installation of roofing assembly and sheet metal work.

1.8 WELDERS' QUALIFICATIONS

1.8.1 Welders Certificates: furnish welders' qualifications to Engineer.

1.8.2 Welding qualifications to be in accordance with CSA B51.

1.8.3 Employ qualified and licensed welders possessing certificates for each procedure to be performed from authority having jurisdiction.

1.8.4 Each welder to possess identification symbol issued by authority having jurisdiction.

1.8.5 Certification of companies for fusion welding of steel structures to be in accordance with CSA-W47.1.

1.8.6 Manufacturer Qualifications: company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.9 SITE CONDITIONS

1.9.1 Prior to start of work verify existing site conditions

1.9.2 Verify dimensions, tolerances, and method of attachment with other work.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Sections and Plates: CSA G40.20M/G40.21.

2.1.2 Steel Tubing: ASTM A500, Grade B.

2.1.3 Steel Rings: forged steel, ring thickness determined by imposed loads.

2.1.4 Steel Cable (between post travel restraints): minimum 13 mm diameter, spiral wound multi-strand stainless steel aircraft cable.

2.1.5 Bolts, Nuts, and Washers for Stainless Steel: stainless steel, matte finish.

2.1.6 Gaskets Under Anchors: neoprene pads, compatible with roof membrane, cut to size.

2.1.7 Welding Materials: CSA-W47.1 for materials being welded.

2.1.8 Shop Primer: Epoxy, anti-corrosive type, two coats.

2.2 FABRICATION

2.2.1 Fit and shop assemble items in largest practical sections, for delivery to site.

2.2.2 Fabricate items with joints tightly fitted and secured.

2.2.3 Continuously seal joined members by intermittent welds and plastic filler.

2.2.4 Grind exposed joints flush and smooth with adjacent finish surface.

2.2.4.1 Make exposed joints butt tight, flush, and hairline.

2.2.4.2 Ease exposed edges to small uniform radius.

2.2.5 Exposed Mechanical Fastenings: screws or bolts; consistent with design of component.

2.2.6 Furnish and install components required for anchorage of fabrications.

2.2.7 Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATION TOLERANCES

2.3.1 Squareness: 3 mm maximum difference in diagonal measurements.

2.3.2 Maximum Deviation From Plane: 1.5 mm from 1 m.

2.4 FINISHES

2.4.1 Prepare uncoated steel (restraint post) surfaces: SSPC-SP 2, no more than 4 hours before applying epoxy primer.

2.4.2 Concealed steel anchors, clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

2.4.3 Do not prime surfaces in direct contact with concrete or where field welding is required.

2.4.4 Concealed Structural Components and Anchors: galvanize after fabrication to CAN/CSA-G164 to minimum 600 g/sq m galvanized coating.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify existing conditions before starting Work.

3.1.2 Verify dimensions, tolerances, and method of attachment with other work.

3.2 PREPARATION

3.2.1 Supply and install steel items required to be cast into concrete or attached to steel framing as clean uncoated metal, with setting templates to appropriate sections.

3.3 INSTALLATION

3.3.1 Install items plumb and level, accurately fitted, free from distortion or defects.

3.3.2 Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

3.3.3 Field weld components as indicated on shop drawings. Perform field welding.

3.3.4 Obtain approval from Engineer prior to site cutting or making adjustments not scheduled.

3.3.5 After erection, apply primer in accordance with MPI Painting Manual to: welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.3.6 Thread aircraft cable through eye-lets at top of post, to linear roof coverage of post restraints; pressure crimp cable ends.

3.4 ERECTION TOLERANCES

3.4.1 Maximum Variation from Plum and Level: 6 mm.

3.5 PROTECTION OF FINISHED WORK

3.5.1 Protect finished Work from damage.

END OF SECTION

SECTION 07 84 00
FIRESTOPPING
TABLE OF CONTENTS

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MEMBER
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Expires Dec 31 2013
Date 01/12/13
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ASSOCIATION OF ARCHITECTS

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 07 84 00
CH0032	**FIRE STOPPING**	**Rev. D2**
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

PART 1 GENERAL

1.1 RELATED WORK

1.1.1 Fire stopping and smoke seals within mechanical assemblies (i.e. inside ducts, dampers) and electrical assemblies (i.e. inside cable trays) are specified in Division 23 and 26 respectively.

1.1.2 Coordinate work of this section with other sections as required properly executing the work and as necessary maintaining satisfactory progress of the work of other sections.

1.2 RELATED SECTIONS

D1 1.2.1 Section 07 46 13 - Preformed Metal Siding.

D1 1.2.2 Section 07 62 00 - Sheet Metal Flashing and Trim.

D1 1.2.3 Section 09 21 16 - Gypsum Board Assemblies.

1.3 REFERENCES

1.3.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.3.2 All work shall be in accordance with this specification and the requirements of the following.

1.3.2.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

1.3.2.1.1 Material Safety Data Sheets (MSDS).

1.3.3 National Building Code of Canada (NBC)

1.3.3.1 Underwriter's Laboratories of Canada (ULC)

1.3.3.1.1 ULC-S115-1995, Fire Tests of Fire stop Systems.

1.4 DEFINITIONS

1.4.1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.

1.4.2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.

1.4.3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.

1.4.4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of non-combustible construction or have "0" annular space in buildings of combustible construction.

1.4.4.1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.5 SUBMITTALS

D1

1.5.1 Submittal shall in accordance with Exhibit 4 – Supplier Document Requirements List

1.5.2 Product Data:

1.5.2.1 Submit manufacturer's printed product literature, specifications and datasheet for materials and prefabricated devices, and include product characteristics, performance criteria, physical size, finish and limitations, and installation instructions. Include documentation of ULC or cUL firestop systems to be used.

1.5.2.2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets.

1.5.3 Shop Drawings:

1.5.3.1 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation.

1.5.3.2 Construction details should accurately reflect actual job conditions.

1.5.4 Samples:

1.5.4.1 Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.

1.5.5 Quality assurance submittals:

1.5.5.1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.

1.5.5.1.1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.

1.5.5.1.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.5.5.1.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

D1

1.5.5.2 Submit manufacturer’s engineering judgement identification number and drawing details when no ULC or cUL system is available. Engineering judgement must include both project name and Contractor’s name who will install firestop system as described in drawing.

1.5.5.3 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

D1

1.5.6 Mock-up

1.5.6.1 Construct mock-up showing service penetrations, fire separation and floor assemblies.

D1

1.5.6.2 Allow 48h for inspection of mock-up by Engineer before proceeding with membrane work.

1.6 QUALITY ASSURANCE

1.6.1 Qualifications:

1.6.1.1 Installer: company and person specializing in fire stopping installations with 5 years documented experience approved by manufacturer.

1.6.2 Manufacturer’s Representative:

1.6.2.1 A manufacturer’s representative shall be on site during initial installation of firestop systems to train appropriate Contractor personnel in proper selection and installation procedures and at commissioning stage to certify acceptance completed installation. Training shall be done as per manufacturer’s written recommendations published in their literature and drawing details.

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Packing, shipping, handling and unloading:

1.7.1.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.7.1.2 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, and ULC markings.

1.7.2 Storage and Protection:

1.7.2.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

1.7.2.2 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

2.1.2 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.

2.1.2.1 Asbestos free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended

2.1.2.2 Fire stop system rating: as indicated on drawings.

2.1.2.3 Service penetration assemblies: systems tested by ULC or cUL in accordance with CAN-ULC-S115.

2.1.2.4 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.

2.1.2.5 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.

2.1.2.6 Non-curing, re-penetrable intumescent sealants, caulking or putty material for use with flexible cables or cable bundles.

2.1.2.7 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

2.1.2.8 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal. Consult with Engineer and damper manufacturer prior to installation ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.

2.1.2.9 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe. No silicone based firestop are allowed to be applied on plastic pipes.

2.1.2.10 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

2.1.2.11 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

2.1.2.12 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

2.1.2.13 Sealants for vertical joints: non-sagging.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION

3.2.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.

3.2.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

3.2.3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.

3.2.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

3.3.1 Install fire stopping and smoke seal material and components in accordance with ULC certification or UL Products Certified for Canada (cUL) and manufacturer's certified tested system listing.

3.3.2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

3.3.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

3.3.4 Tool or trowel exposed surfaces to neat finish.

3.3.5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

3.4.1 Proceed with installation only when submittals have been reviewed by Engineer.

3.4.2 Install floor fire stopping before interior partition erections.

3.4.3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.

3.4.4 Mechanical pipe insulation: certified fire stop system component. Ensure pipe insulation installation precedes fire stopping.

3.5 FIELD QUALITY CONTROL

3.5.1 Inspections: notify Engineer when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.5.2 Manufacturer's Field Services:

3.5.2.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

3.5.2.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5.2.3 Schedule site visits, to review work, as directed by Engineer.

3.6 CLEANING

3.6.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.6.2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 SCHEDULE

3.7.1 Fire stop and smoke seal at:

3.7.1.1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.

3.7.1.2 Edge of floor slabs at precast concrete panels.

3.7.1.3 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.

3.7.1.4 Openings and sleeves installed for future use through fire separations.

3.7.1.5 Around mechanical and electrical assemblies penetrating fire separations.

3.7.1.6 Rigid ducts: greater than 129 cm^2: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 07 92 00
CH0032	JOINT SEALANTS	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 07 92 00
JOINT SEALANTS

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PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Materials, preparation and application for caulking and sealants.

1.1.2 Text to complete other various Sections containing sealant or caulking specifications, including Section 07 52 00 - Modified Bituminous Membrane Roofing.

1.2 RELATED SECTIONS

1.2.1 All Specification Sections containing sealant or caulking.

1.3 REFERENCES

1.3.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.3.2 All work shall be in accordance with this specification and the requirements of the following.

1.3.3 Canadian General Standards Board (CGSB)

1.3.3.1 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.

1.3.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

1.3.4.1 Material Safety Data Sheets (MSDS).

1.3.5 Transport Canada (TC)

1.3.5.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.4 SUBMITTALS

1.4.1 Manufacturer's product data is to describe:

1.4.1.1 Caulking compound.

1.4.1.2 Primers.

1.4.1.3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.4.1.4 Installation instructions, surface preparation and product limitations.

1.4.2 Submit duplicate samples of each type of material and colour.

1.4.3 Cured samples of exposed sealants for each color where required to match adjacent material.

1.4.4 Manufacturer's instructions are to include installation instructions for each product used.

1.5 QUALITY ASSURANCE/MOCK-UP

1.5.1 Construct mock-up to show location, size, shape and depth of joints complete with back-up material, primer, caulking and sealant.

1.5.2 Mock-up will be used:

1.5.2.1 To judge workmanship, substrate preparation, operation of equipment and material application.

1.5.3 Locate where directed.

1.5.4 Allow 24 hours for inspection of mock-up by Engineer before proceeding with sealant work.

1.5.5 When accepted, mock-up will demonstrate minimum standard of quality required for this Work. Approved mock-up may remain as part of finished Work.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Deliver, handle, store and protect materials in accordance with manufacturer’s instructions.

1.6.2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

1.7 PROJECT CONDITIONS

1.7.1 Environmental Limitations:

1.7.1.1 Do not proceed with installation of joint sealants under following conditions:

1.7.1.1.1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.

1.7.1.1.2 When joint substrates are wet.

1.7.2 Joint Width Conditions:

1.7.2.1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

1.7.3 Joint Substrate Conditions:

1.7.3.1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 ENVIRONMENTAL REQUIREMENTS

1.8.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.

1.8.2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

1.8.3 Ventilate area of work as directed by Engineer by use of approved portable supply and exhaust fans.

PART 2 PRODUCTS

2.1 SEALANT MATERIALS

2.1.1 Sealants and Caulking compounds must:

2.1.1.1 Meet or exceed all applicable governmental and industrial safety and performance standards; and

2.1.1.2 Be manufactured and transported in such a manner that all steps of the process, including the disposal of waste products arising there from, will meet the requirements of all applicable governmental acts, by laws and regulations including, for facilities located in Canada, the Fisheries Act and the Canadian Environmental Protection Act (CEPA).

2.1.2 Sealant and caulking compounds must not be formulated or manufactured with: aromatic solvents, fibrous talc or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium, barium or their compounds, except barium sulphate.

2.1.3 Sealant and caulking compounds must not contain a total of volatile organic compound (VOCs) in excess of 5% by height as calculated from records of the amounts of constituents used to make the product.

2.1.4 Sealant and caulking compounds must be accompanied by detailed instructions for proper application so as to minimize health concerns and maximize performance, and information describing proper disposal methods.

2.1.5 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

2.1.6 When low toxicity caulks are not possible, confine usage to areas which off-gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off-gas time.

2.1.7 Where sealants are qualified with primers use only these primers.

2.1.8 Sealants acceptable for use on this project must be listed on CGSB Qualified Products List issued by CGSB Qualification Board for Joint Sealants. Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

2.2.1 Urethanes One Part.

2.2.1.1 Non-Sag to CAN/CGSB-19.13, Type 2.

2.2.2 Silicones One Part.

2.2.2.1 To CAN/CGSB-19.13, mildew resistant.

2.2.3 Preformed Compressible and Non-Compressible back-up materials.

2.2.3.1 Polyethylene, Urethane, Neoprene or Vinyl Foam.

2.2.3.1.1 Extruded closed cell foam backer rod.

2.2.3.1.2 Size: oversize 30 to 50 %.

2.2.3.2 Neoprene or Butyl Rubber.

2.2.3.2.1 Round solid rod, Shore A hardness 70.

2.2.3.3 High Density Foam.

2.2.3.3.1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m^3 density, or neoprene foam backer, size as recommended by manufacturer.

2.2.3.4 Bond Breaker Tape.

2.2.3.4.1 Polyethylene bond breaker tape which will not bond to sealant.

2.3 SEALANT SELECTION

2.3.1 Perimeters of exterior openings where frames meet exterior facade of building: Sealant type: CAN/CGSB-19.13.

2.3.2 Seal interior perimeters of exterior openings as detailed on drawings: Sealant type: CAN/CGSB-19.13.

2.3.3 Perimeters of interior frames, as detailed and itemized: Sealant type: CAN/CGSB-19.13.

2.4 JOINT CLEANER

2.4.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.

2.4.2 Primer: as recommended by manufacturer.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Protect installed work of other trades from staining or contamination.

3.2 SURFACE PREPARATION

3.2.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

3.2.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair work.

3.2.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

3.2.4 Ensure joint surfaces are dry and frost free.

3.2.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

3.3.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

3.3.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

3.4.1 Apply bond breaker tape where required to manufacturer's instructions.

3.4.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

3.5.1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

3.6.1 Sealant.

3.6.1.1 Apply sealant in accordance with manufacturer's written instructions.

3.6.1.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

3.6.1.3 Apply sealant in continuous beads.

3.6.1.4 Apply sealant using gun with proper size nozzle.

3.6.1.5 Use sufficient pressure to fill voids and joints solid.

3.6.1.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

3.6.1.7 Tool exposed surfaces before skinning begins to give slightly concave shape.

3.6.1.8 Remove excess compound promptly as work progresses and upon completion.

3.6.2 Curing.

3.6.2.1 Cure sealants in accordance with sealant manufacturer's instructions.

3.6.2.2 Do not cover up sealants until proper curing has taken place.

3.6.3 Cleanup.

3.6.3.1 Clean adjacent surfaces immediately and leave Work neat and clean.

3.6.3.2 Remove excess and droppings, using recommended cleaners as work progresses.

3.6.3.3 Remove masking tape after initial set of sealant.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 08 11 00
CH0032	**METAL DOORS AND FRAMES**	**Rev. D2**
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 08 11 00
METAL DOORS AND FRAMES
TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 07 21 20 – Low Expanding Foam Sealant.

1.1.2 Section 07 92 00 - Joint Sealants.

1.1.3 Section 08 71 00 - Door Hardware.

1.1.4 Section 08 80 50 – Glazing.

1.1.5 Section 09 91 13 - Interior Painting.

1.1.6 Section 09 97 19 – Painting Exterior Metal Surfaces.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the listed Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.2.2 All work shall be in accordance with this specification and the requirements of the following.

1.2.3 American Society for Testing and Materials (ASTM) SUBMITTALS

1.2.3.1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

1.2.4 Canadian General Standards Board (CGSB)

1.2.4.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.2.4.2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.

1.2.5 Canadian Standards Association (CSA)

1.2.5.1 G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

1.2.5.2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).

1.2.6 Canadian Steel Door Manufacturers' Association, (CSDMA).

1.2.6.1 CSDMA, Specifications for Commercial Steel Doors and Frames, 2000.

1.2.6.2 CSDMA, Recommended Selection and Usage Guide for Commercial Steel Doors, 1990.

1.2.7 National Fire Protection Association (NFPA)

1.2.7.1 NFPA 80-2010, Standard for Fire Doors and Fire Windows.

1.2.7.2 NFPA 252-03, Standard Methods of Fire Tests of Door Assemblies.

1.2.8 Underwriters' Laboratories of Canada (ULC)

1.2.8.1 CAN4-S104-M80, Fire Tests of Door Assemblies.

1.2.8.2 CAN4-S105-M85, Fire Door Frames Meeting the Performance Required by CAN4-S104.

1.2.8.3 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 DESIGN REQUIREMENTS

1.3.1 Design door assembly to withstand minimum 1,000,000 swing cycles in accordance with ANSI A151.1, with no failure of any design features of the door.

1.3.2 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35˚C to 35˚C.

1.3.3 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.

1.3.4 Steel fire rated doors and frames: labeled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 and NFPA 252 for ratings specified or indicated.

1.3.5 Provide fire labeled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104 and NFPA 252 and listed by nationally recognized agency having factory inspection services and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

1.4 SUBMITTALS

1.4.1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, louvred, arrangement of hardware and fire rating and finishes.

1.4.2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing fire rating and finishes.

1.4.3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

1.4.4 Submit test and engineering data, and installation instructions.

1.4.5 Submit one 300 x 300 mm top corner sample of each type door.

1.4.6 Submit one 300 x 300 mm corner sample of each type of frame.

1.4.6.1 Show butt cutout, glazing stops.

1.5 DELIVERY STORAGE AND HANDLING

1.5.1 Deliver, store, handle and protect doors and frames in accordance with manufacturer's instructions.

1.5.2 Deliver, handle and store doors and frames at the job site in such a manner as to prevent damage.

1.5.3 Store doors and frames under cover with doors stored in a vertical position on blocking, clear of floor and with blocking between doors to permit air circulation.

1.6 QUALITY ASSURANCE

1.6.1 Conform to requirements to ANSI A117.1

1.6.2 Company specializing in manufacturing products specified with a minimum of five (5) years documented experience.

D2

1.7 NOT USED

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Hot dipped galvanized steel sheet: to ASTM A653/A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.

2.1.2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653/A653M, ZF75.

2.2 DOOR CORE MATERIALS

2.2.1 Honeycomb construction:

2.2.1.1 Structural small cell, 24.5 maximum kraft paper “honeycomb”, weight 36.3 Kg per ream minimum, density: 16.5 Kg/m³ minimum sanded to required thickness.

2.2.2 Stiffened: face sheets welded insulated core.

2.2.2.1 Expanded polystyrene: CAN/ULC-S701, density 16 to 32 kg/m³.

2.2.3 Temperature rise rated (TRR): core composition to limit temperature rise on unexposed side of door to 250˚C at 60 minutes. Core is to be tested as part of a complete door assembly, in accordance with CAN4-S104, ASTM E152 or NFPA 252, covering Standard Method of Tests of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.

2.2.4 Thermal Insulation material must:

2.2.4.1 Not require being labelled as poisonous, corrosive, flammable or explosive under the Consumer Chemical and Container Regulations of the Hazardous Products Act.

2.2.4.2 Be manufactured using a process that uses chemical compounds with the minimum zone depletion potential (ODP) available.

2.3 ADHESIVES

2.3.1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

2.3.1.1 Adhesive: maximum VOC content 50 g/L to SCAQMD Rule 1168.

2.3.2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

2.4 PRIMER

2.4.1 Touch-up prime CAN/CGSB-1.181.

2.4.1.1 Maximum VOC limit 50 g/L to GC-03.

2.5 ACCESSORIES

2.5.1 Door silencers: single stud rubber/neoprene type.

2.5.2 Exterior top and bottom caps steel.

2.5.3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.

2.5.4 Door bottom seal: Section 08 71 00 – Door Hardware.

2.5.5 Metallic paste filler: to manufacturer's standard.

2.5.6 Fire labels: metal riveted.

2.5.7 Sealant: Section 07 92 00 – Joint Sealants.

2.5.7.1 Maximum VOC limit 240 g/L to SCAQMD Rule 1168.

2.5.8 Low expanding foam sealant: Section 07 21 20.

2.5.8.1 Provide low expanding, single component polyurethane foam sealant installed at head and jamb perimeter of door frame for sealing to building air barrier, vapour retarder and door frame. Foam sealant width to be adequate to provide required air tightness and vapour diffusion control to building air barrier and vapour retarder foam interior. Refer to Section 07 21 20 – Low Expanding Foam Sealant.

2.5.9 Glazing: Tempered and wired in accordance with Section 08 80 50 – Glazing.

2.5.10 Make provisions for glazing as indicated and provide necessary glazing stops.

2.5.10.1 Provide removable stainless steel glazing beads for dry glazing of snap-on type.

2.6 FRAMES FABRICATION GENERAL

2.6.1 Fabricate frames in accordance with CSDMA specifications.

2.6.2 Fabricate frames to profiles and maximum face sizes as indicated.

2.6.3 Exterior frames: 1.2 mm welded, thermally broken type construction.

2.6.4 Interior frames: 1.2 mm welded type construction.

2.6.5 Blank, reinforce, drill and tap frames for mortised, template hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

2.6.6 Protect mortised cutouts with steel guard boxes.

2.6.7 Prepare frame for door silencers, 3 for single door, 2 at head for double door.

2.6.8 Manufacturer's nameplates on frames and screens are not permitted.

2.6.9 Conceal fastenings except where exposed fastenings are indicated.

2.6.10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

2.7 FRAME ANCHORAGE

2.7.1 Shim and anchor new doors in accordance with CAN/CSA A440.4.

2.7.2 Provide appropriate anchorage to floor and wall construction.

2.7.3 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

2.7.4 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

2.7.5 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm o.c. maximum.

2.8 FRAMES: WELDED TYPE

2.8.1 Welding in accordance with CSA W59.

2.8.2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

2.8.3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

2.8.4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.

2.8.5 Securely attach floor anchors to inside of each jamb profile.

2.8.6 Weld in two (2) temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.9 DOOR FABRICATION GENERAL

2.9.1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.

2.9.2 Exterior doors: insulated, hollow steel construction. Interior doors: honeycomb hollow steel construction.

2.9.3 Fabricate doors with longitudinal edges locked seam. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.

2.9.4 Doors: manufacturers' proprietary construction, tested and/or engineered as part of a fully operable assembly, including door, frame, gasketing and hardware in accordance with ASTM E330.

2.9.5 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.

2.9.6 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.

2.9.7 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.

2.9.8 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

2.9.9 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in strict conformance with CAN4-S104 ASTM E152 NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

2.9.10 Manufacturer's nameplates on doors are not permitted.

2.10 HOLLOW STEEL CONSTRUCTION

2.10.1 Form each face sheet for exterior doors from 1.2 mm sheet steel.

2.10.2 Form each face sheet for interior doors from 1.2 sheet steel.

2.10.3 Reinforce doors with vertical stiffeners, securely welded to each face sheet at 150 mm on centre maximum.

2.10.4 Fill voids between stiffeners of exterior doors with polystyrene core.

2.10.5 Fill voids between stiffeners of interior doors with honeycomb core.

2.11 THERMALLY BROKEN FRAMES

2.11.1 Thermal break: rigid polyvinyl chloride extrusion conforming to CGSB 41-GP-19Ma.

2.11.2 Fabricate thermally broken frames separating exterior parts form interior parts with continuous interlocking thermal break.

2.11.3 Apply insulation.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

3.1.1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.

3.1.2 Install doors and frames to CSDMA Installation Guide.

3.2 FRAME INSTALLATION

3.2.1 Set frames plumb, square, level and at correct elevation.

3.2.2 Secure anchorages and connections to adjacent construction.

3.2.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

3.2.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

3.2.5 Caulk perimeter of frames between frame and adjacent material.

3.2.6 Maintain continuity of air barrier and vapour retarder.

3.2.7 Fill exterior frames with foam insulation.

3.3 DOOR INSTALLATION

3.3.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.

3.3.2 Provide even margins between doors and jambs and doors and finished floor as follows.

3.3.2.1 Hinge side: 1.0 mm.

3.3.2.2 Latch side and head: 1.5 mm.

3.3.2.3 Finished floor: 13 mm.

3.3.3 Adjust operable parts for correct function.

3.3.4 Install louvres where indicated.

3.4 FINISH REPAIRS

3.4.1 Touch up with primer finishes damaged during installation.

3.4.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.5 GLAZING

3.5.1 Install glazing for doors and frames in accordance with Section 08 80 50 - Glazing.

3.6 COMMISSIONING

3.6.1 Contractor to instruct maintenance personnel in operation and maintenance of doors and hardware.

3.6.2 Confirm operation and function for all doors and hardware.

3.6.3 Commissioning will be witnessed by Engineer and Certificate will be signed by Contractor and Engineer.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **08 31 00.01**
CH0032	**SPILLWAY ELECTRICAL BLDG ACCESS DOORS - MECHANICAL**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 08 31 00.01
SPILLWAY ELECTRICAL BLDG
ACCESS DOORS – MECHANICAL

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
SCOTT M. PENNEY
SIGNATURE
DEC/6/2013
DATE
NEWFOUNDLAND & LABRADOR

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **08 31 00.01**
CH0032	**SPILLWAY ELECTRICAL BLDG ACCESS DOORS - MECHANICAL**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
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1. GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 23 01 31 – Air Duct Cleaning for HVAC Systems

1.2 SHOP DRAWINGS

1.2.1 Submit catalogue details for each type of door illustrating profiles, dimensions and methods of assembly.

1.3 CLOSEOUT SUBMITTALS

1.3.1 Provide maintenance data for cleaning and maintenance of stainless steel finishes for incorporation into operation and maintenance manual.

1.4 WASTE MANAGEMENT AND DISPOSAL

1.4.1 Separate and recycle waste materials.

1.4.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

1.4.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling.

1.4.4 Divert unused metal materials from landfill to metal recycling facility as approved by the Company.

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Deliver, store and handle materials in accordance with Manufacturer's instructions.

1.5.2 Apply temporary protective coating to finished surfaces. Remove coating after erection. Do not use coatings that will become hard to remove or leave residue.

1.5.3 Leave protective covering in place until final cleaning of building.

2. PRODUCTS

2.1 ACCESS DOORS

2.1.1 Sizes: Except as indicated otherwise, to be minimum sizes as follows:

.1 For body entry: 600 x 600 mm.

.2 For hand entry: 300 x 300 mm.

2.1.2 Construction: Rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180°.

2.1.3 Materials

.1 Tiled surfaces and other special areas: Stainless steel with brushed satin or polished finish as directed by Company.

.2 Other areas: Prime coated steel. Finish painting of primed access doors shall be the responsibility of the Contractor.

2.1.4 Access doors shall be supplied by the Mechanical Subcontractor for installation by the Contractor.

2.1.5 Acceptable products: Mifab, Zurn, or accepted equal.

2.2 EXCLUSIONS

2.2.1 Lay-in tile ceilings: use unobtrusive identification locators.

2.3 FIRE RATED ACCESS DOORS

2.3.1 Provide fire-rated access doors where access to concealed mechanical services is required in fire-rated walls and ceiling.

2.3.2 Maintain integrity of fire-rated separations.

2.3.3 Construction:

.1 Door and trim: 18 ga. steel.

.2 Return frame: 16 ga. steel.

.3 Insulation: 47.6 mm thick mineral wool contained within door cavity.

.4 Hinge: fully concealed, pivot type hinge, allowing opening to 170 degrees.

.5 Latches: self-latching direct action lock, opposite hinge which will accept both key and knurled knob which shall be included with each door.

.6 Inside panel release.

.7 Finish: electrostatically-applied, baked grey enamel, over phosphate treated steel. This will serve as the prime coat. Finish paint coat to be applied in the field by the General Contractor.

.8 Provide Type 304 stainless steel access doors with #4 satin finish where fire-rated access doors are installed in special areas such as tile or marble surfaces.

.9 Acceptable products: National Fire Equipment Model WB-FR standard access door, Zurn, MIFAB, or accepted equal.

2.3.4 Access doors shall be supplied by the Mechanical Subcontractor for installation by the Contractor.

2.3.5 Cutting of wall and ceiling openings, framing of openings with metal stud and installation of 16 mm Type X fire-rated gyproc around the full perimeter of metal stud framing shall be the responsibility of the Contractor.

3. EXECUTION

3.1 INSTALLATION

3.1.1 Installation:

.1 As per Manufacturer's instructions.

3.2 LOCATION

3.2.1 Location: Ensure that equipment is within view and accessible for operating, inspecting, adjusting, servicing without using special tools.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 08 51 00
CH0032	METAL WINDOWS	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 08 51 00
METAL WINDOWS
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N-0450
which is valid for the year 2013

NEWFOUNDLAND AND LABRADOR
MEMBER
Nathaniel Salfas, NLAA
Expires Dec 31 2013
Date: Nov 09, 2012
LICENSED TO PRACTICE
ASSOCIATION OF ARCHITECTS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 07 21 20 – Low Expanding Foam Sealant.

1.1.2 Section 07 26 00 - Vapour Retarders.

1.1.3 Section 07 92 00 - Joint Sealants.

1.1.4 Section 08 80 50 - Glazing.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.2.2 All work shall be in accordance with this specification and the requirements of the following.

1.2.2.1 Aluminum Association (AA)

1.2.2.1.1 Designation System for Aluminum Finishes (2003).

1.2.2.2 Canadian General Standards Board (CGSB)

1.2.2.2.1 CAN/CGSB-1.40-97, Anticorrosive Structural Steel Alkyd Primer.

1.2.2.2.2 CAN/CGSB-79.1-M91, Insect Screens.

1.2.2.3 Canadian Standards Association (CSA International)

1.2.2.3.1 CSA-A440-00/A440.1-00(R2005), A440-00, Windows / Special Publication A440.1-00, User Selection Guide to CSA Standard A440-00, Windows. CAN/CSA-A440.2-09, Fenestration Energy Performance.

1.2.2.3.2 CAN/CSA-Z91-02(R2008), Health and Safety Code for Suspended Equipment Operations.

1.3 SUBMITTALS

1.3.1 Product Data:

1.3.1.1 Submit manufacturer's instructions, printed product literature and data sheets for windows and include product characteristics, performance criteria, physical size, finish and limitations.

1.3.2 Shop Drawings:

1.3.2.1 Indicate materials and details in full size scale for head, jamb and sill, profiles of components, interior and exterior trim, junction between combination units, elevations of unit, anchorage details, location of isolation coating, description of related components, and exposed finishes, fasteners, and caulking. Indicate location of manufacturer's nameplates.

1.3.3 Samples:

1.3.3.1 Submit for review and acceptance of each unit.

1.3.3.2 Samples will be returned for inclusion into work.

1.3.3.3 Submit one representative model of each type window.

1.3.3.4 Include frame, sash, sill, glazing and weatherproofing method, insect screens, surface finish and hardware. Show location of manufacturer's nameplates.

1.3.3.5 Include 150 mm long samples of head, jamb, sill, meeting rail, and mullions to indicate profile.

1.3.4 Test and Evaluation Reports:

1.3.4.1 Submit test reports from approved independent testing laboratories, certifying compliance with specifications, for:

1.3.4.1.1 Windows classifications.

1.3.4.1.2 Anodized finish and weathering characteristics.

1.3.4.1.3 Insect screens.

1.3.4.1.4 Air tightness.

1.3.4.1.5 Water tightness.

1.3.4.1.6 Wind load resistance.

1.3.4.1.7 Condensation resistance.

1.3.4.1.8 Safety drop - vertical sliding windows only.

1.3.4.1.9 Block operation - sliding windows only.

1.3.4.1.10 Sash strength and stiffness - operable casement or projecting.

1.3.4.1.11 Ease of operation - windows with operable lights.

1.3.4.1.12 Sash pull-off - vinyl windows.

1.3.4.1.13 Forced entry resistance.

1.3.4.1.14 Mullian deflection - combination and composite windows.

1.4 CLOSEOUT SUBMITTALS

1.4.1 Operation and Maintenance Data: submit operation and maintenance data for windows for incorporation into manual.

1.5 QUALITY ASSURANCE

1.5.1 Certifications: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.6.3 Storage and Handling Requirements:

1.6.3.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

1.6.3.2 Store and protect windows from nicks, scratches, and blemishes.

1.6.3.3 Replace defective or damaged materials with new.

D2

1.7 NOT USED

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Materials: to CSA-A440/A440.1 supplemented as follows.

2.1.2 All windows by same manufacturer.

2.1.3 Sash: aluminum thermally broken.

2.1.4 Main frame: aluminum thermally broken.

2.1.5 Glass: sealed units in accordance with Section 08 80 50 - Glazing.

2.1.6 Screens: to CAN/CGSB-79.1.

2.1.6.1 Insect screening mesh: count 18 x 14.

2.1.6.2 Fasteners: tamper proof.

2.1.6.3 Screen frames: aluminum colour to match window frames.

2.1.6.4 Mount screen frames for interior replacement.

2.1.7 Exterior metal sills and aluminum facings: extruded aluminum of type and size to suit job conditions; minimum 3 mm thick, complete with joint covers, jamb drip deflectors, chairs, and anchoring devices.

2.1.8 Isolation coating: alkali resistant bituminous paint.

2.1.9 Sealants: in accordance with Section 07 92 00 – Joint Sealants.

2.2 WINDOW TYPE AND CLASSIFICATION

2.2.1 Types:

2.2.1.1 Combination fixed and vented: with insulating glass.

2.2.1.2 Fixed: with insulating glass.

2.2.1.3 Screens: on ventilating portion of windows as indicated.

2.2.2 Classification rating: to CSA-A440/A440.1.

2.2.2.1 Air tightness: A3.

2.2.2.2 Water tightness: B3.

2.2.2.3 Wind load resistance: C3.

2.2.2.4 Condensation resistance: Temperature Index, I40.

2.2.2.5 Forced Entry: F1.

2.2.2.6 Insect Screens: S1.

2.2.2.7 Glazing: G1.

2.3 FABRICATION

2.3.1 Fabricate in accordance with CSA-A440/A440.1 supplemented as follows:

2.3.2 Fabricate units square and true with maximum tolerance of plus or minus 1.5 mm for units with a diagonal measurement of 1800 mm or less and plus or minus 3 mm for units with a diagonal measurement over 1800 mm.

2.3.3 Face dimensions detailed are maximum permissible sizes.

2.3.4 Brace frames to maintain squareness and rigidity during shipment and installation.

2.3.5 Finish steel clips and reinforcement with 380 g/m5 zinc coating to [ASTM A123/A123M.

2.4 ALUMINUM FINISHES

2.4.1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.

2.4.1.1 Clear anodic finish: designation AA- M12, C22, A31.

2.5 ISOLATION COATING

2.5.1.1 Isolate aluminum from following components, by means of isolation coating:

2.5.1.1.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.

2.5.1.1.2 Concrete, mortar and masonry.

2.5.1.1.3 Wood.

2.6 GLAZING

2.6.1 Glaze windows in accordance with CSA-A440/A440.1 and Section 08 80 50 – Glazing.

2.7 HARDWARE

2.7.1 Hardware: stainless steel or white bronze sash locks and aluminum handles to provide security and permit easy operation of units.

2.7.2 Locks: provide operating sash with spring loading locking device, to provide automatic locking in closed position.

2.7.3 Include special keyed opening device for windows normally locked.

2.7.4 Where windows latching devices are located in excess of 1900 mm above floor level: Equip projected units with roto operators with locking handle.

2.7.5 Tie back and life line anchors: to CAN/CSA-Z91, 2 per window.

2.8 AIR BARRIER AND VAPOUR RETARDER

2.8.1 Provide low expanding, single component polyurethane foam sealant installed at head, jamb and sill perimeter of window for sealing to building air barrier, vapour retarder and window frame. Foam sealant width to be adequate to provide required air tightness and vapour diffusion control to building air barrier and vapour retarder foam interior. Refer to Section 07 21 20 – Low Expanding Foam Sealant.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.

3.1.1.1 Visually inspect substrate in presence of Engineer.

3.1.1.2 Inform Engineer of unacceptable conditions immediately upon discovery.

3.1.1.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Engineer.

3.2 INSTALLATION

3.2.1 Window installation:

3.2.1.1 Install in accordance with CSA-A440/A440.1.

3.2.2 Install shims between windows and building frame at each installation screw location. Shim and fasten windows in accordance with manufacturer's recommendations and CAN/CSA A440.4.

3.2.3 Sill installation:

3.2.3.1 Install metal sills with uniform wash to exterior, level in length, straight in alignment with plumb upstands and faces. Use one piece lengths at each location.

3.2.3.2 Cut sills to fit window opening.

3.2.3.3 Secure sills in place with anchoring devices located at end joints of continuous sills and evenly spaced 600 mm on centre in between.

3.2.3.4 Fabricate and install sills to provide minimum 2% slope away from window.

3.2.3.5 Fasten expansion joint cover plates and drip deflectors with self tapping stainless steel screws.

3.2.3.6 Maintain 6 to 9 mm space between butt ends of continuous sills. For sills over 1200 mm in length, maintain 3 to 6 mm space at each end.

3.2.4 Caulking:

3.2.4.1 Seal joints between windows and window sills with sealant. Bed sill expansion joint cover plates and drip deflectors in bedding compound. Caulk between sill upstand and window-frame. Caulk butt joints in continuous sills.

3.2.4.2 Apply sealant in accordance with Section 07 92 00 - Joint Sealants. Conceal sealant within window units except where exposed use is permitted by Engineer.

3.3 CLEANING

3.3.1 Progress Cleaning: Leave Work area clean at end of each day.

3.3.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.4 PROTECTION

3.4.1 Protect installed products and components from damage during construction.

3.4.2 Repair damage to adjacent materials caused by window installation.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

NEWFOUNDLAND AND LABRADOR
MEMBER
Nathaniel Salfas, NLAA
Expires Dec 31 2013
Date: 10 Dec 2012
LICENSED TO PRACTICE
ASSOCIATION OF ARCHITECTS

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Furnish, deliver and install all finish hardware necessary for all doors, also hardware as specified herein and as enumerated in Hardware Groups and as indicated and required by actual conditions at the project site.

1.1.2 Mechanical hardware shall include the furnishing of all necessary screws, bolts, expansion shields and all other devices necessary for the proper application of the hardware.

1.2 RELATED REQUIREMENTS

1.2.1 Section 08 11 00 - Metal Doors & Frames.

1.3 REFERENCES

1.3.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.3.2 All work shall be in accordance with this specification and the requirements of the following.

1.3.3 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufactures' Association:

1.3.3.1 CAN/CGSB-69.17/ ANSI/BHMA A156.2-2003, Bored and Preassembled Locks and Latches.

1.3.3.2 CAN/CGSB-69.18/ANSI/BHMA A156.1-2000, Butts and Hinges.

1.3.3.3 CAN/CGSB-69.19/ANSI/BHMA A156.3-2001, Exit Devices.

1.3.3.4 CAN/CGSB-69.20/ANSI/BHMA A156.4-2000, Door Controls - Closers.

1.3.3.5 CAN/CGSB-69.21/ANSI/BHMA A156.5-2001, Auxiliary Locks and Associated Products.

1.3.3.6 CAN/CGSB-69.22/ANSI/BHMA A156.6-2005, Architectural Door Trim.

1.3.3.7 CAN/CGSB-69.23/ANSI/BHMA A156.7, Template Hinge Dimensions.

1.3.3.8 CAN/CGSB-69.24/ANSI/BHMA A156.8-2005, Door Controls - Overhead Stops and Holders.

1.3.3.9 CAN/CGSB-69.28/ANSI/BHMA A156.12-2005, Interconnected Locks and Latches.

1.3.3.10 CAN/CGSB-69.29/ANSI/BHMA A156.13-2002, Mortise Locks and Latches.

1.3.3.11 CAN/CGSB-69.32/ANSI/BHMA A156.16-2002, Auxiliary Hardware.

1.3.3.12 CAN/CGSB-69.34/ANSI/BHMA A156.18-2006, Materials and Finishes.

1.3.3.13 ANSI/BHMA A156.22-1996, Door Gasketing Systems.

1.3.3.14 ANSI/BHMA A156.26-2000, Continuous Hinges.

1.3.3.15 ANSI/BHMA A156.28-2000, Keying Systems.

1.3.3.16 ANSI/BHMA A156.31-2001, Electric Strikes.

1.3.3.17 ANSI/BHMA A156.21-2001, Thresholds.

1.3.3.18 ANSI/DHI A115, Steel Door Preparation Standards.

1.3.3.19 ANSI/DHI A115.IG, Installation Guide for Doors and Hardware.

1.3.3.20 DHI Abbreviations & Symbols.

1.3.3.21 National Building Code Canada.

1.3.3.22 National Fire Code Canada.

1.3.3.23 NFPA 80, Fire Doors and Windows.

1.3.3.24 NFPA 101, Life Safety Code.

1.3.3.25 NFPA 105, Smoke & Draft B Control Door Assemblies.

1.3.3.26 NFPA 252, Fire Tests of Door Assemblies.

1.3.4 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA)

1.3.4.1 CSDFMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.4 SUBMITTALS

1.4.1 Product Data:

1.4.1.1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations.

1.4.2 Samples:

1.4.2.1 Submit for review and acceptance of each unit.

1.4.2.2 Samples will be returned for inclusion into work.

1.4.2.3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.

1.4.2.4 After approval samples will be returned for incorporation in Work.

1.4.3 Hardware List:

1.4.3.1 Submit contract hardware list.

1.4.3.2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

1.4.4 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.4.5 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.4.6 Acceptable Alternates:

1.4.6.1 Alternates as listed in Part 2 must match the specified product in design, quality, price group, function and size.

1.4.7 Closeout Submittals:

1.4.7.1 Provide operation and maintenance data for door closers, locksets, door holders, electrified hardware, and fire exit hardware.

1.4.7.2 Maintenance Materials Submittals:

1.4.7.3 Extra Stock Materials: Supply maintenance materials in accordance with General Requirements.

1.4.7.4 Tools: Supply 2 sets of wrenches for door closers, locksets, and fire exit hardware.

1.5 QUALITY ASSURANCE

1.5.1 Comply with standards specified.

1.5.2 Products used in the work of this section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to Engineer.

1.5.3 Hardware supplier shall have on staff a qualified Architectural Hardware Consultant, recognized by the Door and Hardware Institute, or a person with equivalent qualifications to assist installers and direct detailing, processing and delivery of material.

1.5.4 Hardware for doors in fire separations and exit doors shall be certified by a Canadian Certification Organization accredited by Standards Council of Canada.

1.5.5 Where required and indicated, supply hardware which is in compliance with The Government of Newfoundland and Labrador Building Accessibility Regulations.

1.5.6 Prior to supplying hardware items, review hardware groups and report to the Engineer any hardware specified which is not in compliant with regulatory agencies.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.6.3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

1.6.4 Storage and Handling Requirements:

1.6.4.1 Store materials off ground, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

1.6.4.2 Store and protect door hardware from nicks, scratches, and blemishes.

1.6.4.3 Protect prefinished surfaces with wrapping and/or strippable coating.

1.6.4.4 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 HARDWARE ITEMS

2.1.1 Only door locks and latch sets listed on ANSI/BHMA Standards list are acceptable for use on this project.

2.1.2 Use one manufacturer's products only for similar items.

2.2 DOOR HARDWARE

2.2.1 Locks and latches:

2.2.1.1 Bored and preassembled locks and latches: to CAN/CGSB-69.17/ANSI/BHMA A156.2, series 4000 bored lock, grade 1, designed for function and keyed as stated in Hardware Schedule.

2.2.1.2 Interconnected locks and latches: to CAN/CGSB-69.28/ANSI/BHMA A156.12, series 5000 interconnected lock, grade 1, designed for function and keyed as stated in Hardware Schedule.

2.2.1.3 Mortise locks and latches: to CAN/CGSB-69.29/ANSI/BHMA A156.13, series 1000 mortise lock, grade 1, designed for function and keyed as stated in Hardware Schedule.

2.2.1.4 Knobs and lever handles: plain design.

2.2.1.5 Roses: round.

2.2.1.6 Normal strikes: box type, lip projection not beyond jamb.

2.2.1.7 Cylinders: key into keying system as directed.

2.2.1.8 Finished to BHMA 626.

2.2.2 Butts and hinges:

2.2.2.1 Butts and hinges: to CAN/CGSB-69.18/ANSI/BHMA A156.1, designated by letter A and numeral identifiers, followed by size and finish, listed in Hardware Schedule.

2.2.3 Continuous Hinges:

2.2.3.1 Continuous hinges to ANSI/BHMA A156.26.

2.2.3.2 Hinges shall be standard or heavy duty as indicated.

2.2.3.3 Hinges shall be full height complete with installation aids and fasteners to suit door and frame conditions.

2.2.3.4 Hinges shall be complete with sufficient number and gauge of wires to operate or monitor as per hardware group notes.

2.2.3.5 Hinges shall be complete with factory prepared access panel to all concealed wiring.

2.2.3.6 Hinges shall be complete with necessary options to meet fire ratings as indicated in door schedule.

2.2.3.7 Quantity size and width of hinges in accordance with manufactures recommendations and ANSI/BHMA A156.26.

2.2.3.8 Specified Acceptable Alternates

Pemko	ABH	Stanley	Gallery Lawrence
CFM83SLFHD	A110	661HD	CH941/CH951

2.2.4 Exit devices:

2.2.4.1 To CAN/CGSB-69.19, function, grade and finish as per schedule. .

2.2.4.2 Exit devices of Rim type with push pad design, non-handed, field sizable with approved labelling as required or as indicated in the door schedule.

2.2.4.3 Exit devices shall be complete with all devices to operate as per the functions indicated in the Hardware Group.

2.2.4.4 Exit devices shall be complete with glass bead conversion kits to suit door lite cut-outs.

2.2.4.5 Lever trim shall be complete with thru-bolted mechanism.

2.2.4.6 Electric Exit devices shall be of matching design with functions as noted in Hardware Groups.

2.2.4.7 Electric Exit devices shall be complete with all necessary relays power supplies and devices to operate as per the notes with the Hardware Group.

2.2.4.8 Specified Acceptable Alternates

Dorma	Von Duprin	Sargent	Lawrence
9300	99L	19-8888	8810S/F

2.2.5 Door Closers and Accessories:

2.2.5.1 Door controls (closers): to CAN/CGSB-69.20/ANSI/BHMA A156.4, designated by letter C and numeral identifiers listed in Hardware Schedule.

2.2.5.2 Closers of narrow slim line design complete rack and pinion hydraulic action.

2.2.5.3 Closers complete with adjustable backcheck unless noted otherwise.

2.2.5.4 Closers equipped with full cover, as noted by model number in Hardware Groups, complete with secure and concealed mounting screws.

2.2.5.5 All manual closers with manufacturer's twenty-five (25) year warranty.

2.2.5.6 Barrier free openings shall be equipped with closers that meet all requirements of the National and Provincial Codes.

2.2.5.7 Adapter plates as noted in Hardware Groups are used for added reinforcing as well as door and frame conditions. Adapter plates shall be added to any opening if required to suit field conditions or door design.

2.2.5.8 Closers shall include all necessary Arm Brackets, Cush arm supports and blade stop spacers to suit door swing, frame reveals or stop conditions.

2.2.5.9 Size and hand closers prior to site delivery in accordance with the Manufactures recommendations.

2.2.5.10 Closers capable of field adjustment of at least fifteen (15) percent.

2.2.5.11 Degree of opening to be as shown on the plans and indicated on the reviewed Hardware Groups.

2.2.5.12 Finish as stated in Hardware Groups.

2.2.5.13 Specified Acceptable Alternates

Dorma	LCN	Sargent	Stanley	Lawrence
8600	1460	1430	D-3550	825BC
8900	4000	281	D-4550	8016BC

2.2.6 Auxiliary locks and associated products: to CAN/CGSB-69.21/ANSI/BHMA A156.5, designated by letter E and numeral identifiers listed in Hardware Schedule. Key into keying system as noted.

2.2.7 Architectural door trim: to CAN/CGSB-69.22, designated by letter J and numeral identifiers listed in Hardware Schedule.

2.2.7.1 Door protection plates: 1.27 mm thick stainless steel, finished to BHMA 630.

2.2.7.2 Push plates: 1.27 mm thick stainless steel, finished to BHMA 630.

2.2.7.3 Push/Pull units: stainless steel, finished to BHMA 630.

2.2.8 Auxiliary hardware: to CAN/CGSB-69.32, designated by letter L and numeral identifiers listed in Hardware Schedule.

2.2.8.1 Combination stop and holder, wall or floor mounted: finished to BHMA 626.

2.2.8.2 Surface bolts lever extension flush bolt: finish to BHMA 626.

2.2.9 Door bottom seal: heavy duty, door seal of extruded aluminum frame and hollow closed cell neoprene weather seal, surface mounted with drip cap, closed ends, and clear anodized finish.

2.2.10 Thresholds: to ANSI/BHMA A156.21, extruded aluminum mill finish, serrated surface, with lip and vinyl door seal insert.

2.2.11 Weather-stripping:

2.2.11.1 Head and jamb seal:

2.2.11.1.1 Extruded aluminum frame and solid closed cell neoprene insert, clear anodized finish.

2.2.12 Astragal: overlapping, extruded aluminum frame with vinyl insert, finished to match doors.

2.3 FASTENINGS

2.3.1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.

2.3.2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

2.3.3 Exposed fastening devices to match finish of hardware.

2.3.4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

2.3.5 Use fasteners compatible with material through which they pass.

2.4 KEYING

2.4.1 Doors, padlocks and other locks to be master keyed as noted in Hardware Schedule. Prepare detailed keying schedule in conjunction with Engineer.

2.4.2 Supply keys in triplicate for every lock in this Contract.

2.4.3 Supply 6 master keys for each master key or grand master key group.

2.4.4 Stamp keying code numbers on keys and cylinders.

2.4.5 Supply construction cores.

2.4.6 Hand over permanent cores and keys to Engineer.

2.5 FINISHES

2.5.1 Following finishes are indicated in hardware groups.

BHMA	CAN MATERIAL	FINISH
626	C26D Brass/Bronze	Satin Chrome
628	C28 Aluminum	Satin Alum, Anodized
630	C32D Stainless Steel	Satin Stainless Steel
652	C26D Steel	Plated Satin Chrome
689	Al All	Painted Aluminum
	Alum Aluminum	Mill Finish
	TMDFF (to match door and frame finish)	

2.6 ABBREVIATIONS, FINISH SYMBOLS AND TERMS

2.6.1 Abbreviations:

ALD ALF	Aluminum Door and Frame
ATMS STMS	Arm/Strike to Template with Machine Screws
BC	Back Check
B3E or B4E	Bevelled 3 or 4 Sides
BTB	Back to Back Mounted
C to C, C/L	Centreline to Centreline

CYL	Cylinder (of a lock)
CIF	Channel Iron Frame
CMK	Construction Master Key
DA	Double Action
DEG	Degree (of opening)
DEL	Delayed Action
DR	Door
FBB or BB	Ball Bearing Hinge
FS FSE	Fail Safe Fail Secure
FTMS 1/2TMS	To Template with full or ½ Machine Screws
GMK	Grand Master Key
MK or MKD	Master Keyed
KA KD	Keyed Alike Keyed different
HMD PSF	Hollow Metal Door Pressed Steel Frame
LH RH	Left Hand Right Hand
LHR RHR	Left Hand Reverse Right Hand Reverse
NRP	Fixed non removable hinge pin
TMS	To Template with Machine Screws

2.6.2 Terms:

AHC	Architectural Hardware Consultant
ANSI	American National Standards Institute, Inc.
CDC	Certified Door Consultant
CSA	Canadian Standards Association
CSC	Construction Specifications Canada
DHI	Door and Hardware Institute

2.6.3 Finishes:

BMHA	CAN.	MATERIAL	FINISH
619	C15	Brass/Bronze	Stain Nickel
628	C28	Aluminum	Satin Alum. Anodized
630	C32D	Stainless Steel	Satin Stainless Steel
652	C626	Steel	Plated Satin Chrome
689	AL	ALL	Painted Aluminum ALU
	ALUM	Aluminum	Mill Finish

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.1.2 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

3.1.3 Furnish manufacturers' instructions for proper installation of each hardware component.

3.2 INSTALLATION

3.2.1 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).

3.2.2 Where door stop contacts door pulls, mount stop to strike bottom of pull.

3.2.3 Install key control cabinet.

3.2.4 Use only manufacturer's supplied fasteners.

3.2.4.1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.

3.2.5 Remove construction cores when directed by Engineer. Install permanent cores and ensure locks operate correctly.

3.2.6 Closers shall be installed according to Manufactures templates and installation instructions. Unless required otherwise installation shall be on pull side of door. Out swing doors shall be on push side using top jamb or parallel arm installation.

3.2.7 Where closer or arm is installed on door sex bolts, finished to match other hardware, will be used.

3.2.8 Degree of opening to be as shown on the plans and indicated on the reviewed hardware schedule.

3.2.9 Wiring Diagrams:

3.2.9.1 Provide any special information, voltage requirements and wiring diagrams to other trades requiring such information.

3.3 EXAMINATION

3.3.1 Visit site prior to start of installation of hardware.

3.3.2 Visit will include examination of openings, site conditions and materials for conditions that prevent proper application of finish hardware.

3.3.3 Installation will imply conditions for installation acceptable hardware contractor to accept responsibility.

3.4 FIELD QUALITY CONTROL

3.4.1 Hardware contractor to have a qualified AHC representative from the manufacturer/supplier on site at Substantial Completion Inspection and at commissioning of the finished hardware. Cost of the visits to be included in contract.

3.5 ADJUSTING

3.5.1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.

3.5.2 Lubricate hardware, operating equipment and other moving parts.

3.5.3 Adjust door hardware to ensure tight fit at contact points with frames.

3.5.4 Where hardware is found defective, repair or replace or correct as desired by inspection reports.

3.6 CLEANING

3.6.1 Perform cleaning after installation to remove construction and accumulated environmental dirt.

3.6.2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.

3.6.3 Remove protective material from hardware items where present.

3.6.4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment.

3.7 PROTECTION

3.7.1 Protect installed products and components from damage during construction.

3.7.2 Repair damage to adjacent materials caused by door hardware installation.

3.8 HARDWARE GROUPS

3.8.1 Provide hardware as specified in the previous articles in sets according to the following groups:

3.8.2 HG-01 (2 Exterior Doors):

Item #1 - 1 Single door (914 x 2134 x 45 mm - HM)

–	1 Continuous Hinge	CFM83SLFHD1	628
–	1 Exit Device	98EO US26D	626
–	1 Cylinder	1E72S2RP	626
–	1 Closer	4041 Rw/PA AL	628
–	1 Bracket	4040-18	689
–	1 Door Contact	A-4103	Std
–	1 Sweep	3452CNB 914 mm	628
–	1 Weather strip	319 CS 914 mm x 2134 mm	628
–	1 Threshold	2005AP 914 mm	628

– Note:

- Free Exiting at all times.
- Doors locked and unlocked by key.
- Doors can be manually dogged open for push/pull operation
- Confirm actual size of threshold from site conditions.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 08 80 50
CH0032	GLAZING	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 08 80 50
GLAZING
TABLE OF CONTENTS

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MEMBER
Nathaniel Sallas, NLAA
Expires Dec 31 2013
Date: 20 NOV 13
LICENSED TO PRACTICE
ASSOCIATION OF ARCHITECTS

PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 07 92 00 – Joint Sealants.

1.1.2 Section 08 11 14 – Metal Doors and Frames.

1.1.3 Section 08 51 13 – Aluminum Windows.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.2.1.1 All work shall be in accordance with this specification and the requirements of the following.

1.2.2 American National Standards Institute (ANSI).

1.2.2.1 ANSI/ASTM E330, Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

1.2.3 American Society for Testing and Materials (ASTM)

1.2.3.1 ASTM C542, Specification for Lock-Strip Gaskets.

1.2.3.2 ASTM D2240, Test Method for Rubber Property – Durometer Hardness.

1.2.4 Canadian General Standards Board (CGSB).

1.2.4.1 CAN/CGSB-12.1, Tempered or Laminated Safety Glass.

1.2.4.2 CAN/CGSB-12.3, Clear Float Glass

1.2.4.3 CAN/CGSB-12.5, Mirrors, Silvered.

1.2.4.4 CAN/CGSB-12.8, Insulating Glass Units.

1.2.4.5 CAN/CGSB-12.11, Wired Safety Glass.

1.2.5 Canadian Standards Association (CSA).

1.2.5.1 CSA A440.2, Energy Performance Evaluation of Windows and Sliding Glass Doors.

1.2.5.2 CSA Certification Program for Windows and Doors.

1.2.6 Flat Glass Manufacturers Association (FGMA).

1.2.6.1 FGMA Glazing Manual.

1.2.7 Laminators Safety Glass Association (LSGA).

1.2.7.1 LSGA Laminated Glass Design Guide.

1.3 SYSTEM DESCRIPTION

1.3.1 Performance Requirements:

1.3.1.1 Provide continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:

1.3.1.1.1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

1.3.1.2 Size glass to withstand wind loads, dead loads and positive and negative live loads as measured in accordance with ANSI/ASTM E330n and NBC latest edition.

1.3.1.3 Limit glass deflection to 1/200 with full recovery of glazing materials.

1.4 SUBMITTALS

1.4.1 Product Data:

1.4.1.1 Submit manufacturer's printed product literature, specifications and data sheet.

1.4.2 Manufacturer's Instructions:

1.4.2.1 Submit manufacturer's installation instructions.

1.4.3 Closeout Submittals:

1.4.3.1 Provide maintenance data including cleaning instructions for incorporation into manual specified in General Requirements.

1.5 QUALITY ASSURANCE

1.5.1 Perform work in accordance with FGMA Glazing Manual IGMAC and Laminators Safety Glass Association – Standards Manual for glazing installation methods. Maintain one (1) copy of each standard document on site.

1.5.2 Provide shop inspection and testing for glass.

1.5.3 Provide certificate of quality compliance from manufacturer.

1.6 NOT USED

1.7 ENVIRONMENTAL REQUIREMENTS

1.7.1 Install glazing when ambient temperature is 10˚C minimum. Maintain ventilated environment for 24 hours after application.

1.7.2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

PART 2 PRODUCTS

2.1 MATERIALS: FLAT GLASS

2.1.1 Float glass: to CAN/CGSB-12.3, Glazing quality, 5 mm minimum thickness.

2.1.2 Safety glass: to CAN/CGSB-12.5, transparent, 6 mm thick.

2.1.2.1 Type 2 - tempered

2.1.2.2 Class B - float

2.1.2.3 Category - 11

2.1.3 Wired glass: to CAN/CGSB-12.11, 6 mm thick.

2.1.3.1 Type 1- Polished both sides (transparent)

2.1.3.2 Wire mesh - style 3, square.

2.2 MATERIALS: SEALED INSULATING GLASS

2.2.1 Insulating glass units: to CAN/CGSB-12.8, double unit, minimum 25 mm overall thickness (as per NBC for window area and climatic conditions.)

2.2.1.1 Glass: to CAN/CGSB-12.3

2.2.1.2 Glass thickness: minimum 6 mm each light (as per NBCC calculations for window area and climatic conditions.)

2.2.1.3 Inter-cavity space thickness: 13 mm.

2.2.1.4 Glass coating: surface number 2 (inside surface of outer light), low “E”.

2.2.1.5 Inert gas: argon.

2.2.1.6 Light transmittance: minimum 0.70.

2.2.2 Insulating glass units for exterior doors: to CAN/CGSB-12.8, double unit, minimum 25 mm overall thickness (as per NBC for window area and climatic conditions.)

2.2.2.1 Glass: to CAN/CGSB-12.1, tempered.

2.2.2.2 Glass thickness: minimum 6 mm each light (as per NBC for glass area and climatic conditions.)

2.2.2.3 Inner-cavity space thickness: 13 mm.

2.2.2.4 Glass coating: surface number 2 (inside face of outer light), low “E”.

2.2.2.5 Inert gas: argon.

2.3 MATERIALS

2.3.1 Sealant: 07 92 00 – Joint Sealants.

2.4 ACCESSORIES

2.4.1 Setting blocks: Neoprene, 80-90 Shore A durometer hardness to ASTM D2240, minimum 100 mm x width of glazing rabbet space minus 1.5 mm x height.

2.4.2 Spacer shims: Neoprene, 50-60 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self adhesive on one face.

2.4.3 Glazing tape: Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D2240; coiled on release paper; black colour.

2.4.4 Glazing splines: resilient polyvinyl chloride, extruded shape to suit glazing channel retaining slot, colour as selected.

2.4.5 Glazing clips: manufacturer's standard type.

2.4.6 Lock-strip gaskets: to ASTM C542.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 EXAMINATION

3.2.1 Verify that openings for glazing are correctly sized and within tolerance.

3.2.2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.3 PREPARATION

3.3.1 Clean contact surfaces with solvent and wipe dry.

3.3.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

3.3.3 Prime surfaces scheduled to receive sealant.

3.4 INSTALLATION: EXTERIOR – WET/DRY METHOD (PREFORMED TAPE AND SEALANT)

3.4.1 Perform work in accordance with FGMA Glazing Manual and Laminators Safety Glass Association - Standards Manual for glazing installation methods.

3.4.2 Cut glazing tape to length and set against permanent stops, 6 mm below sight line. Seal corners by butting tape and dabbing with sealant.

3.4.3 Apply heel bead of sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapour seal.

3.4.4 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.

3.4.5 Rest glazing on setting blocks and push against tape and heel of sealant with sufficient pressure to attain full contact at perimeter of light or glass unit.

3.4.6 Install removable stops with spacer strips inserted between glazing and applied stops 6 mm below sight line.

3.4.7 Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, maximum 9 mm below sight line.

3.4.8 Apply cap bead of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.5 CLEANING

3.5.1 Perform cleaning after installation to remove construction and accumulated environmental dirt.

3.5.2 Remove traces of primer, caulking.

3.5.3 Remove glazing materials from finish surfaces.

3.5.4 Remove labels after Work is complete.

3.5.5 Clean glass using approved non-abrasive cleaner in accordance with manufacturer's instructions.

3.5.6 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.6 PROTECTION OF FINISHED WORK

3.6.1 After installation, mark with an "X" by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION:09 21 16
CH0032	GYPSUM BOARD ASSEMBLIES	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES
TABLE OF CONTENTS

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NEWFOUNDLAND AND LABRADOR - ASSOCIATION OF ARCHITECTS - LICENSED TO PRACTICE
MEMBER
Nathaniel Salfas, NLAA
Expires Dec 31, 2013
Date: 10 Dec 2013

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 06 10 00 – Rough Carpentry.

1.1.2 Section 07 21 16 – Blanket Insulation.

1.1.3 Section 09 22 16 – Non-Structural Metal Framing.

1.1.4 Section 07 84 00 – Fire Stopping.

1.2 REFERENCES

1.2.1 ASTM International

1.2.1.1 ASTM C475 02 (2007), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

1.2.1.2 ASTM C840 08, Standard Specification for Application and Finishing of Gypsum Board.

1.2.1.3 ASTM C1002 07, Standard Specification for Steel Self Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

1.2.1.4 ASTM C1047 09, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

1.2.1.5 ASTM C1177/C1177M [08], Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

1.2.1.6 ASTM C1178/C1178M 08, Standard Specification for Glass Mat Water Resistant Gypsum Backing Board.

1.2.1.7 ASTM C1396/C1396M-09a, Standard Specification for Gypsum Wallboard.

1.2.2 Association of the Wall and Ceilings Industries International (AWCI)

1.2.2.1 AWCI Levels of Gypsum Board Finish-97.

1.2.3 Underwriters' Laboratories of Canada (ULC)

1.2.3.1 CAN/ULC S102 07, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Product Data:

1.3.1.1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

1.4.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.4.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.4.3 Storage and Handling Requirements:

1.4.3.1 Store gypsum board assembly’s materials level off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

1.4.3.2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.

1.4.3.3 Protect from weather, elements and damage from construction operations.

1.4.3.4 Handle gypsum boards to prevent damage to edges, ends or surfaces.

1.4.3.5 Replace defective or damaged materials with new.

1.5 AMBIENT CONDITIONS

1.5.1 Maintain temperature 10ºC minimum, 21ºC maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.

1.5.2 Apply board and joint treatment to dry, frost free surfaces.

1.5.3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

PART 2 PRODUCTS

2.1 MATERIALS

D1

2.1.1 Abuse Resistant board: to ASTM C79, thickness indicated on drawings, Type Ultra Code, 1200 mm wide x maximum practical length, ends square cut, edges squared.

2.1.2 Metal furring runners, hangers, tie wires, inserts, and anchors: to CSA A82.30, galvanized.

D1

2.1.3 Drywall furring channels: 0.5 mm base steel thickness galvanized steel channels for screw attachment of gypsum board.

2.1.4 Steel drill screws: to ASTM C1002.

2.1.5 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, zinc coated by hot dip process, 0.5 mm base thickness, perforated flanges, one piece length per location.

2.1.6 Sealants: in accordance with Section 07 92 00 Joint Sealants.

2.1.7 Joint compound: to ASTM C475, asbestos free.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assembly's installation in accordance with manufacturer's written instructions.

3.1.1.1 Visually inspect substrate in presence of Engineer.

3.1.1.2 Inform Engineer of unacceptable conditions immediately upon discovery.

3.1.1.3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Engineer.

3.2 ERECTION

3.2.1 Do application and finishing of gypsum board to ASTM C840 except where specified otherwise.

3.2.2 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 except where specified otherwise.

3.2.3 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

3.2.4 Install work level to tolerance of 1:1200.

3.2.5 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, and grilles.

3.2.6 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.

3.2.7 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

3.2.8 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

3.2.9 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.

3.2.10 Furr openings and around built in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.

3.2.11 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

3.3 APPLICATION

3.3.1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work has been approved.

3.3.2 Apply single and/or double layer gypsum board to metal furring or framing using screw fasteners for first layer, and screw fasteners for second layer. Maximum spacing of screws 300 mm on centre.

3.3.2.1 Single Layer Application:

3.3.2.1.1 Apply gypsum board on ceilings prior to application of walls to ASTM C840.

3.3.2.1.2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.

3.3.2.2 Double Layer Application:

3.3.2.2.1 Install gypsum board for base layer and exposed gypsum board for face layer.

3.3.2.2.2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.

3.3.2.2.3 Apply base layers at right angles to supports unless otherwise indicated.

3.3.2.2.4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.

3.3.3 Apply 12 mm diameter bead of fire-rated sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut outs around electrical boxes, ducts, in partitions where perimeter sealed with fire-rated sealant.

3.3.4 Install gypsum board on walls vertically to avoid end butt joints. At high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire rated assemblies require vertical application.

3.3.5 Install gypsum board with face side out.

3.3.6 Do not install damaged or damp boards.

3.3.7 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.4 INSTALLATION

3.4.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.

3.4.2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated.

3.4.3 Install insulating strips continuously at edges of gypsum board and casing beads abutting door frames, to provide thermal break.

3.4.4 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

3.4.5 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:

3.4.5.1 Levels of finish:

3.4.5.1.1 Level 0: no tapping, finishing or accessories required.

3.4.5.1.2 Level 1: embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable.

3.4.5.1.3 Level 2: not applicable.

3.4.5.1.4 Level 3: not applicable.

3.4.5.1.5 Level 4: not applicable.

3.4.5.1.6 Level 5: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges.

3.4.6 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

3.4.7 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

3.4.8 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

3.4.9 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

3.4.10 Mix joint compound slightly thinner than for joint taping.

3.4.11 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.

3.4.12 Allow skim coat to dry completely.

3.4.13 Remove ridges by light sanding or wiping with damp cloth.

3.5 CLEANING

3.5.1 Progress Cleaning: Leave Work area clean at end of each day.

3.5.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.6 PROTECTION

3.6.1 Protect installed products and components from damage during construction.

3.6.2 Repair damage to adjacent materials caused by gypsum board assemblies installation.

3.7 SCHEDULES

3.7.1 Construct fire rated assemblies where indicated.

END OF SECTION

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 09 22 16
CH0032	**NON-STRUCTURAL METAL FRAMING**	**Rev. D2**
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 07 92 00 – Joint Sealants.

1.1.2 Section 09 21 16 – Gypsum Board Assemblies.

D1

1.1.3 Section 07 84 00 – Fire Stopping.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.2.1.1 All work shall be in accordance with this specification and the requirements of the following.

1.2.2 American Society for Testing and Materials International, (ASTM).

1.2.2.1 ASTM C645-00, Specification for Non-structural Steel Framing Members.

1.2.2.2 ASTM C754-00, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

1.2.3 Canadian General Standards Board (CGSB).

1.2.3.1 CAN/CGSB-1.40-97, Primer, Structural Steel, Oil Alkyd Type.

D1

1.2.4 Canadian Standards Association

D1

1.2.4.1 CAN/CSA-S136-07 (R2012), North American Specification for the design of Cold-Formed Steel Structural Members.

1.3 QUALITY ASSURANCE

1.3.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.3.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

PART 2 PRODUCTS

2.1 MATERIALS

D1

2.1.1 Non-load bearing channel stud framing: to CSA S136, stud size as indicated on drawings, roll formed from 2.46 mm thickness, hot-dipped galvanized steel sheet minimum Z275 coating, for screw attachment of gypsum board or other panel material. Knock-out service holes at 460 mm centres.

D1

2.1.2 Floor and top tracks: to CSA S136, in widths to suit stud sizes, 50 mm minimum flange height, min Z275 zinc coating.

2.1.3 Acoustical sealant: to Section 07 92 00 – Joint Sealants.

2.1.4 Insulating strip: rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self sticking adhesive on one face, lengths as required.

PART 3 EXECUTION

3.1 ERECTION

3.1.1 Align tracks at floor and top and secure at 600 mm on centre maximum.

D1

3.1.2 Allow minimum deflection gap of 19 mm for double track **or** slotted single top track.

3.1.3 Install damp proof course under stud shoe tracks on slabs-on-grade.

3.1.4 Place studs vertically at 400 mm on centre and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and top. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.

3.1.5 Erect metal studding to tolerance of 1:1000.

3.1.6 Attach studs to bottom and top tracks using screws.

3.1.7 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

3.1.8 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.

3.1.9 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.

3.1.10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.

3.1.11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

3.1.12 Provide 40 mm stud or furring channel secured between studs for attachment of fixtures, equipment or accessories.

3.1.13 Install steel studs or furring channel between studs for attaching electrical and other boxes.

3.1.14 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.

3.1.15 Install continuous insulating strips to isolate studs from uninsulated surfaces.

3.2 CLEANING

3.2.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **09 90 00**
CH0032	**PAINT SYSTEM FOR STRUCTURAL STEEL**	Rev: D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 09 90 00
PAINT SYSTEM FOR STRUCTURAL STEEL
TABLE OF CONTENTS

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REGISTERED PROFESSIONAL ENGINEER
C. TODD SMITH
SIGNATURE
9 Dec 2013
DATE
NEWFOUNDLAND & LABRADOR

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 This specification covers the requirements for materials, surface preparation, application and workmanship for protective coatings to be applied to the structural steel as shown on the drawings.

1.1.2 Paint and Coating are used interchangeably.

1.1.3 Refer also to Section 48 13 10 – General Mechanical Requirements for additional coating requirements.

1.2 RELATED SECTIONS

1.2.1 Section 01 35 43 - General Environmental Requirements

1.2.2 Section 05 12 00 - Structural Steel

1.2.3 Section 05 50 10 - Miscellaneous Metals and Embedded Parts

1.2.4 Section 48 13 10 – General Mechanical Requirements

1.3 DEFINITIONS

1.3.1 LEED: Leadership in Energy and Environmental Design.

1.3.2 VDR: Vendor Data Requirements Form.

1.3.3 SDRL: Supplier Document Requirement List.

1.3.4 OSHA: Occupational Safety and Health Administration.

1.3.5 VOC: Volatile Organic Compound.

1.3.6 DFT: Dry Film Thickness.

1.4 REFERENCES

1.4.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.4.2 All work shall be in accordance with this specification and the requirements of the following codes and standards:

1.4.3 ASTM International Inc.

ASTM D3276	Standard Guide for Painting Inspectors (Metal Substrates)
ASTM D4414	Standard Practice for Measurement of Wet Film Thickness by Notch Gages
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4541	Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers

1.4.4 Society for Protective Coatings

SSPC PA1	Shop, Field and Maintenance Painting of Steel
SSPC PA2	Measurement of Dry Film Thickness with Magnetic Gages
SSPC PS Guide 8	Guide to Top Coating Zinc-Rich Primers
SSPC AB1	Mineral and Slag Abrasives
SSPC AB2	Cleanliness of Recycled Ferrous Metallic Abrasives
SSPC AB3	Ferrous Metallic Abrasive
SSPC SP1	Solvent Cleaning
SSPC SP3	Power Tool Cleaning
SSPC SP10	Near-White Blast Cleaning
SSPC SP11	Power Tool Cleaning To Bare Metal
SSPC SP16	Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steel, and Non-Ferrous Metals
SSPC Vis 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC Vis 3	Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning

1.4.5 National Association of Corrosion Engineers

NACE RP0287	Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape

1.5 GENERAL REQUIREMENTS

1.5.1 All paint application shall be done in shop and not at site, except for the repairs and other touch-ups.

1.5.2 All costs associated with recoating due to failure of meeting the painting specification shall be borne by the Contractor.

1.5.3 The Contractor shall acquaint himself with the requirements of this specification. The Contractor shall be required to inspect and monitor the work of surface preparation and painting workers under his direction.

1.5.4 The Contractor shall maintain a daily log of ambient temperature, relative humidity, work progress, measured paint film thickness, and other information pertinent to the painting work.

1.6 QUALITY ASSURANCE

1.6.1 The Contractor shall comply with an inspection program in conformance with ISO 9001:2008 requirements or equivalent.

1.6.2 The Engineer will monitor the approved quality control program and the inspection and testing plan.

1.6.3 The Engineer reserves the right to inspect work at the fabrication plant at any time during the normal working hours.

1.6.4 Quality of work shall be controlled to meet the requirements of this specification, the referenced codes and standards, and other contract documents in effect on the date of the contract.

1.7 SUBMITTALS

1.7.1 The Contractor shall submit the required documentation to the Engineer for review and approval, in accordance with the Supplier Document Requirements List (SDRL).

1.7.2 All painting related activities shall be incorporated into the fabrication plan. The Contractor shall prepare a detailed painting procedure including (but not limited to) the information listed below for approval:

.1 Detailed Scope.

.2 Surface Preparation.

.3 Materials (including technical data sheets and MSDS).

.4 Application.

.5 Inspection Procedures and Documentation.

.6 Provision for handling and storage of paints and coatings at the shop or the site.

.7 Plans for conformance to National, Provincial or Local Environment Law.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General

2.1.1.1 Paint that is part of the system shall be supplied by the same manufacturer to assure compatibility.

2.1.1.2 Intermediate and top coats shall be tinted to clearly differentiate them from the previous coat.

2.1.2 Paint System

2.1.2.1 The coating to be applied to the structural steel shall consist of the following:

FOR INTERNAL ATMOSPHERIC CONDITION

LAYER	DFT (µm)
Primer: - Organic zinc rich epoxy	75 - 100
Finish: - High-build epoxy polyamide	125 – 150
Total	200 – 250

FOR EXTERNAL ATMOSPHERIC CONDITION

LAYER	DFT (µm)
Primer: - Epoxy polymeric amine	125 - 150
Finish: - Aliphatic acrylic polyurethane	75 – 100
Total	200 – 250

2.1.2.2 All coating products are subject to approval by the Engineer.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Steel specified to be painted shall be prepared and painted in the shop, unless noted otherwise on the drawings.

3.1.2 Finish paint colors shall be approved by the Engineer.

3.1.3 Thinners shall not be used, unless specified otherwise by the paint Manufacturer.

3.1.4 The following surfaces shall not be painted:

.1 Corrosion resistant steel surfaces, i.e., stainless steel and galvanized steels (unless noted otherwise on drawings or in the specifications for special items);

.2 Metal surfaces of copper, bronze and similar finished materials;

.3 Machine finished or field weld areas. However, such surfaces shall be protected with a rust preventive coating and painted after the erection is completed;

.4 Areas of embedded parts which will be in contact with concrete, however, these surfaces shall be cleaned of all rust and scale.

3.1.5 Shop painting shall not be done at ambient air temperatures lower than 7°C.

3.1.6 Paint shall not be applied:

.1 On surfaces whose having a temperature lower than 4°C or whose temperature is 10°C below the ambient air;

.2 On surfaces whose temperature causes blistering or porosity of the paint;

.3 on contaminated surfaces;

.4 In dusty or windy conditions, fog or mist, or when it is raining, snowing or other inclement weather;

.5 On an earlier coat of paint that has not thoroughly dried and hardened.

3.1.7 Contact surfaces of connections shall not be primed nor painted over a surface extending 50 mm beyond the perimeter of the connection.

3.1.8 In the shop, or for large surfaces on site, the paint shall be applied with a an airless paint sprayer under a pressure in conformance with the paint Manufacturer’s recommendations.

3.1.9 On site, on small surfaces, the paint shall be applied with a roller, brush or airless paint sprayer in conformance with the paint manufacturer’s recommendations.

3.1.10 Finished surfaces shall be clean, smooth, without blisters, laps, waves, softening or adherence loss.

3.1.11 Galvanized guardrails which are indicated to be painted safety yellow shall be lightly sweep blasted to create a surface profile of 25-50 micrometers, but without removing the galvanizing, and coated with a surface tolerant epoxy having a minimum dry film thickness of 150-200 micrometers.

3.2 ENVIRONMENTAL CONDITIONS

3.2.1 Blast cleaning shall not be done on any surface that is moist or that may become moist before the application of a primer.

3.2.2 Blast cleaning and paint application shall not be permitted when metal surface temperature is less than 3^{o}C above the dew point or when the relative humidity of the air is greater than 85%.

3.2.3 The ambient temperature, surface temperature, relative humidity and dew point shall be recorded and presented as part of final painting work report.

3.3 SURFACE PREPARATION

3.3.1 Where not specified in Section 48 13 10 – General Mechanical Requirements, surface preparation shall be in accordance with the following.

3.3.2 Surface preparation cleanliness shall be evaluated in accordance with SSPC-Vis 1

3.3.3 All structural steel shall be blast-cleaned in accordance with SSPC-SP10 Near-White Blast Cleaning.

3.3.4 Surface profile shall be verified in accordance with NACE RPO 287 or ASTM 04417. The result shall be recorded and presented as part of final painting work report.

3.3.5 All surface of galvanized steel to be painted shall be prepared according to SSPC-SP16.

3.3.6 Any foreign matter deposited after completion of surface preparation shall be removed prior to painting. In the event that rusting occurs, prepare surfaces again to conform to the requirements above.

3.3.7 Aluminum surfaces shall be prepared in accordance with the following requirements:

.1 Mechanical treatment: ASTM D1730 Type D, no steel wool or brush, or steel particles.

.2 Solvent cleaning: ASTM D1730 Type A.

.3 Chemical conversion and primer: CAN/CGSB-1.132.

3.4 DRY FILM THICKNESS

3.4.1 Dry film thickness measurements shall be made of each coat such as primer and finish coat of the total system, in accordance with the procedure established by SSPC-PA2.

3.4.2 The DFT measurements shall be recorded and presented as part of final painting work report.

3.5 ADHESION TEST

3.5.1 Adhesion shall be checked on separate test specimen in accordance with ASTM D4541. The bond strength between substrate and primer, primer and finish coat shall be at least 2 MPa.

3.5.2 A separate test panel specimen shall be prepared in parallel to the coating of the substrate. One panel carbon-steel plate dimension (150 x 150 x 10 mm) for each lot of pieces.

3.5.3 The adhesion tests result shall be presented as part of final painting work report.

3.6 INSPECTION

3.6.1 Compliance with this specification shall be checked by the Inspector during the entire course of surface preparation and application of the coating system.

3.6.2 Work shall not proceed with the next step of the system sequence (i.e. surface preparation, priming, finish coat application) until the previous work has been inspected and approved by the Inspector.

3.6.3 Magnetic gauges used to check the dry film thickness shall be in accordance with SSPC PA2-73T.

3.6.4 Qualified and experienced inspectors shall be provided to continuously monitor all phases of work including:

.1 Surface preparation;

.2 Pre-treatment;

.3 Paint mixing and authorized paint thinning;

.4 Application of coating systems; and

.5 Inspection of coatings.

3.7 TOUCH-UPS AND REPAIRS ON SITE

3.7.1 Touch-ups, whenever necessary, shall be done after the completion of work. All damaged coating shall be repaired prior to project completion.

3.7.2 The touch-ups shall be done with the same paint system specified in paragraph 2.1.2.

3.7.3 Painted surfaces damaged during transportation, handling and installation shall be prepared in accordance with SSPC-SP1 and SSPC-SP3 prior to applying the specified paint system. The touch-ups shall be in conformance with the painting manufacturer's procedure.

3.7.4 All field welded connection surfaces shall be prepared in accordance with the SSPC-SP11 Power Tool Cleaning to Bare Metal prior to applying the DFT for the specified paint system.

3.7.5 Unpainted surfaces around connections shall be prepared to SSPC-SP11 Power Tool Cleaning to Bare Metal and painted with the same paint system (i.e. primer and finish coats) after final tightening of the bolts. The DFT requirement as per article 3.4 shall apply.

3.8 COATING HOT-DIP GALVANIZED SURFACES

3.8.1 Zinc coated surfaces shall be painted yellow only if security colour is required.

3.8.2 The following painting system shall be applied for interior atmospheric condition:

.1 Epoxy polyamide paint: DFT: 40 – 50 µm.

3.8.3 The following painting system shall be applied for exterior atmospheric condition:

.1 Epoxy polyamide paint: DFT: 40 – 50 µm;

.2 Aliphatic acrylic polyurethane: DFT: 40 – 50 µm.

END OF SECTION

SECTION 09 91 23
INTERIOR PAINTING
TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 08 11 00 – Metal Doors and Frames.

1.1.2 Section 09 21 16 – Gypsum Board Assemblies.

1.2 REFERENCES

1.2.1 Environmental Protection Agency (EPA)

1.2.1.1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - for Surface Coatings.

1.2.2 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

1.2.2.1 Material Safety Data Sheets (MSDS).

1.2.3 Master Painters Institute (MPI)

1.2.3.1 MPI Architectural Painting Specifications Manual 2004.

1.2.4 Society for Protective Coatings (SSPC)

1.2.4.1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications:

1.3.1.1 Contractor: minimum of five years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.

1.3.1.2 Journeymen: qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.

1.3.1.3 Apprentices: working under direct supervision of qualified trades person in accordance with trade regulations.

1.4 SCHEDULING

1.4.1 Submit work schedule for various stages of painting to Engineer for review. Submit schedule minimum of 48 hours in advance of proposed operations.

1.4.2 Obtain written authorization from Engineer for changes in work schedule.

1.5 SUBMITTALS

1.5.1 Product Data:

1.5.1.1 Submit product data and instructions for each paint and coating product to be used.

1.5.1.2 Submit product data for the use and application of paint thinner.

1.5.1.3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS). Indicate VOCs during application and curing.

1.5.2 Samples:

1.5.2.1 Submit full range colour sample chips to indicate where colour availability is restricted.

1.5.2.2 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.

1.5.2.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.5.2.4 Manufacturer's Instructions:

1.5.2.4.1 Submit manufacturer's installation and application instructions.

1.6 MAINTENANCE

1.6.1 Extra Materials:

1.6.1.1 Deliver to extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels.

1.6.1.2 Quantity: provide one four litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

1.6.1.3 Delivery, storage and protection: comply with Engineer requirements for delivery and storage of extra materials.

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Packing, Shipping, Handling and Unloading:

1.7.1.1 Pack, ship, handle and unload materials in accordance with manufacturer's written instructions.

1.7.2 Acceptance at Site:

1.7.2.1 Identify products and materials with labels indicating:

1.7.2.1.1 Manufacturer's name and address.

1.7.2.1.2 Type of paint or coating.

1.7.2.1.3 Compliance with applicable standard.

1.7.2.1.4 Colour number in accordance with established colour schedule.

1.7.3 Remove damaged, opened and rejected materials from site.

1.7.4 Storage and Protection:

1.7.4.1 Provide and maintain dry, temperature controlled, secure storage.

1.7.4.2 Store materials and supplies away from heat generating devices.

1.7.4.3 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.

1.7.5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

1.7.6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.

1.7.7 Remove paint materials from storage only in quantities required for same day use.

1.7.8 Fire Safety Requirements:

1.7.8.1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.

1.7.8.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

1.7.8.3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

1.7.9 Waste Management and Disposal:

1.7.9.1 Separate waste materials for recycling.

1.7.9.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.7.9.3 Place materials defined as hazardous or toxic in designated containers.

1.7.9.4 Ensure emptied containers are sealed and stored safely.

1.7.9.5 Unused coating materials must be disposed of at official hazardous material collections site as approved by Engineer.

1.7.9.6 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

1.7.9.7 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

1.7.9.8 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

1.7.9.9 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:

1.7.9.9.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

1.7.9.9.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

1.7.9.9.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

1.7.9.9.4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.

1.7.9.9.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

1.8 SITE CONDITIONS

1.8.1 Heating, Ventilation and Lighting:

1.8.1.1 Ventilate enclosed spaces.

1.8.1.2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.

1.8.1.3 Where required provide continuous ventilation for seven days after completion of application of paint.

1.8.1.4 Provide minimum lighting level of 323 Lux on surfaces to be painted.

1.8.2 Temperature, Humidity and Substrate Moisture Content Levels:

1.8.2.1 Unless specifically pre-approved written approval by Specifying body or Paint Inspection Agency Authority and product manufacturer, perform no painting when:

1.8.2.1.1 Ambient air and substrate temperatures are below 10 degrees C.

1.8.2.1.2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.

1.8.2.1.3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.

1.8.2.1.4 The relative humidity is under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.

1.8.2.1.5 Rain or snow is forecasted to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

1.8.2.1.6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can withstand 'normal' adverse environmental factors.

1.8.2.2 Perform painting work when maximum moisture content of the substrate is below:

1.8.2.2.1 Allow new concrete and masonry to cure minimum of 28 days.

1.8.2.2.2 15% for wood.

1.8.2.2.3 12% for plaster and gypsum board.

1.8.2.3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".

1.8.2.4 Test concrete, masonry and plaster surfaces for alkalinity as required.

1.8.3 Surface and Environmental Conditions:

1.8.3.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

1.8.3.2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.

1.8.3.3 Apply paint when previous coat of paint is dry or adequately cured.

1.8.4 Additional interior application requirements:

1.8.4.1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.

2.1.2 Provide paint materials for paint systems from single manufacturer.

2.1.3 Only qualified products with E2 "Environmentally Friendly" rating are acceptable for use on this project.

2.1.4 Conform to latest MPI requirements for interior painting work including preparation and priming.

2.1.5 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.

2.1.6 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.

2.1.7 Provide paint products meeting MPI "Environmentally Friendly" E1 ratings based on VOC (EPA Method 24) content levels.

2.1.8 Use MPI listed materials having minimum E2 rating where indoor air quality (odour) requirements exist.

2.1.9 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:

2.1.9.1 Water based, water soluble, water cleanup.

2.1.9.2 Non flammable, biodegradable.

2.1.9.3 Manufactured without compounds which contribute to ozone depletion in the upper atmosphere.

2.1.9.4 Manufactured without compounds which contribute to smog in the lower atmosphere.

2.1.9.5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

2.1.10 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.

2.1.11 Flash point: 61.0 degrees C or greater for water-borne surface coatings and recycled water-borne surface coatings.

2.1.12 Ensure manufacture and process of both water-borne surface coatings and recycled water-borne surface coatings does not release:

2.1.12.1 Matter in undiluted production plant effluent generating 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to natural watercourse or sewage treatment facility lacking secondary treatment.

2.1.12.2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to natural watercourse or a sewage treatment facility lacking secondary treatment.

2.1.13 Water borne paints and stains, recycled water borne surface coatings and water borne varnishes to meet minimum "Environmentally Friendly" E2 rating.

2.1.14 Recycled water borne surface coatings to contain 50% post consumer material by volume.

2.1.15 Recycled water borne surface coatings must not contain:

2.1.15.1 Lead in excess of 600.0 ppm weight/weight total solids.

2.1.15.2 Mercury in excess of 50.0 ppm weight/weight total product.

2.1.15.3 Cadmium in excess of 1.0 ppm weight/weight total product.

2.1.15.4 Hexavelant chromium in excess of 3.0 ppm weight/weight total product.

2.1.15.5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

2.2 COLOURS

2.2.1 Engineer will provide Colour Schedule after Contract award.

2.2.2 Colour schedule will be based upon selection of two base colours and two accent colours.

2.2.3 Selection of colours from manufacturer's full range of colours.

2.2.4 Where specific products are available in restricted range of colours, selection based on limited range.

2.2.5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

2.3.1 Perform colour tinting operations prior to delivery of paint to site. Obtain written approval from Engineer for tinting of painting materials.

2.3.2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

2.3.3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water based paints.

2.3.4 Thin paint for spraying in accordance with paint manufacturer's instructions.

2.3.5 Re mix paint in containers prior to and during application to ensure break up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

2.4.1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss Level 1 - Matte Finish (flat)	Max. 5 Gloss @ 60 degrees	Max. 10 Sheen @ 85 degrees
Gloss Level 2 - Velvet Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

2.4.2 Gloss level ratings of painted surfaces as indicated.

2.5 INTERIOR PAINTING SYSTEMS

2.5.1 Galvanized metal: doors, frames, railings, misc. steel, pipes, overhead decking, and ducts.

2.5.1.1 INT 5.3A - Latex 3 finish.

2.5.2 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:

2.5.2.1 INT 9.2A - Latex 3 finish (over latex sealer).

2.6 SOURCE QUALITY CONTROL

2.6.1 Perform following tests on each batch of consolidated post-consumer material before surface coating is reformulated and canned. Testing by laboratory or facility which has been accredited by Standards Council of Canada.

2.6.1.1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.

2.6.1.2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.

2.6.1.3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 GENERAL

3.2.1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.

3.2.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

3.3.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Engineer damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

3.3.2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

3.3.3 Maximum moisture content as follows:

3.3.3.1 Stucco, plaster and gypsum board: 12%.

3.3.3.2 Concrete: 12%.

3.4 PREPARATION

3.4.1 Protection:

3.4.1.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non staining covers or masking. If damaged, clean and restore surfaces as directed by Engineer.

3.4.1.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

3.4.1.3 Protect factory finished products and equipment.

3.4.2 Surface Preparation:

3.4.2.1 Remove electrical cover plates, light fixtures, surface hardware on doors, and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.

3.4.3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:

3.4.3.1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths, or compressed air.

3.4.3.2 Wash surfaces with a biodegradable detergent, and bleach where applicable, and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

3.4.3.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

3.4.3.4 Allow surfaces to drain completely and allow to dry thoroughly.

3.4.3.5 Prepare surfaces for water based painting, water based cleaners should be used in place of organic solvents.

3.4.3.6 Use trigger operated spray nozzles for water hoses.

3.4.3.7 Many water based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water based paints.

3.4.4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pre-treatment as soon as possible after cleaning and before deterioration occurs.

3.4.5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.

3.4.5.1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.

3.4.5.2 Apply wood filler to nail holes and cracks.

3.4.5.3 Tint filler to match stains for stained woodwork.

3.4.6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

3.4.7 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes, blowing with clean dry compressed air, or vacuum cleaning.

3.4.8 Touch up of shop primers with primer as specified.

3.4.9 Do not apply paint until prepared surfaces have been accepted by Engineer.

3.5 APPLICATION

3.5.1 Method of application is to be as approved by Engineer. Apply paint by brush, roller, air sprayer, or airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.

3.5.2 Brush and Roller Application:

3.5.2.1 Apply paint in uniform layer using brush and/or roller type suitable for application.

3.5.2.2 Work paint into cracks, crevices and corners.

3.5.2.3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.

3.5.2.4 Brush and/or roll out runs and sags, and overlap marks. Rolled surfaces free of roller tracking and heavy stipple.

3.5.2.5 Remove runs, sags and brush marks from finished work and repaint.

3.5.3 Spray application:

3.5.3.1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

3.5.3.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

3.5.3.3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.

3.5.3.4 Brush out immediately all runs and sags.

3.5.3.5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.

3.5.4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.

3.5.5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

3.5.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

3.5.7 Sand and dust between coats to remove visible defects.

3.5.8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.

3.5.9 Finish inside of cupboards and cabinets as specified for outside surfaces.

3.5.10 Finish closets and alcoves as specified for adjoining rooms.

3.5.11 Finish top, bottom, edges and cut-outs of doors after fitting as specified for door surfaces.

3.6 MECHANICAL/ELECTRICAL EQUIPMENT

3.6.1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.

3.6.2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.

3.6.3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

3.6.4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

3.6.5 Do not paint over nameplates.

3.6.6 Keep sprinkler heads free of paint.

3.6.7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.

3.6.8 Paint fire protection piping red.

3.6.9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

3.6.10 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch up as required, and paint conduits, mounting accessories and other unfinished items.

3.6.11 Do not paint interior transformers and substation equipment.

3.7 FIELD QUALITY CONTROL

3.7.1 Standard of Acceptance:

3.7.1.1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

3.7.1.2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.

3.7.1.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.7.2 Field inspection of painting operations to be carried out by independent inspection firm as designated by Engineer.

3.7.3 Advise Engineer when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

3.7.4 Cooperate with inspection firm and provide access to areas of work.

3.7.5 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Engineer.

3.8 RESTORATION

3.8.1 Clean and re install hardware items removed before undertaken painting operations.

3.8.2 Remove protective coverings and warning signs as soon as practical after operations cease.

3.8.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

3.8.4 Protect freshly completed surfaces from paint droppings and dust to approval of Engineer. Avoid scuffing newly applied paint.

3.8.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Engineer.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 09 97 19
CH0032	**PAINTING EXTERIOR METAL SURFACES**	**Rev. D2**
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 09 97 19
PAINTING EXTERIOR METAL SURFACES
TABLE OF CONTENTS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 08 11 00 – Metal Doors and Frames.

1.2 REFERENCES

1.2.1 The Contractor shall comply with the rules and provisions of the *listed* Codes and Standards. The Contractor shall obtain written approval from the Engineer prior to using other equivalent codes and standards.

1.2.1.1 All work shall be in accordance with this specification and the requirements of the following.

1.2.2 Environmental Protection Agency (EPA)

1.2.2.1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings).

1.2.3 Master Painters Institute (MPI)

1.2.3.1 Exterior Structural Steel and Metal Fabrications, 2007.

1.2.3.1.1 EXT 5.1D, Alkyd.

1.2.3.1.2 EXT 5.1G, Polyurethane, Pigmented (over epoxy zinc rich primer and high build epoxy).

1.2.3.1.3 EXT 5.4, Aluminum.

1.2.4 Society for Protective Coatings (SSPC)

1.2.4.1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

1.2.5 National Fire Code of Canada.

1.3 SUBMITTALS

1.3.1 Submit in accordance with General Requirements.

1.3.2 Product Data:

1.3.2.1 Submit manufacturer's instructions, printed product literature and data sheets for [painting exterior metal surfaces] and include product characteristics, performance criteria, physical size, finish and limitations.

1.3.2.2 Submit 2 copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety data Sheets (MSDS).

1.3.3 Samples:

1.3.3.1 Submit for review and acceptance of each unit.

1.3.3.2 Samples will be returned for inclusion into work.

1.3.3.3 Upon request, Engineer will furnish qualified products list of paints.

1.3.3.4 Paints that do not appear on MPI Approved Products List must be approved by Engineer before use on project. When it is proposed to use non-qualified paint, submit 2L sample of paint to Engineer at least 2 weeks prior to commencement of painting for analysis and acceptance. Mark samples with name of project, its location, paint manufacturer's name and address, name of paint, MPI standard number and manufacturers paint code number.

1.3.3.5 Enable Engineer to take 1L samples of each paint delivered to site, one sample from manufacturer's containers and one sample from painters' pot.

1.3.4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3.5 Test Reports: Submit test reports showing compliance with specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

1.4.1 Contractor shall have a minimum of five years proven satisfactory experience. When requested, provide a list of last three comparable jobs including, job name and location, specifying authority, and project manager.

1.4.2 Qualified journeyperson shall be engaged in painting work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyperson in accordance with trade regulations.

1.4.3 Conform to latest MPI requirements for exterior painting work including preparation and priming.

1.4.4 Materials (primers, paints, coatings, fillers, thinners, solvents, etc.) shall be in accordance with MPI Painting Specification Manual "Approved Products" listing and shall be from a single manufacturer for each system used.

1.4.5 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Engineer.

1.4.6 Standard of Acceptance:

1.4.6.1 Walls: No defects visible from a distance of 1000 mm at 90° to surface.

1.4.6.2 Ceilings: No defects visible from floor at 45° to surface when viewed using final lighting source.

1.4.6.3 Final coat is to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.5 SCHEDULING OF WORK

1.5.1 Submit work schedule for various stages of painting to Engineer for approval. Submit schedule minimum of 48 hours in advance of proposed operations.

1.5.2 Obtain written authorization from Engineer for changes in work schedule.

1.5.3 Schedule painting operations to prevent disruption of occupants in and about the building.

1.6 EXTRA MATERIALS

1.6.1 Submit one 4 litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish formula.

1.6.2 Deliver to Engineer and store where directed.

1.7 DELIVERY, HANDLING AND STORAGE

1.7.1 Deliver, store and handle materials in accordance with manufacturer's instructions.

1.7.2 Deliver and store materials in original containers, sealed, with labels intact.

1.7.3 Labels shall clearly indicate:

1.7.3.1 Manufacturer's name and address.

1.7.3.2 Type of paint or coating.

1.7.3.3 Compliance with applicable standard.

1.7.3.4 Colour number in accordance with established colour schedule.

1.7.4 Remove damaged, opened and rejected materials from site.

1.7.5 Provide and maintain dry, temperature controlled, secure storage.

1.7.6 Observe manufacturer's recommendations for storage and handling.

1.7.7 Store materials and supplies away from heat generating devices.

1.7.8 Store materials and equipment in a well ventilated area with temperature range 7ºC to 30ºC.

1.7.9 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

1.7.10 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Engineer. After completion of operations, return areas to clean condition to approval of Engineer.

1.7.11 Remove paint materials from storage only in quantities required for same day use.

1.7.12 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

1.7.13 Fire Safety Requirements:

1.7.13.1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.

1.7.13.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

1.7.13.3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.8 SITE REQUIREMENTS

1.8.1 Heating, Ventilation and Lighting:

1.8.1.1 Ventilate enclosed spaces.

1.8.1.2 Perform no painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10ºC for 24 hours before, during and after paint application until paint has cured sufficiently.

1.8.1.3 Where required, provide continuous ventilation for seven days after completion of application of paint.

1.8.1.4 Provide temporary ventilating and heating equipment where permanent facilities are not available.

1.8.1.5 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities shall be provided by General Contractor.

1.8.2 Temperature, Humidity and Substrate Moisture Content Levels:

1.8.2.1 Unless specifically pre-approved by Engineer and, applied product manufacturer, perform no painting work when:

1.8.2.1.1 ambient air and substrate temperatures are below 10ºC.

1.8.2.1.2 substrate temperature is over 32ºC unless paint is specifically formulated for application at high temperatures.

1.8.2.1.3 substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.

1.8.2.1.4 the relative humidity is above 85% or when dew point is less than 3ºC variance between air/surface temperature.

1.8.2.1.5 rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

1.8.3 Surface and Environmental Conditions:

1.8.3.1 Apply paint finish only in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

1.8.3.2 Apply paint only to adequately prepared surfaces and to surfaces within moisture limits noted herein.

1.8.3.3 Apply paint only when previous coat of paint is dry or adequately cured.

1.8.3.4 Apply paint finishes only when conditions forecast for entire period of application fall within manufacturer's recommendations.

1.8.3.5 Do not apply paint when:

1.8.3.5.1 Temperature is expected to drop below 10ºC before paint has thoroughly cured.

1.8.3.5.2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.

1.8.3.5.3 Surface to be painted is wet, damp or frosted.

1.8.3.6 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.

1.8.3.7 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.

1.8.3.8 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

1.9 WASTE MANAGEMENT AND DISPOSAL

1.9.1 Separate waste materials for reuse and recycling in accordance with General Requirements.

1.9.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.9.3 Place materials defined as hazardous or toxic in designated containers.

1.9.4 Ensure emptied containers are sealed and stored safely.

1.9.5 Unused paint, coating materials must be disposed of at official hazardous material collections site as approved by Engineer.

1.9.6 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal.

1.9.7 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

1.9.8 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

1.9.9 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:

1.9.9.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

1.9.9.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

1.9.9.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

1.9.9.4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.

1.9.10 Empty paint cans are to be dry prior to disposal or recycling (where available).

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Paint materials listed in the latest edition of the Master Painters Institute (MPI) Approved Products List (APL) are acceptable for use on this project.

2.1.2 Paint materials for each coating formula to be products of a single manufacturer.

2.1.3 Low odour products: whenever possible, select products exhibiting low odour characteristics. If two products are otherwise equivalent, select the product with the lowest odour. Only qualified products with E2 or E3 "Environmentally Friendly" rating are acceptable for use on this project.

2.1.4 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, shall:

2.1.4.1 Be water-based, water soluble, water clean-up.

2.1.4.2 Be non-flammable

2.1.4.3 Be manufactured without compounds which contribute to ozone depletion in the upper atmosphere.

2.1.4.4 Be manufactured without compounds which contribute to smog in the lower atmosphere.

2.1.4.5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

2.1.5 Water-borne surface coatings must be manufactured and transported in a manner that steps of processes, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).

2.1.6 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavelant chromium or their compounds.

2.1.7 Water-borne surface coatings must have a flash point of 61.0ºC or greater.

2.1.8 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:

2.1.8.1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.

2.1.8.2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.

2.1.9 Water-borne paints must meet a minimum "Environmentally Friendly" E2 rating.

2.2 COLOURS

2.2.1 Engineer will provide Colour Schedule after Contract award.

2.2.2 Selection of colours will be from manufacturer’s full range of colours.

2.2.3 Where specific products are available in a restricted range of colours, selection will be based on the limited range.

2.2.4 Second coat in a three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

2.3.1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with Engineer's written permission.

2.3.2 Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.

2.3.3 Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.

2.3.4 Thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Engineer.

2.3.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

2.4.1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following values:

Gloss Level /Category	**Units @ 60□**	**Units @ 85º**
G1 - matte finish	0 to 5	max. 10
G2 - velvet finish	0 to 10	10 to 35
G3 - eggshell finish	10 to 25	10 to 35
G4 - satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 – gloss finish	70 to 85	
G7 - high gloss finish	> 85	

2.4.2 Gloss level ratings of painted surfaces shall be as specified herein.

2.5 EXTERIOR PAINTING SYSTEMS

2.5.1 The following paint formulas require a three coat finish as indicated in the MPI Architectural Painting Specifications Manual.

2.5.2 Structural Steel and Metal Fabrications:

2.5.2.1 EXT 5.1J - Pigmented polyurethane finish (over high build epoxy).

2.5.3 Galvanized Metal: not chromate passivated

2.5.3.1 EXT 5.3D - Pigmented polyurethane finish for use in high contact/high traffic areas.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Perform preparation and operations for exterior painting in accordance with MPI Painting Specifications Manual except where specified otherwise.

3.1.2 Apply all paint materials in accordance with paint manufacturer's written application instructions.

3.2 EXAMINATION

3.2.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for painting exterior metal surfaces installation in accordance with manufacturer's written instructions.

3.2.1.1 Visually inspect substrate in presence of Engineer.

3.2.1.2 Carry out tests to determine existence of lead base paint on existing exterior metal surfaces.

3.2.1.3 If lead exists stop work and report findings to Engineer.

3.2.1.4 Inform Engineer of unacceptable conditions immediately upon discovery.

3.2.1.5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Engineer.

3.3 PREPARATION

3.3.1 Remove existing loose and rusted paint from exterior metal surfaces.

3.3.2 New metal surfaces:

3.3.2.1 Clean surfaces of new metal to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and foreign substances in accordance with the following:

3.3.2.1.1 Commercial blast cleaning: to SSPC-SP 6.

3.3.2.1.2 Solvent cleaning: to SSPC-SP 1.

3.3.2.1.3 Hand tool cleaning: to SSPC-SP 2.

3.3.2.1.4 Power tool cleaning: to SSPC-SP 3.

3.3.2.1.5 Brush-off blast cleaning: to SSPC-SP 7.

3.3.2.1.6 Near White Blast Cleaning: to SSPC-SP 10/NACE No. 2.

3.3.2.2 Commercial blast clean rusted and bare metal surfaces where existing paint system has failed.

3.3.2.3 Brush-off blast clean remaining metal surfaces to be painted.

3.3.2.4 Scrape edges of old paint back to sound material where remaining paint is thick and sound, feather exposed edges.

3.3.3 Compressed air to be free of water and oil before reaching nozzle.

3.3.4 Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes, by blowing with clean dry compressed air, or by vacuum cleaning.

3.3.5 Apply paint after prepared surfaces have been accepted by Engineer.

3.3.6 Prior to starting paint application ensure degree of cleanliness of surfaces is to SSPC-Vis1.

3.3.6.1 Apply primer, paint, or pre-treatment after surface has been cleaned and before deterioration of surface occurs.

3.3.6.2 Clean surfaces again if rusting occurs after completion of surface preparation.

3.3.7 Mixing paint:

3.3.7.1 Do not dilute or thin paint for brush application.

3.3.7.2 Mix ingredients in container before and during use and ensure breaking up of lumps, complete dispersion of settled pigment, and uniform composition.

3.3.7.3 Do not mix or keep paint in suspension by means of air bubbling through paint.

3.3.7.4 Thin paint for spraying according to manufacturer's written instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Engineer.

3.3.8 Number of paint coats:

3.3.8.1 New metal surfaces.

3.3.8.1.1 Shop: 2 primer coats to minimum dry film thickness of 35 microns per coat.

3.3.8.1.2 Field: 2 alkyd enamel or aluminum paint coats to minimum dry film thickness of 25 microns per coat.

3.3.8.2 Repainting existing metal surfaces.

3.3.8.2.1 One primer coat to minimum dry film thickness of 35 microns to bare and commercial sand blasted areas.

3.3.8.2.2 Two alkyd enamel or aluminum paint coats to minimum dry film thickness of 25 microns per coat.

3.4 APPLICATION

3.4.1 Manufacturer's Instructions: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.4.2 Apply paint by spraying, brushing, or combination of both. Use sheepskins or daubers when no other method is practical in places of difficult access.

3.4.3 Use dipping or roller coating method of application when specifically authorized by Engineer in writing.

3.4.4 Caulk open seams at contact surfaces of built up members with material approved by Engineer, before second undercoat of primer is applied.

3.4.5 Where surface to be painted is not under cover, do not apply paint when:

3.4.5.1 Air temperature is below 5 degrees C or when temperature is expected to drop to 0 degrees C before paint has dried.

3.4.5.2 Temperature of surface is over 50 degrees C unless paint is specifically formulated for application at high temperatures.

3.4.5.3 Fog or mist occur at site; it is raining or snowing; there is danger of rain or snow; relative humidity is above 85%.

3.4.5.4 Surface to be painted is wet, damp or frosted.

3.4.5.5 Previous coat is not dry.

3.4.6 Supply cover when paint must be applied in damp or cold weather. Supply, shelter, or heat surface and surrounding air to comply with temperature and humidity conditions specified. Protect until paint is dry or until weather conditions are suitable.

3.4.7 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

3.4.8 Apply each coat of paint as continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

3.4.9 Brush application:

3.4.9.1 Work paint into cracks, crevices and corners and paint surfaces not accessible to brushes by spray, daubers or sheepskins.

3.4.9.2 Brush out runs and sags.

3.4.9.3 Remove runs, sags and brush marks from finished work and repaint.

3.4.10 Spray application:

3.4.10.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

3.4.10.2 Provide traps or separators to remove oil and water from compressed air and drain periodically during operations.

3.4.10.3 Keep paint ingredients properly mixed in spray pots or containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

3.4.10.4 Apply paint in uniform layer, with overlapping at edges of spray pattern.

3.4.10.5 Brush out immediately runs and sags.

3.4.10.6 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray. In areas not accessible to spray gun, use brushes, daubers or sheepskins.

3.4.10.7 Remove runs, sags and brush marks from finished work and repaint.

3.4.11 Shop painting:

3.4.11.1 Do shop painting after fabrication and before damage to surface occurs from weather or other exposure.

3.4.11.2 Spray paint contact surfaces of field assembled, bolted, friction type joints with primer coat only. Do not brush primer after spraying.

3.4.11.3 Do not paint metal surfaces which are to be embedded in concrete.

3.4.11.4 Paint metal surfaces to be in contact with wood with either full paint coats specified or three shop coats of specified primer.

3.4.11.5 Do not paint metal within 50 mm of edge to be welded. Give unprotected steel one coat of boiled linseed oil or other approved protective coating after shop fabrication is completed.

3.4.11.6 Remove weld spatter before painting. Remove weld slag and flux by methods as specified in paragraph 3.2.3 Metal Surfaces to be Re-painted.

3.4.11.7 Protect machine finished or similar surfaces that are not to be painted but that do require protection, with coating of rust inhibitive petroleum, molybdenum disulphide, or other coating approved by Engineer.

3.4.11.8 Copy previous erection marks and weight marks on areas that have been shop painted.

3.4.12 Field painting:

3.4.12.1 Paint steel structures as soon as practical after erection.

3.4.12.2 Touch up metal which has been shop coated with same type of paint and to same thickness as shop coat. This touch-up to include cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas.

3.4.12.3 Field paint surfaces (other than joint contact surfaces) which are accessible before erection but which are not to be accessible after erection.

3.4.12.4 Apply final coat of paint after concrete work is completed or as directed by Engineer. If concreting or other operations damage paint, clean and repaint damaged area. Remove concrete spatter and droppings before paint is applied.

3.4.12.5 Where painting does not meet with requirements of specifications, and when so directed by Engineer remove defective paint, thoroughly clean affected surfaces and repaint in accordance with these specifications.

3.4.13 Handling painted metal:

3.4.13.1 Handle painted metal after paint has dried, or when necessary for handling for painting or stacking for drying.

3.4.13.2 Scrape off and touch up paint which is damaged in handling, with same number of coats and kinds of paint as were previously applied to metal.

3.5 FIELD QUALITY CONTROL

3.5.1 Site Tests, Inspections:

3.5.1.1 Upon completion of the painting procedures test for dry film reading and evaluate the results as per SSPC-PA 2.

3.6 CLEANING

3.6.1 Progress Cleaning: clean in accordance with General Requirements.

3.6.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with General Requirements.

3.7 PROTECTION

3.7.1 Protect painted surfaces from damage during construction.

3.7.2 Protection of surfaces:

3.7.2.1 Protect surfaces not to receive paint.

3.7.2.2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats of paint. Remove contaminants from surface and apply paint immediately.

3.7.2.3 Protect cleaned and freshly painted surfaces from dust to approval of Engineer.

3.7.3 Repair damage to adjacent materials caused by painting exterior metal surface application installation.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 01 31**
CH0032	**SPILLWAY ELECTRICAL BLDG AIR DUCT CLEANING FOR HVAC SYSTEMS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 01 31
SPILLWAY ELECTRICAL BLDG
AIR DUCT CLEANING FOR HVAC SYSTEMS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
SCOTT M. PENNEY
SIGNATURE
Dec 6/2013
DATE
NEWFOUNDLAND & LABRADOR

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1. GENERAL

1.1 SUMMARY

1.1.1 New ductwork and related HVAC equipment supplied and installed under this Contract shall be cleaned in accordance with this specification section.

1.2 CONTRACTOR'S QUALIFICATION

1.2.1 Cleaning work shall be carried out by a firm specialized in cleaning of ventilation equipment and accessories. The HVAC system cleaning Subcontractor shall provide a list of the five (5) latest cleaning projects carried out, indicating clients' names and contacts.

1.2.2 The HVAC system cleaning Subcontractor shall be a certified member of a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems. (National Air Duct Cleaners Association (NADCA), or accepted equal.)

1.2.3 The HVAC system cleaning Subcontractor shall have a minimum of one (1) air system cleaning specialist (ASCS) on staff, certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems (NADCA, or accepted equal.)

1.3 CONNECTED WORK

1.3.1 The HVAC system cleaning Subcontractor shall include in his quotation all related work such as dismantling or removal of ceilings, installation of access doors, moving and covering furniture, protecting floors or equipment, unless otherwise directed by the Engineer.

1.3.2 Provide architectural access doors in solid walls and ceilings as required by cleaning operations.

1.3.3 Provide architectural work (demolition/repair/painting) required for the installation of the new access doors. Repair finish to match existing.

1.3.4 Provide access doors in ductwork as required by cleaning operations.

2. PRODUCTS

2.1 EQUIPMENT

2.1.1 MAC2500 system (or equal) complete with 860 kPa minimum air compressor.

2.1.2 Industrial type vacuum cleaner with HEPA filters.

2.1.3 Adjustable mechanical rotary brush.

2.1.4 Specialized Robotic Duct Cleaning System, Brandy II.

2.1.5 Refer to list of equipment in Appendix "A" of this specification section.

2.2 CLEANING PRODUCTS

2.2.1 All cleaning products to comply with the requirements of LEED® credits EQ 4.1 and EQ 4.2.

2.2.2 All cleaning products used shall meet current standards and regulations. The HVAC system cleaning Subcontractor shall supply data sheet on toxicity for each product used. All products shall be accepted by the Engineer.

2.2.3 To prevent system unbalance, yellowing of walls and to maintain air quality, the use of varnish, glue and other sealants attaching dust to the surface is strictly prohibited.

2.2.4 During the execution of the work, the HVAC system cleaning Subcontractor shall use non-polluting products, having no adverse effect on equipment, premises nor environment. Products shall not be toxic, carcinogenic nor offensive to occupants.

2.2.5 Acceptable products for each application (see Appendix "B" of this specification section).

2.3 ACCESS DOORS

2.3.1 Access doors in ductwork shall meet specification Section 23 33 00 - Air Duct Accessories.

2.3.2 Access doors for solid walls and ceilings shall meet specification Section 08 31 00.01 - Access Doors - Mechanical.

3. EXECUTION

3.1 PRE-CLEANING

3.1.1 Video inspection and recording shall be done with a remote robot, utilizing DVD format, for optimum clarity. This shall include a mechanical inspection of safety equipment and ventilation filtration components.

3.1.2 Before commencement of cleaning activities, the HVAC system cleaning Subcontractor shall submit to the Engineer for review a cleaning schedule indicating the description of equipment to be cleaned and the cleaning procedures to be utilized.

3.2 CLEANING

3.2.1 Ductwork:

.1 Metallic ductwork shall be cleaned employing robotic direct contact brushing. The cleaning of the ductwork shall employ a proprietary set of motorized brushes that are designed to operate and fit within the size and conditions of the ductwork. These brushes shall contact the ductwork on all four sides simultaneously, providing a work method that ensures particulate removal of a quality superior to traditional compressed air and hand vacuuming. These brushes shall render the interior surface of ductwork to its original clean, smooth condition. In addition, specialized robotic tracked vehicles shall be used to provide video scanning and direct contact cleaning where applicable.

.2 Both pressurized and cellular foam gaskets shall be employed in the ductwork during cleaning to ensure the loosened particulate is directed to the HEPA filtration units and not allowed to enter the workplace. As a secondary safety precaution in specialized areas, sterilized sheets shall be used as drop cloths.

.3 A proprietary HEPA filtered vacuum air handling machine shall be employed to exhaust contaminants from the ductwork as they are removed from the ductwork surfaces by robotic direct contact brushes and robots.

.4 All vacuum units shall utilize high efficiency absolute filters (better than 99.997% retention at 0.3 microns).

.5 All particulate captured by the HEPA filtration units shall be contained and disposed of at an approved site.

3.2.2 Fans, air handling units and energy recovery units:

.1 Supply, exhaust and return air fans shall be vacuumed utilizing HEPA filtered vacuum equipment.

.2 Fans and fan housings shall be cleaned utilizing HEPA filtered vacuum equipment.

.3 Filter trays and housings shall be vacuumed utilizing HEPA filtered vacuum equipment.

.4 Mixing plenums shall be vacuumed utilizing HEPA filtered vacuum equipment.

.5 Heating coils, cooling coils and heat recovery cores shall be vacuumed utilizing HEPA filtered vacuum equipment. In addition, coils shall be washed with high pressure air and will have their fins combed with coil combs.

3.2.3 Fire dampers:

.1 All vacuuming and cleaning shall be performed with HEPA filtered vacuum equipment. Improper fit and air leakage associated with equipment mounting shall be identified and reported.

.2 Fusible links shall be identified and replaced, if required.

3.2.4 Ventilation diffusers, registers and grilles:

.1 All ventilation diffusers, registers and grilles shall be cleaned utilizing HEPA filtered vacuum equipment.

.2 Mark original settings of mechanism before cleaning.

3.2.5 Access openings:

.1 Robotics shall be used to provide access to the ventilation duct distribution system at all existing outlets to minimize damage to the mechanical integrity of the ventilation systems.

.2 Cut openings in ductwork and install new duct access doors as required to facilitate cleaning operations.

.3 Duct access doors shall meet specification Section 23 33 00 – Air Duct Accessories.

3.2.6 Air intake louvres:

.1 Air intake louvers and screens shall be vacuumed utilizing HEPA filtered vacuum equipment.

3.2.7 Dampers:

.1 Manual balancing dampers and automatic control dampers shall be cleaned utilizing HEPA filtered vacuum equipment.

.2 Mark original settings of mechanism before cleaning.

3.3 POST CLEANING

3.3.1 Inspection and documentation:

.1 After the cleaning procedure is complete, a visual inspection shall again be performed by the robot which shall provide a DVD video of the cleaned ductwork.

.2 All mechanical deficiencies noted in the robotic inspections shall be identified.

3.4 ENGINEER'S INSPECTION

3.4.1 The HVAC system cleaning Subcontractor shall permit free access to the Engineer for the inspection of ongoing work. The HVAC system cleaning Subcontractor shall provide all required assistance to the Engineer during these inspections.

3.4.2 The HVAC system cleaning Subcontractor shall supply remote controlled equipment for the Engineer to visualize progress of HVAC systems cleaning, as required.

APPENDIX "A"

LIST OF EQUIPMENT

Commercial vacuum cleaner 85 L/S:

- Standard filter.

Industrial vacuum cleaner 99 L/S:

- HEPA filter
- 45 to 170 litre tank.

Pick-up unit under vacuum:

- HEPA filter
- 151 litre mobile tank 200, 250, 300, 350 mm hoses
- 104 to 1181 L/S blower.

Brushes with telescopic handle:

- 100, 150, 175, 225, 300, 350 mm.
- 4.87 m reach.

Rotary electric brushes with adapter:

- 100, 150, 175, 225, 300, 350 mm
- Rotation adaptor
- Suction adapter.

Manual brushes in various sizes:

- Manual atomizer
- Electric atomizer
- Stiff brush for coils
- 827 kPa air compressor
- Vacuum cleaner for liquids.

APPENDIX "B"

LIST OF PRODUCTS AND APPLICATIONS

CC800 (degreaser) Distributed by: DMCD Distribution	Turning vanes Dampers Filter sections Fan sections Louvers Drainage pans Plenums Mixing boxes
Neutrac (Neutral detergent, no acid, no alkali) Distributed by: Lalema Inc	Grilles Diffusers Deflectors
CC200 Distributed by: DMCD Distribution	Coils
ET100 (vinyl base) Distribution by : DMCD Distribution	Coating for acoustic insulation

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 05 00**
CH0032	**SPILLWAY ELECTRICAL BLDG COMMON WORK RESULTS FOR HVAC**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 05 00
SPILLWAY ELECTRICAL BLDG
COMMON WORK RESULTS FOR HVAC

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REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
SCOTT M. PENNEY
SIGNATURE
Dec/6/2013
DATE
NEWFOUNDLAND & LABRADOR

1. GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

1.1.2 Section 09 91 23 – Interior Painting.

1.2 SUBMITTALS

1.2.1 Shop drawings; submit drawings stamped and signed for approval.

1.2.2 Shop drawings to show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

1.2.3 Shop drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

1.2.4 Use Mechanical Contractors Association of Canada (MCAC) "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.2.5 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into operations and maintenance manual.

.2 Operation and maintenance manual approved by, and final copies deposited before final inspection.

.3 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.4 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93-Testing, Adjusting and Balancing for HVAC.

.6 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual for approval.

.2 Make changes as required and re-submit as directed.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.8 Site records:

.1 One (1) set of mechanical drawing AutoCAD files shall be provided. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour for each service.

.4 Make available for reference purposes and inspection.

.9 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing (TAB) for HVAC, finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed Mechanical AutoCAD as-built drawings CD with Operation and Maintenance Manuals.

.10 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 QUALITY ASSURANCE

1.3.1 Quality Assurance: in accordance with Quality Requirements.

1.3.2 Health and Safety Requirements: perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.4 MAINTENANCE

1.4.1 Furnish spare parts as specified.

1.4.2 Provide one set of special tools required to service equipment as recommended by manufacturers.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Waste Management and Disposal:

1.5.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

2. PRODUCTS

2.1 MATERIALS

2.1.1 All materials used on this project shall be new and CSA approved unless noted otherwise.

2.1.2 All electrical equipment and wiring shall be in accordance with CSA C22.1, The Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

3. EXECUTION

3.1 PAINTING, REPAIRS AND RESTORATION

3.1.1 Do painting in accordance with Section 09 91 23 - Interior Painting.

3.1.2 Prime and touch up marred finished paintwork to match original.

3.1.3 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

3.1.4 Ferrous supports and site fabricated work shall be primed.

3.1.5 Apply cold galvanizing to all galvanized surfaces which have been field welded, burned or cut.

3.2 CLEANING

3.2.1 Clean interior and exterior of all systems including strainers.

3.3 FIELD QUALITY CONTROL

3.3.1 Site Tests: conduct following tests in accordance with Quality Requirements and submit report as described in 1.2 - SUBMITTALS.

.1 Submit tests as specified in other sections of this specification.

3.3.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in 1.2 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in 1.3 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

3.4.1 The Company shall use equipment and systems for test purposes prior to acceptance. Contractor to supply labour, material, and instruments required for testing.

3.4.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

3.4.3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

3.4.4 Instruction duration time requirements as specified in appropriate sections.

3.4.5 The Company may record these demonstrations on video tape for future reference.

3.5 PROTECTION

3.5.1 Protect equipment and system openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 05 01**
CH0032	**SPILLWAY ELECTRICAL BLDG USE OF HVAC SYSTEMS DURING CONSTRUCTION**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 05 01
SPILLWAY ELECTRICAL BLDG
USE OF HVAC SYSTEMS DURING CONSTRUCTION

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SCOTT M. PENNEY
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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 05 01**
CH0032	**SPILLWAY ELECTRICAL BLDG USE OF HVAC SYSTEMS DURING CONSTRUCTION**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1. General

1.1 SUMMARY

1.1.1 Use of HVAC systems during construction.

1.2 USE OF SYSTEMS

1.2.1 Use of new and/or existing permanent heating and/or ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:

.1 Entire system is complete, pressure tested, cleaned.

.2 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.

.3 There is no possibility of damage from any cause.

.4 Supply ventilation systems are protected by a minimum of MERV 11 filters, which shall be inspected daily, changed every week or more frequently as required.

.5 Return systems have approved filters over all openings, inlets, outlets.

.6 All systems will be:

.1 Operated as per manufacturer's recommendations or instructions.

.2 Operated by Contractor.

.3 Monitored continuously by Contractor.

.7 Warranties and guarantees are not thereby relaxed.

.8 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Company.

.9 Refurbish entire system before project completion; clean internally and externally, restore to "as- new" condition, and replace filters in air systems.

1.2.2 Filters specified in this section are over and above those specified in other sections of this project.

1.2.3 Exhaust systems are not included in any approvals for temporary heating or ventilation.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 23 05 05
CH0032	**INSTALLATION OF PIPEWORK**	Rev: D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 23 05 05
INSTALLATION OF PIPEWORK

TABLE OF CONTENTS

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REGISTERED PROFESSIONAL ENGINEER
K.H.G. JEWER
SIGNATURE
Dec 6, 2013
DATE
PROVINCE OF NEWFOUNDLAND

PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 23 11 13 – Facility Fuel-Oil Piping.

1.2 REFERENCES

1.2.1 Canadian General Standards Board (CGSB):

1.2.1.1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

1.2.2 Newfoundland and Labrador Government Regulations:

1.2.2.1 Newfoundland and Labrador Regulations 58/03 - The storage and handling of gasoline and associated product regulations.

1.2.2.2 Nalcor Energy Engineering Directive # CF-ED-004 – Diesel System Installation and Abandonment Engineering Directive.

1.3 QUALITY ASSURANCE

1.3.1 Installers to be certified to journeyperson and approved by the authority having jurisdiction.

1.4 WASTE MANAGEMENT & DISPOSAL

1.4.1 Separate and recycle waste materials in accordance with local municipal regulations.

1.4.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.4.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling.

1.4.4 Divert unused metal material from landfill to metal recycling facility approved by Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 CONNECTIONS TO EQUIPMENT

3.1.1 In accordance with manufacturer's instructions unless otherwise indicated.

3.1.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

3.2 CLEARANCES

3.2.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

3.2.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, and components.

3.3 DIELECTRIC COUPLINGS

3.3.1 General: Compatible with system, to suit pressure rating of system.

3.3.2 Locations: Where dissimilar metals are joined.

3.3.3 Dielectric Unions are not to be used for purposes of disassembly where disassembly is required. Provide Dielectric union or couplings and separate non-dielectric union.

3.4 PIPEWORK INSTALLATION

3.4.1 Installation by certified journeyperson.

3.4.2 Socket welded fittings as specified in Section 23 11 13 – Facility Fuel-Oil Piping.

3.4.3 Protect openings against entry of foreign material.

3.4.4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

3.4.5 Assemble piping using fittings manufactured to ANSI standards.

3.4.6 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.

3.4.6.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

3.4.7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

3.4.8 Install concealed pipework to minimize furring space, maximize headroom, and conserve space.

3.4.9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

3.4.10 Install, except where indicated, to permit separate thermal insulation of each pipe.

3.4.11 Group piping wherever possible and as indicated.

3.4.12 Ream pipes, remove scale and other foreign material before assembly.

3.4.13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

3.4.14 Provide for thermal expansion as required.

3.4.15 Valves:

3.4.15.1 Install in accessible locations;

3.4.15.2 Remove interior parts before soldering;

3.4.15.3 Install with stems above horizontal position unless otherwise indicated;

3.4.15.4 Valves accessible for maintenance without removing adjacent piping;

3.4.15.5 Install valves as indicated and as required for a code compliant system.

3.4.15.6 Install piping in accordance with 23 11 13 – Facility Fuel-Oil Piping.

3.5 FLUSHING OUT OF PIPING SYSTEMS

3.5.1 In accordance with Section 23 11 13 - Facility Fuel-Oil Piping

3.5.2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition.

3.6 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

3.6.1 Advise Engineer, 48 hours minimum prior to performance of pressure tests.

3.6.2 Pipework: Test as specified in relevant sections of other sections or Divisions, Nalcor Engineering Directive and in accordance with Newfoundland and Labrador Regulations 58/03, whichever is more stringent.

3.6.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of other Divisions.

3.6.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

3.6.5 Conduct tests in presence of Engineer.

3.6.6 Pay costs for repairs or replacement, retesting, and making good. Engineer to determine whether repair or replacement is appropriate.

3.6.7 Insulate or conceal work only after approval and certification of tests by Engineer.

3.6.8 Provide test reports for all piping installed under this contract to Engineer for review. Reports to include the following:

3.6.8.1 Date of test;

3.6.8.2 Witness to test;

3.6.8.3 Pipe tested (i.e. pipe type, size, material, service and location);

3.6.8.4 Test duration;

3.6.8.5 Test pressure;

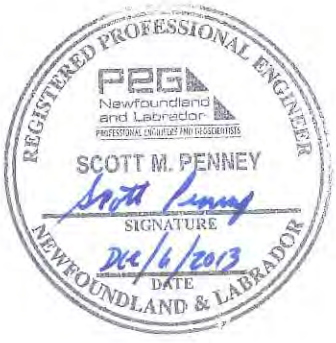
3.6.8.6 Test results;

3.6.8.7 Signatures of all involved in test including Engineer.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 05 13**
CH0032	**SPILLWAY ELECTRICAL BLDG COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 05 13
SPILLWAY ELECTRICAL BLDG
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT



1. GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

.1 Electrical motors, drives and guards for mechanical equipment and systems.

1.2 REFERENCES

1.2.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

1.2.2 Model National Energy Code for Buildings (MNECB).

1.2.3 National Electrical Manufacturers Association (NEMA).

1.2.4 U.S. Department of Energy (DOE) Energy Policy Act (EPACT).

1.3 SUBMITTALS

1.3.1 Product Data:

.1 Shop Drawings: Submit drawings stamped and signed for approval.

.2 Quality Control: in accordance with Quality Requirements.

.1 Instructions: submit manufacturer's installation instructions.

.3 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into operations and maintenance manual.

1.4 QUALITY ASSURANCE

1.4.1 Quality Assurance: in accordance with Quality Requirements.

1.4.2 Health and Safety Requirements: perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.5.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

2. PRODUCTS

2.1 GENERAL

2.1.1 Motors 1 HP and above shall be NEMA premium efficiency.

2.1.2 Motors below 1 HP shall be standard efficiency in accordance with the Energy Policy Act (EPACT) and the requirements of ASHRAE 90.1.

2.1.3 All electrical equipment and wiring shall be in accordance with CSA C22.1, The Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

2.2 MOTORS

2.2.1 Provide motors for mechanical equipment as specified.

2.2.2 Motors shall be NEMA design B unless otherwise noted.

2.2.3 Motors shall be insulation Class B unless otherwise noted. Class B insulated motors shall have a motor insulation temperature rating of 130°C with an allowable temperature rise at full load with 1.0 service factor of 80°C and an allowable temperature rise at 1.15 service factor of 90°C. The reference ambient temperature shall be 40°C. The 10°C temperature differential between the allowable maximum temperature shall provide a "hot spot" allowance for the interior of the motor winding.

2.2.4 All motors shall be suitable for variable torque application unless otherwise noted.

2.2.5 All motors to have minimum 1.15 service factor unless otherwise noted.

2.2.6 See mechanical data sheets for motor HP and voltage.

2.2.7 All motors to be squirrel cage induction motors unless otherwise noted.

2.2.8 All motors to be continuous duty rated.

2.2.9 All motor enclosures to be TEFC unless otherwise noted.

2.2.10 Motors shall be regreaseable and shall have bearings with a minimum L10 life of 200,000 hrs.

2.3 TEMPORARY MOTORS

2.3.1 If delivery of specified motor will delay completion or commissioning work, install motor accepted by the Company for temporary use. Work will only be accepted when specified motor is installed.

2.4 DRIVE GUARDS

2.4.1 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

3. EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

3.2.1 Fasten securely in place.

3.2.2 Make removable for servicing, easily returned into, and positively in position.

3.3 FIELD QUALITY CONTROL

3.3.1 Site Tests: conduct following tests in accordance with Quality Requirements and submit report as described in 1.3 - SUBMITTALS.

.1 As specified in other sections of this specification.

3.3.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in 1.3 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in 1.4 - QUALITY ASSURANCE.

3.4 CLEANING

3.4.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 23 05 17
CH0032	**PIPE WELDING**	Rev: D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 23 05 17
PIPE WELDING

TABLE OF CONTENTS

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REGISTERED PROFESSIONAL ENGINEER
K.H.G. JEWER
SIGNATURE
Dec 9, 2013
DATE
PROVINCE OF NEWFOUNDLAND

PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 23 05 05 – Installation of Pipework.

1.1.2 Section 23 11 13 – Facility Fuel-Oil Piping.

1.2 REFERENCES

1.2.1 American Society for Testing and Materials (ASTM):

1.2.1.1 ASTM E709, Standard Guide for Magnetic Particle Examination.

1.2.2 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):

1.2.2.1 ANSI/ASME B31.9, Building Services Piping.

1.2.2.2 ANSI/ASME Boiler and Pressure Vessel Code:

1.2.2.2.1 Section V: Non-destructive Examination.

1.2.2.2.2 Section IX: Welding and Brazing Qualifications.

1.2.3 American National Standards Institute/American Water Works Association (ANSI/AWWA):

1.2.3.1 ANSI/AWWA C206, Field Welding of Steel Water Pipe.

1.2.4 American Welding Society (AWS):

1.2.4.1 AWS C1.1, Recommended Practices for Resistance Welding.

1.2.4.2 AWS D1.1/D1.1M, Structural Welding Code – Steel.

1.2.4.3 AWS Z49.1, Safety Welding, Cutting and Allied Process.

1.2.4.4 AWS W1, Welding Inspection Handbook.

1.2.5 Canadian General Standards Board:

1.2.5.1 CAN/CGSB-48.2, Spot Radiography of Welded Butt Joints in Ferrous Materials.

1.2.6 Canadian Standards Association (CSA International):

1.2.6.1 CSA W48 Series, Filler Metals and Allied Materials for Metal Arc Welding.

1.2.6.2 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.

1.2.6.3 CSA-W117.2, Safety in Welding, Cutting and Allied Processes.

1.2.6.4 CSA W178.1, Certification of Welding Inspection Organizations.

1.2.6.5 CSA W178.2, Certification of Welding Inspectors.

1.2.7 Provincial regulations:

1.2.7.1 Province of Newfoundland and Labrador, Boiler, Pressure Vessel and Compressed Gas Regulations.

1.3 QUALIFICATIONS

1.3.1 Welders:

1.3.1.1 Welding qualifications in accordance with CSA B51.

1.3.1.2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.

1.3.1.3 Furnish welder's qualifications to Engineer/Architect.

1.3.1.4 Each welder to possess identification symbol issued by authority having jurisdiction.

1.3.2 Inspectors:

1.3.2.1 Inspectors qualified to CSA W178.2.

1.4 QUALITY ASSURANCE

1.4.1 Registration of welding procedures in accordance with CSA B51 and Provincial regulations.

1.4.2 Copy of welding procedures available for inspection.

1.4.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.5 APPLICATION

1.5.1 Pipe steel support assemblies.

1.5.2 Socket welded piping, valves and fittings.

PART 2 PRODUCTS

2.1 ELECTRODES

2.1.1 Electrodes: in accordance with CSA W48 Series.

PART 3 EXECUTION

3.1 WORKMANSHIP

3.1.1 Welding: in accordance with ANSI/ASME B31.9, ANSI/ASME Boiler and Pressure Vessel Code, Section IX and ANSI/AWWA C206, using procedures conforming to AWS C1.1, and special procedures specified elsewhere in Division 23 and applicable requirements of provincial authority having jurisdiction.

3.2 INSTALLATION REQUIREMENTS

3.2.1 Identify each weld with welder's identification symbol.

3.2.2 Backing rings:

3.2.2.1 Where used, fit to minimize gaps between ring and pipe bore.

3.2.3 Fittings:

3.2.3.1 NPS 2 and smaller: install welding type sockets.

3.2.3.2 Branch connections: install welding tees or forged branch outlet fittings.

3.3 INSPECTION AND TESTS – GENERAL REQUIREMENTS

3.3.1 Review weld quality requirements and defects limits of applicable codes and standards with Engineer/Architect before work is started.

3.3.2 Formulate "inspection and Test Plan" in co-operation with Engineer/Architect.

3.3.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

3.3.4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.4 SPECIALIST EXAMINATIONS AND TESTS

3.4.1 General:

3.4.1.1 Perform examinations and tests by specialist engaged by Contractor, qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Engineer/Architect.

3.4.1.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

3.4.1.3 Inspect and test welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and spot or full gamma ray radiographic (hereinafter referred to as "radiography") or magnetic particle tests. As per applicable reference standard or as specified.

3.4.2 Hydrostatically test welds to requirements of ANSI/ASME B31.9 and/or requirements of specification Section 23 05 05 – Installation of Pipework or Section 23 11 13 – Facility Fuel – Oil Piping whichever is greater.

3.4.3 Visual examinations: include entire circumference of weld externally and wherever possible internally. All welds to be visually inspected.

3.4.4 Failure of visual examinations:

3.4.4.1 Upon failure of a weld by visual examination, perform additional testing as directed by Engineer/Architect of total of up to 10% of all welds performed by the welder responsible for the weld failure, selected by Engineer/ Architect by either radiographic or magnetic particle tests depending upon weld type.

3.4.5 Full radiographic tests for piping system.

3.4.5.1 Spot radiography to CAN/CGSB-48.2.

3.4.5.1.1 Conduct spot radiographic tests of up to 10% of welds, selected at random by Engineer/Architect from welds which would be most difficult to repair in event of failure after system is operational.

3.4.5.2 Radiographic film:

3.4.5.2.1 Identify each radiographic film with date, location, name of welder, and submit to Engineer/Architect. Replace film if rejected because of poor quality.

3.4.5.3 Interpretation of radiographic films:

3.4.5.3.1 By qualified radiographer.

3.4.5.4 Failure of radiographic tests:

3.4.5.4.1 Extend tests to all welds by welder responsible for failed welds.

3.4.6 Full magnetic particle tests for piping systems:

3.4.6.1 Magnetic particle testing to ASTM E709.

3.4.6.2 Procedure as outlined above for radiography.

3.5 DEFECTS CAUSING REJECTION

3.5.1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessel Code.

3.6 REPAIR OF WELDS WHICH FAILED TESTS

3.6.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 05 48**
CH0032	**SPILLWAY ELECTRICAL BLDG VIBRATION & SEISMIC CONTROLS FOR HVAC PIPING & EQUIPMENT**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 05 48
SPILLWAY ELECTRICAL BLDG
VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0450
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
SCOTT M. PENNEY
SIGNATURE
Dec/4/2013
DATE
NEWFOUNDLAND & LABRADOR

1. GENERAL

1.1 SUMMARY

1.1.1 Section includes:

.1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 RELATED SECTIONS

1.2.1 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

1.2.2 Section 23 34 00 – HVAC Fans

1.3 REFERENCES

1.3.1 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS)

1.3.2 National Building Code of Canada (NBC)

1.3.3 American Society of Civil Engineers (ASCE/SEI):

.1 ASCE/SEI-7, Minimum Design Loads for Buildings and Other Structures.

1.3.4 Canadian Standards Association (CSA)

.1 CSA 5832 – Seismic Risk Reduction of Operational and Functional Components (OFCs) of Building

1.3.5 Sheet Metal And Air Conditioning Contractors' National Association (SMACNA)

.1 Seismic Restraint Manual – Guidelines for Mechanical Systems

1.4 SUBMITTALS

1.4.1 Shop drawings.

.1 Shop drawings; submit drawings stamped and signed for approval.

.2 Provide separate shop drawings for each isolated system, complete with performance and product data.

.3 Seismic control/restraint system shop drawings shall be sealed by a professional engineer registered in the Province of Newfoundland and Labrador.

.4 Provide detailed drawings, calculations and layouts of seismic control measures.

1.4.2 Quality assurance submittals: submit following in accordance with Quality Requirements.

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.5 QUALITY ASSURANCE

1.5.1 Health and Safety:

.1 Perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

2. PRODUCTS

2.1 GENERAL

2.1.1 Size and shape of bases type and performance of vibration isolation to be as indicated.

2.2 HANGERS

2.2.1 To be utilized to isolate suspended sources of audible and inaudible sound and vibration such as inline pumps, inline fans, piping and ductwork.

2.2.2 Shipped to site fully assembled and ready for installation in threaded metal rod suspension systems.

2.2.3 Free standing, large diameter, laterally stable steel springs in series with an elastomer-in-shear insert, assembled into a stamped or welded bracket.

2.2.4 Hanger shall incorporate a high deflection, colour coded spring element with load transfer plate and a 10 mm deflection elastomeric isolator.

2.2.5 Minimum lateral stiffness of 1.2 times the rated vertical stiffness.

2.2.6 Specially designed spring load plate shall prevent the possibility of short circuiting.

2.2.7 Hangers shall allow a support rod misalignment through a 30º arc without short circuiting.

2.2.8 Hanger brackets shall be capable of carrying a 500% overload without failure.

2.2.9 Rated hanger deflection shall be 25 mm.

2.2.10 Hanger bracket and spring element to be epoxy powder coated.

2.2.11 Acceptable product: Vibron Model SRH, Korfund, Vibro-Acoustics, or accepted equal.

2.3 SEISMIC CONTROL MEASURES

2.3.1 General:

.1 Design seismic control measures to meet requirements of the current National Building Code of Canada (NBC). The building is defined as a post-disaster building as per Section 1.4.1.2, Div. A, NBC. The Seismic Restraint System (SRS) shall be designed as per Section 4.1.8.18, Div. B, NBC. The area specific seismic data used for the calculations such as acceleration at ground level for 0.2 seconds and 1 second shall be per Appendix C, Climatic and Seismic Information for Building Design in Canada, Div. B, NBC.

.2 All systems and equipment shall remain operational during and after earthquakes. Design shall conform to SMACNA and CSA-S832. Performance objective to be “Functional (F)” and performance level to be “high” according to Section 5.2.4 of CSA-S832.

.3 The design calculations, drawing and details shall be performed and sealed by a professional engineer registered in the Province of Newfoundland and Labrador. These shall be submitted for approval, including shop drawings and Technical Data Sheets.

.4 Seismic Restraint System shall be from one manufacturer.

.5 Seismic control system to work in every direction.

.6 Fasteners and attachment points to resist same maximum load as seismic restraint.

.7 Drilled or power driven anchors and fasteners are not permitted.

.8 No equipment, equipment supports or mounts shall fail before failure of structure.

.9 Supports of cast iron or threaded pipe not permitted.

.10 Seismic control measures not to interfere with integrity of fire stopping.

2.3.2 Static Equipment:

.1 Anchor equipment to equipment supports. Anchor equipment supports to structure.

.2 Suspended equipment:

.1 Use one or more of the following methods:

.1 Install tight to structure.

.2 Cross brace in every direction.

.3 Brace back to structure

.4 Cable restraint system

.3 Seismic Restraints:

.1 Cushioning action gentle and steady.

.2 Never reach metal-like stiffness.

.3 Prevent sway in horizontal plane, “knocking” in vertical plane, sliding and buckling in axial direction.

2.3.3 Vibration Isolated Equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm of clearance during normal operation of equipment and systems between seismic restrain and equipment.

.2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

2.3.4 Piping Systems:

.1 Fire protection systems: to NFPA 13.

.2 Piping systems: hangers longer than 300 mm; brace at each hanger.

.3 Compatible with requirements for anchoring and guiding of piping systems

2.3.5 Bracing methods:

.1 Structural angles or channels

.2 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

3. EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

3.2.1 Seismic control measures to meet requirements of NBC.

3.2.2 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.

3.2.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

3.2.4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS 4: first 3 points of support. NPS 5 to NPS 8: first 4 points of support. NPS 10 and Over: first 6 points of support.

.2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

3.2.5 Support ductwork connected to mechanical equipment with isolation hangers with 25 mm minimum static deflection as follows:

.1 All ductwork within mechanical rooms.

.2 All ductwork within first 3 points of support from rotating equipment

3.2.6 All duct connections to mechanical equipment shall be made with flexible duct connectors.

3.2.7 Where isolation is bolted to floor, use vibration isolation rubber washers.

3.2.8 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level before isolation adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

3.3.1 Manufacturer's Field Services:

.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.

.2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:

.1 Upon completion of installation.

.3 Submit manufacturer's reports to Company within 3 days of manufacturer representative's review.

.4 Make adjustments and corrections in accordance with written report.

3.3.2 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, recommend remedial action.

3.4 CLEANING

3.4.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.5 SYSTEM DESIGN

3.5.1 The isolation materials manufacturer shall be responsible for the proper submission of isolators to accomplish the specified minimum static deflections, for all isolators, based on the actual weight distribution of equipment to be isolated. Confirm acceptability of

specified minimum static deflection based upon the natural frequency of the rotating equipment.

3.5.2 The Mechanical Subcontractor shall furnish a complete set of accepted shop drawings of all mechanical equipment to receive vibration isolation and seismic control devices to the vibration isolation and seismic control manufacturer, based upon which the selection of vibration isolators and seismic restraint system will be completed. The shop drawings to be furnished shall include operating weights of the equipment and the distribution of weight at support points.

3.5.3 The Mechanical Subcontractor shall furnish a complete layout of ductwork and piping, showing size or weight and support points of the ductwork and piping systems, to the vibration isolation and seismic control manufacturer, for selection and layout of isolation hangers and seismic restraint system.

3.6 SUBMITTALS

3.6.1 Shop drawings:

.1 The Mechanical Subcontractor shall have prepared by the vibration isolation and seismic control manufacturer, and shall submit for acceptance, drawings showing the construction of the isolation devices to be used, including specific selection of isolators for the equipment to be furnished for this project, and shall include a tabulation of the design data for each isolator, including spring O.D., free operating, and solid heights, and ratio of horizontal to vertical stiffness, and other required data to clearly indicate that the specified isolator types and minimum static deflections are provided for the system submitted.

.2 The Mechanical Subcontractor shall have prepared by the vibration isolation and seismic control manufacturer, and shall submit for acceptance; drawings, design calculations, details, shop drawings and technical data sheets for the seismic restraint system. The calculations shall be sealed and signed by a professional engineer registered in the Province of Newfoundland and Labrador.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 05 53.01**
CH0032	**SPILLWAY ELECTRICAL BLDG MECHANICAL IDENTIFICATION**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 05 53.01
SPILLWAY ELECTRICAL BLDG
MECHANICAL IDENTIFICATION

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEG Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEG Newfoundland and Labrador
SCOTT M. PENNEY
SIGNATURE
Dec/6/2013
DATE
NEWFOUNDLAND & LABRADOR

1. GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

.1 Materials and requirements for the identification of piping systems, duct work, valves and controls, including the installation and location of identification systems.

.2 Sustainable requirements for construction and verification.

1.2 RELATED SECTIONS

1.2.1 Section 09 91 23 - Interior Painting.

1.3 REFERENCES

1.3.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3, Identification of Piping Systems.

1.4 SUBMITTALS

1.4.1 Product Data:

.1 Submittals: submit drawings stamped and signed for approval.

1.5 QUALITY ASSURANCE

1.5.1 Quality assurance: in accordance with Quality Requirements.

1.5.2 Health and Safety:

.1 Perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

2. PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

2.1.1 Metal or plastic laminate nameplate mechanically fastened to each piece of tagged equipment by manufacturer.

2.1.2 Lettering and numbers to be raised or recessed.

2.1.3 Information to include, as appropriate:

.1 Equipment: Manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

2.2.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

2.2.2 Construction:

.1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

2.2.3 Sizes:

.1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

2.2.4 Locations:

.1 Terminal cabinets, control panels: Use size # 5.

.2 Equipment in Mechanical Rooms: Use size # 9.

2.3 IDENTIFICATION OF PIPING SYSTEMS

2.3.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

2.3.2 Pictograms:

.1 Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.

2.3.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

2.3.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

2.3.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

2.3.6 Materials for background colour marking, legend, arrows:

.1 Peel and stick markers and arrows held in place with pressure sensitive tape.

.1 Acceptable product: Seton OPTI-Code pipe markers and arrows held in place with Seton 59653 40 mm wide pressure sensitive tape, Brady, or accepted equal.

2.3.7 Colours and Legends:

.1 Where not listed, obtain direction from Company.

.2 Colours for legends, arrows, to following table:

Background colour	Legend, arrows
Green	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Equipment Drainage	Green	Equip. Drain
Control Panels, Devices and Conduit for low voltage	To Section 25 33 01 – HVAC Controls and Instr. control wiring	

2.4 DUCTING IDENTIFICATION

2.4.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

2.4.2 Colours: black or co-ordinated with base colour to ensure strong contrast

2.4.3 Identifying system: e.g. Supply FAN-VSG-0001, Exhaust FAN-VSE-0001

2.5 CONTROLS COMPONENTS IDENTIFICATION

2.5.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in section 25 33 01 – HVAC Controls and Instrumentation.

2.5.2 Inscriptions to include function and (where appropriate) fail-safe position, component ID name.

2.6 LANGUAGE

2.6.1 Identification to be in English.

3. EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 TIMING

3.2.1 Provide identification only after all painting specified in Section 09 91 23 - Interior Painting has been completed.

3.3 INSTALLATION

3.3.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

3.3.2 Provide ULC and/or CSA registration plates as required by respective agency.

3.4 NAMEPLATES

3.4.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

3.4.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

3.4.3 Protection

.1 Do not paint, insulate or cover in any way.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

3.5.1 On long straight runs in open areas in equipment rooms, galleries, tunnels: At not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

3.5.2 Adjacent to each change in direction.

3.5.3 At least once in each small room through which piping or ductwork passes.

3.5.4 On both sides of visual obstruction or where run is difficult to follow.

3.5.5 On both sides of separations such as walls, floors, partitions.

3.5.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

3.5.7 At beginning and end points of each run and at each piece of equipment in run.

3.5.8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.

3.5.9 Identification to be easily and accurately readable from usual operating areas and from access points.

.1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 CLEANING

3.6.1 Upon completion and verification of performance of installation, remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 05 93**
CH0032	**SPILLWAY ELECTRICAL BLDG TESTING, ADJUSTING, AND BALANCING FOR HVAC**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 05 93
SPILLWAY ELECTRICAL BLDG
TESTING, ADJUSTING AND BALANCING FOR HVAC

1. GENERAL

1.1 SUMMARY

1.1.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

1.1.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this Section.

1.1.3 This Section specifies the requirements and procedures for total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results. In addition carry out acoustical testing as identified below.

1.1.4 Test, adjust, and balance the following mechanical systems:

.1 Supply air systems (2440–FAN-VSG-0001).

.2 Return air systems (2440–FAN-VSG-0001).

.3 Exhaust air systems (2440–FAN-VSE-0001, 2440–FAN-VSE-0002).

1.2 DEFINITIONS

1.2.1 Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:

.1 The balance of air and water distribution.

.2 Adjustment of total system to provide design quantities.

.3 Electrical measurement.

.4 Verification of performance of all equipment and automatic controls.

.5 Acoustical testing of finished systems.

1.2.2 Test: To determine quantitative performance of equipment

1.2.3 Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).

1.2.4 Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.

1.2.5 Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.

1.2.6 Report forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data sheets should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

1.2.7 Terminal: The point where the controlled fluid enters or leaves the distribution system. These are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

1.2.8 Main: Duct or pipe containing the system's major or entire fluid flow.

1.2.9 Submain: Duct or pipe containing part of the systems' capacity and serving two or more branch mains.

1.2.10 Branch main: Duct or pipe serving two or more terminals.

1.2.11 Branch: Duct or pipe serving a single terminal.

1.3 QUALIFICATIONS OF TAB PERSONNEL

1.3.1 Submit names of personnel certified to perform TAB within 90 days of award of contract.

1.3.2 Provide documentation confirming qualifications, successful experience.

1.3.3 Test and Balance Technician's Qualifications: minimum 3-years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.

1.3.4 Agency Qualifications:

.1 Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

.2 The independent testing, adjusting, and balancing agency shall be certified by National Environmental Balancing Bureau (NEBB) or by the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project and shall have at least one Technician certified by NEBB or AABC as a Test and Balance Technician.

1.3.5 Codes and Standards:

.1 NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

.2 AABC: "National Standards For Total System Balance".

.3 American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE):

.1 ASHRAE Handbook, HVAC Applications Volume, Chapter 36, Testing, Adjusting, and Balancing.

1.3.6 Recommendations and suggested practices contained in the TAB Standard: mandatory.

1.3.7 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

1.3.8 Use TAB standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

1.3.9 Where instrument manufacturer calibration recommendations are more stringent than those listed in the TAB standard, use manufacturer's recommendations.

1.3.10 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures and requirements are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or SMACNA), requirements and recommendations contained in these procedures and requirements are mandatory.

1.4 PURPOSE OF TAB

1.4.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.

1.4.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

1.4.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.5 EXCEPTIONS

1.5.1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.6 CO-ORDINATION

1.6.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

1.6.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.7 PRE-TAB REVIEW

1.7.1 Review contract documents before project construction is started and confirm in writing adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

1.7.2 Review specified standards and report in writing all proposed procedures which vary from standard.

1.7.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7.4 Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the Company, Engineer and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

1.8 START-UP

1.8.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

1.8.2 Follow special start-up procedures specified elsewhere in other Divisions.

1.9 OPERATION OF SYSTEMS DURING TAB

1.9.1 Operate systems for length of time required for TAB and as required by Company for verification of TAB reports.

1.9.2 Systems operation: systems shall be fully operational prior to beginning procedures.

1.10 START OF TAB

1.10.1 Notify Company 7 days prior to start of TAB.

1.10.2 Start TAB when building is essentially completed, including:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.

.2 Application of weatherstripping, sealing, caulking.

.3 All pressure, leakage, other tests specified elsewhere in other Divisions.

.4 All provisions for TAB installed and operational.

1.10.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 Outlets installed, volume control dampers open.

1.11 APPLICATION TOLERANCES

1.11.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5%, minus 5%.

1.12 ACCURACY TOLERANCES

1.12.1 Measured values to be accurate to within plus or minus 2% of actual values.

1.13 INSTRUMENTS

1.13.1 Prior to TAB, submit list of instruments to be used together with serial numbers.

1.13.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

1.13.3 Calibrate within 3 months of TAB. Provide certificate of calibration.

1.14 SUBMITTALS

1.14.1 Submit, prior to commencement of TAB:

.1 Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.

.2 Sample Forms: Submit sample forms, if other than those standard forms prepared by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) are proposed.

1.15 PRELIMINARY TAB REPORT

1.15.1 Draft report: Upon completion of testing, adjusting, and balancing procedures, prepare draft report on the approved forms. Draft report may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft report in the same manner specified for the final report. Submit 2 complete sets of draft report. Only 1 complete set of draft report will be returned with comments.

1.16 TAB REPORT

1.16.1 Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Technician. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems.

1.16.2 Final Report: Upon verification and approval of draft report, prepare final report, type written, and organized and formatted as specified below. Submit 2 complete sets of final report.

1.16.3 Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:

.1 General Information and Summary

.2 Air Systems

.3 Hydronic Systems

.4 Special Systems.

1.16.4 Report Contents: Provide the following minimum information, forms and data:

.1 General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, the Company, Technician, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name, address, telephone number, and signature of the Certified Test and Balance Technician. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

.2 The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

.3 Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.17 VERIFICATION

1.17.1 Reported results subject to verification by the Company.

1.17.2 Provide manpower and instrumentation to verify up to 30 % of reported results.

1.17.3 Number and location of verified results to be at discretion of the Company.

1.17.4 Bear costs to repeat TAB as required to satisfaction of the Company.

1.18 SETTINGS

1.18.1 After TAB is completed to satisfaction of the Company, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

1.18.2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.19 COMPLETION OF TAB

1.19.1 TAB to be considered complete when final TAB Report received and accepted.

1.20 AIR SYSTEMS

1.20.1 Standard: TAB to be to most stringent of this section or TAB standards of AABC or NEBB.

1.20.2 Do TAB of systems, equipment, components, controls specified in other Divisions.

1.20.3 Qualifications: personnel performing TAB to be qualified to standards of AABC or NEBB.

1.20.4 Quality assurance: Perform TAB under direction of supervisor qualified to standards of AABC or NEBB.

1.20.5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, amperage and volts for each stage of electrical heating coils.

1.20.6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

1.20.7 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.21 OTHER TAB REQUIREMENTS

1.21.1 General requirements applicable to work specified in this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified in this section.

.2 Quality assurance: as for air systems specified in this section.

1.21.2 Building pressure conditions:

.1 Adjust HVAC systems, airflow rates to specified values to achieve proper building pressurization.

2. PRODUCTS (NOT APPLICABLE)

3. EXECUTION

3.1 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING

3.1.1 Before operating the system, perform these steps:

.1 Obtain design drawings and specifications and become thoroughly acquainted with the design intent.

.2 Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return, and exhaust) and control system.

.3 Compare design to installed equipment and field installations.

.4 Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.

.5 Check filters for cleanliness.

.6 Check dampers for correct and locked position, and control system for completeness of installation before starting fans.

.7 Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

.8 Determine best locations in main and branch ductwork for most accurate duct traverses.

.9 Place outlet dampers in the full open position.

.10 Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

.11 Lubricate all motors and bearings.

.12 Check fan belt tension.

.13 Check fan rotation.

3.2 MEASUREMENTS

3.2.1 Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.

3.2.2 Provide instruments meeting the specifications of the referenced standards.

3.2.3 Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.

3.2.4 Apply instrument as recommended by the manufacturer.

3.2.5 Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

3.2.6 When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.

3.2.7 Take all reading with the eye at the level of the indicated value to prevent parallax.

3.2.8 Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.

3.2.9 Take measurements in the system where best suited to the task.

3.3 PERFORMING TESTING, ADJUSTING, AND BALANCING

3.3.1 Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.

3.3.2 Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

3.3.3 Patch insulation, ductwork, and housings, using materials identical to those removed.

3.3.4 Seal ducts and piping, and test for and repair leaks.

3.3.5 Seal insulation to re-establish integrity of the vapor barrier.

3.3.6 Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

3.3.7 Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.4 RECORD AND REPORT DATA

3.4.1 Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards, and as accepted on the sample report forms.

3.4.2 Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

END OF SECTION

Lower Churchill Project	TECHNICAL SPECIFICATION	SECTION: **23 05 94**
CH0032	**SPILLWAY ELECTRICAL BLDG PRESSURE TESTING OF DUCTED AIR SYSTEMS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 05 94
SPILLWAY ELECTRICAL BLDG
PRESSURE TESTING OF DUCTED AIR SYSTEMS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEG Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEG Newfoundland and Labrador
SCOTT M. PENNEY
SIGNATURE
DEC 6/2013
DATE
NEWFOUNDLAND & LABRADOR

Lower Churchill Project	TECHNICAL SPECIFICATION	SECTION: **23 05 94**
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1. GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 23 31 13.02 – Metal Ducts – High Pressure to 2500 Pa

1.1.2 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

1.2 GENERAL

1.2.1 This section is applicable to all sections of duct over 5 m in length, forming part of a supply, return or exhaust ductwork system.

1.2.2 All ductwork installed on this project as outlined in Item 1.2.1 above shall be pressure tested unless it is part of the exclusions outlined in Item 1.4 below.

1.3 TIMING

1.3.1 Ducts to be tested before installation of insulation or any other form of concealments.

1.3.2 Test after seals have cured.

1.3.3 Test when ambient temperature will not affect effectiveness of seals, gaskets, etc.

1.4 EXCLUSIONS

1.4.1 Flexible connections to diffusers

1.5 REFERENCES

1.5.1 SMACNA HVAC Air Duct Leakage Test Manual

1.6 TEST PROCEDURES

1.6.1 Maximum lengths of ducts to be tested during any one individual test to be consistent with the capacity of the test equipment being utilized

1.6.2 Section of duct to be tested to include:

.1 Fittings, branch ducts, tap-ins.

1.6.3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.

1.6.4 Base partial system leakage calculations on Reference Standard

1.6.5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage

1.7 TESTING AGENCY

1.7.1 Installing Contractor or certified NEBB/AABC TAB agency

1.8 VERIFICATION

1.8.1 Engineer to witness tests and to verify reported results.

1.8.2 Testing results to be certified by the same TAB agency accepted by Engineer to undertake TAB on this project

1.9 TEST INSTRUMENTS

1.9.1 Testing agency to provide instruments for tests.

1.9.2 Test apparatus to include:

.1 Fan capable of producing required static pressure.

.2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.

.3 Flow measuring instrument compatible with the orifice plate.

.4 Calibration curves for orifice plates used

.5 Flexible duct for connecting to ductwork under test.

.6 Smoke bombs for visual inspections.

1.9.3 Test apparatus to be accurate to within ±3% of flow rate and pressure.

1.9.4 Submit details of test instruments to be used to Engineer at least three months before anticipated start date.

1.9.5 Test instruments to be calibrated and certificate of calibration deposited with Engineer no more than 28 days before start of tests.

1.9.6 Instruments to be recalibrated every six months thereafter.

1.10 SYSTEM LEAKAGE TOLERANCES

1.10.1 As outlined in SMACNA HVAC Air Duct Leakage Test Manual for the applicable duct static pressure class, seal class, and leakage class in each instance. The applicable duct pressure class shall be determined from the external static pressure in the air handling unit and fan data sheets. The listed external static pressure is not the duct

pressure class. Consult the SMACNA HVAC Air Duct Leakage Test Manual for further clarification in this matter.

1.10.2 Evaluation of test results to use surface area of duct test section and pressure in duct as basic parameters.

1.11 REPORT FORMS

1.11.1 Submit proposed report form and test report format for acceptance. Do not start tests until acceptance received in writing.

1.12 PRESSURE TEST REPORTS

1.12.1 Prepare report of results and submit within 24 hours of completion of tests. Include:

.1 Schematic of entire system.

.2 Schematic of section under test showing test site.

.3 Required and achieved static pressures.

.4 Orifice differential pressure at test sites.

.5 Permissible and actual leakage flow rate (L/s) for test sites.

.6 Witnessed certification of results.

1.12.2 Include test reports in final TAB report for Commissioning Manual.

2. PRODUCTS

(Not Applicable)

3. EXECUTION

3.1 EXECUTION

3.1.1 Carry out trial leakage test to demonstrate workmanship.

3.1.2 After acceptance of trial leakage test, proceed with installation of remaining ductwork

3.1.3 Test each entire duct system in sections. Section size to be tested shall only be limited by the capabilities of the testing equipment.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 07 13**
CH0032	**SPILLWAY ELECTRICAL BLDG DUCT INSULATION**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 07 13
SPILLWAY ELECTRICAL BLDG
DUCT INSULATION

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PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
SCOTT M. PENNEY
SIGNATURE
Dec/6/2013
DATE
NEWFOUNDLAND & LABRADOR

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 07 13**
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1. GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 23 05 53.01 – Mechanical Identification.

1.1.2 Section 23 31 13.02 – Ductwork Metallic to 2500 Pa.

1.2 REFERENCES

1.2.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.2.2 American Society for Testing and Materials International, (ASTM)

.1 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.2 ASTM C518, Standard Test Method for Steady Stat Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

.3 ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

.4 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.

.5 ASTM C795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.

.6 ASTM C921, Standard Practice for Determining Properties of Jacketing Materials for Thermal Insulation.

.7 ASTM B209, Specification for Aluminum and Aluminum Alloy Sheet and Plate.

1.2.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation

1.2.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

1.2.5 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies

1.2.6 Model National Energy Code of Canada for Buildings (MNECB)

1.2.7 International Standards Organization (ISO):

.1 ISO 9000 – Quality Standards

1.3 DEFINITIONS

1.3.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces

.2 "EXPOSED" - will mean "not concealed" as defined herein

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories

1.3.2 TIAC Codes:

.1 CRD: Commercial Round Ductwork,

.2 CRF: Commercial Rectangular Finish.

1.4 SHOP DRAWINGS

1.4.1 Submit for acceptance manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 MANUFACTURERS' INSTRUCTIONS

1.5.1 Installation instructions to include procedures used and installation standards achieved.

1.6 QUALIFICATIONS

1.6.1 Installer: certified in performing work of this section, and have at least 5 years successful experience in this size and type of project, qualified to standards of TIAC.

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.7.2 Protect from weather and construction traffic.

1.7.3 Protect against damage from any source.

1.7.4 Store at temperatures and conditions recommended by manufacturer.

1.7.5 Any water damaged insulation shall be removed and replaced by the contractor at no additional costs to the contract.

1.8 QUALITY ASSURANCE

1.8.1 Insulation materials must be manufactured at facilities certified and registered with an approved registrar to conform to ISO 9000 quality standards

1.9 WASTE MANAGEMENT AND DISPOSAL

1.9.1 Separate and recycle waste materials in accordance with municipal regulations.

1.9.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.9.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

1.9.4 Divert unused metal materials from landfill to metal recycling facility.

1.9.5 Divert unused adhesive material from landfill to official hazardous material collections site.

1.9.6 Do not dispose of unused adhesive materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

1.10 ENVIRONMENTAL REQUIREMENTS

1.10.1 Insulation adhesives, mastics and cements shall be applied only in ambient conditions (i.e. temperature and relative humidity) which are within the published guidelines of the insulation manufacturer.

2. PRODUCTS

2.1 FIRE AND SMOKE RATING

2.1.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

2.2.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

2.2.2 Thermal conductivity:

.1 Rigid mineral fibre board:

.2 "K" factor of 0.032 wm.ºC at mean ambient temperature of 24ºC when tested in accordance with ASTM C612, Type 1A and 1B, rigid.

2.2.3 TIAC Code C-1: Rigid mineral fibre to ASTM C612 with factory applied vapour retarder jacket to CGSB.51-GP-52Ma:

.1 Density: 96.11 kg/m^3

.2 Installed “R” values:

.1 25 mm thick: 0.73 m^2-°C/w.

.2 50 mm thick: 1.45 m^2-°C/w.

.3 Sound absorption coefficients when tested in accordance with ASTM C423, Type A mounting, as follows:

	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
25 mm thick	0.10	0.35	0.85	1.04	1.05	1.03
50 mm thick	0.38	0.93	1.10	1.07	1.07	1.07

.4 Noise reduction coefficient: 0.80 for 25 mm thick and 1.05 for 50 mm thick.

.5 Acceptable product: Johns-Manville Series 800 spin-glass, Type 817 with FSK reinforced foil and paper (Foil - Scrim-Kraft), Manson, Owens-Corning, Knauf, or accepted equal.

2.3 JACKETS

2.3.1 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Acceptable product: S. Fattal Thermocanvas, or accepted equal.

2.3.2 Aluminum:

.1 To ASTM B209 with moisture barrier.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Stucco embossed or corrugated.

.4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick 304 stainless steel.

.5 Acceptable product: Ideal Products Aluminum jacketing with polysurlyn moisture retarder, or approved equal.

2.4 ACCESSORIES

2.4.1 Vapour retarder lap sealer:

.1 Solvent based, non-flammable wet, fire-resistant dry.

.2 Acceptable product: Monsey Bakor 230-39, Foster, Childers or accepted equal.

2.4.2 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.1 Acceptable product: Duro Dyne, Dyn Air or accepted equal.

2.4.3 Contact adhesive: quick setting:

.1 Non-flammable, rubberized emulsion based adhesive.

.2 Acceptable product: Monsey Bakor 200-38, Foster, Childers or accepted equal.

2.4.4 Canvas adhesive: washable.

.1 Fire resistive, heavy duty resin emulsion insulation lagging coating.

.2 Acceptable product: Monsey Bakor 120-09, Foster, Childers or accepted equal.

2.4.5 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

.1 Acceptable product: Duro Dyne, Dyn-Air or accepted equal.

3. EXECUTION

3.1 PRE-INSTALLATION REQUIREMENTS

3.1.1 Pressure testing of ductwork systems complete, witnessed and certified.

3.1.2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

3.2.1 Install in accordance with TIAC National Standards.

3.2.2 Apply materials in accordance with manufacturer's instructions and as indicated.

3.2.3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

3.2.4 Supports, Hangers in accordance with Section 23 31 13.02 - Ductwork Metallic to 2500 Pa:

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

3.2.5 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

3.3.1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness
All fresh air, mixed air and supply air duct associated with 2440-FAN-VSG-0001 from intake up and including the duct mounted heating coil	C-1	Yes	50 mm
Generator room exhaust air duct and plenum	C-1	Yes	50 mm
Diesel generator intake plenum and ductwork	C-1	Yes	50 mm

	TIAC Code	Vapour Retarder	Thickness
Diesel generator exhaust/recirculation plenum and ductwork	C-1	Yes	50 mm
Exhaust ductwork associated with 2440-FAN-VSE-0001/0002 within 3 m of exterior wall penetration.	C-1	Yes	50 mm
Electrical room fresh air intake plenum and ductwork including filter housing	C-1	Yes	50 mm

3.3.2 The insulation table above represents types and material thicknesses for thermal insulation mounted on the exterior of ductwork.

3.3.3 Utilize metal corners on all exposed rectangular ducts/plenums to be insulated.

3.3.4 Finishes: conform to following table:

Indoor, concealed	None
Indoor, exposed	Aluminum CRF/3 and CRD/4

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 07 14**
CH0032	**SPILLWAY ELECTRICAL BLDG THERMAL INSULATION FOR EQUIPMENT**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 07 14
SPILLWAY ELECTRICAL BLDG
THERMAL INSULATION FOR EQUIPMENT

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
SCOTT M. PENNEY
SIGNATURE
24/6/2013
DATE
NEWFOUNDLAND & LABRADOR

1. GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 23 05 53.01 – Mechanical Identification.

1.2 REFERENCES

1.2.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

.1 ANSI/ASHRAE/IESNA 90.1 SI, Energy Standard for Buildings except Low-Rise Residential Buildings.

1.2.2 American Society for Testing and Materials (ASTM International):

.1 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.2 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

.3 ASTM C449/C449M, Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.4 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.

.5 ASTM C518, Standard Test Method for Steady State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

.6 ASTM C533, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

.7 ASTM C921, Standard Practice for Determining Properties of Jacketing Materials for Thermal Insulation.

.8 ASTM B209, Specification for Aluminum Alloy Sheet and Plate.

1.2.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

1.2.4 Thermal Insulation Association of Canada (TIAC)

.1 National Insulation Standards.

1.2.5 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

1.2.6 International Standards Organization (ISO):

.1 ISO 9000 - Quality Standards.

1.3 SHOP DRAWINGS

1.3.1 Submit for acceptance manufacturer's catalogue literature related to installation and fabrication of joining recommendations.

1.4 QUALIFICATIONS

1.4.1 Installer to be specialist in performing work of this section, and have at least 5 years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.5.2 Protect from weather and construction traffic.

1.5.3 Protect against damage from any source.

1.5.4 Store at temperatures and conditions recommended by manufacturer.

1.5.5 Any water damaged insulation shall be removed and replaced by the Contractor at no additional cost to the Contract.

1.6 QUALITY ASSURANCE

1.6.1 Insulation material must be manufactured at facilities certified and registered with an approved registrar to conform to ISO 9000 quality standards.

1.7 WASTE MANAGEMENT AND DISPOSAL

1.7.1 Separate and recycle waste materials in accordance with municipal regulations .

1.7.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.7.3 Collect and separate for disposal: paper, plastic, polystyrene, and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan

1.7.4 Divert unused metal materials from landfill to metal recycling facility.

1.7.5 Divert unused adhesive material from landfill to official hazardous material collections site.

1.7.6 Do not dispose of unused adhesive material into sewer systems, lakes, or streams, onto the ground or in other locations where it will pose health or environmental hazard.

1.8 ENVIRONMENTAL REQUIREMENTS

1.8.1 Insulation adhesives, mastics and cements shall be applied only in ambient conditions (i.e. temperature and humidity) which are within the published guidelines of the insulation manufacturer.

2. PRODUCTS

2.1 FIRE AND SMOKE RATING

2.1.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

2.2.1 Mineral Fibre: Includes glass fibre, rock wool, slag wool.

2.2.2 Thermal conductivity:

.1 Rigid mineral fibre board:

"K" factor of 0.035 W/m.ºC at mean ambient temperature of 24ºC when tested in accordance with ASTM C612, Type 1A and 1B, rigid.

.2 Rigid molded calcium silicate:

"K" factor as described in table below in accordance with ASTM C177, ASTM C518 and ASTM C335.

Mean Temp °C	38	93	149	204	260	316	371
Conductivity W/m-°C	0.053	0.058	0.064	0.071	0.079	0.087	0.096

2.2.3 TIAC Code A-2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Thermal properties to requirements of ASTM C533.

.2 Pre-formed, high temperature, abuse-resistant pipe and block insulation.

.3 Composed of hydrous calcium silicate for use on systems operating up to 650°C.

.4 Inorganic, noncombustible, asbestos free.

.5 Flame spread / smoke developed ratings of 0/0.

.6 Acceptable product: Industrial Insulation Group Thermo-12 Gold, Manson, Owens-Corning, Knauf or accepted substitute.

2.2.4 TIAC Code C-1: Rigid mineral fibre board to ASTM C612 with factory applied vapour retarder jacket to CGSB.51-GP-52Ma:

.1 Density: 96.11 kg/m³.

.2 Installed “R” values:

.1 25 mm thick: 0.73 m².ºC/W.

.2 50 mm thick: 1.45 m².ºC/W.

.3 Sound absorption coefficients when tested in accordance with ASTM C423, Type A mounting, as follows:

	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
25 mm thick	0.10	0.35	0.85	1.04	1.05	1.03
50 mm thick	0.38	0.93	1.10	1.07	1.07	1.07

.4 Noise reduction coefficient: 0.80 for 25 mm thick and 1.05 for 50 mm thick.

.5 Acceptable product: Johns-Manville Series 800 spin-glass, Type 817 with FSK reinforced foil and paper (Foil - Scrim-Kraft), Manson, Owens-Corning, Knauf, or accepted substitute.

2.3 JACKETS

2.3.1 Canvas:

.1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.1 Acceptable manufacturer: S. Fattal Thermo Canvas, or accepted substitute.

2.3.2 Aluminum:

.1 To ASTM B209 with moisture barrier.

.2 Thickness: 0.50 mm sheet

.3 Finish: Stucco embossed or corrugated.

.4 Jacket banding and mechanical seals: 12mm wide, 0.5 mm thick 304 stainless steel.

.5 Acceptable products: Ideal Products Aluminum jacketing with polysurlyn moisture retarder, or accepted substitue.

2.4 ACCESSORIES

2.4.1 Vapour retarder lap sealer :

.1 Solvent based, non-flammable wet, fire-resistant dry.

.2 Acceptable product: Monsey Bakor 230-39, Foster, Childers, or accepted substitute.

2.4.2 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum:

.1 Acceptable product: Duro Dyne, Dyn Air, or accepted substitute.

2.4.3 Contact adhesive: quick setting:

.1 Non-flammable, rubberized emulsion based adhesive.

.2 Acceptable product: Monsey Bakor 200-38, Foster, Childers, or accepted substitute.

2.4.4 Canvas adhesive: washable

.1 Fire resistive, heavy duty resin emulsion insulation lagging coating.

.2 Acceptable product: Monsey Bakor 120-09, Foster, Childers, or accepted substitute.

2.4.5 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation:

.1 Acceptable product: Duro Dyne, Dyn-Air, or accepted substitute.

2.4.6 Glass or fabric reinforcing cloth:

.1 Open weave, high strength, resin treated, fibreglass cloth.

.2 Thread count of 10 x 10 strands per square inch.

.3 Thickness: 0.20 mm.

.4 Weight: 2.2 ounces per square yard.

.5 Acceptable product: Childers Chil-Glas #10 glass fibre reinforcing mesh.

3. EXECUTION

3.1 PRE- INSTALLATION REQUIREMENTS

3.1.1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.

3.1.2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

3.2.1 Install in accordance with TIAC National Standards

.1 Hot equipment: To TIAC code 1503-H.

.2 Cold equipment: to TIAC code 1501-C.

3.2.2 Provide vapour retarder as recommended by manufacturer.

3.2.3 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.

3.2.4 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

3.2.5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports outside vapour retarder jacket.

3.3 EQUIPMENT INSULATION SCHEDULES

3.3.1 Hot Equipment:

.1 TIAC code A-2 with air gap, mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.

.1 Thicknesses:

.1 Diesel Generator Silencer/Muffler: 50 mm.

3.3.2 Cold equipment:

.1 TIAC Code C-1 with mechanical fastenings and 13 mm cement reinforced with one layer of reinforcing mesh and covered with a vapour barrier coating.

.1 Thicknesses:

.1 Electrical Room Intake Filter Housing: 50 mm.

3.3.3 Finishes:

.1 TIAC code CDR/4 aluminum jacket for the TIAC Code A-2 insulated systems.

.2 TIAC code CRF/3 aluminum jacket for the TIAC Code C-1 insulated systems.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 23 08 01
CH0032 POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT	PERFORMANCE VERIFICATION MECHANICAL PIPING SYSTEM	Rev: D2
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 23 08 01
PERFORMANCE VERIFICATION MECHANICAL PIPING SYSTEM

TABLE OF CONTENTS

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 23 08 01
CH0032	**PERFORMANCE VERIFICATION MECHANICAL PIPING SYSTEM**	Rev: D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
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PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 23 11 13 – Facility Fuel-Oil Piping.

1.2 FUEL OIL SYSTEMS

1.2.1 Environmental protection systems:

1.2.1.1 Test oil storage tank leakage detection system using Manufacturer's recommended procedures.

1.2.1.2 Test spill protection and over-fill protection systems using Manufacturer's recommended procedures.

1.2.2 Operational Tests:

1.2.2.1 Charge system and verify operation.

1.2.2.2 Verify adequacy of flow rates and pressure from storage facilities to generator.

1.2.2.3 For further details refer to relevant sections of Mechanical Division.

1.2.2.4 Ensure foot valves and shut off valves are operating properly.

1.2.3 Notify authorities having jurisdiction to enable witnessing of tests as required.

1.2.4 Test all systems and equipment in accordance with Newfoundland and Labrador regulation 58/03 - Storage and Handling of Gasoline & Associated Products Regulations as well as CCME – Environmental Code of Practices for Aboveground & Underground Storage Tank Systems Containing Petroleum & Allied Petroleum Products, or elsewhere as specified.

1.3 REPORTS

1.3.1 Provide testing reports as requested by Engineer or Authority having jurisdiction.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 23 11 13
CH0032	**FACILITY FUEL-OIL PIPING**	Rev: D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 23 11 13
FACILITY FUEL-OIL PIPING

TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGL Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL: No 138
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
K.H.G. JEWER
SIGNATURE
Dec 9, 2013
DATE
PROVINCE OF NEWFOUNDLAND

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 23 11 13
CH0032	**FACILITY FUEL-OIL PIPING**	Rev: D2
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PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section includes:

1.1.1.1 Materials and installation for light fuel oil piping from oil tanks to generator set.

1.2 RELATED SECTIONS

1.2.1 Section 23 05 05 – Installation of Pipework.

1.2.2 Section 23 05 17 – Pipe Welding

1.2.3 Section 23 08 01 – Performance Verification of Mechanical Piping Systems.

1.2.4 Section 33 56 13 – Aboveground Fuel Storage Tanks.

1.3 REFERENCES

1.3.1 American Petroleum Institute:

1.3.1.1 Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class 1, Division 1 and Division 2. API Recommended Practice 500.

1.3.2 American Society of Mechanical Engineers (ASME):

1.3.2.1 ASME-B1.20.1, Thermal Threads, General Purpose (Inch).

1.3.2.2 ASME-B16.3, Malleable-Iron Threaded Fittings.

1.3.2.3 ASME-B16.11, Forged Fittings, Socket Welding and Threaded.

1.3.2.4 ASME-B16.34, Valves-Flanged, Threaded and Welding End.

1.3.2.5 ASME-B31.1, Power Piping.

1.3.2.6 ASME-B40.100, Pressure Gauges and Gauge Attachments.

1.3.3 American Society for Testing and Materials (ASTM):

1.3.3.1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.

1.3.3.2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

1.3.3.3 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.

1.3.4 Canadian Standards Association (CSA):

1.3.4.1 CAN/CSA-B139, Installation Code for Oil Burning Equipment.

1.3.4.2 CAN/CSA-B140.0, General Requirements for Oil Burning Equipment.

1.3.5 CCME (Canadian Council of Ministers of the Environment) Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.

1.3.6 CNRL -58/03 – Storage and Handling of Gasoline and Associated Products Regulations under the Environmental Protection Act.

1.3.7 Health Canada/Workplace Hazardous Materials Information Systems:

1.3.7.1 Material Safety Data Sheets (MSDS).

1.3.8 Manufacturers Standardization Society of the Valve and Fitting Industry (MSS):

1.3.8.1 MSS SP-58, Standard for Pipe Hangers and Supports – Materials, Design and Manufacture.

1.3.8.2 MSS SP-69, Standard for Pipe Hangers and Supports – Selection and Application.

1.3.8.3 MSS SP-79, Standard for Socket Welding Reducer inserts.

1.3.8.4 MSS SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.3.8.5 MSS SP-83, Standard for Class 3000 Steel Pipe Unions Socket Welding and Threaded.

1.3.8.6 MSS SP-89, Pipe Hangers and Supports – Fabrication and Installation Practices.

1.3.9 National Fire Protection Association (NFPA):

1.3.9.1 NFPA 30, Flammable and Combustible Liquids Code.

1.3.10 National Fire Code of Canada, Latest Edition.

1.3.11 Nalcor Energy Engineering Directive # CF-ED-004 – Diesel System Installation and Abandonment Engineering Directive.

1.4 SUBMITTALS TO ENGINEER

1.4.1 Product Data:

1.4.1.1 Submit Manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

1.4.1.2 Indicate on Manufacturer's catalogue literature the following: valves, piping and fittings.

1.4.2 Submit WHMIS MSDS. Indicate VOC's for adhesive and solvents during application and curing.

1.4.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

1.4.4 Certificates: submit certificates signed by Manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4.5 Instructions: submit Manufacturer's installation instructions.

1.4.6 Closeout submittals: Submit operation, maintenance and engineering data and incorporate into Operation and Maintenance Manual.

1.5 QUALITY ASSURANCE

1.5.1 Pre-Installation Meeting: Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.

1.5.1.1 Verify project requirements.

1.5.1.2 Review installation and substrate conditions.

1.5.1.3 Co-ordination with other building subtrades.

1.5.1.4 Review Manufacturer's installation instructions and warranty requirements.

1.5.2 Trades people to have journeyperson qualifications.

1.6 DELIVERY, STORAGE & HANDLING

1.6.1 Waste Management and Disposal:

1.6.1.1 Separate waste materials for reuse and recycling in accordance with municipal regulations.

1.6.1.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.6.1.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling.

1.6.1.4 Separate for reuse and recycling and place in designated containers, steel, metal and plastic waste.

1.6.1.5 Place materials defined as hazardous or toxic in designated containers.

1.6.1.6 Handle and dispose of hazardous material in accordance with Canadian Environmental Protection Act (CEPA), Transportation of Dangerous Goods Act (TDGA), Regional and Municipal regulations.

1.6.1.7 Divert unused metal materials from landfill to metal recycling facility as approved by Engineer.

1.6.1.8 Unused paint, coating materials must be disposed of at official hazardous material collection site as approved by Engineer.

1.6.1.9 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

PART 2 PRODUCTS

2.1 FUEL OIL PIPE (ABOVE GROUND)

2.1.1.1 Steel: to ASTM A53/A53M, Schedule 40, seamless, socket welded end connections.

2.2 FITTINGS

2.2.1 Steel:

2.2.1.1 Forged Steel, Class 3000 Socket welded fittings.

2.2.1.2 Unions: Forged Steel, Class 3000 Socket Welded to MSS-SP-83.

2.2.1.3 Nipples: Schedule 40, to ASTM A53/A53M.

2.3 BALL VALVES

2.3.1 To be installed to isolate equipment, at tank supply connections, at supply line where it enters the building and elsewhere as indicated in the NFC and CSA B139 documents.

2.3.2 Ball valves shall be a fire safe design to API 607 complete with graphite packing and gaskets.

2.3.3 Socket welded end connections.

2.3.4 Shall be able to be closed against the supply of fuel.

2.3.5 Three–piece construction, carbon steel ASTM A216 Grade WCB Phosphate Coated.

2.3.6 13.78 MPa (gauge) WOG, cold non-shock.

2.3.7 Stainless steel trim and hardware.

2.3.8 Stainless steel vented ball.

2.3.9 Blowout proof system.

2.3.10 Statically grounded ball, stem and body.

2.3.11 Two position locking.

2.3.12 Valves shall be suitable for outdoor service.

2.3.13 Acceptable manufacturers: NIBCO KM-590-CS-R-66-FS-LL, Apollo, Jenkins, Milwaukee, Newman Hattersly, Kitz, Toyo, Crane, or approved equal.

2.4 AUTOMATIC CLOSING BALL VALVES

2.4.1 To be installed on fuel tank supply line adjacent to tank and on fuel oil supply line adjacent to the generator set and elsewhere as indicated in CSA B139 & NFC.

2.4.2 Valve shall permit automatic closing of fuel oil supply line in the event of a fire. Valve shall include UL listed thermal links that melt at 74^0 C allowing the valve to close tightly and shall be able to be manually opened or closed.

2.4.3 Ball valve type.

2.4.4 Valve shall be suitable for outdoor service.

2.4.5 Socket welded end connections.

2.4.6 Bronze body and disc. Carbon steel construction, suitable for use with diesel fuel oil.

2.4.7 Valve shall be factory mutual (FM) approved.

2.4.8 Fully ported.

2.4.9 Maximum working pressure of 861kPa.

2.4.10 Valves shall be in accordance with ULC S651.

2.4.11 Acceptable manufacturers: Essex TA Series or approved equal.

2.5 FLEXIBLE BRAIDED HOSE

2.5.1 Austenitic 300 series stainless steel.

2.5.2 End connections: Union end connections.

2.5.3 Hose to be line size.

2.5.4 Minimum Length: 600mm.

2.5.5 Maximum rated working pressure: 1,034 KPa @ 21^0 C.

2.5.6 Flexible hoses to be suitable for outdoor service.

2.5.7 Install at fuel oil tank connections, day tank connections and generator set connections.

2.5.8 Hose shall be in accordance with ULC/ORD C536.

2.5.9 Acceptable manufacturers: Fire-Shield Hose Master, Swagelok, or approved equal.

2.6 PIPE COATING

2.6.1 Pipe to be field primed and painted in accordance with Nalcor Engineering Directive.

2.7 DUPLEX FUEL OIL TRANSFER PUMP PACKAGE

2.7.1 Factory piped, duplex pumping package.

2.7.1.1 Pump package shall be complete with two (2) pressure relief valves; full port ball type isolating valves at unit inlet and outlet to isolate each pump; lift type check valves for each pump outlet; in-line type check valves for each pump inlet; one (1) combination high/ low pressure switch on the common discharge; one (1) full port ball type isolating shut off valve mounted at the common discharge header; two (2) liquid filled pressure gauges with needle type isolating valves; two (2) liquid filled compound suction gauges with needle type isolating valves; a cast iron basket type suction strainer with 60 mesh stainless steel screen for each individual pump; and all necessary schedule 80 piping to allow for a complete duplex assembly. Pump package set shall be assembled on a 6mm fabricated epoxy lined steel base with a 50 mm drip lip all around to extend under all pumps, valves, strainer, and fittings at pumps.

2.7.1.2 Pumps shall be positive displacement, self-priming heavy duty rotary helical gear type pumps.

2.7.1.3 Microprocessor-based Programmable Logic Control Strategy, Nema4X Enclosure, UL/CSA LISTED; Main Disconnect, Magnetic Motor Starters, Hand-Off-Auto Selector Switches, Pilot Lights for 'Power On', Motor 'Run' and Motor ‘Trip’, Terminal Strip, Pump Failure Pilot Light and Manual Reset, Audible Alarm Buzzer and Silence Push Button, High and Low Pressure Cut Outs/ Red Pilot Light/ Reset, Provisions for Main Tank and Day Tank Status (High Level, Critical High Level, Low Level within the day tank and high level and low level within the main tank) with Red Pilot Lights and Dry Alarm Contacts for each, and provision for all alarms to signal at BAS / EMCS. Control panel shall also switch operation of pumps from lead to lag to maintain equal run times on the equipment.

2.7.1.3.1 Pressure sensing device shall be installed and shall shut pumps down when the pressure falls below or rises above the normal operating pressure.

2.7.1.3.2 Duplex pumping system shall come complete with level sensing devices for both the main tank and the day tank. Provide a four (4) level control switch and a separate critical high level switch for the day tank. Provide a two (2) level control switch for the main tank.

2.7.1.3.2.1 Floats to be of stainless steel construction.

2.7.1.3.2.2 Floats shall come complete with a 2” MNPT connection and junction box.

2.7.1.3.2.3 Switch assemblies shall be certified to CAN/CSA Std. C22.2 No. 1010-1, CAN/CSA Std. C22.2 No. 30. Assembly shall also conform to UL1203 and ANSI/ISA S82-3.

2.7.1.3.2.4 The four level switch shall control the systems as follows:

2.7.1.3.2.4.1 High level – set at 95% of day tank volume, shall indicate high level alarm and stop all pumps.

2.7.1.3.2.4.2 Stop pumps level – set at 90% of day tank volume and stops all pumps.

2.7.1.3.2.4.3 Lead pump start level – set at 75% of day tank volume, start lead pump.

2.7.1.3.2.4.4 Low level – set at 65% of day tank volume, shall indicate low level alarm and start lag pump.

2.7.1.3.2.5 The single critical high level switch in the day tank shall stop all power to the fuel pump system and shall be set for 97% of the day tank volume.

2.7.1.3.2.6 The two-level switch in the main tank shall indicate a high level alarm at 95% of the tank volume and indicate a low level alarm at 25% of the tank volume and stop pumps.

2.7.1.3.3 Pumping system operation shall be controlled by the level sensing devices located in the day tank and main tank and shall automatically maintain the fuel level in the day tank.

2.7.1.3.4 Pump control panel shall be used to open the solenoid on the main tank whenever the pumps are in operation.

2.7.1.3.5 Pump control panel shall accept a signal from the day tank control panel to stop pumping if the day tank experiences a leak within the secondary containment area.

2.7.1.3.6 Entire system shall be suitable for installation in an unheated enclosure where ambient conditions will vary from -50º C during the winter to 40º C in the summer.

2.7.1.4 Pumping package shall be complete with a NEMA 4X stainless steel enclosure to house entire package. Enclosure shall be weatherproof as it will be located outside and shall be corrosion resistant. Enclosure shall be suitably rated for hazardous locations if it is located within such an area.

2.7.1.5 Pump Criteria:

2.7.1.5.1 Liquid: Diesel fuel oil.

2.7.1.5.2 Flow rate: 0.063 L/S.

2.7.1.5.3 Pressure: 413kPa.

2.7.1.6 Acceptable manufacturers: Pumps - Albany Model 03GC61412; Strainers - Albany Model Simplex Series; Controller - DUCON Series Duplex Fuel Oil Management Control Center; Pump package - Albany Model FODUP/03GC/BS Duplex Fuel Oil Transfer Pumpset, Preferred Utilities, or approved equal.

2.8 FOOT VALVE

2.8.1 Install at bottom of tank suction lines as indicated.

2.8.2 Valve to be double poppet type.

2.8.3 Valve to be of bronze construction with lapped-in seats.

2.8.4 Flat poppets.

2.8.5 20 mesh monel screen.

2.8.6 Acceptable manufacturers: Preferred Utilities Manufacturing Corporation or approved equal.

2.9 VACUUM BREAKER

2.9.1 Brass body with threaded ends.

2.9.2 Stainless steel ball.

2.9.3 EPN “O” ring seat.

2.9.4 Positive bubble tight closing.

2.9.5 Suitable for pressure up to 2.07 mPa.

2.9.6 Valve shall be installed to prevent vacuums within the system as per code requirement.

2.9.7 Acceptable manufacturers: Model VB, Preferred Utilities MFG Corp or approved equal.

2.10 SOLENOID VALVE:

2.10.1 Solenoid valve shall be suitable for operating pressures and diesel fuel oil piping applications.

2.10.2 Normally closed hung piston design.

2.10.3 Solenoid valve shall open upon receipt of an electronic signal.

2.10.4 Valve shall operate on 120 Volt AC. Operation on other voltages shall be factory options.

2.10.5 Viton seal.

2.10.6 Continuous duty Class H standard coil with other available options, as required to suit installation.

2.10.7 Zero pressure differential required for operation.

2.10.8 Integral thermal relief.

2.10.9 Watertight enclosure and rated for a variety of hazardous locations, NEMA 3, 4X, 7 and 9; groups C and D.

2.10.10 Cast bronze body.

2.10.11 Provide strainer with 100 mesh screen upstream of solenoid valve.

2.10.12 Acceptable manufacturers: Morrison Bros. Co, Model 710 or approved equal.

2.11 FLOW METER

2.11.1 Turbine type flow meter suitable use with diesel fuel oil with a flow rate in the range of 1.9 to 45425 LPM.

2.11.2 NPT end fittings.

2.11.3 Stainless steel body construction with 17-4 PH stainless steel hydraulically balanced rotor and metal ball bearings.

2.11.4 Linearity: +/- 0.5%.

2.11.5 Repeatability: +/- 0.1%.

2.11.6 Temperature Range: -276º C to 232º C.

2.11.7 Pressure Drop: 34 kPa at nominal rated flow.

2.11.8 Furnished with standard fluid calibration.

2.11.9 Complete with mounting boss and pickup coil for totalizer.

2.11.10 Complete with totalizer as follows:

2.11.10.1 Input power: 5 to 48 VDC, Reverse Polarity Protected.

2.11.10.2 Internal Power: D Lithium Battery.

2.11.10.3 Temperature Rating: Operating: -30º C to 75º C and Storage: -40º C to 85º C.

2.11.10.4 Enclosure: Explosion Proof Aluminum.

2.11.10.5 Serial Communications: RS-232 (optional).

2.11.10.6 Signal Input: Magnetic, RF Modulated (external power required), Pulse.

2.11.10.7 Temperature Compensation: Two Wire RTD (optional).

2.11.10.8 Outputs: Scaled Pulse, Rate (4-20 mA), Alarm (optional).

2.11.10.9 Approvals: NMI approved, meets all Handbook 44 requirements for cryogenics.

2.11.11 Acceptable manufacturers: Liquid Controls Group, Sponsler Precision Turbine Meter with IT 400 totalizer: or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Install materials and equipment as required and in accordance with Nalcor Engineering Directive and Section 23 05 05 – Installation of Pipework, supplemented as specified herein. In addition, install materials and equipment in accordance with CAN/CSA-B139, CAN/CSA-B140.0, ASME B31.9, NFC and CCME documents.

3.1.2 All devices and components shall be rated for use within the space classification they are installed in. Refer to API Recommended Practice 500 for additional information on hazardous locations near fuel systems.

3.1.3 Piping:

3.1.3.1 Provide Non-Destructive Examination (NDE) report for welding of exterior fuel oil piping. Unless specifically stated to the contrary, fabrication, assembly and welding shall conform to ASME B31.1. Cut piping accurately to measurements established for the work. Work piping into place without springing or forcing. Piping and equipment within buildings shall be entirely out of the way of lighting fixtures and doors, windows, and other openings. Locate overhead piping in buildings in the most inconspicuous positions. Do not bury or conceal piping until it has been inspected, tested, and approved. Where pipe passes through building structure, pipe joints shall not be concealed, but shall be located where they may be readily inspected and building structural shall not be weakened. Avoid interference with other piping, conduit, or equipment. Except where specifically required, vertical piping shall run plumb and straight and parallel to walls. Piping connected to equipment shall be installed to provide flexibility for vibration. Adequately support and anchor piping so that strain from weight of piping is not imposed on the equipment.

3.1.3.2 Clearances for welding:

3.1.3.2.1 Provide clearances from walls, ceilings, and floors to permit the installation of joints. The clearances shall be at least 150 mm for pipe sizes NPS 4 and less, 250 mm for pipe sizes over NPS 4, and sufficient in corners. However, the specified clearances shall not waive requirements for welders to be qualified for the positions to be welded.

3.1.3.3 Cleaning and flushing procedures:

3.1.3.3.1 Before jointing and erection of piping, thoroughly clean interiors of pipe sections and components. In steel pipe, loosen scale and other foreign matter by rapping sharply and expel by wire brush and swab. Blow out steel pipe and components with compressed air at 689 kPa (gage) or more. Maintain cleanliness by closure of pipe openings with caps or plugs. Before making final terminal connections, blow out complete system with compressed air at 689 kPa (gage) or more.

3.1.3.4 Changes in pipe size:

3.1.3.4.1 Use reducing fittings for changes in pipe size. The use of bushings shall not be permitted. In horizontal lines, NPS 2½ inches and larger, reducing fittings shall be of the eccentric type to maintain the bottom of the lines in the same plane.

3.1.3.5 Drainage and flexibility:

3.1.3.5.1 Piping shall be free of unnecessary pockets and shall be installed level. Provide flexibility by use of fittings, loops and offsets in piping. Install branches at top of a main to prevent carryover of foreign matter. Provide lockable drain valves at all system low points to facilitate complete system drain down.

3.1.4 Welding procedures:

3.1.4.1 Perform welding in accordance with qualified procedures using qualified welders and welding operators. Do not perform welding when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The Engineer will determine when weather or working conditions are unsuitable for welding. Welding of hangers, supports, and plates to structural members shall be in accordance with AWS D1.1/D1.1M.

3.1.4.2 Cleaning for welding:

3.1.4.2.1 Surfaced to be welded shall be free from loose scale, slag, rust, paint, oil, and other foreign material. Joint surfaces shall be smooth and free from defects which might affect proper welding. Clean each layer of weld metal thoroughly by wire brushing, grinding, or chipping prior to inspection or deposition of additional weld material.

3.1.4.3 Welding of valves:

3.1.4.3.1 Disassemble valves subject to damage from heat during welding and reassemble after installation. Open valves off the seat when not subject to heat damage during welding; do not backseat valve.

3.1.5 Threaded joints:

3.1.5.1 Cut pipe ends square, remove fins and burrs, and cut taper pipe threads in accordance with ASME B1.20.1. Threads shall be smooth, clean, and full cut. Apply thread tape to male threads only. Work piping into place without springing or forcing. Backing off to permit alignment of threaded joints will not be permitted. Engage threads so that not more than three threads remain exposed.

3.1.6 Valves:

3.1.6.1 Install valves at the locations indicated and elsewhere as required for the proper functioning of the system and as required by CCME, NFC and CSA B139.

3.1.6.2 Install valves with items upright or horizontal unless approved otherwise by Engineer.

3.1.7 Hangers and supports:

3.1.7.1 Selection, fabrication and installation of piping hangers and supports shall conform to MSS SP-58, MSS SP-69 and MSS SP-89, except that spacing of the hangers and supports shall be as per Table I.

3.1.7.2 Table I - Maximum Span for Pipe (Meters)

NPS	Std. Wt. Steel Pipe Schedule 40
½	1.50
¾	1.75
1	2.00
1 ½	2.30
2	2.60

2 ½	2.80
3	3.10
3 ½	3.35
4	3.5
6	4.20
8	4.70
10	5.20
12	5.55

3.1.8 Pressure gauges:

3.1.8.1 Provide pressure gauge with a ¼ NPS Schedule 40 pipe nipple and quarter turn mini-ball valve, installed between the gauge and the line.

3.1.8.2 Provide compound pressure gauges at suction of fuel oil pumps.

3.1.9 Strainers:

3.1.9.1 Provide 60 mesh stainless steel basket strainers at each fuel pump suction.

3.1.9.2 At time of project substantial completion, clean out basket strainers.

3.1.10 Equipment installation:

3.1.10.1 Install piping in a manner that does not place a strain on any of the equipment.

3.1.11 Cleaning of system:

3.1.11.1 Clean the various system components before final closing as the installations are completed. Remove foreign matter from equipment and surrounding areas. Preliminary or final tests shall not be permitted until the cleaning is completed to the satisfaction of the Engineer.

3.1.12 Unions:

3.1.12.1 Provide unions where necessary to permit easy disconnection of piping and apparatus, and as indicated.

3.1.13 Identification of piping:

3.1.13.1 Identify piping in accordance with Nalcor Engineering Directive, CSA B139 and NFCC.

3.1.14 Flexible Connections:

3.1.14.1 Flexible connections shall be installed in accordance with manufactures recommendations in locations indicated.

3.2 FIELD QUALITY CONTROL

3.2.1 Welding examinations:

3.2.1.1 Contractor shall perform visual examinations to detect surface and internal discontinuities in completed welds as per specification Section 23 05 17 - Pipe Welding. Verify piping welds meet the acceptance criteria. Visually examine all welds. When examination indicates defects in a weld, joint, the weld shall be repaired by a qualified welder. Remove and replace defects as specified in ASME B31.9, unless otherwise specified. Repair defects discovered between weld passes before additional weld material is deposited. Whenever a defect is removed, and repair by welding is not required, blend the affected area into the surrounding surface, eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, examine the area by the same methods which first revealed the defect to ensure that the defect has been eliminated. After rewelding, re-examine the repaired area by radiography for butt welded joints or magnetic particle analysis for socket welded joints as per specification Section 23 05 17 - Pipe Welding. Any indication of a defect shall be regarded as a defect unless re-evaluation by surface conditioning and re-examination shows that no unacceptable defects are present. The use of any foreign material to mast, fill in, seal, or disguise welding defects will not be permitted.

3.2.1.2 Upon failure of a weld by visual inspection, carry out radiographic or magnetic particle inspections as applicable of up to 10% of all welds performed by the welder responsible for the failed weld. The individual welds selected for radiographic examination shall be chosen by the Engineer.

3.2.2 Testing:

3.2.2.1 General requirements, testing:

3.2.2.1.1 Perform testing after cleaning. Contractor shall provide everything for tests. Tests shall be subject to the approval of the Engineer.

3.2.2.2 Hydrostatic tests:

3.2.2.2.1 Preliminary preparation:

3.2.2.2.1.1 Remove or isolate from the system the fuel pump, fuel storage tank, generator, instruments, and equipment which would be damaged by water during hydrostatic tests and reinstall after successful completion of tests.

3.2.2.2.2 Performance of hydrostatic tests:

3.2.2.2.2.1 Vent or flush air from the piping system. Pressurize system for 10 minutes with water at 689 kPa, then reduce to design working pressure and check for leaks and weeps. Install a test pressure gauge in the piping system to observe any loss in pressure. Maintain required test pressure for a sufficient length of time to enable an inspection of all joints and connections.

3.2.2.2.3 System fill:

3.2.2.2.3.1 After satisfactory completion of hydrostatic pressure test, blow system dry with clean, oil-free compressed air, and fill with service fluid. Flush for a minimum of 2 hours with the service fluid. Remove and clean basket strainers at completion of flushing exercise. Dispose of fuel oil used for flushing in accordance with requirements of authority having jurisdiction.

3.2.2.2.3.2 The Contractor shall be responsible to provide fuel oil for flushing purposes. The Contractor shall also be responsible for all costs associated with disposal of fuel oil used for flushing purposes.

3.2.2.3 Operational tests:

3.2.2.3.1 Test fuel oil equipment as in service to determine compliance with contract requirements and warranty. During the tests, test equipment under every condition of operation. Test safety controls to demonstrate performance of their required function. Completely test system for compliance with specifications.

3.2.2.4 Check entire installation is approved by Authority having jurisdiction.

3.2.2.5 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tool and equipment.

3.2.2.6 Provide testing reports as requested by Engineer or authority having jurisdiction.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 23 11 14
CH0032	**FUEL STORAGE TANK ELECTRONIC MONITORING SYSTEMS**	Rev: D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 23 11 14
FUEL STORAGE TANK ELECTRONIC MONITORING SYSTEMS
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
K.H.G. JEWER
SIGNATURE
Nov 15, 2012
DATE
PROVINCE OF NEWFOUNDLAND

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 23 11 14
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PART 1 GENERAL

1.1 SUMMARY

1.1.1 This specification details the requirements for furnishing and installing an electronic monitoring system for above grade double wall storage tanks for diesel fuel.

1.1.2 This specification describes specifically a continuous monitoring and leak detection system.

1.2 RELATED SECTIONS

1.2.1 Section 33 56 13: Aboveground Fuel Storage Tanks

1.3 REFERENCES

1.3.1 The fuel storage tanks monitoring system shall meet all applicable standards and regulatory agency requirements including, but not limited to, the standards and requirements of the following:

1.3.1.1 American National Standards Institute (ANSI).

1.3.1.2 American Petroleum Institute (API).

1.3.1.3 American Society for Testing and Materials (ASTM).

1.3.1.4 Environmental Protection Agency (EPA).

1.3.1.5 National Fire Protection Agency (NFPA).

1.3.1.6 Canadian Standards Association (CSA).

1.3.1.7 Canadian Underwriters Laboratories Inc. (CUL).

1.3.1.8 Canadian Electrical Code Part 1 C22.1-98.

1.3.1.9 Canadian Council of Resource and Environment Ministers Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products.

1.3.1.10 National Fire Code of Canada.

1.4 SHOP DRAWINGS

1.4.1 Submittals:

1.4.1.1 Submit product data for all materials specified in this section.

1.4.1.2 Submit operation and maintenance data and incorporate into Operations and Maintenance Manual.

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Waste Management and Disposal:

1.5.1.1 Separate and recycle waste material in accordance with municipal regulations.

PART 2 PRODUCTS

2.1 OPERATIONAL SPECIFICATIONS

2.1.1 In-tank leak detection:

2.1.1.1 The system shall utilize in-tank probes based on the magnetostrictive principle for liquid level measurement and in-tank leak detection.

2.1.1.2 The tank gauges shall be capable of performing a static tank tightness test to an accuracy of 0.37 L/h with at least a 98% probability of detection [P(D)] and no more than 1% probability of false alarm [P/(FA)].

2.1.1.3 The system shall have the ability to be programmed to run a static 0.74 L/h quick leak test. The static leak test will take one hour and commence 30 minutes after the last dispensing cycle or five hours from the last delivery, whichever is greater.

2.1.1.4 The system shall have the ability to conduct automatic continuous statistical leak detection tests without the need to shut down tanks for scheduled test times.

2.1.1.5 The system shall continuously collect product height and temperature information from each tank and, without input from any other source, utilize dynamic pattern analysis to determine when idle periods in each respective tank begin and end. Idle time information thus collected shall be transferred to the systems database for qualification.

2.1.1.6 The system shall be capable of evaluating after each idle period the quality of information stored in the database. The idle period qualification shall consider

noise factors affecting the idle time such as dispensing, deliveries, temperature changes, temperature stratification and evaporation.

2.1.1.7 The system shall be capable of dynamically qualifying the idle time data and selecting the best available data to perform a 0.74 L/h tank tightness evaluation.

2.1.1.8 The system shall employ the use of dynamic feedback variables in the algorithm to evaluate the noise factor patterns associated with a tank, thus tailoring the algorithms to each individual tank.

2.1.1.9 The system shall perform a new 0.74 L/h tank tightness evaluation as each new piece of idle period data is added to the database.

2.1.1.10 The system, when operated in the continuous statistical leak detection mode, shall be third-party certified. The test shall meet or exceed U.S. EPA standards with a 99% probability of detecting a 0.74 L/h leak and less than 0.1% probability of false alarm. It shall meet federal, provincial and local compliance requirements for monthly monitoring.

2.1.1.11 In conjunction with having the ability to perform a continuous statistical leak test, the monitoring system shall have the ability to perform a static leak test to an accuracy of 99% probability of detecting a leak and 1% probability of false alarm.

2.1.2 Environmental compliance reports:

2.1.2.1 The system shall have the ability to provide a record of the last three occurrences of each type of alarm or warning condition detected by the system.

2.1.2.2 The system shall provide the following types of reports related to environmental compliance matters:

2.1.2.2.1 System status messages.

2.1.2.2.2 In-tank warning and alarm messages.

2.1.2.2.3 In-tank tightness evaluation report.

2.1.2.2.4 Liquid sensor warning and alarm messages.

2.1.2.2.5 Normally-closed sensor warning and alarm conditions.

2.1.2.2.6 Hydrostatic sensor warning and alarm conditions/high or low liquid level conditions.

2.1.2.2.7 External input messages.

2.1.2.2.8 Discriminating containment sump sensor warning and alarm messages.

2.1.2.2.9 Software module alarm message.

2.1.3 Product inventory control (tank gauging):

2.1.3.1 The tank management system shall collect product height and temperature data from magnetostrictive level sensors and compute gross and temperature-compensated net litres for each tank. The operator may choose from inventory or delivery information to generate a complete set of inventory or delivery printed reports.

2.1.3.2 The system shall automatically generate an inventory increase report when a delivery of product to a tank has taken place. The report shall include the time and date of the delivery, the starting volume in the tank, the ending volume in the tank, the starting temperature of the fuel, the ending temperature of the fuel, and the inventory increase amount.

2.1.3.3 The system shall have the ability to store up to the ten most recent inventory increases in memory for business management purposes.

2.1.4 Inventory management reports:

2.1.4.1 General:

2.1.4.1.1 The system shall monitor inventory in metric units and produce a combination of automatic and manual reports for each tank, which include the following information:

2.1.4.1.1.1 Fuel volume.

2.1.4.1.1.2 Fuel height.

2.1.4.1.1.3 Water height.

2.1.4.1.1.4 Fuel temperature.

2.1.4.1.1.5 Ullage.

2.1.4.1.1.6 Temperature – compensated fuel volume.

2.1.4.1.1.7 Last inventory increase amount.

2.1.4.1.1.8 Last in-tank leak test results.

2.1.4.1.1.9 Time and data.

2.1.4.1.1.10 Tank identification.

2.1.4.1.1.11 Fuel type identification.

2.1.4.1.1.12 90% ullage.

2.1.4.1.2 A printout of the inventory status report shall be generated any time the operator presses the print button while the system is in the normal operating mode or generated automatically three times a day with the information stored in memory.

2.1.4.1.3 The system shall provide an automatic delivery report, programmed to print from 1 to 99 minutes after bulk delivery to a tank is complete. The information shall include product label, date, starting and ending time, starting and ending volumes, temperature of the fuel as well as the net volume increase. The information shall be available in metric units.

2.1.4.1.4 The system shall be able to generate reports in a display/printer format as well as a computer format upon demand.

2.1.4.2 Fuel management reports:

2.1.4.2.1 The system shall be able to generate fuel management reports in a display/printer format as well as a computer format upon demand via the RS-485 serial communications interface.

2.1.4.2.2 A printout of the fuel management status report shall be generated any time the operator presses the print button while the system is in the normal operating mode either on the front panel of the console, or on the personal computer to which the console is directly connected via the RS-485 interface.

2.1.4.2.3 The system shall provide a report outlining the current inventory, usage and the number of days of fuel remaining.

2.1.5 Communications:

2.1.5.1 General:

2.1.5.1.1 The tank monitoring system shall provide the ability to communicate with locally attached electronic devices through an RS-485 port or remote locations via an internal modem. The system shall provide data in a display or packed computer data format.

2.1.5.1.2 The communications protocol shall be the Manufacturer's standard serial communications protocol.

2.1.5.1.3 The tank monitoring system shall provide all reports available on the integral printer through the communications port. These shall include all reports associated with inventory management, environmental compliance and diagnostics/troubleshooting.

2.1.5.1.4 The system shall provide for setup and configuration through the communications port using the Manufacturer's standard serial communications protocol.

2.1.5.2 Serial communications:

2.1.5.2.1.1 The system shall provide an RS-485 communications interface for data transmission to a locally attached computer.

2.1.5.3 Auto-dial site fax modem:

2.1.5.3.1 The tank monitoring system shall provide an internal auto-dial fax 2400/1200/300 baud, Hayes-compatible modem, with twin snap in RJ-11 jacks for direct data transmission over phone lines, capable of transmitting information directly to a fax machine, PC or teletype.

2.1.5.3.2 The auto-dial fax/modem shall include the following capabilities:

2.1.5.3.2.1 Dial up to eight user-programmed phone numbers.

2.1.5.3.2.2 Transmit up to 16 user selected reports to each phone number. The reports can consist of:

2.1.5.3.2.2.1 System status;

2.1.5.3.2.2.2 Inventory information;

2.1.5.3.2.2.3 Deliveries;

2.1.5.3.2.2.4 Tank leak test results;

2.1.5.3.2.2.5 Sensor status;

2.1.5.3.2.2.6 Alarm Histories.

2.1.5.3.2.3 Program calling times and schedules for each of the eight phone numbers

2.1.5.3.2.4 Selectable automatic dialling to report any alarm condition immediately. The call shall be immediate on alarm occurrence, selectable by alarm type and assignable any or all of the eight user-programmed phone numbers.

2.1.5.3.2.5 Selectable fax/computer/teletype compatibility. In addition to automatically dialling out at pre-programmed times or to report an alarm condition, the system shall have the ability to receive calls form a PC to query the tank monitoring system for information.

2.1.5.3.2.6 The answer/receive mode shall be selectable with provisions for enabling or disabling the answer mode for telephone line sharing applications.

2.1.6 Input/Output devices:

2.1.6.1 Output relay module:

2.1.6.1.1 The system shall provide the ability to enable external audible/visual alarms or control external devices through a relay contact closure.

2.1.6.1.2 The system shall provide 4 Form C contact relays per interface module.

2.1.6.1.3 The system shall provide the ability to interface up to 8 relay output modules per system for a total of 32 relays.

2.1.6.1.4 The system shall provide the ability to program the relay in either a Normally Open or Normally closed orientation.

2.1.6.1.5 The system shall provide the ability to assign in-tank, sensor, external input, or system alarm conditions to a select relay.

2.1.6.1.6 The system shall provide the ability to designate a 20-character label to a device connected to the output relay through system programming.

2.1.7 Alarms

2.1.7.1 The tank monitoring system shall provide an audible and visual indication of all system, in-tank leak, and external sensor alarm conditions.

2.1.7.2 The system alarm conditions shall include:

2.1.7.2.1 Maximum product level.

2.1.7.2.2 High level limit.

2.1.7.2.3 Overfill alarm.

2.1.7.2.4 High water alarm.

2.1.7.2.5 Second high water alarm.

2.1.7.2.6 Delivery needed alarm.

2.1.7.2.7 Low limit.

2.1.7.2.8 Theft.

2.1.7.2.9 Periodic warning and alarm.

2.1.7.2.10 Annual warning and alarm.

2.1.7.3 The tank monitoring system shall provide an audible and visual alarm indication for in-tank leak failures (11.3 L/h, 0.37 L/h and 0.74 L/h) and external sensor leak failures (fuel, water, sensor out).

2.1.7.4 In conjunction with providing an audible and visual alarm, the system shall have the ability to print out all alarm conditions to the integral thermal printer.

2.1.7.5 The system shall have the ability to send all alarm conditions to the RS-485 serial communications port for data transmission to a central computer. The system shall have the ability to transmit the alarm condition immediately or program a delay time before sending. The system shall also have the ability to enter a repeat function in the programming to repeat sending the alarm condition.

2.1.7.6 The system shall have the ability to automatically dial out and transmit system, in-tank leak, and external sensor alarm conditions to a fax machine.

2.1.7.7 The system shall provide the Operator with the ability to disable the audible portion of an alarm but the visual alarm shall not be disabled until the alarm condition has been corrected.

2.1.7.8 The system shall be equipped with external audible and visual alarms. The external alarm boxes shall be manufactured in watertight gasketed enclosures for installation in an outdoor environment. The external alarm boxes shall interface to the tank monitoring system via internal relays.

2.1.7.9 The system shall have the ability to store up to three alarm occurrences in memory. The Operator shall have the ability to print the alarm history and alarm status on the integral printer as well as retrieve alarm history and alarm status through the communications interface (RS-485, or 2400/1200/300 baud auto-dial fax/modem).

2.1.8 Setup (startup/installation):

2.1.8.1 The system shall contain parameter-driven software to adapt the tank monitor to site specifications. The parameters must be enterable in assigned fields at the time of system startup. In addition, the parameters must be field updatable so that changes in tank diameter/dimensions as well as site specifications can be added.

2.1.8.2 The system shall provide the use of a security code to prohibit unauthorized entry to the systems set-up parameters. The system security code shall be a six-digit number entered through the front-panel keyboard or through the external communications interface. The security code shall have the capability of containing alpha or numeric characters.

2.1.8.3 A four-line, 24-character custom location header to identify the site must be user-programmable. The header must appear automatically on inventory status reports, leak detection reports and automatic delivery reports each time they are printed.

2.1.8.4 Set-up parameters shall include the following:

2.1.8.4.1 System setup data.

2.1.8.4.2 Communications setup data.

2.1.8.4.3 In-tank setup data.

2.1.8.4.4 Fuel management setup.

2.1.8.4.5 In-tank leak test setup data.

2.1.8.4.6 Liquid sensor setup data.

2.1.8.4.7 2-wire C.L. (Type A) setup data.

2.1.8.4.8 3-wire C.L. (Type B) setup data.

2.1.8.4.9 External input setup data.

2.1.8.4.10 Output relay setup data.

2.1.9 Diagnostics/Troubleshooting.

2.1.9.1 All diagnostic information shall be generated by the system itself. The system shall not allow the user to change or enter diagnostic information in any way. The following diagnostic information shall be included in the system:

2.1.9.1.1 Probe diagnostics:

2.1.9.1.1.1 Probe type.

2.1.9.1.1.2 Serial number.

2.1.9.1.1.3 Probe length.

2.1.9.1.1.4 Dry and wet calibration values.

2.1.9.1.2 System diagnostics:

2.1.9.1.2.1 Software revision level.

2.1.9.1.2.2 Software part number.

2.1.9.1.2.3 Software creation date.

2.1.9.1.3 Fuel management diagnostics:

2.1.9.1.3.1 Days of fuel remaining.

2.1.9.1.3.2 Average consumption per day.

2.1.9.1.3.3 Last day consumption.

2.1.9.1.3.4 Predicted daily consumption.

2.1.9.1.4 In-tank diagnostics.

2.1.9.1.5 In-tank leak results.

2.1.9.1.6 Liquid sensor diagnostics.

2.1.9.1.7 Discriminating containment sump sensor diagnostics.

2.1.9.1.8 Alarm history report.

2.1.10 Reports:

2.1.10.1 The system shall provide the capability to print diagnostic information on the system's integral printer for hard-copy documentation and historical record keeping.

2.2 PRODUCT SPECIFICATIONS/CAPACITIES

2.2.1 Console:

2.2.1.1 The console shall be wall mounted using external mounting tabs.

2.2.1.2 The console shall be equipped with a two-line, 24-character liquid crystal display for on-site viewing of all inventory, leak detection and alarm information.

2.2.1.3 The console shall be equipped with a 24-button front-panel keyboard with control and alphanumeric functions for programming, operating and reporting functions.

2.2.1.4 The console shall be equipped with three front-panel indicators to provide a visual indication of power on, warning and alarm conditions.

2.2.1.5 The console shall be equipped with an integral, 24-character, thermal report printer with built-in take-up spool for hard-copy documentation of inventory, leak detection, alarm information, and facsimile transmission confirmation.

2.2.1.6 The console shall be equipped with a back-up battery to maintain all programming information as well as inventory, leak detection and alarm information in the event of a power outage.

2.2.1.7 The console shall be a modular design to accept additional business management, leak detection and communications features in the future.

2.2.1.8 The console shall be equipped with four 44 mm diameter conduit knockouts on the top and bottom of the monitor for rigid conduit entry into the monitor. Two conduit entries (top and bottom) shall be designated for the intrinsically safe compartment, and two conduit entries (top and bottom) shall be designated for the high-power compartment.

2.2.1.9 The console shall be separated into three compartments for:

2.2.1.9.1 Intrinsically safe wiring and devices.

2.2.1.9.2 High-power wiring and devices.

2.2.1.9.3 Communications wiring and devices.

2.2.1.10 The console shall have an internal quick-disconnect connector for 120 Vac wiring to the console for ease of installation, service and troubleshooting.

2.2.1.11 The console shall be equipped with the ability to communicate directly with an external printing device or PC. The system shall also have the ability to communicate with a remote device via the telephone lines.

2.2.1.12 The console shall be capable of communication in English.

2.2.1.13 The console shall be equipped with internal audible and visual warning and alarm indicators.

2.2.1.14 The console shall be intrinsically safe with Canadian Standards Association (CSA), and Canadian Underwriters Laboratories (CUL) approval.

2.2.1.15 The console shall be mounted and wired according to the manufacturer-supplied installation manuals, with all underground intrinsically safe field wiring enclosed in dedicated conduit and separate from all other wiring.

2.2.1.16 The console shall continuously monitor all probes and sensors, reporting not only normal operating conditions, but also system malfunctions or failures.

2.2.2 Modules:

2.2.2.1 General:

2.2.2.1.1 The tank monitoring system shall incorporate a modular design to allow the factory installation of system features to meet specific application requirements as well as field installation/modification of features at a later date to meet changing business, environmental compliance or regulatory requirements.

2.2.2.1.2 The modular design shall consist of one console with the ability to accept plug-in modules. The console shall be divided into three compartments to separate and house plug-in modules for intrinsically safe devices, high power devices and communications devices.

2.2.2.1.3 The interface of additional enclosures to the original console shall not be considered a modular design.

2.2.2.2 Module compartments:

2.2.2.2.1 The system shall have the ability to contain up to eight modules in the high-powered area of the console. The modules to be supplied for this specific application shall consist of:

2.2.2.2.1.1 A four-relay output interface module that can be programmed to actuate external alarm devices when assigned alarm limits are exceeded or alarm conditions are identified.

2.2.2.2.2 The system shall have the ability to contain up to eight modules in the intrinsically safe area of the console. The modules to be supplied for this specific application shall consist of:

2.2.2.2.2.1 A four-input probe interface module compatible with the magnetostrictive probe.

2.2.2.2.3 The system shall have the ability to contain up to three modules in the communications compartment of the console. The modules to be supplied for this specific application shall consist of:

2.2.2.2.3.1 An RS-485 interface module providing data transmission to a computer, or printing device.

2.2.2.2.3.2 A SiteFax 2400/1200/300 baud modem interface module with twin snap in jacks for direct data transmission over the phone lines, utilizing the Hayes command set, with the ability to automatically call a fax machine based on the occurrence of an alarm condition or a pre-programmed report transmission time.

2.2.3 Probes:

2.2.3.1 The probe shall be capable of utilizing shielded gas and oil resistant wire between 14 AWG and 18 AWG for field connections.

2.2.3.2 There shall be no more than two conductors between the probe and control console.

2.2.3.3 The probe shall be capable of performing a leak detection test to 0.37 L/h or higher.

2.2.3.4 Third-party certification is required in accordance with the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Automatic Tank Gauging Systems" (0.74 L/h monthly monitoring).

2.2.3.5 Third-party certification is required in accordance with the U.S. EPA's "Volumetric Tank Tightness Testing Method" (0.37 L/h annual tank tightness test).

2.2.3.6 A cap and ring kit, available from the manufacturer, shall be supplied with each oil tank probe for easy installation and removal.

2.2.3.7 The probe shall use digital communications protocol format for maximum RF/EMF resistance immunity.

2.2.3.8 The probes serving above ground storage tanks shall be supplied with AST installation kits.

2.2.4 Communications:

2.2.4.1 Auto-dial site fax modem:

2.2.4.1.1 The modem shall utilize the standard Hayes command set.

2.2.4.1.2 The modem shall have the capability of automatically switching between 2400, 1200 and 300 baud.

2.2.4.1.3 The modem shall utilize two snap-in RJ-11 jacks for phone line interface.

2.2.4.1.4 The system shall have the ability to program in up to eight phone numbers assigned to a fax/modem module.

2.2.4.1.5 The system shall have the ability to enter in up to 20 characters maximum for the destination phone number.

2.2.4.1.6 The destination type shall be fax, teletype or computer, selectable by destination.

2.2.4.1.7 The system shall be capable of redialling a location from three to 99 times, selectable by destination.

2.2.4.1.8 The system shall be capable of redial intervals from one to 60 minutes, selectable by destination.

2.2.4.1.9 The system shall call immediately on an alarm occurrence selectable by alarm type, assignable by destination.

2.2.4.1.10 The system shall allow for answer/receive disabling for line sharing applications.

2.2.4.2 RS-485 serial communication interface:

2.2.4.2.1 The system shall have the capability to communicate directly with a computer, teletype or printer.

2.2.4.2.2 The system shall provide direct interface via an industry Standard Pin connector using standard RS-485 serial communications hand-shaking signals.

2.2.5 Acceptable manufacturers:

2.2.5.1 Veeder-Root or approved equal Fuel Storage Tank Monitoring System, as specified including the following:

2.2.5.1.1 One (1) TLS-350 Plus console with printer.

2.2.5.1.2 One (1) CSLD software enhancement module.

2.2.5.1.3 One (1) four input probe interface module.

2.2.5.1.4 One (1) four relay output interface module.

2.2.5.1.5 One (1) dual port RS-232/RS-485 interface module.

2.2.5.1.6 One (1) SiteFax interface module.

2.2.5.1.7 One (1) magnetostrictive probe sized to suit tank.

2.2.5.1.8 One (1) magnetostrictive probe installation kit to suit.

2.2.5.1.9 One (1) above ground storage tank installation kit for magnetostrictive probe to suit.

2.2.5.1.10 One (1) NPS 4 riser cap and ring kit.

2.2.5.1.11 One (1) overfill alarm.

2.2.5.1.12 One (1) alarm acknowledgement switch.

2.2.5.1.13 One (1) interstitial sensor to suit main fuel tank.

2.2.5.1.14 All other components as required for a complete working system.

PART 3 EXECUTION

3.1 MANUFACTURER'S SUPPORT/FIELD SERVICE

3.1.1 Technical support:

3.1.1.1 The Manufacturer shall provide technical phone support available to customers from 8:00 a.m. to 7 p.m. EST on a daily basis.

3.1.2 Field service:

3.1.2.1 The Manufacturer shall provide a Field Service Representative to provide on-site customer support and training, as well as overseeing the installation of the tank monitoring system by the installation Contractor.

3.1.2.2 The Manufacturer's Field Service Representative shall be available for on-site training of company maintenance personnel on installation, programming and troubleshooting of the tank monitoring system.

3.1.2.3 The Manufacturer shall have a Newfoundland field service staff.

3.1.3 Warranty registration and checkout form:

3.1.3.1 The Manufacturer shall provide a certified Field Service Representative to start up the fuel storage tank monitoring system.

3.1.3.2 The start up shall consist of installation checkout, operation checkout and customer training on use of the equipment.

3.1.3.3 The Manufacturer's Field Service Representative shall complete a warranty registration and check out form to properly document the site information to include:

3.1.3.3.1 Installation location.

3.1.3.3.2 Installer.

3.1.3.3.3 Equipment identification.

3.1.3.3.4 Tank information.

3.1.3.3.5 Leak detector information.

3.1.3.3.6 Start-up field service representative information.

3.1.3.3.7 Customer approval.

3.1.4 ISO-9000:

3.1.4.1 The Manufacturer shall maintain an ISO-9001 rating ensuring quality management of design, manufacturing, training and technical documentation.

3.2 DOCUMENTATION

3.2.1 Manuals:

3.2.1.1 The Manufacturer shall supply product documentation that addresses the following categories as additional support:

3.2.1.1.1 Site preparation and installation instructions.

3.2.1.1.2 System setup instructions.

3.2.1.1.3 System operating instructions.

3.2.1.1.4 Probe installation instructions.

3.2.1.1.5 Individual module installation instructions.

3.2.1.1.6 Product data sheets.

3.2.1.1.7 Troubleshooting and repair manuals.

3.2.1.1.8 Wiring diagrams which include the following:

3.2.1.1.8.1 Identification of all devices and equipment terminals, and all external connection terminal blocks.

3.2.1.1.8.2 All external wiring connections with approved wire colours and circuit designations.

3.2.1.1.9 Serial communications manuals.

3.2.2 Third-party certification:

3.2.2.1 The Manufacturer shall supply third-party documentation for all products certifying that performance meets or exceeds EPA requirements.

3.2.3 Authorized service personnel listing:

3.2.3.1 The Manufacturer shall supply a formal list of all local authorized distributors and service contractors for sales, installation, training and support.

D2

3.3 NOT USED

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 31 13.02**
CH0032	**SPILLWAY ELECTRICAL BLDG METAL DUCTS – HIGH PRESSURE TO 2500 Pa**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-MS-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 31 13.02
SPILLWAY ELECTRICAL BLDG
METAL DUCTS – HIGH PRESSURE TO 2500 Pa

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGL Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGL Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
SCOTT M. PENNEY
SIGNATURE
DEC/6/2013
DATE
NEWFOUNDLAND & LABRADOR

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 31 13.02**
CH0032	**SPILLWAY ELECTRICAL BLDG METAL DUCTS – HIGH PRESSURE TO 2500 Pa**	Rev : D2
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1. GENERAL

1.1 SUMMARY

1.1.1 Section includes:

.1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

1.2 RELATED SECTIONS

.1 Section 07 84 00 – Firestopping

.2 Section 23 05 94 – Pressure Testing of Ducted Air Systems.

1.3 REFERENCES

1.3.1 American Society for Testing and Materials (ASTM)

.1 ASTM A480/A480M, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A621/A621M, Specification for Steel Sheet and Strip, Carbon, Hot-Rolled, Drawing Quality.

.3 ASTM A653/A653M, Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.4 ASTM A924, Standard Specification for General Requirements for Sheet Steel, Metallic-coated by the Hot-Dip Process.

.5 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

1.3.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3.4 National Fire Protection Agency (NFPA)

.1 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

1.3.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.2 SMACNA HVAC Duct Leakage Test Manual.

.3 IAQ Guidelines for Occupied Buildings Under Construction.

1.3.6 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC S110, Fire Tests for Air Ducts.

1.4 SUBMITTALS

1.4.1 Submit shop drawings and product data for acceptance.

1.4.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets for the following:

.1 Sealants.

.2 Tape.

.3 Proprietary Joints.

1.5 QUALITY ASSURANCE

1.5.1 Certification of Ratings:

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.5.2 Health and Safety:

.1 Perform construction occupational health and safety in accordance with Health and Safety Requirements.

.2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Protect on site stored or installed absorptive material from moisture damage.

1.6.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

2. PRODUCTS

2.1 SEAL CLASSIFICATION

2.1.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
1000 to 2500	A
750	B
500	C
250	C
125	C

2.1.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints made airtight with sealant, tape or combination thereof.

.3 Class C: transverse joints made air tight with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.

2.1.3 Duct systems seal classification required shall be determined from external static pressure listed in fan and air-handling equipment datasheets. This shall be the seal class used to determine acceptable air leakage when carrying out the duct testing specified in Section 23 05 94 - Pressure Testing of Ducted Air Systems.

2.1.4 Irrespective of the SMACNA specified sealing methodology for the respective duct static pressure construction class, all rectangular and round duct shall be sealed to a minimum of Class B with all transverse and longitudinal seams sealed.

2.2 SEALANT

2.2.1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.

.1 Acceptable product: Dura-Dyne S-2, Foster, Childers, Monsey Bakor, or accepted equal.

2.3 TAPE

2.3.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

.1 Acceptable product: Dura-Dyne FT-2, Foster, Childers, Monsey Bakor, or accepted equal.

2.4 DUCT LEAKAGE

2.4.1 In accordance with SMACNA HVAC Duct Leakage Test Manual and specification Section 23 05 94 - Pressure Testing of Ducted Air System.

2.5 FITTINGS

2.5.1 Fabrication: to SMACNA.

2.5.2 Radiused elbows:

.1 Rectangular: Centreline radius: 1.5 times width of duct.

.2 Round: smooth radius or five piece. Centreline radius: 1.5 times diameter.

2.5.3 Mitred elbows, rectangular:

.1 Single or double thickness turning vanes

2.5.4 Branches:

.1 Rectangular main and branch: with 45° entry on branch.

.2 Round main and branch: enter main duct at 45° with conical connection.

.3 Rectangular main and round branch: choice of either 45° main duct entry with conical connection or spin-on connection.

.4 Provide volume control damper in branch duct near connection to main duct.

.5 Main duct branches: with volume control damper.

2.5.5 Transitions:

.1 Diverging: 20° maximum included angle.

.2 Converging: 30° maximum included angle.

2.5.6 Offsets:

.1 Full short radiused elbows as indicated.

2.5.7 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

2.6 FIRESTOPPING

2.6.1 Retaining angles around duct, on both sides of fire separation.

2.6.2 Firestopping material and installation must not distort duct. Leave room between fire damper sleeve and wall opening for thermal expansion in the event of a fire event.

2.6.3 Material and installation within annular space between ducts, fire damper sleeves and adjacent fire separation.

2.7 GALVANIZED STEEL (RECTANGLUAR)

2.7.1 Lock forming quality: Z90 zinc coating.

2.7.2 Thickness, fabrication and reinforcement: metal gauges, transverse joint type and required reinforcement in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2005 Version, for the external static pressure listed in the air-handling equipment datasheets.

2.7.3 Steel thickness and zinc coating class is to be factory stenciled on the steel.

2.7.4 All longitudinal joints to be Pittsburgh Lock type unless otherwise indicated. See Item 3.3 of this specification section.

2.8 STAINLESS STEEL

2.8.1 Application:

.1 All ductwork/plenums associated with diesel generator intake and diesel generator radiator exhaust/recirculation

.2 Intake and exhaust plenums directly behind wall mounted louvers.

2.8.2 To ASTM A480/A480M, Specification for General Requirements for Flat Rolled Plate, Sheet and Strip, Type 304.

2.8.3 Thickness, fabrication and reinforcement: metal gauges, transverse joint type and required reinforcement in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible 2005 Version, for the external static pressure listed in the fan and air-handling equipment datasheets.

2.8.4 #2B mill finish.

2.8.5 All longitudinal joints in rectangular duct to be Pittsburgh Lock type unless otherwise indicated. See Item 3.3 of this specification section.

2.8.6 All longitudinal joints in round duct to be either butt welded or lap and seam welded.

2.9 HANGERS AND SUPPORTS

2.9.1 Strap hangers: of same material as duct. See detail on drawings for strap hanger material thickness and strap hanger spacing.

2.9.2 Extend strap hangers down side and turn under 25 mm fastening securely to side and underside of duct.

2.9.3 Hanger configuration: to ASHRAE and SMACNA.

2.9.4 Support vertical ducts with angles screwed to duct and bearing on building structure.

2.9.5 Hangers: black carbon steel angle (primed) with black carbon steel rods to ASHRAE and SMACNA. See detail on drawings for angle iron size and thickness, rod diameter, and angle spacing.

2.9.6 Upper hanger attachments:

.1 Open web steel joist: plate washer secured to bottom angle of OWSJ.

.1 Acceptable product: Myatt Figure 545 plate washer, Grinnell, Hunt, or accepted equal.

.2 Horizontal steel joist and steel beams: standard C-clamp secured to joist angle.

.1 Acceptable product: Myatt Figure 568 C-clamp, Grinnell, Hunt, or accepted equal.

.3 For concrete ceiling: manufactured carbon steel heavy duty ceiling clips.

.1 Acceptable product: Myatt Figure 515, Grinnell, Hunt, or accepted equal.

.4 Upper attachment Unistrut: Suspension from ceiling mounted Unistrut channel.

.1 Acceptable product: Unistrut P1010 channel nuts with spring size to accept 12 mm diameter threaded rod.

2.9.7 Hanger support rod:

.1 Horizontal roof and floor applications: continuous threaded rod.

.1 Acceptable product: Myatt Figure 434, Grinnell, Hunt, or accepted equal.

3. EXECUTION

3.1 GENERAL

3.1.1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE and SMACNA.

3.1.2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm beyond insulated duct.

3.1.3 Support risers in accordance with ASHRAE and SMACNA.

3.1.4 Install breakaway joints in ductwork on sides of fire separation.

3.1.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

3.2 HANGERS

3.2.1 Strap hangers: install in accordance with SMACNA and drawings, whichever is more stringent.

3.2.2 Angle hangers: complete with locking nuts and washers.

3.2.3 Hanger spacing: in accordance with ASHRAE, SMACNA and drawings, whichever is more stringent

3.2.4 All duct upper hanger attachment assemblies to be of galvanized finish.

3.2.5 Supply and install steel supports where none exist and are required to accommodate suspension of ductwork.

3.2.6 Upper attachment Unistrut: Suspension from unistrut channel

.1 Acceptable Manufacturers: Unistrut P1010 Channel nuts with spring sized 12 mm diameter threaded rod

3.3 WELDED DUCT

3.3.1 Provide welded duct for the following:

.1 All ductwork/plenums associated with diesel generator intake and diesel generator radiator exhaust/recirculation.

.2 All horizontal duct servicing wall mounted exhaust fans back 1.5 m from connection to fan.

.3 Sheet metal intake and exhaust plenums directly behind wall mounted louvers.

.4 All horizontal duct back 1.5 meters from sheet metal intake and exhaust plenums

.5 All fresh air intake ducting for Electrical Room

3.3.2 Form bottom of horizontal duct without longitudinal seams.

3.3.3 All longitudinal seams and traverse joints shall be soldered or welded.

3.4 SEALING AND TAPING

3.4.1 Apply sealant to outside of joint to manufacturer's recommendations.

3.4.2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.5 HEAVY GAUGE DUCT

3.5.1 All ducting to be of minimum 18 gauge for ducts over 550 mm in width and 20 gauge for ducts at or under 550 mm in width.

3.6 LEAKAGE TESTS/COMMISSIONING

3.6.1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air System.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 33 00**
CH0032	**SPILLWAY ELECTRICAL BLDG AIR DUCT ACCESSORIES**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 33 00
SPILLWAY ELECTRICAL BLDG
AIR DUCT ACCESSORIES

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEG Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
PERMIT HOLDER
This Permit Allows
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To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEG Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
SCOTT M. PENNEY
SIGNATURE
Dec/6/2013
DATE
NEWFOUNDLAND & LABRADOR

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 33 00**
CH0032	**SPILLWAY ELECTRICAL BLDG AIR DUCT ACCESSORIES**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1. GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

.1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

1.2 REFERENCES

1.2.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

1.2.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA – HVAC Duct Construction Standards – Metal and Flexible.

1.3 SUBMITTALS

1.3.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

.1 Flexible connections

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

.2 Submit WHMIS MSDS, indicate VOCs for adhesive and solvents during application and curing.

1.3.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.3.3 Instructions: submit manufacturer's installation instructions.

1.3.4 Closeout Submittals: submit maintenance and engineering data for incorporation into operations and maintenance manual.

1.4 QUALITY ASSURANCE

1.4.1 Health and Safety:

.1 Perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).

.4 Separate for reuse and recycling and place in designated containers steel, metal, and plastic waste in accordance with Waste Management Plan (WMP).

.5 Divert unused metal materials from landfill to metal recycling facility.

2. PRODUCTS

2.1 GENERAL

2.1.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

2.2.1 Frame: galvanized sheet metal frame 0.66 mm thick with fabric clenched by means of double locked seams.

2.2.2 Material:

.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40ºC to plus 90ºC, density of 1.3 kg/m². Fabric consisting of PTFE films reinforced with high strength fibreglass substrate.

.1 Acceptable product: Papco Texflex, Dura-Dyne, Dyn Air, or accepted equal.

.2 Canvas connections will not be accepted.

2.3 ACCESS DOORS IN DUCTS

2.3.1 Door: two panel design with inner and outer panels pressed from 24 gauge galvanized mild steel for sizes 200mm x 125mm, 300mm x 150mm, and 450mm x 250mm and 22 gauge galvanized mild steel for sizes 550mm x 350mm and 650mm x 450mm. Standard thickness shall be nominal 25 mm.

2.3.2 Insulation: 20 mm thick insulation totally contained between door panels. Insulation shall have a density of 40 Kg per cubic meter.

2.3.3 Seal: extruded seal with welded seam incorporating an integral flexible hollow tube for low leakage performance fitted between the two door panels for strength and stability.

2.3.4 Frame: pressed one piece dual flange/frame from 24 gauge galvanized mild steel for all sizes. Frame to be pre-punched for duct mounting.

2.3.5 Latches: zinc plated steel progressive cam fasteners and fastening clamps, two sets for sizes 200mm x 125mm and 300mm x 150mm, four sets for size 450mm x 250mm, and six sets for sizes 550mm x 350mm and 650mm x 450mm. Cam fasteners to be positioned at strategic locations for optimum closure, and low leakage.

2.3.6 Security chain: retaining safety chain is to be fitted to both door and frame to alleviate damage or injury.

2.3.7 Suitable for mounting in insulated and non-insulated ducts both internal and external.

2.3.8 Flat oval shape.

2.3.9 Provide complete with cut-out templates for duct.

2.3.10 Doors to be tested to 2 kPa static pressure and shall conform to American and British leakage standards DW 144 Class A and C.

2.3.11 Acceptable product: Air Management Inc. (AMI) ACC Series, AST, or accepted equal.

2.4 TURNING VANES

2.4.1 Factory or shop fabricated single and double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST PORTS

2.5.1 1.6 mm thick steel zinc plated after manufacture.

2.5.2 Cam lock handles with neoprene expansion plug and handle chain.

2.5.3 28 mm minimum inside diameter. Length to suit insulation thickness.

2.5.4 Neoprene mounting gasket.

2.5.5 Acceptable product: Duro-Dyne IP1 or IP2, Dyn Air, or accepted equal.

2.6 SPIN-ON COLLARS

2.6.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

2.6.2 Sheet metal thickness to corresponding round duct standards.

2.7 OPEN ENDED DUCT PROTECTION

2.7.1 To be used during construction.

2.7.2 Co-extruded polyethylene, green in colour, designed to adhere to galvanized steel, 600% elongation, 2.5 mil thickness, 13.1 lbs/in tensile strength.

2.7.3 Acceptable product: Ductmate Proguard, or accepted equal.

3. EXECUTION

3.1 INSTALLATION

3.1.1 Flexible connections:

.1 Install in following locations:

.1 Outlet connection of diesel generator radiator.

.2 Inlets and outlets of inline fan 2440-FAN-VSG-0001.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

3.1.2 Access doors and viewing panels:

.1 Size:

.1 200mm x 125mm one hand or sight.

.2 300mm x 150mm one hand and sight.

.3 450mm x 250mm both hands and sight.

.4 550mm x 350mm full body entry.

.5 650mm x 450mm full body entry plus ladder.

.2 Locations:

.1 Fire dampers.

.2 Control dampers.

.3 Devices requiring maintenance.

.4 Required by code.

.5 Elsewhere as indicated.

3.1.3 Instrument test ports.

.1 General:

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations.

.1 For traverse readings:

.1 Inlets and outlets of fan systems.

.2 Main and sub-main ducts.

.3 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by Engineer.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

3.1.4 Turning vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.1.5 Utilize covering protection over all open end ducts during construction. This includes suspended ducts under construction as well as ductwork temporarily stored on floor on construction site awaiting installation.

3.2 CLEANING

3.2.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 33 14**
CH0032	**SPILLWAY ELECTRICAL BLDG DAMPERS - BALANCING**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 33 14
SPILLWAY ELECTRICAL BLDG DAMPERS - BALANCING

PROVINCE OF NEWFOUNDLAND AND LABRADOR
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To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGL Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
SCOTT M. PENNEY
SIGNATURE
Dec/6/2013
DATE
NEWFOUNDLAND & LABRADOR

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 33 14**
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1. GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

.1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.

1.2 REFERENCES

1.2.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

1.2.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

1.3.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.

.2 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

.3 Indicate the following:

.1 Specifications.

.4 Quality assurance submittals:

.1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: Submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

1.4.1 Health and Safety Requirements:

.1 Perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's instructions.

1.5.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

2. PRODUCTS

2.1 GENERAL

2.1.1 Manufacture to SMACNA standards.

2.2 MANUAL BALANCING DAMPERS

2.2.1 Rectangular:

.1 Frame: for units under 914 mm wide x 305 mm high the frame shall be 22 gauge galvanized steel. For units over 914 mm wide x 305 mm high the frame shall be 18 gauge steel formed into a structural hat channel shape with tabbed corners for reinforcement.

.2 Blades: for units under 914 mm wide x 305 mm high the blades shall be single skin, 22 gauge galvanized steel with center 'V' groove for reinforcement. For units over 914 mm wide x 305 mm high the blades shall be single skin 18 gauge galvanized steel with three longitudinal grooves for reinforcement.

.3 Bearings: corrosion resistant synthetic sleeve type turning in an extruded hole in the damper frame.

.4 Axles: round, screwed into the damper blade.

.5 Provide single blade dampers for ducts up to 914 mm wide x 305 mm high . Provide multiple blade dampers for ducts larger than 914 mm wide x 305 mm high in either direction.

.6 Maximum size single section: 1219 mm wide x 1219 mm high .

.7 Minimum size: 127 mm wide x 102 mm high .

.8 Dampers are to be supplied approximately 6 mm smaller than given duct dimensions.

.9 Acceptable product: Air Management Inc. (AMI) Model MD2005, Ruskin, or accepted equal.

2.2.2 Round:

.1 Frame: 20 gauge galvanized steel, 178 mm long.

.2 Blade: single skin 20 gauge galvanized steel.

.3 Bearings: corrosion resistant molded synthetic type.

.4 Axle: control shaft shall extend beyond the frame through a factory mounted, locking hand quadrant. Axle to be 10 mm square shape.

.5 Maximum damper size: 508 mm diameter .

.6 Minimum damper size: 102 mm diameter .

.7 Dampers are to be supplied approximately 6 mm smaller than given duct dimensions.

.8 Maximum temperature: 121ºC.

.9 Acceptable product: Air Management Inc (AMI) Model MD200R, Ruskin, or accepted equal

3. EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

3.2.1 Install where indicated.

3.2.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

3.2.3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.

3.2.4 Runouts to registers and diffusers: located as close as possible to main ducts.

3.2.5 All dampers to be vibration free.

3.2.6 Ensure damper operators are observable and accessible.

3.3 CLEANING

3.3.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 33 15**
CH0032	**SPILLWAY ELECTRICAL BLDG DAMPERS - OPERATING**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 33 15
SPILLWAY ELECTRICAL BLDG DAMPERS - OPERATING

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 33 15**
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Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1. GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

.1 Operating dampers for mechanical forced air ventilation and air conditioning systems.

1.2 RELATED SECTIONS

.1 Section 23 33 00 – Air Duct Accessories.

1.3 REFERENCES

1.3.1 American Society for Testing and Materials International (ASTM)

.1 ASTM A 653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.3.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

1.4.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.

1. Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

.2 Indicate the following:

1. Performance data

2. Specifications

1.4.2 Quality assurance submittals: submit following

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.4.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into operation and maintenance manual.

1.5 QUALITY ASSURANCE

1.5.1 Health and Safety Requirements:

.1 Perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.5.2 Certificates:

.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

2. PRODUCTS

2.1 MULTI-LEAF DAMPERS

2.1.1 Parallel blade at intakes and exhausts of two position control applications (i.e. full open or closed). Opposed blade at intakes and exhausts of mixed air application (i.e. economizer mixing boxes). Return dampers shall be parallel blade.

2.1.2 Refer to Data Sheets for details such as type, blade action, size and performance data.

2.1.3 All dampers, including those associated with the diesel generator, shall be supplied and installed by the Mechanical Subcontractor.

2.1.4 Insulated aluminum dampers, applicable to dampers: 2440-MD-VSE-0001, 2440-MD-VSE-0002, 2440-MD-VSE-0003, 2400-MD-VSG-001, 2440-MD-VSG-0003, 2440-MD-VSG-0005 and 2440-MD-VSG-0006.

.1 Frames: extruded aluminum (6063T5) damper frame not less than 2.03 mm in thickness. Damper frame to be 101 mm deep and shall be insulated with extruded polystyrene 0.035 RSI/mm on four sides when installed "flanged to duct". All dampers on this project to be "flanged to duct" type. Entire frame shall be thermally broken by means of two polyurethane resin pockets, complete with thermal cuts.

.2 Blades: air-foil, aluminum extrusions (6063T5) shall be thermally broken and internally insulated with non-cfc, expanded polyurethane foam RSI 1.16. Complete blade shall have an insulating factor of RSI 0.40 and a temperature index of 80.

.3 Bearings shall be composed of Celcon/polycarbonate.

.4 Blade gaskets and side seals shall be silicone for extreme cold temperature application. Adhesive or clip-on type blade seals shall not be approved. Seals shall remain flexible down to -73°C.

.5 Operator: supplied and installed by the Controls Subcontractor.

.6 Linkage hardware: installed in frame side and constructed of aluminum and corrosion resistant, zinc and nickel plated steel, complete with cup-point trunnion screws for a slip-proof grip.

.7 Performance:

.1 Leakage: in closed position to be less than 40 L/s per m² against 1 kPa differential static pressure standard air.

.2 Pressure drop: at full open position (600 mm x 600 mm) shall not exceed 10 Pa at 5.1 m/s.

.8 Dampers shall be designed for operation in temperatures ranging between -73°C and 85°C.

.9 Acceptable product: Tamco Series 9000 ECT, Honeywell, Johnson, Ruskin, Alumavent, or accepted equal.

2.1.5 Non-insulated dampers, applicable to dampers: 2440-MD-VSG-0002 and 2440-MD-VSG-0004:

.1 Frames: extruded aluminum (6063T5) damper frame not less than 2.03 mm in thickness. Damper Frames to be 101 mm deep. All dampers on this project to be “flanged to duct” type

.2 Blades: Extruded aluminum (6063T5), interlocking blades, air foil profiles, complete with extruded EPDM blade gaskets. Frame seals shall be extruded silicone. Adhesive or clip-on type blade seals shall not be accepted.

.3 Bearings shall be composed of Celcon-Polycarbonate.

.4 Linkage: hardware shall be installed in frame side and be constructed of aluminum and corrosion resistant zinc and nickel plated steel, complete with cup-point trunnion screws for a slip-proof grip.

.5 Operator: supplied and installed by the Controls Subcontractor.

.6 Performance:

1. Leakage: In closed position to be less than 15.2 L/s per m^2 against 0.25 kPa differential static pressure

2. Pressure drop: At full open position (1200 mm x 1200 mm) shall not exceed 4 Pa at 5.1 m/s.

.7 Acceptable product: Tamco 1000 Series, Honeywell, Johnson, Ruskin, Alumavent, or accpeted equal.

3. EXECUTION

3.1 INSTALLATION

3.1.1 Install where indicated.

3.1.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

3.1.3 Seal multiple damper modules with silicon sealant.

3.1.4 Install access door adjacent to each damper. See Section 23 33 00 – Air Duct Accessories.

3.1.5 Ensure dampers are observable and accessible.

3.1.6 Provide jackshafts and/or damper jumpers, depending upon application, to connect multiple damper modules. Quantity of jackshafts and jumpers to be determined by damper supplier.

3.2 CLEANING

3.2.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Equipment Number	2440-MD-VSE-0001	2440-MD-VSE-0002	2440-MD-VSE-0003
General:			
Manufacturer	Tamco	Tamco	Tamco
Type	Insulated Alum.	Insulated Alum.	Insulated Alum.
Model	9000 ECT	9000 ECT	9000 ECT
Area Served	Elect. Rm. Exhaust	Elect. Rm. Exhaust	Elect. Rm. Intake
Construction	Aluminum	Aluminum	Aluminum
Blade Action	Parrallel	Parrallel	Parrallel
Duct Dimensions:			
Width (mm)	350	350	600
Height (mm)	350	350	600
Multiple Modules	No	No	No
Performance:			
Maximum Airflow (L/s)	800	800	1600
Face Velocity (m/s)	6.5	6.5	4.4
Pressure Drop (Pa)	48.5	48.5	7.8
Estimated Torque Req. (N-m)	1.6	1.6	3.1
Actuator:			
Instrument Number	2440-Z-VSE-0001	2440-Z-VSE-0002	2440-Z-VSE-0003
Manufacturer	Belimo	Belimo	Belimo
Type	Spring Return	Spring Return	Spring Return
Model	LF24-S US	LF24-S US	LF24-S US
Multiple Actuators	No	No	No
Control Action	On / Off	On / Off	On / Off
Spring Return	Yes	Yes	Yes
Action when De-energized	Close	Close	Close
Torque (N-m)	4	4	4
Power Supply	24 VAC	24 VAC	24 VAC
Max Power Consumption ea. (VA)	7.0	7.0	7.0
Control Input	N/A	N/A	N/A
Position Feedback	No	No	No
Auxilliary Switches	1 SPDT, 3A @ 250V	1 SPDT, 3A @ 250V	1 SPDT, 3A @ 250V
Remarks	-	-	-

Equipment Number	2440-MD-VSG-0001	2440-MD-VSG-0002	2440-MD-VSG-0003
General:			
Manufacturer	Tamco	Tamco	Tamco
Type	Insulated Alum.	Non-insul. Airfoil Ctrl	Insulated Alum.
Model	9000 ECT	1000	9000 ECT
Area Served	Gen. Rm. Intake	Gen. Rm. Return	Gen. Rad. Outdoor
Construction	Aluminum	Aluminum	Aluminum
Blade Action	Opposed	Parrallel	Parrallel
Duct Dimensions:			
Width (mm)	450	600	3000
Height (mm)	600	450	2000
Multiple Modules	No	No	4 - 1500x1000
Performance:			
Maximum Airflow (L/s)	400	320	20853
Face Velocity (m/s)	1.5	1.2	3.5
Pressure Drop (Pa)	3.2	0.0	10.2
Estimated Torque Req. (N-m)	1.6	2.3	12.8
Actuator:			
Instrument Number	2440-Z-VSG-0001	2440-Z-VSG-0002	2440-Z-VSG-0003
Manufacturer	Belimo	Belimo	Belimo
Type	Spring Return	Spring Return	Spring Return
Model	LF24-MFT-S US	LF24-MFT-S US	AFB24-S
Multiple Actuators	No	No	Yes (4)
Control Action	Modulating	Modulating	On / Off
Spring Return	Yes	Yes	Yes
Action when De-energized	Close	Open	Open
Torque (N-m)	4	4	20
Power Supply	24 VAC	24 VAC	24 VDC
Max Power Consumption ea. (VA)	5.0	5.0	7.5
Control Input	2-10 VDC	2-10 VDC	N/A
Position Feedback	2-10 VDC	2-10 VDC	No
Auxilliary Switches	1 SPDT, 3A @ 250V	1 SPDT, 3A @ 250V	2 SPDT, 3A @ 250V
Remarks	-	-	Controlled by D.G.

Equipment Number	2440-MD-VSG-0004	2440-MD-VSG-0005	2440-MD-VSG-0006
General:			
Manufacturer	Tamco	Tamco	Tamco
Type	Non-insul. Airfoil Ctrl	Insulated Alum.	Insulated Alum.
Model	1000	9000 ECT	9000 ECT
Area Served	Gen. Rad. Recirc.	Gen. Rad. Exhaust	Gen. Rm. Exhaust
Construction	Aluminum	Aluminum	Aluminum
Blade Action	Opposed	Parrallel	Opposed
Duct Dimensions:			
Width (mm)	3000	4000	450
Height (mm)	1300	2400	450
Multiple Modules	2 - 1500x1300	4 - 2000x1200	No
Performance:			
Maximum Airflow (L/s)	20853	20853	400
Face Velocity (m/s)	5	2.2	2
Pressure Drop (Pa)	6.1	5.0	5.4
Estimated Torque Req. (N-m)	17.8	20.4	1.2
Actuator:			
Instrument Number	2440-Z-VSG-0004	2440-Z-VSG-0005	2440-Z-VSG-0006
Manufacturer	Belimo	Belimo	Belimo
Type	Spring Return	Spring Return	Spring Return
Model	AFB24-MFT-S	AFB24-S	LF24-MFT-S US
Multiple Actuators	Yes (2)	Yes (4)	No
Control Action	Modulating	On / Off	Modulating
Spring Return	Yes	Yes	Yes
Action when De-energized	Close	Open	Close
Torque (N-m)	20	20	4
Power Supply	24 VAC	24VDC	24 VAC
Max Power Consumption ea. (VA)	10.0	7.5	5.0
Control Input	2-10 VDC	N/A	2-10 VDC
Position Feedback	2-10 VDC	No	2-10 VDC
Auxilliary Switches	2 SPDT, 3A @ 250V	2 SPDT, 3A @ 250V	1 SPDT, 3A @ 250V
Remarks	-	Controlled by D.G.	-

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 33 16**
CH0032	**SPILLWAY ELECTRICAL BLDG DAMPERS – FIRE AND SMOKE**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 33 16
SPILLWAY ELECTRICAL BLDG
DAMPERS – FIRE AND SMOKE

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SCOTT M. PENNEY
SIGNATURE
26/6/2013
DATE
NEWFOUNDLAND & LABRADOR

1. GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

Fire and smoke dampers, and fire stop flaps.

1.2 RELATED SECTIONS

.1 Section 23 33 00 – Air Duct Accessories

1.3 REFERENCES

1.3.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

.1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3.3 Underwriters Laboratories of Canada (ULC)

.1 CAN4-S112, Fire Test of Fire Damper Assemblies.

.2 ULC-S505, Fusible Links for Fire Protection Service.

.3 ULC-555, Standard for Fire Dampers.

1.4 SUBMITTALS

1.4.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.

.1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

Indicate the following:

.1 Fire dampers.

.2 Operators.

.3 Fusible links.

.4 Design details of break-away joints.

1.4.2 Quality assurance submittals; submit the following:

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

Instructions: submit manufacturer's installation instructions.

1.4.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into operation and maintenance manual.

1.5 QUALITY ASSURANCE

1.5.1 Health and Safety Requirements: Perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.5.2 Certificates:

.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.6 MAINTENANCE

1.6.1 Extra Materials:

.1 Provide maintenance materials.

.2 Provide the following:

.1 Six fusible links of each type.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.7.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

2. PRODUCTS

2.1 FIRE DAMPERS (IN WALL OR FLOOR)

2.1.1 Applicable to Fire Damper: 2440-FD-VSE-0001.

2.1.2 Furnish and install, at locations shown on plans, fire dampers constructed and tested in accordance with the current edition of UL555 Standard for Fire Dampers. Dampers up to 5.95 m^2 for vertical mount and 2.32 m^2 for horizontal mount shall be classified for dynamic closure to a minimum 12.1 m/s and 996 Pa static pressure for horizontal air flow, air flow up and air flow down. Velocity and pressure ratings shall include both in-duct and no-duct installations. Each fire damper shall be marked with a UL Classified 1½ hour fire protection rating, the maximum velocity/pressure rating for each horizontal and vertical installation and "for use in dynamic systems". Dampers marked "for use in static systems only" are not permitted. In addition, each dynamic fire damper shall include a 74ºC fusible link. Each dynamic fire damper shall include an integral roll formed steel sleeve and retaining angles furnished by the damper manufacturer to ensure appropriate installation. Submittal information shall include the fire protection rating, maximum velocity/pressure ratings and the manufacturer's UL installation instructions. Each fire damper shipment shall include the same UL installation instructions. The dampers shall be installed in accordance with these instructions.

2.1.3 Rectangular fire dampers to be Style 'B' with blades out of airstream for reduced airflow restriction, 80-90% free area.

2.1.4 Round fire dampers to be style WR, welded, 90-95% free area, round enclosure. The wall sleeve shall be rectangular and the blades shall be out of the airstream for reduced airflow restriction.

2.1.5 Vertical and horizontal closure spring operation for assured closure under air flow (i.e. fans on) in HVAC systems.

2.1.6 Shall meet all UL and NFPA criteria for primary fire dampers installed in walls with fire resistive rating of less than 3 hours.

2.1.7 Provide integral sleeves of sufficient length to full, span wall or floor assembly opening.

2.1.8 Fire dampers in metal stud walls or supported in wall or floor openings with metal stud framing shall have such framing installed in accordance with the damper manufacturer's recommendations.

2.1.9 Acceptable product: Ruskin Model DIBD2 (1½ hr.), Nailor, Controlled Air, Air Management Inc. (AMI), or accepted equal.

3. EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

3.2.1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

3.2.2 Provide duct mounted and wall and/or ceiling mounted access door adjacent to each damper. See Section 23 33 00 – Air Duct Accessories. All ceiling and wall mounted access doors required to gain access to fire dampers and linkages shall be supplied by the Mechanical Subcontractor for field installation by the Contractor. These doors shall be shop primed for field painting by the Contractor. All duct mounted access doors shall be supplied and installed by the Mechanical Subcontractor.

3.2.3 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

3.2.4 Install break-away joints of approved design on each side of fire separation.

3.2.5 Supply fire damper with integral sleeve and retaining angles.

3.3 CLEANING

3.3.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 COMMISSIONING

3.4.1 Verify dampers are in open position.

3.4.2 Confirm fusible links are acceptable.

3.4.3 Confirm firestopping is complete.

END OF SECTION

Equipment Number	2440-FD-VSE-0001
General:	
Manufacturer	Ruskin
Type	Curtain - Dynamic
Model	DIBD2
Area Served	Elect. Rm. Intake
Style	"B" Out of Airstream
Damper Orientation	Vertical
Duct Dimensions:	
Width (mm)	1000
Height (mm)	1000
Multiple Modules	Yes
Performance:	
Maximum Airflow (L/s)	1600
Face Velocity (m/s)	1.6
Details:	
Separation Rating	2 hr
Damper Rating	1-1/2 hr
Remarks	-

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 34 00**
CH0032	**SPILLWAY ELECTRICAL BLDG HVAC FANS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 34 00
SPILLWAY ELECTRICAL BLDG
HVAC FANS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEG Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N-0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEG Newfoundland and Labrador
SCOTT M. PENNEY
SIGNATURE
NOV/28/2013
DATE
NEWFOUNDLAND & LABRADOR

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

.1 Fans, motors, accessories, and hardware for commercial use.

1.2 RELATED SECTIONS

.1 Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

.2 Section 23 33 00 – Air Duct Accessories.

.3 Section 23 05 48 – Vibration and Seismic Control for HVAC Piping and Equipment.

1.3 REFERENCES

1.3.1 Air Conditioning and Mechanical Contractors (AMCA)

.1 AMCA 99, Standards Handbook.

.2 AMCA 300, Reverberant Room Method for Sound Testing of Fans.

.3 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

1.3.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/AMCA 210/ASHRAE 51, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

1.3.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3.4 American Bearing Manufacturer's Association (ABMA)

.1 ANSI/AMBA 9, Load Ratings and Fatigue Life for Ball Bearings.

.2 ANSI/AMBA 11, Load Ratings and Fatigue Life for Roller Bearings.

1.4 MANUFACTURED ITEMS

1.4.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

1.5 SUBMITTALS

1.5.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.

.2 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

1.5.2 Shop Drawings:

.1 Submit shop drawings and product data.

1.5.3 Provide:

.1 Fan performance curves showing specific point of operation, with flow, static pressure and horsepower clearly plotted.

.2 Sound rating data for the eight octave bands.

.3 Dimensional data

.4 Installation procedures

.5 Filter free velocity, initial & final static pressure, MERV rating.

1.5.4 Indicate:

.1 Motors, sheaves, bearings, shaft details

.2 Minimum performance achievable with variable speed controllers.

1.5.5 Quality assurance submittals:

.1 Submit the following.

.2 Instructions: submit manufacturer's installation instructions.

1.5.6 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into operation and maintenance manual.

1.6 QUALITY ASSURANCE

1.6.1 Health and Safety Requirements: perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.7 MAINTENANCE

1.7.1 Extra Materials:

.1 Provide maintenance materials.

.1 Spare parts to include:

1. Matched sets of belts for each fan. For fans driven by a single belt a “set” is to be defined as a single belt.

2. One set of filters for start-up and commissioning, one set for the building occupancy (final filters) and one spare set of filters for each equipment.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:

.1 Bearings and seals

.2 Belts

.3 Addresses of suppliers

.4 List of specialized tools necessary for adjusting, repairing or replacing

.5 Filters

1.8 DELIVERY, STORAGE, AND HANDLING

1.8.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Storage: Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions. For long term storage follow manufacturer's installation, operations and maintenance manual.

1.8.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

1.9 ENVIRONMENTAL REQUIREMENTS

1.9.1 Do not operate fans for any purpose, temporary or permanent, until ductwork is clean, bearings lubricated and fan has been run under observation.

1.10 NOT USED

PART 2 PRODUCTS

2.1 FANS GENERAL

2.1.1 Capacity: flow rate, static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data as indicated on data sheets.

2.1.2 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

2.1.3 Sound ratings: comply with AMCA 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.

2.1.4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal.

2.1.5 Motors:

.1 In accordance with Section 23 05 13 – Common Motor Requirements for HVAC Equipment supplemented as specified herein.

.2 For use with variable speed controllers where specified.

.3 Sizes as indicated on data sheets.

2.1.6 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Control for HVAC Piping and Equipment.

2.1.7 Flexible connections: to Section 23 33 00 – Air Duct Accessories.

2.2 IN-LINE CENTRIFUGAL - BELT DRIVEN

2.2.1 Applicable to Fan 2440-FAN-VSG-0001.

2.2.2 Casings: heavy duty housing and drive enclosure, internal structural supports and bracing constructed of galvanized steel. Assembly complete with two bolted access panels and integral duct connection flanges. Casing finish to be factory standard.

2.2.3 Impeller: aluminum construction, backward inclined centrifugal type, non-overloading operation. Wheel to be statically and dynamically balanced. The wheel cone shall be carefully matched to the inlet cone for precise running tolerances.

2.2.4 Provide fan assembly compete with insulated housing of 25 mm thick acoustic insulation for noise reduction and condensation control. Insulation shall be constructed of fibreglass liner.

2.2.5 Fan to be pre-wired to external mounted junction box supplied complete with unit. Factory mounted disconnect switches are not required, disconnects shall be supplied and installed by the electrical subcontractor.

2.2.6 Supports:

.1 Wall bracket/floor mounted: support brackets bolted to bottom of casing. Provide unit complete with standard spring isolators sized to match the weight of the fan. Standard spring isolators shall be supplied integral with the fan for field installation.

2.2.7 Bearings: heavy duty, pillow block ball bearings. Bearings shall be designed for minimum L10 life in excess of 80,000 hours. Provide internal bearing cover, easily removable for servicing.

2.2.8 Belt drive:

.1 Provide internal belt fairing, insulated external belt and motor cover.

.2 Machined cast iron pulley factory set to the required RPM and adjustable for final system balancing.

.3 Drive sized for 150% of driven horsepower.

.4 Fan shaft to be ground and polished steel sized so that the first critical speed is at least 25% over the maximum operating speed.

.5 Belts to be static free and oil resistant.

2.2.9 Performance criteria: see data sheets.

2.2.10 Motors:

.1 Carefully matched to the fan load.

.2 Mounted out of the airstream.

.3 Provide adjustable motor mount.

.4 External belt/motor cover to be acoustically insulated.

.5 Heavy duty ball bearing type.

.6 Adjustable motor pulley.

.7 Totally enclosed fan cooled (TEFC) motor enclosure.

2.2.11 Inlet filter box:

.1 Applicable to filter box: 2440-FR-VSG-0001

.2 Provide factory assembled single unit by fan manufacturer for installation on inlet of fan.

.3 Configuration shall be V-Bank for increased area and reduced pressure drop, and face velocity.

.4 Filters shall be M.E.R.V. 8, 51 mm thick, pleated panel filters.

.5 Performance: See fan data sheets

.6 Provide inlet filter box compete with insulated housing of 25 mm thick acoustic insulation for noise reduction and condensation control. Insulation shall be constructed of fiberglass liner.

.7 Removable access panels on both sides for filter replacement.

2.2.12 Acceptable product: Greenheck BSQ Series in-line centrifugal c/w inlet filter box, Trane, Barry Blower, Penn, Industrial Air, Sheldons, Acme, Loren Cook, Jencofan, Twin City Fans, or accepted equal.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 FAN INSTALLATION

3.2.1 Install fans as indicated, complete with resilient mountings, flexible electrical leads and flexible connections in accordance with Section 23 33 00 – Air Duct Accessories.

3.2.2 Provide sheaves and belts required for final air balance.

3.2.3 Bearings and extension tubes to be easily accessible.

3.2.4 Access doors and access panels to be easily accessible.

3.3 CLEANING

3.3.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 COMMISSIONING

3.4.1 Confirm sequence of operations with control system.

3.4.2 Verify balancing report.

3.4.3 Check filter status. Install clean filters. Verify tight fit with minimal air leakage.

3.4.4 Confirm damper operation. Ensure dampers operate freely and sufficient damper motors are provided.

3.4.5 Verify dampers seal tight when closed.

3.4.6 Ensure cleaning is complete.

3.4.7 Confirm heating coil capacity. Measure inlet and outlet temperatures.

3.4.8 Confirm fire alarm interlocks.

3.4.9 Confirm belt tension and confirm it is within manufacturer’s recommendations.

3.4.10 Verify fan balance and confirm within tolerance.

3.4.11 Verify bearing lubrication.

3.4.12 Verify ease of accessibility for maintenance.

3.4.13 Demonstrate maintenance required and training.

3.4.14 Confirm installation as per manufacturer’s instructions.

3.4.15 Confirm correct fan rotation.

3.4.16 Measure and record motor voltage and amperage.

END OF SECTION

Equipment Number	2440-FAN-VSG-0001
General:	
Manufacturer	Greenheck
Type	Centrifugal Inline
Model	BSQ-130HP-7
Area Served	Generator Room
Construction	Standard
Drive	Belt
Coating	Standard
Performance:	
Airflow (L/s)	400
Static Pressure (Pa)	372 ESP + 16.2 Filter
Speed (RPM)	1903
Electrical Data:	
Motor (HP)	3/4
Voltage (Volts)	575
Phase	3
Frequency (Hz)	60
Enclosure	TEFC
Motor Speed (RPM)	1725
Windings	1
Options:	
Disconnect	No
Curb	N/A
Backdraft Damper	No
Vibration Isolation	Standing Spring Isolators
Filters	Yes - See Remarks
Birdscreen	N/A
Other	Insulated Housing
Sound Power (dB):	
63 Hz	83
125 Hz	78
250 Hz	78
500 Hz	72
1000 Hz	64
2000 Hz	65
4000 Hz	61
8000 Hz	57
Sones	12.6
Remarks	2440-FR-VSG-0001 Sloped Filter Box - 51mm Pleated Filters, MERV 8.

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 34 25**
CH0032	**SPILLWAY ELECTRICAL BLDG PACKAGED ROOF AND WALL EXHAUSTERS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 34 25
SPILLWAY ELECTRICAL BLDG
PACKAGED ROOF AND WALL EXHAUSTERS

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section includes:

.1 Fans, motors, accessories and hardware for packaged roof and wall exhausters

1.2 RELATED SECTIONS

1.2.1 Section 23 05 13 – Common Motor Requirements for HVAC Equipment

1.2.2 Section 23 33 00 – Air Duct Accessories

1.2.3 Section 23 33 15 – Dampers - Operating

1.3 REFERENCES

1.3.1 Air Movement and Control Association (AMCA):

.1 99 - Standards Handbook.

.2 200 - Publication, Air Systems.

.3 201 - Publication, Fans and Systems.

.4 202 - Publication, Troubleshooting.

.5 203 - Publication, Field Performance Measurement of Fan Systems.

.6 211 - Publication, Certified Ratings Program - Product Rating Manual for Fan Air Performance.

.7 300 - Standard Reverberant Room Method for Sound Testing of Fans.

.8 311 - Publication Certified Ratings Program - Product Rating Manual for Fan Sound Performance.

.9 99-2408 - Operating Limits for Centrifugal Fans.

1.3.2 Air Movement and control Association. (AMCA), American National Standards Institute (ANSI):

.1 204 - Standard Balance Quality and Vibration Levels for Fans.

.2 210 - Standard Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

1.3.3 American National Standards Institute (ANSI):

.1 11 - Method of Evaluating Load Ratings of Bearings.

1.3.4 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):

.1 Chapter 45 - 2003 Handbook, HVAC Applications.

.2 Chapter 7 - 2001 Fundamentals handbook, Sound-Vibration.

.3 Chapter 32 - 2001 Fundamentals handbook, Duct Design.

.4 Chapter 18 - 1992 HVAC System and Equipment handbook, Fans.

1.3.5 National Fire Protection Association (NFPA):

.1 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

1.3.6 Underwriters Laboratories (UL):

.1 507 - Electric Fans.

.2 705 - Standard Power Ventilators.

1.4 MANUFACTURED ITEMS

1.4.1 Catalogued or published ratings for manufactured items: obtain from tests carried out by manufacturer or those ordered by manufacturer by independent testing agency signifying adherence to codes and standards in force.

1.5 SUBMITTALS

1.5.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets. Include product characteristics, performance criteria, and limitations.

.1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS)

1.5.2 Shop Drawings:

.1 Submit shop drawings and product data.

1.5.3 Provide:

.1 Fan performance curves showing specified point of operation flow, static pressure and horsepower clearly plotted.

.2 Sound rating data for the eight octave bands

.3 Installation procedures

.4 Outlet velocity

.5 Clearly indicate AMCA certification

.6 Dimensional Data

1.5.4 Quality Assurance Submittals:

.1 Submit the following.

.2 Instructions: Submit manufacturer's installation instructions

1.5.5 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into operation and maintenance manual.

1.6 QUALITY ASSURANCE

1.6.1 Health and Safety Requirements: Perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.6.2 Performance ratings: conform to AMCA Standard 211 and 311. Fans must be tested in accordance with ANSI/AMCA Standard 210 and AMCA Standard 300 in an AMCA accredited laboratory. Fans shall be certified to bear the AMCA label for air performance seal.

1.6.3 Each fan shall be given a balancing analysis which shall be applied to wheels at the outside radius. The maximum allowable static and dynamic imbalance shall be 0.05 ounces (Balance grade of G6.3).

1.6.4 Comply with the National Electrical Manufacturer's Association (NEMA), standards for motors and electrical accessories.

1.7 MAINTENANCE

1.7.1 Extra Materials:

.1 Provide maintenance materials.

.1 Spare parts to include:

1. Matched set of belts for each fan. For fans driven by a single belt a “set” is to be defined as a single belt

1.7.2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:

.1 Bearings and seals

.2 Belts

.3 Addresses of suppliers

.4 List of specialized tools necessary for adjusting, repairing or replacing

1.8 DELIVERY, STORAGE AND HANDLING

1.8.1 Packaging, Shipping and Handling:

.1 Deliver, store and handle materials in accordance with manufacturer’s written instructions.

.2 Storage: store materials in a dry area indoors, protected from damage and in accordance with manufacturer’s instructions. For long term storage, follow manufacturer’s installation, operations and maintenance manual.

1.8.2 Waste Management and Disposal:

.1 Construction/demolition waste management and disposal: Separate waste materials for reuse and recycling.

1.9 ENVIRONMENTAL REQUIREMENTS

1.9.1 Do not operate fans for any purpose, temporary or permanent, until ductwork is clean, bearings lubricated and fan has been test run under observation.

D2

1.10 NOT USED

PART 2 PRODUCTS

2.1 CENTRIFUGAL SIDEWALL EXHAUSTER – BELT DRIVEN

2.1.1 Applicable to Fans 2440-FAN-VSE-0001 & 2440-FAN-VSE-0002

2.1.2 Construction:

.1 Housings: heavy gauge aluminum complete with rigid internal support structure.

.2 Impeller: aluminum backward inclined, non-overloading, statically and dynamically balanced. Wheel cone shall be matched to the Venturi for maximum efficiency.

.3 Drive frame assembly shall be constructed of heavy gauge steel. Drive shall be sized for a minimum of 150% of the driven horsepower. Pulleys shall be of the cast iron type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing. Belts shall be static free and oil resistant.

.4 Provide bird guard of rigid wire mounted on the fan's discharge perimeter.

.5 Provide without integral backdraft damper. Fans shall be equipped with an operable damper installed at the inlet of the fan by the Mechanical Subcontractor.

.6 Permanently lubricated and sealed pillow block ball bearings selected for a minimum L10 life in excess of 100,000 hours at maximum catalogued operating speed.

.7 Motor and drive components to be installed out of the airstream.

.8 First critical speed to be at least 25% over the maximum operating speed.

.9 Solid polished steel shaft.

.10 Motor and drive shall be supported on vibration insulators.

2.1.3 Mounting:

.1 A leak proof fan housing shall be constructed with a one piece windband with an integral rolled bead for additional strength.

.2 Fan shall be provided with a mounting plate, which is attached and sealed to the wall prior to locating the unit

2.1.4 Electrical:

.1 All motors over 1 HP to be NEMA premium efficiency. Motors below 1 HP to be standard efficiency EPACT.

.2 All motors to be open drip proof (ODP) unless otherwise indicated.

.3 Provide electric motors in voltages and horsepowers indicated.

.4 All motors to have 1.15 service factor (minimum)

.5 Supply fans pre-wired internally to a factory supplied and installed disconnect switch.

.6 Motors to be carefully matched to the fan load.

.7 Accessories:

.1 Supply each fan complete with initial belt for operation as well as one (1) spare belt.

.8 Acceptable manufacturers: Greenheck CWB Series, Penn, ACME, Jenn, Loren Cook.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.2 EXAMINATION

3.2.1 Examine areas to receive fans. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected.

3.3 PREPARATION

3.3.1 Ensure roof/wall openings are square, accurately aligned, correctly located, and in tolerance.

3.4 INSTALLATION

3.4.1 Install fans system as indicated on the manufacturer's Installation, Operation and Maintenance Manual (IOM) and contract drawings.

3.4.2 Install fans in accordance with manufacturer's instructions.

3.5 SYSTEM START-UP

3.5.1 Refer to manufacturer's Installation, Operation, and Maintenance Manual (IOM)

3.6 ADJUSTING

3.6.1 Adjust exhaust fans to function properly.

3.6.2 Adjust belt tension.

3.6.3 Lubricate bearings.

3.6.4 Adjust drive for final system balancing.

3.6.5 Check wheel overlap.

3.7 CLEANING

3.7.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.8 PROTECTION

3.8.1 Protect installed product and finished surfaces from damage during construction.

3.8.2 Protect installed exhaust fans to ensure that, except for normal weathering, fans will be without damage or deterioration at time of substantial completion.

3.9 COMMISSIONING

.1 Confirm sequence of operations with control system.

.2 Verify balancing report.

.3 Confirm damper operation. Ensure dampers operate freely and sufficient damper motors are provided.

.4 Verify dampers seal tight when closed.

.5 Ensure cleaning is complete.

.6 Confirm fire alarm interlocks.

.7 Measure belt tension and confirm it is within manufacturer's recommendations.

.8 Verify fan balance and confirm within tolerance.

.9 Verify bearing lubrication.

.10 Verify ease of accessibility for maintenance.

.11 Demonstrate maintenance required and training.

.12 Confirm installation as per manufacturer's instructions.

.13 Confirm correct fan rotation.

.14 Measure and record motor voltage and amperage.

3.10 RIGGING

3.10.1 All costs associated with lifting fans into final location shall be borne by the Mechanical Subcontractor.

END OF SECTION

Equipment Number	2440-FAN-VSE-0001	2440-FAN-VSE-0002
General:		
Manufacturer	Greenheck	Greenheck
Type	Centrifugal Sidewall	Centrifugal Sidewall
Model	CWB-161HP-10	CWB-161HP-10
Area Served	Electrical Room	Electrical Room
Construction	Standard	Standard
Drive	Belt	Belt
Coating	Standard	Standard
Performance:		
Airflow (L/s)	800	800
Static Pressure (Pa)	434	434
Speed (RPM)	1552	1552
Electrical Data:		
Motor (HP)	1	1
Voltage (Volts)	575	575
Phase	3	3
Frequency (Hz)	60	60
Enclosure	TEFC	TEFC
Motor Speed (RPM)	1725	1725
Windings	1	1
Options:		
Disconnect	Yes	Yes
Curb	N/A	N/A
Backdraft Damper	No	No
Vibration Isolation	N/A	N/A
Filters	No	No
Birdscreen	Yes	Yes
Other	-	-
Sound Power (dB):		
63 Hz	77	77
125 Hz	75	75
250 Hz	79	79
500 Hz	72	72
1000 Hz	68	68
2000 Hz	69	69
4000 Hz	67	67
8000 Hz	61	61
Sones	13.9	13.9
Remarks	-	-

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 35 16**
CH0032	**SPILLWAY ELECTRICAL BLDG ENGINE EXHAUST SYSTEM**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 35 16
SPILLWAY ELECTRICAL BLDG
ENGINE EXHAUST SYSTEM

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N045B
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
SCOTT M. PENNEY
SIGNATURE
Dec/6/2013
DATE
NEWFOUNDLAND & LABRADOR

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 35 16**
CH0032	**SPILLWAY ELECTRICAL BLDG ENGINE EXHAUST SYSTEM**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1. GENERAL

1.1 SUMMARY

1.1.1 Section includes:

.1 Diesel generator set engine exhaust stack

1.2 REFERENCES

1.2.1 Underwriters' Laboratories of Canada (ULC).

1.2.2 National Fire Protection:

.1 NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.

.2 NFPA 211, Standard for Chimneys, Fire Places, Vents, and Solid Fuel-Burning Appliances.

1.3 MANUFACTURED ITEMS

1.3.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

1.4 SUBMITTALS

1.4.1 Product Data:

.1 Submit manufacturer’s printed product literature, specifications and data sheets. Include product characteristics, performance criteria and limitations

.1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS)

1.4.2 Submit shop drawings and product data.

1.4.3 Clearly indicate following:

.1 Methods of sealing sections.

.2 Methods of expansion.

.3 Details of thimbles.

.4 Bases/Foundations.

.5 Supports.

.6 Rain caps.

.7 Installation procedures.

1.4.4 Quality assurance submittals:

.1 Submit the following.

.2 Instructions: Submit manufacturer's installation instructions

1.4.5 Closeout submittals:

.1 Provide operation and maintenance data for incorporation into operation and maintenance manual.

1.5 QUALITY ASSURANCE

1.5.1 Health and safety requirements: perform construction operational health and safety in accordance with Health and Safety Requirements

1.6 MAINTENANCE

1.6.1 Provide operation and maintenance data for incorporation into operation and maintenance manual.

1.7 DELIVERY, STORAGE, HANDLING AND UNLOADING

1.7.1 Packaging, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions

.2 Storage: Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions. For long term storage, follow manufacturer's installation, operations and maintenance manual.

1.7.2 Waste management and disposal:

.1 Construction and demolition waste management and disposal: separate waste materials for reuse and recycling.

2. PRODUCTS

2.1 NO. 2 FUEL OIL PRESSURE STACK CHIMNEY

2.1.1 ULC labelled, 540°C rated, No. 2 fuel oil.

2.1.2 Sectional, prefabricated, double wall with 100 mm insulation, mated fittings and couplings.

.1 Liner: 316 Stainless steel.

.2 Shell: aluminized steel up to roof-line and 316 stainless steel at roof penetration and above roof.

.3 Outer seal between sections: outer channel band.

.4 Inner seal between sections: inner vee band with high temperature sealant.

.5 Inside diameter: 305 mm

2.1.3 Acceptable manufacturers: Selkirk Metalbestos Model IPS; Security Chimney, Van Packer Company.

2.2 ACCESSORIES

.1 Flat roof tall cone flashing for chimney (TFC4).

.2 Storm collar for tall cone flashing (SCC4)

.3 Flip top for termination of chimney (FLC4). Canadian version suitable for cold weather application.

.4 Provide drain tee cap at base of vertical stack secured directly to bottom of 45° lateral tee fitting. Drain connection shall be 1 NPT (TCC4).

.5 Provide 45° lateral tee connection in horizontal breeching (JLC4).

.6 Provide 45° elbow at base of stack (EL45C4).

.7 Provide closure ring at top of stack prior to installation of flip top (CRC4).

.8 Provide explosion relief valve (ERC4).

.9 Provide flange adapter at outlet of silencer and connection to explosion relief valve (FDC4).

.10 Provide lined bellows expansion joint (BJC4).

.11 Provide manifold tee (MTC4).

.12 Provide plate support assemblies at exit of lined bellows and at base of vertical stack (PAC4).

.13 Provide full angle ring guide (FRC4).

.14 Provide installation lengths as required.

.15 For the purpose of the proposal, the estimated vertical stack length shall be 4 metres. The actual required length to be field confirmed by the Mechanical Subcontractor before ordering.

.16 Provide hangers and supports as required.

.17 Provide miscellaneous steel supports to support the plate support assemblies on either side of lateral tee. The supply and installation of this miscellaneous support steel shall be the responsibility of the Mechanical Subcontractor and not the engine exhaust system supplier.

.18 Provide insulated roof curb sized to suit the chimney roof penetration. The supply of the roof curb shall be the responsibility of Contractor. Installation shall be the responsibility of the Contractor.

3. EXECUTION

3.1 INSTALLATION - GENERAL

3.1.1 Support chimney as indicated.

3.1.2 Install flashing on chimney penetrating roof.

3.1.3 Stack flashing shall be flashed into the roof by the Contractor. Cutting of roof penetration shall also be the responsibility of the Contractor.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 37 13**
CH0032	**SPILLWAY ELECTRICAL BLDG DIFFUSERS, REGISTERS AND GRILLES**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 37 13
SPILLWAY ELECTRICAL BLDG
DIFFUSERS, REGISTERS AND GRILLES

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PEG Newfoundland and Labrador
SCOTT M. PENNEY
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1. GENERAL

1.1 SUMMARY

1.1.1 Section includes:

.1 Supply, return and exhaust grilles, diffusers and registers for commercial use.

1.2 REFERENCES

1.2.1 American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE).

.1 ASHRAE 70, Method of Testing for Rating the Performance of Air Ducts and Outlets.

1.3 SYSTEM DESCRIPTION

1.3.1 Performance requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.4 SUBMITTALS

1.4.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.

.2 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data sheets (MSDS).

.3 Indicate following:

.1 Capacity

.2 Throw and terminal velocity

.3 Noise criteria

.4 Pressure drop

.5 Neck velocity

1.4.2 Quality assurance submittals: submit following.

.1 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

1.5.1 Health and Safety Requirements: perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

1.7 MAINTENANCE

1.7.1 Extra Materials:

.1 Provide maintenance materials.

.2 Include:

.1 Keys for volume control adjustment

.2 Keys for air flow pattern adjustment.

2. PRODUCTS

2.1 GENERAL

2.1.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated in data sheets.

2.1.2 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board.

.3 Concealed fasteners.

2.1.3 Concealed manual volume control damper operators as indicated.

2.1.4 Colour: as per data sheets.

2.1.5 Acceptable product: E. H. Price, Titus, Nailor, Carnes, Airvector, Anemostat, Kreuger, Metalaire, or accepted equal.

2.2 MANUFACTURED UNITS

2.2.1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

2.3 SUPPLY GRILLES AND REGISTERS

2.3.1 See data sheets.

2.4 RETURN AND EXHAUST GRILLES AND REGISTERS

2.4.1 See data sheets.

2.5 DIFFUSERS

2.5.1 See data sheets.

3. EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

3.2.1 Install in accordance with manufacturer's instructions.

3.2.2 Install with flat head stainless steel or cadmium plated screws in countersunk holes where fastenings are visible.

3.2.3 Bolt grilles, registers and diffusers in place

3.2.4 Provide concealed safety chain on each grille, register and diffuser.

3.3 CLEANING

3.3.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Equipment Number	GR-01	GR-02
General:		
Manufacturer	Price	Price
Type	Heavy Duty Louvered Return	Heavy Duty Louvered Supply Adj.
Model	95/L/A	920/L/A
Area Served	Various Return / Exhaust	Various Supply
Construction	Steel	Steel
Finish	B12 - White	B12 - White
Details:		
Frame	-	-
Mounting	Surface / Exposed Duct	Surface / Exposed Duct
Module Size	-	-
No. of Slots or Cones	0	0
Discharge Pattern	0^{o} Deflection	-45^{o} to 45^{o} Deflection
Fastening	Countersunk Screws	Countersunk Screws
Accessories	-	-
Remarks	-	-

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 37 20**
CH0032	**SPILLWAY ELECTRICAL BLDG LOUVRES, INTAKES AND VENTS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 37 20
SPILLWAY ELECTRICAL BLDG
LOUVRES, INTAKES AND VENTS

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1. GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

.1 Mechanical louvers.

1.2 REFERENCES

1.2.1 American Society for Testing and Materials International (ASTM)

.1 ASTM E 90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.2 ASTM A653/A653M, Specification for Sheet Steel, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

1.2.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.2.4 Heating, Ventilating, and Air-conditioning Manufacturers Association (HEVAC).

1.2.5 Building Services Research and Information Association (BSRIA).

1.2.6 American Architectural Manufacturers Association (AAMA)

.1 AAMA 605.2, Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.

1.3 SYSTEM DESCRIPTION

1.3.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

.2 Provide product certificate signed by the louver manufacturer certifying that their products comply with the specified requirements and have been tested in accordance with the HEVAC Technical Specification by the accredited laboratories at the Building Services Research and Information Association (BSRIA).

1.4 SUBMITTALS

1.4.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.

.1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

.2 Indicate following:

.1 Pressure drop.

.2 Face area.

.3 Free area.

.4 Dimensions

.5 Mullion spacing.

.6 Structural supports.

.7 Retention clips.

.8 Louvre effectiveness at stopping rain penetration.

.9 Free air velocity at onset of beginning water penetration in accordance with AMCA water test (i.e. 3.18 mL of water per square meter of louver free area during a 15 minute test period).

1.4.2 Quality assurance submittals: submit following.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

1.5.1 Health and Safety Requirements: perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.5.2 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.5.3 Air performance, water penetration: provide louvers complying with performance requirements indicated by testing manufacturer's stock units of height and width indicated. Wall louvers shall be tested according to the HEVAC Technical Specification "Laboratory Testing and Rating of Weather Louvres When Subject to Wind Driven Rain".

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

2. PRODUCTS

2.1 FIXED LOUVRES - ALUMINUM

2.1.1 Applicable to louvres: 2440-LV-VSG-0001, 2400-LV-VSG-0002, 2440-LV-VSG-0003, 2440-LV-VSG-0004 and 2440-LV-VSE-0001.

2.1.2 General: furnish and install where shown on the drawings horizontal, drainable sightproof, storm resistant, fixed blade louvres with extruded aluminum frames and blades, designed to collect and drain water to exterior of sill by means of multiple gutters in blades and channels in jambs and mullions.

2.1.3 Material: frame and blades to be fabricated from 6063-T5 aluminum alloy. Blades to be minimum 1.52 mm thick extrusions and frames to be minimum 2.03 thick.

2.1.4 Louvre thickness: 100 mm.

2.1.5 Blade: storm resistant blade with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.

2.1.6 Mullions: at 1500 mm maximum centres.

2.1.7 Fasteners: stainless steel nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, stainless steel washer and aluminum body.

2.1.8 Sill flashing: provide louvre sill flashing 102 mm high by full depth of louvre formed from minimum 1.27 mm thick aluminum. Sill flashing pan to have continuously welded side panels.

2.1.9 Screen: louvre to be furnished with a heavy duty bird screen and frame of 19 mm x 2.33 mm intercrimp aluminum wire and heavy duty 2.28 mm thick aluminum frame, rewireable. The screen to be 14.3 mm front to back and have a free area of 76.9%. Bird screen to be held in place with #8 stainless steel sheet metal screws. Screen to be mounted at back of louvre and to have mill finish.

2.1.10 Finish: louvre shall be finished with an inhibitive thermo-cured primer, 0.2 mil minimum dry film thickness, and a thermo-cured fluorocarbon coating containing Kynar 500 resin, 1.0 mil minimum thickness. All aluminum shall be thoroughly cleaned, etched and given a chromated conversion pre-treatment before application of the Kynar/Hylar coating. The coating shall receive a bake cycle of 17 minutes at 232°C. All finishing procedures shall be one continuous operation in the plant of the manufacturer. Manufacturer to furnish an extended 20 year limited warranty for the Kynar/Hylar coating. This limited warranty shall begin on the date of Project Completion.

2.1.11 Colour: to be selected by Company.

2.1.12 Performance requirements: the louvre manufacturer shall submit certified test data from a Building Services Research and Information Association (BSRIA) accredited testing laboratory. The louvre shall be tested at a rain fall rate of 75 mm/hr and an exterior wind velocity directed into the face of the louvre of 13 m/s. The test data must show that, at a ventilation rate of 0.00 m^3/s, the louvre effectiveness ratio meets or exceeds 98.3%. The test louvre size shall be 1016 mm x 1016 mm.

2.1.13 Supports: louvre manufacturer shall supply complete with the louvre and sill flashing pan, clip angles constructed of aluminum. These clip angles shall be installed by the Mechanical Subcontractor.

2.1.14 Design criteria: see data sheets.

2.1.15 Acceptable product: Construction Specialties Model RS-4300, Penn, Ruskin, Air Balance Inc., American Warming and Ventilating, NCA, Nailor, Airolite, Ventex, or accepted equal.

3. EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

3.2.1 In accordance with manufacturer's and SMACNA recommendations.

3.2.2 Reinforce and brace as indicated.

3.2.3 Anchor securely into opening. Seal with caulking around to ensure weather tightness.

3.3 CLEANING

3.3.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Equipment Number	2440-LV-VSE-0001	2440-LV-VSG-0001
General:		
Manufacturer	Construction Specialties	Construction Specialties
Type	Storm Resistant Fixed Horz.	Storm Resistant Fixed Horz.
Model	RS-4300	RS-4300
Area Served	Electrical Room Intake	Diesel Generator Rad. Intake
Louver Dimensions*:		
Width (mm)	1000	4000
Height (mm)	1200	3500
Depth (mm)	100	100
Performance:		
Maximum Airflow (L/s)	1600	20853
Free Area Velocity (m/s)	2.84	3.17
Pressure Drop (Pa)	27.4	34.5
Details:		
Finish	Kynar 500 / Hylar 5000	Kynar 500 / Hylar 5000
Color	Selected During Shop Dwg.	Selected During Shop Dwg.
Birdscreen	Yes	Yes
Remarks	-	-
* All louver dimensions are nominal, hard conversions from imperial dimensions. Exact opening sizes required for installation shall be forwarded to the Contractor by the Mechanical Subcontractor.		

Equipment Number	2440-LV-VSG-0002	2440-LV-VSG-0003
General:		
Manufacturer	Construction Specialties	Construction Specialties
Type	Storm Resistant Fixed Horz.	Storm Resistant Fixed Horz.
Model	RS-4300	RS-4300
Area Served	Generator Room Intake	Diesel Generator Rad. Exhaust
Louver Dimensions*:		
Width (mm)	450	4000
Height (mm)	750	2400
Depth (mm)	100	100
Performance:		
Maximum Airflow (L/s)	400	20853
Free Area Velocity (m/s)	2.52	4.63
Pressure Drop (Pa)	21.4	50.6
Details:		
Finish	Kynar 500 / Hylar 5000	Kynar 500 / Hylar 5000
Color	Selected During Shop Dwg.	Selected During Shop Dwg.
Birdscreen	Yes	Yes
Remarks	-	-
* All louver dimensions are nominal, hard conversions from imperial dimensions. Exact opening sizes required for installation shall be forwarded to the Contractor by the Mechanical Subcontractor.		

Equipment Number	**2440-LV-VSG-0004**
General:	
Manufacturer	Construction Specialties
Type	Storm Resistant Fixed Horz.
Model	RS-4300
Area Served	Generator Room Exhaust
Louver Dimensions*:	
Width (mm)	450
Height (mm)	600
Depth (mm)	100
Performance:	
Maximum Airflow (L/s)	400
Free Area Velocity (m/s)	3.16
Pressure Drop (Pa)	23.5
Details:	
Finish	Kynar 500 / Hylar 5000
Color	Selected During Shop Dwg.
Birdscreen	Yes
Remarks	-
* All louver dimensions are nominal, hard conversions from imperial dimensions. Exact opening sizes required for installation shall be forwarded to the Contractor by the Mechanical Subcontractor.	

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 44 00**
CH0032	**SPILLWAY ELECTRICAL BLDG HVAC AIR FILTRATION**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 44 00
SPILLWAY ELECTRICAL BLDG
HVAC AIR FILTRATION

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1. GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

.1 Filters, filter gauges and filter housing for inline fresh air supply filters.

1.2 RELATED SECTIONS

.1 Section 23 07 14 – Thermal Insulation for Equipment

1.3 REFERENCES

1.3.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

1.3.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.

1.3.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.4 MANUFACTURED ITEMS

1.4.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

1.5 SUBMITTALS

1.5.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.

.1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

1.5.2 Shop Drawings:

.1 Submit shop drawings.

.2 Indicate following:

.1 Filter housing dimensions

.2 Filter face velocity

.3 Initial & final static pressure

.4 MERV rating

1.5.3 Quality assurance submittals: submit following .

.1 Instructions: submit manufacturer's installation instructions.

1.5.4 Closeout Submittals

.1 Provide maintenance data for incorporation into operation and maintenance manual.

1.6 QUALITY ASSURANCE

1.6.1 Health and Safety Requirements: perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.7 MAINTENANCE

1.7.1 Extra materials:

.1 Provide maintenance materials.

.1 One set of filters for start-up and commissioning, one set for the building occupancy (final filters) and one spare set of filters for each equipment.

.2 Furnish list of individual manufacturer’s recommended spare parts for equipment, include:

.1 Address of suppliers

.2 List of specialized tools necessary for adjusting, repairing or replacing

.3 Filters

1.8 DELIVERY, STORAGE, AND HANDLING

1.8.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Storage: store materials in a dry area indoors, protected from damage and in accordance with manufacturer’s instructions. For long term storage, follow manufacturer’s installation, operations and maintenance manual.

1.8.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling .

2. PRODUCTS

2.1 GENERAL

2.1.1 Media: suitable for air at 100% RH and air temperatures between -40°C and 50°C.

2.1.2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated on datasheets.

2.1.3 Pressure drop when clean and dirty, sizes and thickness: as indicated on datasheets.

2.2 FILTER HOUSING

2.2.1 Applicable to filter housing: 2440-FR-VSE-0001.

2.2.2 General:

.1 Filter housing shall be a single stage filter system consisting of 16-gauge galvanized steel enclosure, aluminum filter mounting tracks in a V-bank configuration, dual access doors, static pressure tap, filter sealing gaskets and door seals. In-line housing depth shall not exceed 711 mm

2.2.3 Construction:

.1 The housing shall be constructed of 16-gauge galvanized steel with pre-drilled standing flanges, Z-channel corner post construction, and shall be weatherproof and suitable for outdoor installation.

.2 The housing shall accept 51 mm deep nominal filters. The filter tracks shall be of aluminum construction and shall be an integral component of the housing. The tracks shall have fin seals to eliminate filter air bypass and ribs to allow filters to slide easily in the filter tracks.

.3 Dual access doors, swing-open type, shall include high-memory sponge neoprene gasket to facilitate a door-to-filter seal. Each door shall be equipped with adjustable and replaceable positive sealing UV-resistant star style knobs and replaceable door hinges.

.4 The housing shall include a pneumatic fitting to allow the installation of a static pressure gauge to evaluate pressure drop across any combination of installed filters.

2.2.4 Performance:

.1 Leakage at rated airflow, upstream to downstream of filter shall be less than 1% at 744 Pa. Leakage into or out of the housing shall be less than 0.5% at 744 Pa.

.2 Accuracy of pneumatic pressure fitting, when used to evaluate a single-stage shall be accurate within +/- 3% at 149 Pa.

2.2.5 Acceptable product: Camfil Farr V-bank Glide/Pack, AAF or approved equal.

2.3 PLEATED PANEL FILTER

2.3.1 Applicable to filter housing: 2440-FR-VSE-0001.

2.3.2 General:

.1 Air filters shall be medium efficiency ASHRAE pleated panels consisting of cotton and synthetic media, welded wire media support grid, and beverage board enclosing frame.

.2 Sizes shall be as noted on datasheets.

2.3.3 Construction:

.1 Filter media shall be a cotton and synthetic blend, lofted to a uniform depth of 3.8 mm and formed into a uniform radial pleat.

.2 A welded wire grid, spot-welded on 25 mm centers and treated for corrosion resistance shall be bonded to the downstream side of the media to maintain radial pleats and prevent media oscillation.

.3 An enclosing frame of no less than 28-point high wet strength beverage board shall be provided. The frame shall be bonded to the media on all sides to prevent air bypass. Integral diagonal support members on the air entering and air exiting side shall be bonded to the apex of each pleat to maintain uniform pleat spacing in varying airflows.

2.3.4 Performance:

.1 The filter shall have a minimum efficiency reporting value of MERV 8 when evacuated under the guidelines of ASHRAE standard 52.2. it shall also have a MERV-A of 8 when tested per Appendix J of the same standard, the media shall maintain or increase in efficiency over the life of the filter.

.2 Filter initial and final static pressure resistance: see datasheets

.3 The filter shall have an energy cost index (ECI) value of five stars.

.4 Filter shall be classified by Underwriters Laboratory as UL Class 2.

.5 Filter manufacturer shall guarantee the integrity of the filter pack to 500 Pa.

2.3.5 Acceptable product: Camfill Farr 30/30, AAF Perfect Pleat Ultra or accepted equal.

2.4 FILER GAUGES – DIAL TYPE

2.4.1 Applicable to filter gauges: 2440-PDI-VSG-0001 and 2440-PDI-VSE-0001

2.4.2 Each filter bank shall be furnished with a magnehelic filter gauge with a 121 mm O.D. white static pressure dial with black figures and zero pointer adjustment.

2.4.3 Acceptable product: Dwyer Series 2000 Air Filter Gauge or accepted equal.

3. EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 FILTER HOUSING/FILTER INSTALLATION

3.2.1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.2.2 Replace filter set following commissioning with final filter set.

3.2.3 Complete filter housing insulation in accordance with Section 23 07 14 – Thermal Insulation for Equipment.

3.3 FILTER GAUGES

3.3.1 Install type as indicated across each filter bank in approved and easy readable location.

3.3.2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.4 CLEANING

3.4.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.5 COMMISSIONING

3.5.1 Check for filter status, install clean filters.

3.5.2 Ensure filter housing is clean.

3.5.3 Verify filters fit tight with minimal air leakage.

3.5.4 Verify ease of accessibility for maintenance.

3.5.5 Demonstrate maintenance required and training.

3.5.6 Confirm correct installation as per manufacturer’s instructions.

END OF SECTION

Equipment Number	**2440-FR-VSE-0001**
General:	
Manufacturer	Camfil Farr
Type	Inline Duct Housing
Model	V-Bank Glide Pack
Area Served	Electrical Room
Housing Dimensions:	
Width (mm)	914
Height (mm)	692
Length (mm)	711
Performance:	
Airflow (L/s)	1600
Housing Inlet Velocity (m/s)	2.53
Filter Face Velocity (m/s)	1.44
Details:	
Quantity	2 - 300x600, 2 - 600x600
Model	30/30
Type	Pleated Panel
Thickness (mm)	51.00
Rating	MERV 8
Static Pressure - Intial (Pa)	32
Static Pressure - Final (Pa)	248
Remarks	-
Note: 2440-FR-VSG-0001 is included integral with fan 2440-FAN-VSG-0001.	

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 55 01**
CH0032	**SPILLWAY ELECTRICAL BLDG DUCT HEATERS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 23 55 01
SPILLWAY ELECTRICAL BLDG
DUCT HEATERS

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SCOTT M. PENNEY
SIGNATURE
2013/DEC/6
DATE
NEWFOUNDLAND & LABRADOR

1. GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

.1 Materials and application of electric duct heaters.

1.2 RELATED SECTIONS

1.2.1 Section 26 05 00 – General Electrical Requirements.

1.3 REFERENCES

1.3.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 46, Electric Air-Heaters.

1.3.2 Department of Justice Canada (Jus.)

.1 Canadian Environmental Protection Act (CEPA)

1.3.3 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act (TDGA)

1.4 SUBMITTALS

1.4.1 Submit product data and include:

.1 Element support details.

.2 Heater: total kW rating, voltage, phase.

.3 Number of stages.

.4 Rating of stage: rating, voltage, phase.

.5 Heater element watt/density and maximum sheath temperature.

.6 Maximum discharge temperature.

.7 Physical size.

.8 Unit support.

.9 Performance limitations.

.10 Clearance from combustible materials.

.11 Internal components wiring diagrams.

.12 Minimum operating airflow.

.13 Pressure drop, operating and minimum airflow.

1.5 QUALITY ASSURANCE

1.5.1 Health and Safety:

.1 Perform construction occupational health and safety in accordance with Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Place materials defined as hazardous or toxic in designated containers.

.5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.6 Ensure emptied containers are sealed and stored safely.

.7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

2. PRODUCTS

2.1 DUCT HEATERS

2.1.1 Duct heaters: flange type or insert type. Applicable to duct heater: 2440-HC-VSG-0001

2.1.2 To carry CSA Approval.

2.1.3 Elements:

.1 Coils machine crimped into stainless steel terminals extending at least 25mm into the air stream.

.2 All terminal hardware shall be stainless steel.

.3 Coils shall be supported by ceramic bushings staked into the supporting brackets.

.4 Helical coils of 80% nickel, 20% chromium, Type A wire.

2.1.4 Frames: Heater frames and boxes shall be corrosion resistant steel.

2.1.5 Terminal box:

.1 NEMA 1 general purpose enclosure.

.2 Hinged, latching cover.

.3 Multiple concentric knockouts to accept field wiring.

.4 Terminal blocks to accommodate field wiring.

.5 All internal wiring to be complete with 105ºC rated insulation.

2.1.6 Ratings:

.1 Heaters to be rated for voltage, phase, and KW capacity as indicated on datasheet.

.2 All three phase heaters to have equal, balanced, three phase stages.

.3 Supply heaters with both fixed and proportional heating stages to provide for close discharge air temperature control. Engineer to accept staging design of heating coil prior to construction.

2.1.7 Controls:

.1 Factory mounted and wired in control box. Use terminal blocks for power and control wiring.

.2 Controls to include:

.1 Magnetic contactors.

.2 Fixed differential pressure switch.

.3 Manual and automatic reset high limit.

.4 Control transformers.

.5 Solid state relays.

.6 Door interlocked disconnect switch (non-fused).

.7 HRC load fuses.

.8 Electronic hybrid step controller.

.9 Heater to be controlled by 0 – 10 VDC remote control signal from the building control system

2.1.8 Performance: see data sheets.

2.1.9 Provide heater complete with protective screens on inlet/outlet.

2.1.10 Acceptable Product: Thermolec, Neptronic, or accepted equal.

3. EXECUTION

3.1 INSTALLATION

3.1.1 Make power and control connections in accordance with CSA C22.2 No.46. Install in accordance with manufacturer's instructions.

3.2 COMMISSIONING

3.2.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements.

3.2.2 Confirm heating coil operation. Measure and record inlet and outlet temperatures.

3.2.3 Measure and record voltage and amperage for coil at varying control points.

3.2.4 Demonstrate maintenance required and training.

3.2.5 Confirm correct installation as per manufacturer’s instructions.

END OF SECTION

Equipment Number	**2440-HC-VSG-0001**
General:	
Manufacturer	Thermolec
Type	Slip-In
Model	Thermo-V
Area Served	Generator Room
Coil Material	Nickel Chrome Alloy
Duct Dimensions:	
Width (mm)	450
Height (mm)	450
Performance:	
Airflow (L/s)	400
Velocity (m/s)	1.98
Static Pressure (Pa)	25
Entering Air Temp (^{o}C)	-2.6
Leaving Air Temp (^{o}C)	21.8
No of Fixed Stages	0
Fixed Stage Output ea. (kW)	0
SCR Stage Output (kW)	12
Total Capacity (kW)	12
Heat Density (kW/m^{2})	59.3
Electrical Data:	
Voltage (Volts)	600
Phase	3
Frequency (Hz)	60
Controls:	
Control Type	SCR
Control Signal	0-10 VDC
Remarks	-

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 82 33.05**
CH0032	**GATE GUIDE HEATERS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 23 82 33.05
GATE GUIDE HEATERS
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **23 82 33.05**
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MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – General Electrical Requirements.

.2 Section 26 05 21 – Wires and Cables (0-1000 V)

.3 Section 26 24 19 – Motor Control Centres

.4 Section 26 29 03.02 – Control and Monitoring

.5 Section 26 29 03.02 – Control and Monitoring – Hydro-Mechanical

1.2 DEFINITIONS

.1 DHL Diversion Supply Level

.2 FSL Full Supply Level

.3 MI Mineral Insulated

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2 No. 130, Requirements for Electrical Resistance Heating Cables and Heating Device Sets.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Exhibit 4 – Supplier Document Requirements List. Include product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Exhibit 4 – Supplier Document Requirements List.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Instructions: submit manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS

.1 Submit operation and maintenance data for heating cable in accordance with Exhibit 4 – Supplier Document Requirements List

.2 Record layout of cables in poured-in-place concrete or in pipe sleeves embedded in concrete, indicating depth of cables.

2 PRODUCTS

2.1 GATE GUIDE HEATERS

.1 Mineral Insulated (MI) Heating Cables.

.1 Stainless steel sheathed heating cables to Section 26 05 21 - Wires and Cables (0 - 1000 V).

.2 Heaters to be fed from 600V, 3 phase supply.

.2 Temperature Controller

.1 Electronic single loop temperature controller with capability for modulation

.2 Suitable for 100 Ohm platinum RTD temperature sensor input.

.3 Output to match solid state relay or power controller.

.3 Solid State relay

.1 Electronic solid state relay (SSR) rated 600 V with current rating suitable for heater rating.

.2 SSR can be combined with the temperature controller.

2.2 CONTROLS

.1 Remote high temperature cut-out.

.2 Gate guide RTD temperature sensors for each heating circuit.

.3 Provide power to controllers as required.

.4 Controllers and SSRs shall be installed in individual control enclosures or located in a heater control panel with other controllers and SSRs.

.5 Controllers and SSRs may also be installed in the Hoist MCCs.

3 EXECUTION

3.1 INSTALLATION

.1 Install heaters and controls as indicated and in accordance with manufacturer's instructions.

.2 Make power and control connections.

.3 For the Spillway gate guide heaters and the Spillway upstream Stoplog guide temporary heaters, added length of cold leads for the MI heater cables, and support cables if required, shall be provided for operation of the guide heaters when the reservoir is at DHL during the Diversion Phase, and when the reservoir is as FSL for long term operation.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements.

.2 Ensure that heaters and thermostatic controls operate correctly.

END OF SECTION

SECTION 23 82 39.01
UNIT HEATERS - ELECTRIC
TABLE OF CONTENTS

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PEGNL Newfoundland and Labrador
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1 GENERAL

1.1 RELATED SECTIONS

.1 Section 23 09 33 - Electric and Electronic Control System for HVAC.

.2 Section 26 05 00 - General Electric Requirements.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.46, Electric Air-Heaters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit product data in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Submit product data sheets for unit heaters. Include:

.1 Product characteristics.

.2 Performance criteria.

.3 Mounting methods.

.4 Physical size.

.5 kW rating, voltage, phase.

.6 Cabinet material thicknesses.

.7 Limitations.

.8 Colour and finish.

.3 Submit product data sheets for unit heaters.

.1 Include product characteristics, performance criteria, physical size, limitations and finish.

.4 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence and cleaning procedures.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for unit heaters for incorporation into manual in accordance with Exhibit 4 – Supplier Document Requirements List.

2 PRODUCTS

2.1 UNIT HEATERS

.1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet or vertical discharge cone type with cone diffusers as indicated.

.2 Fan type unit heaters with built-in high-heat limit protection, fan-delay switches.

.3 Fan motor: totally enclosed, permanently lubricated ball bearing type with resilient mount.

.1 Built-in fan motor thermal overload protection.

.4 Hangers: as indicated.

.5 Elements: mineral insulated steel sheath with aluminum, continuous helical brazed fins.

.6 Cabinet: steel, 1.6 mm thick, fitted with brackets for rod or wall mounting.

.1 Phosphatized and finished with 2 coats baked enamel in beige colour.

2.2 CONTROLS

.1 Wall mounted thermostats: low voltage electronic type.

.2 Unit heaters shall be complete with control transformers, 24 V control circuit and 24 V relay.

3 EXECUTION

3.1 INSTALLATION

.1 Suspend unit heaters from ceiling or mount on wall as indicated. Provide mounting bracket as required.

.2 Install thermostats in locations indicated.

.3 Make power and control connections.

3.2 COMMISSIONING

.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requiremets.

.2 Test cut-out protection when air movement is obstructed.

.3 Test fan delay switch to assure dissipation of heat after element shut down.

.4 Test unit cut-off when fan motor overload protection has operated.

.5 Ensure heaters and thermostatic controls operate correctly.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **25 33 01**
CH0032	**SPILLWAY ELECTRICAL BLDG HVAC CONTROLS AND INSTRUMENTATION**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 25 33 01
SPILLWAY ELECTRICAL BLDG
HVAC CONTROLS AND INSTRUMENTATION

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PART 1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 23 05 00 - Common Work Results for HVAC

1.2 SCOPE

1.2.1 Provide and install the master and slave programmable logic controllers in accordance with drawings and specifications. The PLC to include but not necessarily be limited to power supply with integral surge protection, back-up non-volatile memory card, microprocessor, graphic touch screen interface, input and output ports, interface modules, control cables, panel mount personal computer, HMI software, and field control devices.

1.2.2 Interfacing operator workstation shall be located remotely from this building. Operator workstation shall not be included in this contract. Remote access to the HVAC PLC system shall be over the internet using a web browser such as Explorer.

1.2.3 Provide peripheral devices, transducers, and transmitters required for control and monitoring functions.

1.2.4 Provide all required control cabling in accordance with drawings and Section 1.3 System Description.

1.2.5 Provide all required software.

1.2.6 The PLC control system shall be furnished, installed, serviced, and guaranteed by the Controls Subcontractor. This work shall include but shall not be limited to programming, shop drawing development, supervision, commissioning, calibration, testing, instruction of operating personnel, and development of operation and maintenance manual.

1.3 SYSTEM DESCRIPTION

1.3.1 The Controls Subcontractor shall be responsible to supply and install a complete control system to service the Spillway Electrical Building HVAC System. The PLC system shall be integrated into a complete system with remote monitoring.

1.3.2 The control system architecture shall be a master/slave arrangement. The master PLC shall be located in the Generator Room. It shall communicate with one (1) slave PLC: located in the Electrical Room.

1.3.3 A Company supplied operator work station (OWS) shall be installed on site remote to the Spillway Electrical Building. A full development version of Thrihedral VTS HMI software shall be supplied by the Controls Subcontractor and installed on this computer. The licence shall be for a 1000 tag version of the software. This computer shall act as the back-up server.

1.3.4 A panel mounted PC shall be installed in the cabinet of the master PLC in the Generator Room of the Spillway Electrical Building. A full development version of the Thrihedral VTS HMI software shall be supplied by the controls contractor and installed on this computer. The licence shall be a 1000 tag version of this software. This computer shall be the main server.

1.3.5 Each licensed version of VTS shall be provided with the following options:

.1 Alarm dialer to send alarms via email or pager.

.2 VTS internet client monitoring tool.

.3 VTS internet server/client option.

1.3.6 The OWS and the panel mount PC shall be interconnected via a fibre optic link supplied and installed by the Company.

1.3.7 Remote communication to one (1) concurrent internet client shall be provided. The internet client OWS shall not require VTS software to be installed. During the initial connection between the internet server and the internet client, an Active-X software package shall be downloaded onto the internet client OWS which shall give full monitoring and control capabilities to the internet client.

1.3.8 The primary internet server shall be the panel mounted PC in the generator room of the Spillway Electrical Building. The back-up internet server shall be the remote OWS.

1.3.9 All power wiring required to service equipment supplied by the Controls Subcontractor shall be supplied and installed by the Electrical Subcontractor. This shall include all conduit.

1.3.10 All control wiring required to service equipment supplied by the Controls Subcontractor shall be supplied and installed by the Controls Subcontractor. The Controls Subcontractor shall be responsible to supply and install the conduit to carry this wiring.

1.3.11 The mounting of all control cabinets supplied by the Controls Subcontractor shall be the responsibility of the Controls Subcontractor.

1.3.12 All wiring terminations at equipment supplied by the Controls Subcontractor shall be the responsibility of the Controls Subcontractor to undertake.

1.3.13 The installation of pressure transmitters, damper actuators, temperature transmitters, etc., supplied by the Controls Subcontractor shall be the responsibility of the Controls Subcontractor.

1.3.14 All combination magnetic motor starters shall be supplied and installed by the Electrical Subcontractor unless otherwise indicated.

1.3.15 Provide a touch screen panel mount personal computer for local annunciation, status monitoring, and changing of system set points, at the PLC cabinet in the Generator Room.

1.3.16 Provide a HMI touch screen for local annunciation, status monitoring, and changing of systems set points, at the slave PLC cabinet in the Electrical Room.

1.3.17 Supply PLC system to service the project with input/output capacity as outlined in drawings.

1.4 QUALIFICATIONS

1.4.1 The Controls Subcontractor shall have designed and installed a minimum of five (5) similar PLC - based systems within the past ten (10) years.

1.4.2 Provide to Engineer list of installations with similar equipment requirements demonstrating compliance. Provide project title, client name, and contact telephone number.

1.5 SUBMITTALS

1.5.1 Submit product data. Submittals shall include the following:

.1 Clear concise description of control philosophy.

.2 Detailed description of how control philosophy shall be implemented in the programming. Description shall be in English language with detailed flow charts and logic diagrams to clearly describe how each device is controlled.

.3 Clear identification of configuration data different from default values not in PLC.

.4 List of all adjustable set point parameters complete with assigned address.

.5 Dimension drawing of components.

.6 Schematic and wiring diagrams indicating all components, input and output locations, terminal points, and points of interconnection.

.7 List of components.

.8 Product bulletins.

.9 Certified Test Reports.

1.5.2 Provide operation and maintenance data for incorporation into operation and maintenance manual.

.1 Provide material to cover the following items:

.1 Equipment documentation:

.1 General Description

1. Logic diagrams and description

.2 Associated instrumentation manual

.3 Peripheral equipment manual

.4 Components manual:

.1 Components standardized identification

.2 Manufacturer's and catalogue numbers

.3 Contractor's references

.2 Software documentation:

.1 Operator's programming manuals.

.2 User's documentation.

.3 Programmer's references.

.3 Drawings and diagrams:

.1 Inter-elements and terminals wiring diagrams and external cabling diagrams consisting of:

.1 Inter-modules and inter-elements cable list

.2 AC and DC power distribution

.3 Functional blocks

.4 Card layout

.5 External cabling terminals

.6 Grounding

.7 Signal conditioning

.4 Diagnostic and hardware-checking programs:

.1 For each diagnostic program supply:

.1 Description and use

.2 Instruction listing

.2 Delivery of final documents to coincide with systems 90% completion and should final documents not be available at the time, manuals suitable for personnel training shall be prepared and delivered. In this case, the final documents to be delivered before Substantial Completion of the system.

1.6 HEALTH AND SAFETY

1.6.1 Perform construction occupational health and safety in accordance Health and Safety Requirements.

1.7 WASTE MANAGEMENT AND DISPOSAL

1.7.1 Separate and recycle waste materials.

1.7.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

1.7.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

1.7.4 Divert unused metal materials from landfill to metal recycling.

1.8 MAINTENANCE MATERIALS

1.8.1 The Controls Subcontractor shall supply a recommended spare parts list for a two-year operating period.

D2

1.9 NOT USED

1.10 DELIVERY

1.10.1 Equipment shall be handled and stored in accordance with manufacturer's instructions. Specialized storage instructions shall be included with equipment at time of shipment.

PART 2 PRODUCTS

2.1 SOFTWARE - GENERAL

2.1.1 Provide all software required for a complete operating system. All PLC software to be provided as an integral part of the PLC, and not dependent upon any other computer device for execution.

2.1.2 The system shall be set up such that screen development, associated logic development, and custom report development for the entire system can be modified from a remote location via an internet based connection utilizing remote configuration techniques. Changes in configuration made at this location shall be electronically transferable to any and all nodes on the network, as selected by the developer, without requiring the developer to physically go to the nodes. It shall not be necessary to have the development key installed on the node to which the modifications are transferred.

2.1.3 Program functions shall include contacts, coils, timers, counters, floating point mathematical functions, shift registers, bit and word operations.

2.1.4 All programs shall execute automatically without need for operator intervention, and shall allow user customization. Programs shall be applied to devices as required and as described in the system sequence of operation. The PLC system shall be able to

execute configured processes defined by the user to automatically perform calculations and control routines.

2.1.5 Remote support shall be configured such that all systems on the network are accessible utilizing an internet based connection.

2.1.6 The system shall be configured in such a manner to ensure it cannot be rendered inoperable.

2.1.7 At all times, operators shall be able to perform control actions. It shall not be necessary to wait for alarms to be posted, or any other function to be performed before operators are able to input commands to the system irrespective of what other tasks the operating system is performing.

2.1.8 All functionality shall be supported simultaneously. It shall not be necessary for an operator to discontinue logging of trend data to generate reports.

2.1.9 Process Inputs and Variables: It shall be possible to use any of the following in a confined process:

.1 Any system-measured point data or status.

.2 Any calculated data.

.3 Any results from other processes.

2.1.10 Process Triggers: Configured processes may be triggered based on any combination of the following:

.1 Time of day.

.2 Calendar date.

.3 Other processes.

.4 Events (point alarms).

2.2 PROGRAMMABLE LOGIC CONTROLLER (PLC) DESIGN DESCRIPTION

2.2.1 Applicable to main controllers: 2440-MC-VSE-0001 and 2440-MC-VSG-0001

2.2.2 A major consideration of the controller system shall be its all-in-one design, with I/O expansion. This allows the user to quickly and easily install, service and replace the controller and expansion modules if necessary. The supplier must have available a number of I/O options for the controller that include:

.1 Power: 120Vac, 24Vdc.

.2 Inputs: 120Vac, 240Vac, 24V dc sink, 24Vdc source, 4-20ma Analog , 0-10v Analog, RTD and Thermocouple.

.3 Outputs: Relay (some of which must have individual isolation), 24Vdc source, 4-20ma Analog, 0-10v Analog and TRIAC.

2.2.3 The controller must be part of a larger family of packaged and modular programmable controllers that provide program transport (ability to move a customer's program between platforms in both directions), and also share programming tools, a common instruction set, and common communications to serial based devices (computers, electronic operator interfaces, etc).

2.2.4 All hardware of the controller shall operate at an ambient temperature of -20° to 60°C (-4° to 140°F), with an ambient temperature rating for storage of -40° to +85°C (-40° to +185°F).

2.2.5 The controller hardware shall function continuously in the relative humidity range of 5% to 95% with no condensation.

2.2.6 The controller shall have at least two dedicated serial ports which support RS-232-C signals. These ports must be capable of local and remote (via modem) programming, troubleshooting and data manipulation.

2.2.7 The controller shall have at least one dedicated serial port which supports RS-485 signals. This port must be capable of local and remote programming, troubleshooting and data manipulation.

2.2.8 The controller shall have at least one RJ-45 port which supports 10/100 Mbps EtherNet/IP. This port must be capable of local and remote programming, troubleshooting and data manipulation.

2.2.9 The controller system shall be designed and tested to operate in high electrical noise environments, and must meet or exceed:

.1 EN 61000-4-2 (ESD Immunity).

.2 ENV 50204 (Radiated Immunity).

.3 EN 61000-4-3 (Radiated RF Immunity).

.4 EN 61000-4-4 (Fast Transient Immunity).

.5 EN 61000-4-5 (Surge Transient Immunity).

.6 EN 61000-4-6 (Conducted RF Immunity).

.7 EN 55011 (Conducted and Radiated Emissions).

.8 EN 61000-4-11 (Line Related Tests).

2.2.10 Acceptable products: Allen Bradley, Omron, Panasonic**,** or accepted equal.

2.3 PLC MAIN HARDWARE

2.3.1 The CPU shall be a self-contained unit, and will be capable of displaying Ladder Rung program execution through its RS-232/RS-485 and EtherNet/IP communication ports. The CPU will control all I/O scanning and communications servicing.

2.3.2 All components of the controller system shall be housed in a single chassis. (Power supply, embedded I/O circuitry, CPU, Memory and communications shall be resident in one enclosure.)

2.3.3 The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating a "green" indicator when no fault is detected and a "red" indicator when a fault is detected.

2.3.4 The packaged controller shall be designed to operate in a free air flow environment. (Convection cooling only, no fans or other air moving devices shall be required).

2.3.5 The controller shall provide a simple embedded Human Machine Interface (HMI). This HMI must provide the ability to monitor/change user data and also to display messages and data to the user. The ability to receive numeric input from the HMI which can be utilized by the controller's program must also be supported.

2.3.6 The controller must provide a mechanism to manually set the communication port to a known state (factory out of box preferred). Systems that do not provide a mechanism to manually set the communications port to a known state are not acceptable.

2.3.7 The controller must provide at least two digital trim potentiometers that are accessible from the front of the controller while the controller is operating.

2.3.8 The controller must support front accessible memory modules that can be inserted or removed while the system is operating (in run).

2.3.9 The main front panel of the controller shall include the following indicators:

Power, Run, Fault, Force

2.3.10 Processor mode shall be selected by a command from a programming device. Available settings must include modes:

RUN	Control program executing.
PROGRAM	Controller not executing, user program can be uploaded or downloaded.
SINGLE SCAN TEST	The PLC scans and solves the user program once, does NOT control the real world outputs, and stops.
CONTINUOUS SCAN TEST	The PLC continuously scans the user program, but does NOT control the real world outputs.

2.3.11 Non-volatile memory shall store the operating system, user program, and all user data to protect against memory loss in the case of power loss or system shut-down.

2.3.12 Acceptable products: Allen Bradley, Omron, Panasonic, or accepted equal.

2.4 PLC POWER

2.4.1 The packaged controller shall operate in compliance with one of two types of electrical service:

.1 120/240 VAC, single phase, in power systems that operate on 50/60 Hz. It must be capable of auto-detect to operate with either of these AC voltages or frequencies without the user needing to jumper or setup the unit.

.2 24V dc Class 2 SELV.

2.4.2 All AC powered controllers with 24Vdc inputs must be capable of supplying a minimum of 24Vdc at 200ma. This can be used to provide external 24Vdc power for input devices (sensors, switches etc.).

2.4.3 The onboard power supply must be capable of supplying all necessary power to all subsystems (CPU, Memory, local I/O, etc.) in addition to a minimum of 7 expansion I/O modules, without external wiring.

2.4.4 The power supply shall provide surge protection, isolation, and power outage carry-over of at least 1 cycle of the AC line.

2.4.5 In cases where the AC line is especially unstable or subject to unusual variations it shall be possible to install a constant voltage transformer having a sinusoidal output waveform.

2.4.6 At the time of power-up, the power supply shall inhibit operation of the processor and I/O modules until the DC voltages are within specifications.

2.4.7 Acceptable products: Allen Bradley, Omron, Panasonic, or accepted equal.

2.5 PLC PROGRAM STORAGE

2.5.1 The program storage medium shall be a solid state non-volatile type.

2.5.2 The controller shall be capable of addressing up to a minimum of 10K data words, where each word is comprised of 16 data bits.

2.5.3 Available user memory shall consist of a minimum of 20K words of program and data.

2.5.4 Controller shall support up to 128K bytes for data logging.

2.5.5 Controller shall support up to 64K bytes for recipe storage.

2.5.6 The controller must provide the capability to use a non volatile memory module that can be inserted or removed while power is applied to the controller.

2.5.7 The memory module must support the ability to selectively protect multiple areas of user data from being overwritten if/when a download occurs.

2.5.8 Memory modules must be capable of write once read many operations. This is a write once feature that if enabled inhibits a user from clearing the program currently stored in the memory module.

2.5.9 The memory module must support automatic program download whenever power is applied.

2.5.10 The memory module must support the ability to detect if a fault is present during the power up sequence, if a fault is present download the program that is in the memory module and enter the run mode. If a fault is not present the controller proceeds normally without memory module intervention.

2.5.11 The operator should be able to backup memory, including data and program logic onto a CD, DVD, hard disk, or memory module.

2.5.12 The packaged controller system must be capable of storing the following data:

.1 External Output Status.

.2 External Input Status.

.3 Timer Values.

.4 Counter Values.

.5 Signed Integer Numbers (16 bit).

.6 Signed Integer Numbers (32 bit).

.7 Binary data (bit, BCD, HEX).

.8 ASCII String Data.

.9 Internal Processor Status Information.

2.5.13 The above listed data shall be distinguishable to the CPU by the addressing format. Management of the data into memory subsections shall be an automatic function of the CPU operating system. Data can be displayed in Binary, Hexadecimal, or Decimal. Function-specific data such as processor status shall have dedicated displays that annotate the meaning of specific control bits and words within them and allow for selective control where appropriate.

2.5.14 If contacts or entire rungs are intentionally deleted from an existing logic program, the remaining program shall be automatically repositioned to fill this void. Whenever contacts or entire rungs are intentionally inserted into an existing program, the original program shall automatically be repositioned to accommodate the enlarged program.

2.5.15 The controller must support a minimum of 12 pulse inputs. Pulse inputs allow a fast signal to be captured and held long enough for the controller to detect the signal, once read the signal is automatically reset.

2.5.16 The number of times that a normally open (N.O.) and/or normally closed (N.C.) contact of an address can be programmed shall be limited only by the memory capacity to store these instructions.

2.5.17 Ladder logic programs must have immediate access to the sub elements of control structures (timers, counters, sequencers etc.) by word (presets, accumulators etc.) and bit (status bits).

2.5.18 Acceptable products: Allen Bradley, Omron, Panasonic**,** or accepted equal.

2.6 PLC INPUTS / OUTPUTS - GENERAL

2.6.1 A minimum of 4 isolated digital input groups, 1 isolated analog input group, 6 isolated digital output groups and 1 isolated analog output group shall be located on the self-contained controller. At least 4 relays shall be individually isolated.

2.6.2 The system must support at least 112 discrete I/O points using expansion I/O modules.

2.6.3 Isolation shall be between all internal logic and external circuits.

2.6.4 Each input and output point shall have a visual indicator to display ON/OFF status.

2.6.5 All user wiring to I/O modules shall be through a heavy-duty terminal strip. Pressure-type screw terminals shall be used to provide fast, secure wire connections.

2.6.6 Inputs shall have adjustable filter time constants to improve input performance in high speed applications, and to limit the effects of voltage transients.

2.6.7 The system must support 7 expansion modules (input / output, discrete or analog).

2.6.8 Acceptable products: Allen Bradley, Omron, Panasonic, or accepted equal.

2.7 PLC INPUTS / OUTPUTS - SPECIFIC

2.7.1 The controller manufacturer shall offer input/output hardware consisting of the following types:

2.7.2 Standard Inputs:

.1 Inputs: 120Vac, 240Vac, 24V dc sink, 24Vdc source, 4-20ma Analog , 0-10v Analog, RTD and Thermocouple.

2.7.3 High Speed Counters:

.1 Each controller with 24Vdc inputs must have at least 3 high speed counters (HSC) capable of detecting a 100 kHz pulse stream built onboard.

.1 Each HSC must be capable of detecting pulses as narrow as 5 microseconds (100 kHz) and directly control (turn on or off) controller outputs independent of the processor scan.

.2 Each HSC must be cable of detecting single ended inputs, quadrature inputs, and high speed inputs with external controls (hold and reset).

.3 Each HSC must be completely configurable (input filters, modes of operation, etc.) using computer based software. Runtime control of the HSC must be allowed through commands (instructions) in the user (ladder) program (Reset accumulator, change presets, change output patterns and setpoints, enable/disable HSC operation etc).

.4 Data and status within each HSC must also be accessible from external devices through the controller's communication ports.

2.7.4 High Speed Inputs:

.1 Each controller with 24Vdc inputs must have at least 12 inputs that can catch and hold for one inputs scan a 5 microsecond input signal.

.2 Each controller with 24Vdc inputs must have 4 high speed inputs capable of generating an input interrupt. When used for input interrupt functionality, the controller must be capable of executing a predefined range of logic. Each input must be configurable to run its own user defined block of logic.

2.7.5 Standard Outputs:

.1 Outputs: Relay (some of which must have individual isolation), 24Vdc source, 4-20ma Analog, 0-10v Analog and Triac

.2 Relay outputs for DC devices which operate at 5 to 125Vdc, with 2 amp continuous current capacity at 24Vdc and 1 amp continuous current capacity 125Vdc.

.3 Relay outputs for AC devices which operate at 5 to 264Vac with 5 amp continuous current capacity for UL508 up to 40°C (3A above 40°C) and 3 amp continuous current capacity for UL1604, Class 1, Division 2, Hazardous Locations, Groups A, B, C, D.

2.7.6 High Speed Output:

.1 Each controller with 24Vdc outputs must have at least 3 high speed outputs. The outputs must be capable of generating PTO (pulse train output) signals. The PTO signals must be capable of generating motion profiles using either trapezoid or S curve acceleration and deceleration profiles.

.2 The outputs must also be configurable for PWM (pulse width modulated) signals. When configured for PWM the controller must provide trapezoid acceleration/deceleration of either the frequency or duration portions of the PWM waveform.

2.7.7 Acceptable products: Allen Bradley, Omron, Panasonic, or accepted equal.

2.8 PLC NETWORKING AND COMMUNICATIONS

2.8.1 The controller shall support direct connection to a programming computer equipped with a standard RS-232 serial port.

2.8.2 The controller shall support direct connection to a programming computer equipped with a standard RS-485 port.

2.8.3 The controller shall support direct connection to a programming computer equipped with a standard 10/100Mbps EtherNet/IP port.

2.8.4 The controller shall support direct connection to a modem for remote programming functionality

2.8.5 The packaged controller shall support full function peer to peer communications (program management, controller to controller messaging, etc.):

.1 When directly connected by an RS-232 cable, RS-485 cable or Ethernet cable

.2 A “local” (hard wired) peer to peer network that supports up to 32 devices

2.8.6 The controller shall directly support EtherNet/IP peer-to-peer messaging.

2.8.7 The controller family shall support connectivity with DeviceNet. The controller must provide DeviceNet slave I/O functionality to a DeviceNet master, peer to peer messaging over DeviceNet, explicit messaging support over DeviceNet.

2.8.8 The controller shall support ½ duplex slave communications on a network capable of at least of 250 nodes. The ½ duplex network shall support program upload/download, monitoring, and peer to peer (slave to slave) communications.

2.8.9 The controller shall support connectivity to up to 31 other devices across a DH-485 network.

2.8.10 The controller shall support the DF1 Radio Modem protocol.

2.8.11 The controller shall support Modbus RTU master and slave communications.

2.8.12 The controller shall support bi-directional ASCII communications to send initialization strings to a modem, text with embedded data to a printer or terminal, receive ASCII from smart scales, bar code devices, etc.

2.8.13 The controller shall provide the ability to change the RS-232 communications port between the out of box factory default settings, and the user configuration settings. This operation must be allowed to occur at any time.

2.8.14 The controller must support baud rates from 300 to 38.4k baud.

2.8.15 Acceptable products: Allen Bradley, Omron, Panasonic, or accepted equal.

2.9 PANEL MOUNT PC

2.9.1 Application:

.1 Panel mount PC, located in Generator Room

2.9.2 Description:

.1 Touchscreen Panel Mount PC; 8GB CF Solid State Computer; Performance Model: Core Duo 1.2GHz; 1GB DDR2 RAM; CD/DVD-RW.

2.9.3 Monitor Selection:

.1 Bulletin: 6181F Solid-State Computers

.2 Monitor Size: 15-inch TFT Display

.3 Screen Type: Touch Screen

.4 Display: Bezel Aluminum

.5 Package: Performance Package

.6 Operating System: Microsoft Windows XP Professional

.7 Voltage: 120/240V AC

2.9.4 Acceptable product: Allen Bradley 6181F-15TPXP, Omron, Panasonic, or accepted equal.

2.10 HMI TOUCHSCREEN

2.10.1 Application:

.1 HMI touchscreen for slave PLC located in Electrical Room

2.10.2 Description:

.1 6" Color (Transmissive CSTN) Touchscreen

2.10.3 Component Data:

.1 Size: 6 inches

.2 Operator Input: Touch Screen

.3 Display Type: Color

2.10.4 Controller Information:

.1 Control Interface: Ethernet

.2 Component Port: Ethernet

2.10.5 Acceptable products: Allen Bradley 2711C-T6C, Omron, Panasonic or accepted equal.

2.11 SOFTWARE - GRAPHICAL OPERATOR INTERFACE

2.11.1 Alarms:

.1 The system shall provide capability of changing alarm levels, and adding alarms while maintaining system operation.

.2 Annunciation shall be provided immediately following occurrence of an alarm. The annunciator shall continue to indicate until the alarm is acknowledged.

.3 Alarm printer control shall be provided on an “Alarm Disable” screen. Operators shall be able to select any portion of the historical alarm log for printing by specifying the start and end time. Operators shall be able to specify the alarm type for inclusion in the alarm print out. Alarms not specified shall not be printed.

.4 An historical alarm log shall be maintained for a period of 45 days. The system shall automatically erase historical alarm log data older than 45 days.

.5 The alarm types which shall be supported are as follows:

.1 TYPE 1 - SYSTEM CRITICAL ALARMS

Alarm condition results in a window being displayed describing the alarm condition and what immediate action the operator should take. To clear the pop-up window, an operator must click on an acknowledge button on the pop-up. The historical alarm log shall record when first triggered in yellow, when acknowledged in red, and when cleared in green. The alarm log shall indicate the date, time and description of the alarm condition. An alarm condition shall be communicable to an auto-dialer if not acknowledged within 2 minutes.

.2 TYPE 2 - SYSTEM DISCRETE ALARMS

Alarm conditions are generated in the PLCs and shall latch in alarm state until acknowledged. The alarm shall remain on the screen until cleared in the field. The historical alarm log shall record when first triggered in red, when cleared in blue, but shall not log when acknowledged. The historical alarm log shall indicate the date, time and description of the alarm condition.

.3 TYPE 3 - CONTROL SYSTEM LOGICAL AND ANALOG ALARMS

Alarm conditions are based upon logical conditions and analog values. The alarm shall latch in alarm state until acknowledged and shall remain on the screen until cleared in the field. The historical alarm log shall record when first triggered in yellow, when cleared in green but shall not log when acknowledged. The alarm log shall indicate the date, time and description of the alarm condition.

.4 TYPE 4 - STATUS EVENTS

These events are logged by the alarm printer. These alarms shall not require acknowledgement and shall not display on the alarm banner. The alarms shall be viewable on the historical alarm log in dark blue. The alarm log shall not log when the trigger returns to the off state. The alarm log shall indicate the date, time and description of the status event.

.6 Operators shall be able to lock alarms in the state at run-time from an “Alarm Control” screen such that the alarm continues to display on the screen as active irrespective of the actual alarm condition in the field. When alarms have been locked, all screens shall display a warning that alarms have been locked.

.7 Operators shall be able to change alarm levels for those alarms at run-time from an “Alarm Control” screen such that the alarm continues to display on the screen as active irrespective of the actual alarm condition in the field.

.8 Operators shall be able to disable those alarms at run-time from the “Alarm-Control” screen such that the alarm will not be triggered irrespective of the actual alarm condition in the field. When alarms have been disabled, all screens shall display a warning that alarms have been disabled.

2.11.2 Trending:

.1 The system shall be configured to record, recall and simultaneously graph a minimum of four (4) analog trends over any specified time base.

.2 A trend screen selection box shall allow an operator to select separate trend periods for each of the two trend charts displayed on the screen by entering the time and date for which the information is required.

.3 Each trend, scale and legend shall be clearly displayed using different colours.

.4 Real time trends shall scroll from right to left.

.5 The printing shall be performed in conjunction with tasks on the control system simultaneously as a plot is generated and printed.

.6 The following trending shall be provided:

.1 TYPE 1 - SHORT TERM

Accessible for a period of not less than 30 days. The sample interval shall be 1 minute.

.2 TYPE 2 - HISTORICAL ANALOG

Logged at 30 minute intervals using a sample interval of 1 minute. Provision for discontinuation data logging on a trend by trend basis during pre-defined periods by changing a single data point in the control logic for each trend to be disabled. Record maximum, minimum, total and average values.

.3 TYPE 3 - HISTORICAL EVENTS

The system shall log event trends including runtimes, number of starts and stops, and specific alarm occurrences. Provision shall be made for disabling data logging during pre-defined periods by changing a data point in control logic for each trend to be disabled.

.7 It shall be possible to add no less than 10 additional trends to each trend type without disabling data collection for trends already defined or changing the database configuration.

.8 Provision shall be made for removal of individual trends from each trend type without disabling other trends already defined or changing the database,

.9 Trend removal shall not place restrictions on accessibility of information previously stored on the system.

2.11.3 Historical:

.1 The system shall use a report function point as the report generator.

.2 The data, once stored by the database server shall be accessible by Microsoft Excel or Access.

.3 The software shall recognize database gaps caused by system shutdown or disabling of portions thereof due to power failure, or system maintenance, by indicating the data is not available. Missing data shall not restrict access to data preceding or following the gap.

.4 Security measures shall be implemented in order to ensure data integrity. Only supervisory staff with knowledge of the appropriate passwords shall be able to access data in the historical database.

.5 The database shall provide for the storage of 3 months (minimum) of data on-line all times.

.6 It shall be possible to report the values of analog trends and average, maximum and minimum values for analog trends between certain hours, on specified days of the week, during specified months, during specified years.

2.11.4 Reports:

.1 The system shall be configured to allow “Ad-hoc” inquiries of historical data simply by entering the necessary parameters into a pre-defined spreadsheet template.

.2 Spreadsheet templates shall be provided to automate the generation of monthly summary reports, annual summary reports, monthly equipment run-time reports, annual equipment run-time reports, monthly chemical usage reports, annual chemical usage reports, monthly operational reports.

.3 The network data collection workstation shall be equipped with a CD-R/W drive. All reports configured via the report point shall be directed and stored on a R/W disk. The operator shall have the ability to make backup copies of data.

2.11.5 Screen Development:

.1 All screen development shall be fully windows compliant and make optimal use of pop-up windows, scroll bars, and push buttons.

.2 It shall be possible to perform all control actions with a mouse type pointing device.

.3 Devices shall be animated to show them as running and shall change colour to indicate status where feasible.

.4 Pop-up windows shall be used to display additional information and/or to allow set point selection and operational changes.

.5 Any and all information shall be capable of being displayed on more than one screen and be simultaneously displayed in more than one format (eg: bar chart and analog format).

.6 Critical dialogue box overlay pop-up windows shall be used to enable changes to devices shown on the underlying screen. The pop-up box shall support keyboard data entry, mouse, pick-up and dynamic mouse scroll bars for selection of analog input values.

2.11.6 Security:

.1 It shall not be possible to modify system configuration, without having sufficient security clearance.

.2 Four distinct system security levels shall be provided as follows:

.1 Level 1 - Supervision only.

.2 Level 2 - Supervision and control.

.3 Level 3 - Supervision, control and access to the operating system.

.4 Level 4 - Configuration, supervision, control and access to the operating system.

2.12 TEMPERATURE TRANSMITTERS

2.12.1 General:

.1 All temperature sensors shall 100 ohm platinum RTDs.

2.12.2 Space Temperature Transmitters; Applicable to 2440-TT-VSG-0004 and 2440-TT-VSE-0001:

.1 Vandalproof Transmitters:

.1 100 ohm platinum Type RTD, IEC 751, 385 Alpha, thin film.

.2 Wall mount.

.3 Stainless steel plate.

.4 Dimensions: to suit standard concealed electrical wall enclosure.

.5 4-20mA output.

.6 Temperature range: 0 to 50ºC (transmitter).

.7 Power supply: 15 to 35 VDC or 22-32 VAC.

.8 Connections: 2 or 3 wire.

.9 Accuracy: ±0.1% of span.

.10 .Acceptable product: Greystone TE500AS21A2, BAPI, Honeywell, Johnson Controls, Veris, or accepted equal.

2.12.3 Duct temperature transmitters; applicable to 2440-TT-VSG-0001, 2440-TT-VSG-0002, and 2440-TT-VSG-0003

.1 Insertion

.1 100 ohm, platinum Type RTD, IEC 751, 385 Alpha, thin film.

.2 Duct mount.

.3 ABS enclosure.

.4 450 mm probe length.

.5 304 Stainless steel probe material.

.6 Sensor to be encapsulated in 6.35 mm outside diameter probe.

.7 4-20mA output

.8 Temperature range: 0 to 100ºC (transmitter).

.9 Accuracy: ±0.1% of span.

.10 Power supply: 15 to 35 VDC or 22 to 32 VAC.

.11 Connections: 2 or 3 wires.

.12 Acceptable product: Greystone TE500B-2F21A3, BAPI, Honeywell, Johnson Controls, Veris, or accepted equal.

2.13 A/C CURRENT SENSOR

2.13.1 Applicable to current sensors: 2440-IT-VSG-0001, 2440-IT-VSE-0001 and 2440-IT-VSE-0002.

2.13.2 Solid state current sensing transducer that converts a primary circuit current to a proportional output signal.

2.13.3 Maximum input current: 80/120/180 Amps continuous.

2.13.4 Three (3) selectable ranges:

.1 Low: 0-10 Amps.

.2 Mid: 0-20 Amps.

.3 High: 0-50 Amps.

2.13.5 Environment: -30ºC to 70ºC, 0-95% RH non-condensing.

2.13.6 Response time: 100 mS (0-90%).

2.13.7 Material: self-extinguishing ABS.

2.13.8 Split core design.

2.13.9 Dimensions: 70 x 87 x 30 mm.

2.13.10 Output: 0-10 Vdc.

2.13.11 Induction powered.

2.13.12 Accuracy: ±1% full span.

2.13.13 Frequency: 40-100 Hz.

2.13.14 Protection circuitry: reverse voltage protected and output limited.

2.13.15 Acceptable product: Greystone SC-551-1, Veris, BAPI, Honeywell, Johnson Controls, or accepted equal.

2.14 DIFFERENTIAL PRESSURE TRANSDUCER

2.14.1 Application: Filter Pressure Drop; applicable to: 2440-PDT-VSG-0001 and 2440-PDT-VSE-0001

2.14.2 Measured Variable: Differential Pressure.

2.14.3 Power Supply: 12-24 VDC/24VAc

2.14.4 Output Signal: 4-20 mA

2.14.5 Pressure Range: 124 Pa to 1240 Pa.

2.14.6 3 Wire Connection.

2.14.7 Accuracy: +/- 1% F.S.O.

2.14.8 Overpressure: 138 kPa

2.14.9 Operating Humidity: 90%R.h. non-condensing

2.14.10 Load Resistance: 250 ohm

2.14.11 Operating Temperature: -25°C to 70°C

2.14.12 Acceptable Product: Autotron 860D-30, Veris, BAPA, Honeywell, Johnson Controls or accepted equal.

2.15 ELECTRIC ISOLATION RELAY

2.15.1 Supply and install relays with SPDT contacts capable of switching:

.1 15 Amps at 120 VAC and with a 24 VAC coil rated at 46 mA.

.2 10 Amps at 110 VAC and with a 120 VAC coil rated at 9.2 mA.

.3 7.5 Amps at 100 VAC and with a 110 VAC coil rated at 21.8 mA.

2.15.2 Provide each relay with a NEMA 1 general purpose electrical enclosure with lockable cover sized to suit. Terminals shall be plug-in/solder type.

2.15.3 Acceptable product: Omron General Purpose LY2 Relays, Honeywell, Johnson Controls, or accepted equal.

2.15.4 Controls Subcontractor to determine appropriate relay to utilize for each respective application.

2.16 CONTROL TRANSFORMER

2.16.1 Comply with NEMA Standard DC20-1992 for voltage-regulating ability.

2.16.2 CSA certified.

2.16.3 Energy limiting winding.

2.16.4 Primary voltage: 120/1/60.

2.16.5 Secondary voltage: 24 VAC.

2.16.6 Transformer VA capacity to be sized by contractor to suit the application. Do not exceed 100 VA on any one (1) single low voltage control transformer.

2.16.7 Provide independent control transformer for PLC controllers with full wave rectifiers.

2.16.8 Provide separate control transformer for actuators controlled from PLC controller with full wave rectifiers.

2.16.9 Acceptable product: Marcus Indoor Type MC enclosed style single phase transformer, Honeywell, Johnson Controls, or accepted equal.

2.17 HIGH TEMPERATURE SWITCH (FIRESTAT)

2.17.1 Where shown on the drawings or described in the sequences of operation for individual systems, provide high temperature cut-out to shut down respective fan system. Applicable to: 2440-TSH-VSG-0001.

2.17.2 Rod and tube type sensing element.

2.17.3 Two position manual reset type.

2.17.4 Set at 57ºC to shut down fan equipment.

2.17.5 UL approved.

2.17.6 Switch action: SPST open high.

2.17.7 Range: -4°C to 102°C.

2.17.8 Range adjuster: knob.

2.17.9 Electric rating: 125 VA @ 24 to 600 VAC.

2.17.10 Acceptable product: Johnson Controls A25AN-1, Honeywell, Greystone, Veris, BAPI, or accepted equal.

2.18 LOW TEMPERATURE SWITCH (FREEZESTAT)

2.18.1 Where shown on the drawings or described in the sequence of operation for individual systems, provide low temperature cut-out to shut down respective fan system. Applicable to: 2440-TSL-VSG-0001

2.18.2 4 wire, 2 circuit contact block with two (2) sets of isolated contacts.

2.18.3 Contacts shall be long-life, snap-acting. Contacts switch action shall be open low.

2.18.4 Range: -10 to 15°C.

2.18.5 Range adjustment: screw driver slot.

2.18.6 Manual reset type with setpoint adjustment.

2.18.7 6 m long 3.2 mm diameter vapour charged sensing element installed completely across either air handling unit casing internal cross section or duct cross section.

2.18.8 When any 300 mm long section of the element senses a temperature as low as the setpoint, the contacts shall open.

2.18.9 Set at 0°C to shut down fan equipment.

2.18.10 Electrical: pilot duty 125 VA @ 24 to 600 VAC.

2.18.11 Acceptable product: Johnson Controls A70HA-1C, Honeywell, Greystone, Veris, BAPI, or accepted equal.

2.19 AUTOMATIC CONTROL DAMPERS

2.19.1 Low leakage: all control dampers shall be low leakage type unless otherwise specified.

2.19.2 Damper construction: specified in Section 23 33 15 – Dampers – Operating.

2.19.3 All control dampers are to be the responsibility of the Mechanical Subcontractor. The Controls Subcontractor shall be responsible to supply and install electric damper actuators.

2.20 DAMPER ACTUATORS (GENERAL)

2.20.1 Electronic actuation shall be provided.

2.20.2 The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assembly shall be of a "V" bolt design with associated "V" shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a "V" clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 27 mm when the damper is constructed in this manner. Single bolt or set screw type fasteners are not acceptable.

2.20.3 The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.

2.20.4 For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.

2.20.5 All spring return actuators shall be capable of both clockwise and counterclockwise spring return operation by simply changing the mounting orientation.

2.20.6 Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. All proportional actuators shall provide a 2 to 10 VDC position feedback signal.

2.20.7 All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 watts for DC applications. Actuators operating on 120 VAC power shall not require more than 10 VA.

2.20.8 All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 6.7 N-m torque capacity shall have a manual crank for this purpose.

2.20.9 All proportional actuators shall have an external, built-in switch to allow the reversing of direction of rotation.

2.20.10 Actuators shall be provided with a conduit fitting and a minimum 1 m long electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

2.20.11 Actuators shall be Underwriters Laboratories Standard 873 listed and Canadian Standards Association Class 4813 02 certified as meeting correct safety requirements and recognized industry standards.

2.20.12 Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a 2-year manufacturer's warranty, starting from the date of project completion. Manufacturer shall be ISO9001 certified.

2.21 SMALL DAMPER ACTUATOR (TWO POSITION)

2.21.1 Provide in following locations:

.1 2440-Z-VSE-0001

.2 2440-Z-VSE-0002

.3 2440-Z-VSE-0003

2.21.2 Direct coupled, spring return.

2.21.3 Provide complete with mounting bracket and screws.

2.21.4 95 degree angular rotation.

2.21.5 4 N•m torque capacity.

2.21.6 Running time for 95 degree stroke rotation to be 75 seconds.

2.21.7 Power supply: 24 VAC.

2.21.8 Power consumption: 5 watts running, 2.5 watts holding.

2.21.9 Transformer sizing: 7 VA.

2.21.10 Control signal: on/off SPST.

2.21.11 Provide complete with auxiliary switch, SPDT rated 3A @ 250 VAC.

2.21.12 Acceptable product: Belimo LF24-S US, Honeywell, Johnson Controls, or accepted equal.

2.22 SMALL DAMPER ACTUATOR (MODULATING)

2.22.1 Provide in following locations:

.1 2440-Z-VSG-0001

.2 2440-Z-VSG-0002

.3 2440-Z-VSG-0006

2.22.2 Direct coupled, spring return.

2.22.3 Provide complete with mounting bracket and screws.

2.22.4 95 degree angular rotation.

2.22.5 4 N.m torque capacity.

2.22.6 Running time for 95 degree stroke rotation to be 150 seconds.

2.22.7 Power supply: 24 VAC.

2.22.8 Power consumption: 2.5 W running, 1.0 watts holding

2.22.9 Transformer sizing: 5 VA.

2.22.10 Control signal: 2-10 VDC.

2.22.11 Input Impedance: 100,000 ohm for 2-10 VCD (0.1 mA)

2.22.12 Provide complete with 2-10 VDC, 0.5 mA maximum feedback position signal.

2.22.13 Provide complete with one (1) SPDT auxiliary switch rated 3A @ 250 VAC.

2.22.14 Acceptable product: Belimo LF24-MFT-S US, Honeywell, Johnson Controls, or accepted equal.

2.23 LARGE DAMPER ACTUATOR (TWO POSITION)

2.23.1 Provide in the following locations:

.1 2440-Z-VSG-0003 (4 total)

.2 2440-Z-VSG-0005 (4 total)

2.23.2 Direct coupled, spring return.

2.23.3 Provide complete with mounting bracket and screws.

2.23.4 95 degrees angular rotation.

2.23.5 20 N.m torque capacity.

2.23.6 Running time for 95 degree stroke rotation to be 75 seconds.

2.23.7 Power supply: 24 VAC.

2.23.8 Power consumption: 5 watts running, 2.5 watts holding.

2.23.9 Transformer sizing: 7.5 VA.

2.23.10 Control signal: on/off SPST

2.23.11 Provide complete with two (2) SPDT auxiliary switches rated 3A @ 250 VAC.

2.23.12 Acceptable product: Belimo AFB24-S, Honeywell, Johnson Controls, or accepted equal.

2.24 LARGE DAMPER ACTUATOR (MODULATING)

2.24.1 Provide in the following locations:

.1 2440-Z-VSG-0004 (2 Total)

2.24.2 Direct coupled, spring return

2.24.3 Provide complete with mounting bracket and screws

2.24.4 95 degree angular rotation

2.24.5 20 N.m torque capacity

2.24.6 Running time for 95 degree stroke rotation to be 75 seconds.

2.24.7 Power supply: 24 VAC

2.24.8 Power consumption: 7.5 watt running, 3 watt holding.

2.24.9 Transformer sizing: 10 VA

2.24.10 Control signal: 2-10 Vdc

2.24.11 Input impedance: 100,000 ohm for 2-10Vdc (0.1 mA)

2.24.12 Provide actuator with 2-10 Vdc, 0.5 ohm mA maximum feedback position signal

2.24.13 Provide complete with two (2) SPDT auxiliary switches rate 3A @ 250 VAC

2.24.14 Acceptable product: Belimo AFB24-MFT-S, Honeywell, Johnson Controls or accepted equal.

2.25 LOCAL CONTROL PANELS

2.25.1 Applicable to control panels: 2440-CP-VSE-0001 and 2440-CP-VSG-0001.

2.25.2 All control panels shall be factory constructed by the PLC supplier, incorporating the control system manufacturer's standard designs and layouts. Control panels shall be NEMA 4 fully enclosed, with hinged door, and key-locking latch.

2.25.3 In general, the control panels shall consist of the PLC controller(s), and I/O devices - such as relays, transducers, and so forth - that are not required to be located external to the control panel due to function.

2.25.4 All I/O connections on the PLC shall be extended to a numbered, colour-coded, and labelled terminal strip for ease of maintenance and expansion. Wiring to I/O devices shall be made from this terminal strip.

2.25.5 All other wiring in the panel, internal and external, shall be made to additional line or low voltage colour-coded and labelled terminal strips. Low and line voltage wiring shall be segregated. All terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.

2.25.6 All wiring for every control panel shall follow a common colour-coded format. All terminal strip colour coding and numbering shall follow a common format. All wiring shall be neatly installed in plastic trays or tie-wrapped.

2.25.7 Wiring terminations from field control devices to PLC controllers inside local control panels shall be the responsibility of the Controls Subcontractor.

PART 3 EXECUTION

3.1 PLC INTERFACING AND PERIPHERALS

3.1.1 The programming means shall be a Microsoft Windows based desktop/portable.

3.1.2 Programming software must run on Windows 98/ME/NT/2000/2003 Server/XP, Vista, or Windows 7 environments.

3.1.3 The programming software and the controller shall support online editing.

3.1.4 The programming terminal shall be compatible for interfacing with an electrical service of either 120 VAC, 50/60 Hz. or 220 VAC, 50/60 Hz.

3.1.5 The terminal shall provide for selecting the communication rate between 110 and 38400 baud for RS-232-C communications.

3.1.6 The programming terminal shall be capable of displaying a rung consisting of a maximum of seven (7) series elements and six (6) parallel elements.

3.1.7 The means to indicate contact or output status shall be by intensification or color change of the contact or output on the CRT screen. Each element's status shall be shown independently, regardless of circuit configuration.

3.1.8 The controller system shall be able to interface with a data terminal which is RS-232-C compatible (up to 38400 baud) to generate hard copy logic diagrams and/or message generation.

3.1.9 The system shall have the capability to interface to a CD, DVD and/or a hard disk for loading a user program into, or recording the contents of, the processor's memory. It shall be possible to load or record the entire contents or selected portions of memory.

3.1.10 The controller must also have a small easy to use operator interface (OI) specifically designed to enhance operator interaction with the control system. The OI device should be panel mountable. Features required are menuing capabilities, security features, active display of data, limit test of entered data, and scaling of data to and from the controller. The system should make use of intuitive on screen programming features. All OI programs must be capable of being saved to disk and transported to other OI devices or programming computers. OI programs should be transferred via a RS-232 serial communications link between the computer and the OI device.

3.2 PLC PROGRAMMING TECHNIQUES

3.2.1 The programming format shall be relay ladder diagram.

3.2.2 It shall be possible to program a maximum instruction matrix containing as many as 128 instructions.

3.2.3 The capability shall exist to change a contact from normally open to normally closed, add instructions, change addresses, etc. It shall not be necessary to delete and reprogram the entire rung.

3.2.4 It shall be possible to insert relay ladder diagram rungs anywhere in the program, even between existing rungs, provided there is sufficient memory to accommodate these additions.

3.2.5 It shall be necessary to issue a two part command in order to delete all relay ladder rungs from memory. This will provide a safeguard wherein the operator must verify their intentions before erasing the entire program.

3.2.6 Latch functions shall be internal and programmable.

3.2.7 The system shall have the capability to address up to 10K words of data.

3.2.8 The system must support up to 255 data files. Each data file must be configurable from 1 to 255 data elements, and type (timers, counters, integer (16 or 32bit), string, message or PID) Any number of timers, counters and internal bits up to a maximum of 10k words of data.

3.2.9 All management of instructions and data in memory shall be handled by the CPU. Instructions shall permit programming timers in the "ON" or "OFF" delay modes. Timer programming shall also include the capability to interrupt timing without resetting the timers. Counters shall be programmable using up-increment, down-increment or both. All timer and counter data must be accessible from the ladder program and also any communications device.

3.2.10 Timer instructions shall include selectable time bases in increments of 1.0, 0.01, and 0.001 second. The timing range of each timer shall be from 0 to 32,767 increments. It shall be possible to program and display separately the timer's preset and accumulated values.

3.2.11 The controller shall use a signed integer data format. The signed integer format (-32,768 to +32,767) must be used throughout the controller, (counters, storage registers, math operations etc).

3.2.12 The controller shall support signed integer math functions consisting of addition, subtraction, multiplication, division, scale with parameters, and square root.

3.2.13 Instructions shall be provided for file manipulation instructions such as “file fill”, “first in-first out”, “last in-first out” shall be supported by the system. Four function math instructions and instructions for performing "logical OR", "logical AND", "exclusive OR", and comparison instructions such as "less than", "greater than", and "equal to" shall be included within the system. All instructions shall execute on either single words, double words or files.

3.2.14 The system shall contain instructions for reading, writing, and manipulation of ASCII data. Instructions such as string extraction, concatenation, and byte swapping of data.

3.2.15 The system shall contain instructions which will construct synchronous 16 bit word shift registers. Additional instructions shall be provided to construct synchronous bit shift registers.

3.2.16 The controller shall have a jump instruction which will allow the programmer to jump over portions of the user program to a portion marked by a matching label instruction.

3.2.17 The controller shall have an instruction which will allow the programmer to display a combination of bits, integers and strings to the embedded HMI and optionally to receive bits, integers, or long integers from the HMI.

3.2.18 In applications requiring repeatable logic rungs it shall be possible to place such rungs in a subroutine section. Instructions which call the subroutine and return to the main program shall be included within the system. It shall be possible to program several subroutines and define each subroutine by a unique label. The processor will support nesting of subroutines. The program format as displayed on the CRT shall clearly define the main program and all subroutines.

3.2.19 The program format shall display all instructions on a CRT programming panel with appropriate mnemonics to define all data entered by the programmer. The system shall be capable of providing a "HELP" instruction which when called by the

programmer will display on the CRT a list of instructions and all data required to enter an instruction into the system memory.

3.2.20 At the request of the programmer, data contained in system memory shall be displayed on the CRT programming panel. This monitoring feature shall be provided for input/output status, timer/counter data, files, and system status. Ladder logic rungs shall be displayed on the CRT with rung numbers in sequential order.

3.2.21 The system shall have the capability to enter rung comments above ladder logic rungs. These comments may be entered at the same time the ladder logic is entered.

3.2.22 It shall be possible to manually set (force) either on or off all hardwired input or output points. Removal of these forced I/O points shall be either individually or totally through selected keystrokes. The programming terminal shall be able to display forced I/O points.

3.2.23 The execution of the program logic shall be accelerated by scanning the rung only until a positive decision as to the state of the outputs has been made. In many cases this will mean skipping over logic elements if the output condition has been predetermined.

3.2.24 A means to program a fault recovery routine shall exist. When a major system fault occurs in the system, the fault recovery routine shall be executed and then the system shall determine if the fault has been eliminated. If the fault is eliminated, program execution resumes. If the fault still exists, the system will shut down.

3.2.25 An interrupt routine shall be programmable such that the routine shall be executed regularly. The interval at which the routine is executed shall be user-specified in the range of 1 to 32767 milliseconds in 1 msec increments. This routine must be able to close an asynchronous control loop consisting of 32 Input points, 32 output points, 100 contact/coils, 10 addition instructions, 10 subtraction instructions and 32 circular comparison (Limit) instructions while never exceeding a 3 millisecond interval. The measurement of this interval is from after the Input filter delay time to the time that the physical outputs start to transition.

3.2.26 The ability to program ladder logic via symbols from the global database of the packaged controller shall exist.

3.2.27 The CPU shall support indirect addressing of inputs and outputs, along with all data table words (integer, binary, timers, and counters) for the software instruction set.

3.2.28 The system shall support both bit and word level diagnostic instructions.

3.2.29 To facilitate conditional event detection programming, output instructions shall include a "one shot" instruction which may be triggered on the low-to-high (rising) rung condition.

3.2.30 The processor shall support Master Control Reset (Relay) type functionality to selectively disable sections of relay ladder logic.

3.3 DYNAMIC ANIMATED COLOUR GRAPHIC DISPLAYS

3.3.1 System displays shall show all analog and binary object types within the system.

3.3.2 Provide dynamic system graphics incorporating all analog and binary object types within the system. The graphics shall incorporate all controls as indicated on the drawings and specified herein. The graphics shall include but shall not be limited to the following:

.1 The floor plan of the Electrical Spillway Building shall indicate all PLC controllers, all controlled mechanical and electrical equipment, all electric starters and control panels, room names and numbers, etc. All equipment and controllers shown on floor plan shall be considered as ‘hot’ key, such that clicking on that particular item shall bring up the full colour graphic associated with that item.

.2 HVAC system associated with 2440-FAN-VSG-0001.

.3 Diesel generator/recirculation damper system

.4 Heat relief system associated with 2440-FAN-VSE-001 and 2440-FAN-VSE-0002

3.3.3 Colour graphic displays, and system schematics shall be provided in order to optimize system performance analysis, speed alarm recognition, and simplify user interaction. The Controls Subcontractor shall fully configure the colour graphics and plot all associated control/monitoring points on the screen. Electronic copies of all colour graphics screens shall be provided to the Engineer for approval. The process shall be on-going during the control system installation to enable the Engineer to properly review the graphics. It is the intention that the colour graphic submissions occur frequently throughout the control system construction period so that the Engineer can comment on and revise the graphics until a satisfactory product is achieved.

3.3.4 Dynamic values and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention.

3.3.5 The 'As-Built' sequence of operation in text form shall be available for each piece of equipment on its respective graphic through activation of a dedicated 'sequence' button. The text files shall be Microsoft Word documents.

3.3.6 The operator graphical interface shall allow users to access the various system schematics via a graphical penetration scheme, menu selection, or text-based commands. The operator shall be able to point to and click on a piece of equipment and display an animated flow diagram of the equipment, with all control and monitoring points associated with that piece of equipment, including set points. Set points shall be capable of being overridden or modified from this screen.

3.3.7 The windowing environment shall allow the user to simultaneously view several graphics at the same time to analyze total system operation, or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

3.4 FACTORY TESTING

3.4.1 Standard factory test reports on system components shall be provided for engineers approval.

3.4.2 Three (3) copies of factory test reports required for submittals.

3.5 INSTALLATION

3.5.1 Install PLC equipment, cabling, control, and peripheral devices in accordance with drawings and manufacturer recommendations.

3.5.2 The Controls Subcontractor shall provide the services of a certified factory-trained manufacturer's representative to assist in the installation and start-up of the equipment specified under this section for a minimum period of five (5) working days. The manufacturer's representative shall provide technical direction and assistance in general assembly of equipment, connections and adjustments, and testing of the assembly and all system components. Provide name and credentials of manufacturer's representative to Engineer for review prior to arrival on site. Engineer reserves right to approve or disapprove of manufacturer's representative.

3.5.3 The following minimum work shall be performed by the Controls Subcontractor under the technical direction of the manufacturer's service representative:

.1 Install logic programming.

.2 Start-up/Run/Check programming scheme.

.3 Check proper operation of PLC.

3.5.4 A qualified factory-trained manufacturer's representative shall certify in writing that all equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

3.5.5 The Controls Subcontractor shall provide three (3) copies of the manufacturer's representative's certification.

3.5.6 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

3.5.7 Temperature transmitters, controllers, relays: install in CSA 2 enclosures or as specified. Provide for electrolytic isolation in all cases when dissimilar metals make contact.

3.5.8 Support field-mounted transmitters as required.

3.5.9 Install wall mounted devices and control tubs on plywood panel properly attached to wall. Supply and installation of plywood shall be the responsibility of the Contractor. Plywood shall be good one side. Plywood panels shall be painted by the Contractor to match the wall colour onto which they are to be mounted.

3.6 TEMPERATURE TRANSMITTERS

3.6.1 Stabilize to ensure minimum field adjustments or calibrations.

3.6.2 To be readily accessible and adaptable to each type of application so as to allow for quick easy replacement and servicing without special tools or skills.

3.6.3 Outdoor installation:

.1 Protect from solar radiation and wind effects.

.2 Install in CSA 4X enclosures.

3.6.4 Duct installations:

.1 Do not mount in dead air space.

.2 Location to be within sensor vibration and velocity limits.

.3 Thermally isolate elements from brackets and supports so as to respond to air temperature only.

.4 Support sensor element separately from coils, filter racks.

3.7 PANELS

3.7.1 Arrange for conduit and tubing entry from top, bottom or either side.

3.7.2 Use modular multiple panels if necessary to handle all requirements.

3.7.3 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

3.7.4 Identify wiring and conduit clearly.

3.8 FIELD MOUNTED TRANSMITTERS AND SENSORS

3.8.1 Support properly.

3.8.2 Install wall mounted devices on plywood panel attached properly to wall.

3.9 FIELD QUALITY CONTROL

3.9.1 The Controls Subcontractor shall demonstrate that the system is functioning within the specified criteria.

.1 Demonstration is to validate 100% of the data points operation and include the operation of 100% of the connected field points.

3.9.2 Engineer or representative may use any device or material provided under this contract or otherwise to make tests before Final Acceptance.

3.9.3 The Controls Subcontractor shall be responsible for any equipment damage or injury during testing.

3.9.4 Provide the full commissioning of the system after all equipment is in operation. Commissioning to include a completed detailed calibration and functional check of every separate point, together with a complete run-through of all functions on all systems connected to ensure that all equipment, systems and circuits are functioning as specified. Commissioning to include but not limited to:

.1 Confirm all control points are connected and operating.

.2 Confirm all equipment controlled by the control system are functioning properly.

.3 Confirm all sensors are calibrated and installed correctly.

.4 Verify all sequences. Provide all necessary additional programming required to achieve a fully functional system.

.5 Verify all control system alarms.

.6 Verify all graphical representations.

.7 Review maintenance procedures with manufacturer's representative and provide training.

3.9.5 Not used.

3.9.6 Not used.

3.10 FIELD POINTS TESTING

3.10.1 This step shall verify that all of the installed points receive or transmit the correct information. All binary input points are to be tested using the HAND / OFF / AUTOMATIC selector switch on the associated motor starter or by manually jumpering across the field device contacts.

3.10.2 All analog output points shall be tested using a command from the operator workstation to modulate the output device from minimum calibrated signal to maximum calibrated output.

3.10.3 All analog input points are to be tested by comparing the reading obtained through the operator workstation or portable terminal to the value of an independent testing meter.

3.11 IDENTIFICATION OF EQUIPMENT

3.11.1 Identify each piece of control equipment with sticker identifying the equipment and functions with a letter and number designation.

3.11.2 Sticker shall be minimum size 75 mm x 25 mm of plastic construction with white lettering. Stickers shall be securely attached to the control devices and equipment by adhesion.

3.12 INPUT/OUTPUT POINTS LIST

3.12.1 Provide all analog and binary object types as required to provide control system as outlined on the drawings and described in the systems operating sequences.

3.12.2 See Input/Output Schedules for the PLC on drawings.

3.13 TRAINING

3.13.1 The Controls Subcontractor to provide practical instruction for personnel designated by the Company. Such instruction to emphasize operation and operational maintenance of the entire system and must be carried out on site.

3.13.2 Phase 1:

.1 This session of training is to introduce the concepts of programmable logic control methods and equipment. It is intended that this session lay the ground work for the following session. The topics to be covered are as follows:

.1 Introduction to Programmable Logic Control.

.2 System overview.

.3 Identification of Control Components.

.4 Review of shop drawings for the building.

.5 Detailed discussion of sequences of operation.

.6 Walk through of mechanical and electrical.

3.13.3 Time period shall be 8 hours (1 day) and shall commence when the installation is 80% complete. This phase of training shall not require the systems to be fully functional, but is intended to give the attendees a familiarity with the equipment being installed and a solid ground work for Phase 2.

3.13.4 Phase 2:

.1 This session of training shall consist of a complete review of the control system as installed. The Controls Subcontractor shall ensure that at the conclusion of this training the field operating staff are competent to carry out the monitoring and control of the mechanical systems installed.

.2 Time period shall be 8 hours (1 day) and shall commence within 1 month of completion. This phase of the training is intended to highlight any deficiencies in the operators understanding of the control system and identify if further training shall be required.

3.14 SEQUENCE OF OPERATION

3.14.1 Fan 2440-FAN-VSG-0001:

.1 The HVAC system is an indoor, recirculatory style system complete with an economizer, filter section, electric heating coil, and supply fan. The system shall function to heat and ventilate the Generator Room. The addition of the economizer shall allow the system to provide free cooling when available.

.2 The description of operation for the system is as follows:

.1 When the fan is shut down, the outdoor air and exhaust air dampers are closed, and the return air damper is open. When the fan is shut down, all alarm change of state processing associated with the fan shall be suspended.

.2 The fan is stopped/started by a binary output from the PLC. The schedule of operation of the unit shall be provided by the Company and shall be integrated into software by the Controls Subcontractor. Outside the schedule of operation, the fan shall be started on a call for space heating.

.3 The supply fan starter control circuit shall have the following devices wired in series:

.1 Firestat (Discharge Duct)

.2 Low Limit Thermostat on leaving side of heating coil.

.3 Fire alarm Shut Down Contact If all of these devices are in their closed positions, then the start circuit to the supply fan is completed.

.4 When the unit is started, the outdoor air and exhaust dampers shall commence to open and the normally open return air damper shall commence to close. A PI control loop shall control the 0-10 VDC control output to each of the three (3) dampers. The PI loop output shall be ramped from 0 to 100% over a two minute period. Simultaneously another reverse PI control loop shall attempt to maintain the mixed air temperature at set point. The PLC shall select the lowest of the two outputs to control the damper actuators. After the two minute ramp has timed out after start-up the PLC shall control the economizer dampers off of mixed air temperature only.

.5 The supply air temperature shall be controlled by the Generator Room space temperature sensor. The PLC shall be responsible for resetting the unit discharge air temperature. The SAT limits shall be as follows:

SAT
13^{o}C (min)
18.3^{o}C (max)

.6 Supply air temperature control:

.1 The exhaust, outdoor and return air dampers shall be modulated to maintain a mixed air temperature equal to the supply air set point less an adjustable offset to account for fan heat. An initial value of 2oC shall be input into the PLC to account for this offset. This offset shall be adjustable.

.2 The heating coil has two (2) modes of operation, which are dependent on the mixed air temperature:

Mode 1: mixed air temperature is more than 2°C below the supply air set point less the offset. The heating coil signal increases as the supply air temperature falls below set point and decreases as the supply air temperature rises above set point.

Mode 2: mixed air temperature is not more than 2°C below the supply air set point less the offset. The heating coil output is set to 0%.

.7 The fan shall be equipped with a high limit thermostat in the supply duct to shut the unit down should it detect temperatures exceeding 57°C.

.8 A low limit thermostat in the leaving air side of the electric heating coil shall be set to open at 0°C. If this thermostat opens the supply fan will be de-energized. This device is to be manually reset.

.9 The supply fan filter bank is to be equipped with a differential pressure transducer, which shall measure the differential pressure across each filter bank and signal an alarm to the OWS if the measured differential pressure exceeds the pre determined set point. This set point shall be user adjustable and initially set at 248 kPa. This alarm shall be classified as a HVAC minor alarm and notification with a digital output shall be made to the main control room.

.10 An AC current sensor in the fan starter shall provide an analog input to the PLC proportional to the current draw of the fan motor for fan status indication. If the fan is commanded on and no current is detected at the AC current sensor within 30 seconds, then an alarm event shall register at the OWS. This alarm shall be classified as HVAC major alarm and notification via a digital output shall be made to the main control room.

.11 The system shall be capable of free cooling through economizer damper modulation. The space temperature and outdoor air temperature shall be used to determine if free cooling is available.

.12 The minimum economizer position shall be set to 20% to provide minimum fresh air.

.13 A single flat plate temperature transmitter shall be installed in the Generator Room.

.14 Space temperature set point shall be adjustable from the OWS. The preliminary occupied set point shall be 5°C. The preliminary unoccupied set point shall be 5°C.

.15 The space temperature shall be monitored for extremes at all times. The space maximum and minimum temperatures shall be user adjustable from the OWS. The preliminary space maximum temperature shall be 50°C and the preliminary space minimum temperature shall be 0°C. If these limits are exceeded, respective alarms shall be generated at the OWS. These alarms shall be classified as HVAC major alarms and notification via a digital output shall be made to the control room.

3.14.2 Diesel Generator Radiator Dampers:

.1 The outdoor air and exhaust air damper actuators (8 total) shall be spring return, normally opened, two position dampers. These dampers shall be controlled from the start circuit for the diesel generator and shall not be controlled by the PLC. These dampers shall be powered closed when the diesel generator is not in operation and opened via a relay linked to the start command from the diesel generator.

.2 A normally opened contact from the start command relay shall be used to provide indication of diesel genset operation to the PLC.

.3 The recirculation air damper actuators (2 total) shall be spring return, normally closed, modulating dampers. These dampers shall be controlled from the PLC based on space temperature. When the start command signal is received, the recirculation damper shall be modulated with a PI loop to maintain the space temperature at set point. When the start command signal is absent these dampers shall be closed.

3.14.3 Fans 2440-FAN-VSE-0001 & 2440-FAN-VSE-0002:

.1 These fans serve as the heat relief exhaust system for the Electrical Room.

.2 These fans shall be started/stopped by the PLC.

.3 A single flat plate temperature transmitter shall be installed in the Electrical Room.

.4 The fans shall be controlled in a two-stage lead/lag arrangement based on the deviation from space temperature set point. A PI loop shall attempt to maintain the space at set point. At 50% signal the lead fan shall start and at 100% signal the lag fan shall start. The lag fan shall be stopped at 50% and the lead fan shall be stopped at 0%. The designation of lead/lag shall be alternated based on run hours between both exhaust fans. Total run hours for each fan shall be displayed on the system graphic.

.5 A fire alarm contact shall be provided in each fan start circuit to prevent operation during a fire.

.6 When either exhaust fan is commanded on the receptive exhaust damper is energized and an isolation relay is energized for the intake damper. Either exhaust fan is capable of opening the common intake damper. Once the exhaust damper and intake dampers are fully open, the exhaust fan end switch shall make and the intake end switch isolation relay shall make, thereby allowing control power to energize the fan contactor coil and start the fan.

.7 The fan shall remain energized and run continuously until it is de-energized by the PLC.

.8 An AC current senor in each fan starter shall provide an analog input to the PLC proportional to the current draw of the fan motor for fan status indication. If the fan is commanded on and no current is detected at the AC current sensor within 30 seconds, then an alarm event shall register at the OWS. These alarms shall be classified as HVAC minor alarms and notification via a digital output shall be made to the main control room.

.9 The intake filter bank is to be equipped with a differential pressure transducer which shall measure the differential pressure across the filter bank and signal an alarm to the OWS if the measured differential pressure exceeds the pre-determined set point. This set point shall be user adjustable and initially set at 248 Pa. This alarm shall be classified as a HVAC minor alarm and notification via a digital output shall be made to the main control room.

.10 The space temperature shall be monitored for extremes at all times. The space maximum and minimum temperatures shall be user adjustable from the OWS. The preliminary space maximum temperature shall be 40°C and the preliminary space minimum temperature shall be 0°C. If these limits are exceeded, respective alarms shall be generated at the OWS. These alarms shall be classified as HVAC major alarms and notification via digital output shall be made to the main control room.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 00**
CH0032	**GENERAL ELECTRICAL REQUIREMENTS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 05 00

GENERAL ELECTRICAL REQUIREMENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
G. W. HAINES
SIGNATURE
1-Dec-2013
NEWFOUNDLAND & LABRADOR
Rev. D2

1 GENERAL

1.1 GENERAL

.1 This Section defines the common electrical requirements applicable to the design, manufacture, testing, transport and delivery to Worksite, storage, installation, commissioning, and setting out of the electrical work requirements for the equipment described in these specifications.

.2 If Contractor offers materials, equipment, design, calculations or tests which are in conformity with Standards other than those specified, Contractor shall submit full details of the differences between the proposed Standards and the specified Standard shall be supplied for Engineer's review and Acceptance.

.3 The Work shall include all labor, materials, parts and accessories that, even though not individually specified, are necessary to implement, operate and maintain a complete facility.

.4 All electrical equipment shall be adequately identified by securely attaching properly sized lamacoid labels. Equipment, cables and wiring identification numbering scheme shall be in accordance with documents MFA-SN-CD-3350-ME-LS-0003-01 and MFA-SN-CD-33430-EL-SD-0002-01. All design drawings shall properly reflect the identification numbering scheme.

.5 The materials, parts and accessories shall be supplied, installed and tested prior to Acceptance of the work.

.6 Electrical Equipment must be approved in accordance with the requirements of:

.1 CSA standards; or

.2 Other recognized documents, where such CSA standards do not exist or are not applicable; or

.7 Electrical equipment is considered approved when:

.1 The equipment has been certified by a certification organization accredited by the Standards Council of Canada as a certification body. and bears that organization's certification mark as evidence of having conformed to the appropriate Canadian Standards Association (CSA) standards established under the provisions of the Canadian Electrical Code; or

.2 The equipment has been field evaluated to CSA SPE 1000 by an inspection body accredited by the Standards Council of Canada as an inspection body.

1.2 RELATED REQUIREMENTS

.1 MFA-SN-CD-2000-ME-SP-0002-01; Preservation, Mechanical Completion and Commissioning Requirements.

1.3 REFERENCES

1.3.1 Unless otherwise specified in the Contract, the equipment covered by these specifications shall be in accordance with the latest issue of the following Standards at the time of contract award. Should conflict occur between the Standards mentioned below, the most stringent requirements shall govern.

1.3.2 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 0.3. Test Methods for Electrical Wires and Cables.

.3 CSA C22.2 No. 0.4. Bonding and Grounding of Electrical Equipment

.4 CSA C22.1 No. 0.8. Safety Function for Electronic Technology

.5 CSA C22.2 No. 14. Control Equipment

.6 CSA C22.1 No. 16. Insulated Conductor for Electronic Equipment

.7 CSA C22.2 No. 35. Extra Low Voltage Control Cables

.8 CSA C22.2 No. 38. Thermoset Insulated Wire and Cables

.9 CSA C22.2 No. 45. Rigid Conduit

.10 CSA C22.2 No. 75. Thermoplastic insulated Wire and Cable

.11 CSA C22.2 No. 100. Motors

.12 CSA C22.2 No. 126. Cable Tray Systems

.13 CSA C22.2 No. 131. Teck Cables

.14 CSA C22.2 No. 158. Terminal Blocks

.15 CSA C22.2 No. 239. Control and Instrumentation Cables

.16 CAN/CSA-C22.3 No. 1, Overhead Systems.

.17 CAN/CSA-C22.3 No. 7, Underground Systems.

D1

.18 CAN3-C235. Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

1.3.3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.2 IEEE C37.1. IEEE Guide for Protective Relays Application to Power Transformer

.3 IEEE C37.90. Relay and Relay Systems Associated with Electrical Apparatus

.4 IEEE C37.91. Guide for Protective Relay Applications to Power Transformers

.5 IEEE 1584. Guide for Performing Arc-Flash Hazard Calculations

1.3.4 International Electrotechnical Commission (IEC)

.1 IEC 60059. Standard Current Ratings

.2 IEC 60073. Indicator Lamp Colors

.3 IEC 60144. Degree of Protection of Enclosures for Low-Voltage Switchgear and Control gear

.4 IEC 60255. Electric Relays

.5 IEC 60270. Partial Discharge Measurement

.6 IEC 60391. Wire Identification

.7 IEC 60529. Classification of Degrees of Protection Provided by Enclosures

.8 IEC 60617. Graphical Symbols for Diagrams

.9 IEC 61850. Communication Networks and Systems for Power Utility Networks

1.3.5 National Electrical Manufacturers Association

.1 NEMA MG-1. Motors and Generators

.2 NEMA MG-2. Safety Standards for Motors and Generators

1.4 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

.2 AC – alternating current.

.3 DC – direct current.

1.5 SUBMITTALS

.1 Submittals: in accordance with Exhibit 4 Supplier Documents Requirements List.

1.6 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.3 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.4 Language operating requirements: provide identification nameplates and labels for control items in English.

1.7 POWER SUPPLIES (LOW VOLTAGE)

.1 Equipment and devices requiring electric power shall be built in agreement with the following power supply parameters:

.1 600 Vac, 60 Hz, 3 phases, 4 wire-power circuits (Neutral Solidly Grounded).

.2 120 Vac, 60 Hz, single phase.

.3 125 Vdc, control and relay protection circuits.

.4 48 Vdc, telecommunication equipment.

.2 Contractor shall clearly indicate voltage, current and power requirements for each item of equipment.

.3 The voltages available to Contractor are 600 Vac, 120 Vac and 125 Vdc. Any voltage required internal to equipment other that specified above shall be Contractor's responsibility.

.4 Equipment shall be suitable for AC voltage variations of plus or minus 10% and frequency variations of plus or minus 5%.

.5 Equipment shall be suitable for DC voltage variations of plus 15% to minus 20%.

1.8 ARC FLASH HAZARD

.1 If applicable, an arc flash hazard analysis in accordance with IEEE 1584 will be prepared by Engineer for all electrical systems. However the actual equipment detailed characteristics to perform arc flash analysis shall be supplied in time by Contractor

.2 The electrical systems shall be designed such that the results of the arc flash hazard analysis do not exceed 8 cal/cm^2 (category 2).

1.9 SAFETY SCREENING EQUIPMENT

.1 Ensure the safety clearances of any live part of the equipment which is not in a grounded screen enclosure are as specified. Where these clearances are not obtainable with an accepted arrangement of the equipment, provide grounded screen enclosures or partitions to prevent contact with any live part. Ensure that the maximum size of screen openings is a square of 25 mm x 25 mm.

.2 Provide the means of access to the guarded or screened area with interlocking equipment.

1.10 PROVISION FOR EQUIPMENT LOCKOUT AND ISOLATION

D1

1.10.1 All devices that could conceivably be required to be isolated for maintenance, protection of personnel, access to equipment etc. shall be designed to be lockable and that the

lockable location itself shall be visible and safe to access. All energy sources related to the equipment to be maintained shall be designed to be isolated and locked out;

D1

1.10.2 Electrical isolating devices including breakers, safety switches, starters and fuse holders, that are installed on circuits rated higher than 110 V shall be pad lockable;

1.10.3 Electrical isolating devices that are installed on circuits rated higher than 300 V shall be equipped with a means of visually verifying isolation when in the open position, without exposing the circuit conductors or parts;

1.10.4 A means of visual verification is preferred on electrical isolating devices that are installed on circuits rated higher than 100 V and up to 300 V;

1.10.5 Every device capable of being isolated and locked out shall be capable of being locked with a standard 1-1/2” padlock with 6 mm dia. shackle, even if the device has a built in key lock. Each of these lockout points shall be capable of supporting the weight of multiple lockout hasps and padlocks;

1.10.6 Where a blocking device is required as part of the isolation and lockout of equipment, this device shall be designed to withstand 150% of any load that could inadvertently be applied to it.

1.10.7 Three phase disconnect switches shall be installed within sight of, but not more than 9 m away from, all motors and equipment connected to 600 V and above. The disconnect switches shall have visual confirmation and be capable of being pad lockable open or closed.

1.11 SEISMIC DESIGN REQUIREMENTS

1.11.1 Electrical Equipment and Systems

D1

.1 All electrical equipment and systems shall remain fully operational immediately after a seismic event without any intervention.

D1

1.11.2 Seismic Loads

.1 All electrical equipment and systems, except for that in the spillway hoist building and towers, shall be designed to withstand seismic horizontal acceleration of 0.091 g.

1.11.3 Electrical Equipment and Systems in Spillway Hoist Building and Towers

D1

.1 The design of electrical equipment and systems to be installed in the spillway hoist building and towers, shall be based on a horizontal ground acceleration of 0.091 g at the tower base and applying the appropriate amplification factors based on the NBCC assuming that there shall be no permanent deformation in any part of the structure after a seismic event.

2 PRODUCTS

2.1 MOTORS

.1 Contractor shall be fully responsible for determining that the motor duty cycle, rating, performance, tests and mechanical arrangements are all entirely relevant and in Good Utility Practice.

.2 Motors shall be squirrel cage, totally enclosed and fan cooled (TEFC), 1.15 service factor. AC motors of 1/4 HP and larger shall be 3 phase. AC motors shall be sized so that calculated horsepower requirements do not exceed the "HP" rating stamped on nameplate. Motors shall be high efficiency type, except those used for intermittent service.

.3 The insulation system shall be Class F or higher, but in each case temperature rises shall be limited to Class B on continuous full rated load.

.4 Sealed ball or roller bearings shall be used. Vertical shaft motors shall have thrust bearings accepted by Engineer.

.5 The terminal box shall be weatherproof (NEMA 4) and firmly fixed to the motor frame. Terminal boxes shall be suitable for the connectors of CSA Teck cables or liquid-tight flexible metal conduit. There shall be a ground terminal inside the terminal box for grounding the bare ground conductor of cables.

.6 Local disconnecting means shall be provided for all motors.

.7 Motors shall meet EEMAC/NEMA and CSA Standards.

2.2 STARTERS AND CONTACTORS

.1 Motor starters shall be equipped with contactors and have short circuit protection and disconnecting devices. All starters shall be of one manufacture.

.2 Starters and contactors shall be suitable for direct on line starting, continuous duty. They shall be installed in motor control centers for indoor installation and weatherproof enclosures (NEMA 4X) for outdoor installation. Enclosures shall be complete with provision for locks, for cable gland, bus bars, internal wiring, terminal strips, etc. The starters of the Essential Services MCC shall be required to ride out a short power interruption when power returns on the 25 kV system with the diesel generator supplying the essential loads.

D1

.3 Starters and contactors shall be capable of satisfactory operation, without damage, when the voltage is down to 85 percent of nominal and up to 110 percent of nominal.

2.3 MOLDED CASE CIRCUIT BREAKERS

.1 Molded case circuit breakers shall be one, two or three pole as required, having thermal time delay and instantaneous trip. They shall have ground fault trips where required. They shall be rated for the available fault currents. All breakers shall be

visible break or have observation windows and shall have a provision for locks. Derating factors of CSA shall apply to these breakers where applicable.

.2 Circuit breakers used in conjunction with motor starters or contactors shall have the operating mechanisms interlocked with the starter or contactor cover, so that the cover cannot be opened unless the circuit breaker is open. The interlock shall be defeatable for trouble shooting purposes. The circuit breakers shall comply with the applicable CSA/IEEE/ANSI Standards.

D1

.3 Molded Case Circuit Breakers shall be in accordance with Section: 26 28 16.02, Molded Case Circuit Breakers.

2.4 PILOT DEVICES

.1 Pilot devices such as selector switches, push button stations and thermostats shall be of heavy duty type, and where mounted outdoors they shall be housed in weatherproof enclosures especially designed for the environment.

.2 Electrical contacts for control, alarm and shutdown shall have a capacity of not less than 5 A at 125 Vdc.

.3 Provide LED indicating lamps, colored as necessary.

.4 Each switching and grounding device shall be provided with all necessary auxiliary switches, contactors and mechanisms for indication, protection, control, interlocking, supervisory and other services as required. All auxiliary switches shall be wired to a suitable terminal strips whether they are in use or not.

.5 Provide heavy duty contacts for all auxiliary switches and ensure they have a positive wiping action when closing.

.6 Provide discharge resistors when required, to prevent undue arcing during the operation of the contactors.

.7 Provide all relays in accordance with applicable CSA/IEEE/ANSI Standards and of a type accepted by Engineer. Mark relays associated with the three phases with the appropriate phase color and mark all fuses and label links. Mount the relay elements, fuses or links associated with the A, B and C phases on the left, middle and right respectively, when viewed from the front of the panel.

.8 Design all the equipment to withstand vibrations without damage from earthquakes.

.9 Ensure all relays have sufficient thermal capacity for continuous energization.

.10 Provide control, indication and selector switches, and rotary type switches, all with enclosed contacts which are accessible by the removal of covers.

.11 Provide control push buttons where specified.

.12 Ensure "Close" or "Start" actions of all switches are clockwise (as seen from the front) and that the opposite actions are counter-clockwise.

.13 Provide contacts in operating and control switches, limit switches, auxiliary relays, etc., of adequate rating for the voltage and current to be carried. Ensure all 125 Vdc switches have making, conducting and breaking capacity of at least 0.4 A at 125 Vdc and L/R 40 ms. Provide the required number of positions, maintained and momentary contacts as necessary.

.14 Take measures to reduce over voltages due to breaking circuits containing inductances to such values that they do not cause any damage to the equipment or its functions.

.15 Provide colors of indicating lights per IEC Publication 60073.

.16 Ensure that fuse and link carriers and bases are of molded insulating materials that respect CSA requirements.

.17 Engrave the operating and indicating devices with "C" for "Close" and "O" for "Open". If color coding is employed, "Close" or "Closed" shall be red and "Open" shall be green.

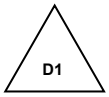
2.5 INSTRUMENT AND METERS

.1 All instruments and meters with the exception of the synchronoscope and incoming and run voltmeters shall be digital type. All instruments and meters shall be heavy-duty industrial type, dustproof and capable of withstanding severe shock or vibration. The instruments shall comply with applicable CSA/IEEE/ANSI Standards.

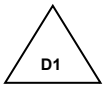
2.6 TERMINAL BLOCKS

.1 Terminal blocks on custom panels and relay panels shall be States, Type NT, sliding link ZWM-250, as manufactured by the States Manufacturing Company for CT circuits, VT circuits, main 120 Vac feeder to the panel and main 125 Vdc feeder to the panel.

.2 States type terminal blocks shall be used on all CT and VT circuits as well as 120 Vac and 125 Vdc circuits.



.3 In telecommunication panels, the terminal blocks shall be Phoenix UDK series, knife disconnect type or accepted equivalent.



.4 Terminal blocks for status and telemetry points shall be Phoenix UDK series, knife disconnect type. All other terminal blocks shall be Phoenix UDK series.

.5 When terminal blocks are mounted such that the links are in a vertical position, the sliding link shall drop open when loose, except for CT circuits where the link shall drop closed.

.6 Terminal blocks shall be arranged in groups of not more than twelve (12) terminals, to facilitate wiring and identification. Terminal blocks for CT and VT leads shall be arranged in groups of four (4) terminals.

.7 Each terminal shall have marker strip, and be discretely marked. Duplication of terminal identification for any one panel or cubicle will not be accepted.

.8 Terminal strips shall be spaced at not less than 200 mm on centers. For rear access panels and cubicles, mount the terminals vertically at the sides of the cubicles and set them at an angle toward the rear doors to give easy access to terminations and to enable the wire numbers to be read without difficulty. For wall mounted junction boxes and for front access rack panels, mounting the terminals vertically in rows across the panel is the preferred method. Horizontal mounting in rows down the panel may be acceptable following layout submission.

.9 The bottom of the terminal strips shall be at least 200 mm above the glanding point for incoming cables.

.10 Terminal strips shall be provided with pairs of terminals for incoming and outgoing wires and do not connect more than two wires to any one terminal. They shall be sized appropriately for the size of cable (external) and wire (internal) used. Double layer terminals shall not be used for any function.

.11 Separate terminal strips shall be provided for all power, controls, instruments, meters and relays requiring external connection.

.12 The panel wiring shall be connected to one side of the terminal strip with the opposite side reserved for outgoing cable connections.

.13 Adequate space shall be provided on both sides of the terminal blocks for connecting wires and for wire markers. Where practical, arrange terminals for external connections for consecutive connection of conductors within one cable. At least 20% spare terminals shall be provided in each panel or cubicle.

.14 Terminations shall be grouped according to function (CT, VT, Trip, Alarm, etc.) and remote equipment. Provide labels on the fixed portion of the terminal strips showing the function of the group.

.15 Covers shall be provided with insulating material, preferably transparent, on terminal strips on which connections for circuits with a voltage equal to or greater than 200 volts are terminated.

.16 The use of terminal strips to provide junction points for wires which are not required in the associated cubicle shall be avoided.

2.7 TEST FACILITIES AND TRIP ISOLATION

.1 In addition to the test facilities provided on each relay and on the protection signaling equipment, provide, for each CT and VT system group, one AC type test block.

.2 Provide test facilities to enable complete isolation of the group of relays from the instrument transformers without affecting other devices on the same circuit. Also provide facilities to use test plugs either to inject test current or voltage into the relay group or to check the actual currents and voltages being supplied from the instrument transformers. Provide the necessary test plugs on a one per type basis and ship these with the panels.

.3 Equip all CT disconnection points with shorting facilities on the CT side of the disconnection point. Provide CT ground links to ground the CT neutral on the CT side of this disconnection point. Ensure that each CT and/or VT circuit is normally grounded at one point only. Provide this ground at the VT for VT circuits and at the first protection panel for CT circuits. In differential circuits, provide facilities to temporary ground the ungrounded CTs if disconnected from the normal CT ground point.

D1

.4 The AC type test block shall be ABB Flexitest Switches.

.5 Provide test facilities to enable complete isolation of each relay (IEDs and auxiliary relays) for all DC signals input and output, such as trip signals and breaker failure initiation signals. Also provide facilities to use test plugs either to inject test voltage

or to check the actual voltages being supplied. Blocking switches ABB type FT-1 (FT-1X if needed) shall be used.

2.8 SMALL WIRING INTERNAL TO EQUIPMENT

D1 .1 Control wiring in switchgear and motor control centers shall be Anixter M22759/16 (Tefzel).

D1 .2 Internal protection panel wiring shall be Anixter M22759/16-14-0 single conductor, #14A AWG, multi-strand wire, 600V (Anixter M22759/16-12-0, #12 AWG to be used for CT wiring in panel).

.3 Sensitive control circuits shall be effectively shielded against extraneous signals and interference.

.4 Wiring connections shall be readily accessible and removable for test or other purposes. Wiring between terminals of the various devices shall be point to point.

.5 Splices are not acceptable. Wire runs shall be neatly tucked inside the panels or in wiring troughs. Whenever possible, unused areas of the panels shall be kept free of wiring to facilitate the installation of future equipment.

.6 Proper wiring raceways shall be installed, in panels and cubicles. Wiring shall be neatly tucked in the troughs. Sufficient slack shall be left at component terminals to permit rearrangement of connections between the terminals on any particular component. Raceways shall be sized so that sufficient space is provided for external wiring.

.7 All shield drain wires shall be individually terminated with the cable shield being maintained as close as possible to point of termination. Insulation between shields shall be maintained up to the point of termination and at remote end where shields are not grounded.

.8 Except where Standards allow otherwise, equipment of different voltages (i.e. 600 Vac, 120 Vac, 125 Vdc) housed in the same panel or cubicle shall be separated by suitable barriers to segregate equipment with different voltage rating. The barrier shall be of sheet steel or of flame retardant, non-metallic, insulating material. A protective cover shall be provided on any exposed 600 V terminals together with a warning label.

.9 The dependent both end marking system of wire identification, as defined in IEC 60391 shall be used in all panels and equipment junction boxes, terminal boxes, etc. Colored wire or colored wire markers shall be used to specifically identify CT and VT wires and their phase identification. Green striped wire shall be used for all isolated ground connections. Black or white wire markers and black wire shall be used for other circuits.

.10 The wire markers used shall be made of insulating material with a glossy finish to prevent adhesion of dirt. Ensure that they are not affected by moisture or oil and are clearly and permanently marked (white on black or black on white or color). Temporary marking shall be prohibited.

.11 The same wire numbers shall not be re-used in the same panel on wires forming connections which are not directly connected in series or parallel.

.12 As far as is reasonably possible, group all outgoing wiring by function with those going to a common destination allocated to adjacent terminal blocks. Submit terminal block configurations for Engineer's Review and Acceptance.

.13 All power, control and protection and low level signal wiring shall be physically separated from each other in the raceways. Control and protection wiring associated with the Group A shall be kept separate from the Group B system wiring as far as practical. Provide separate raceways for power cables and mark the working voltage of each power circuit on the associated terminal strips.

.14 Cabling for indicating instruments and other devices producing transducer level outputs (4-20 mA) shall be wired using individually shielded wires. Provide one (1) extra terminal per pair of terminals for the grounding of this shield noting that the shield may only be actually grounded at one end.

.15 The overall armor of incoming cables shall be connected to ground at both ends of all cable runs by a suitable method and/or cable terminator accepted by Engineer.

.16 The wiring diagrams or terminal block layouts for panels and cubicles shall be drawn as viewed from the direction of normal access (back for rear access panels, front for front access rack terminals and cubicles, back for swing racks). Show the terminal strips as arranged in service on drawings. Terminal block wiring tables listed in an equivalent manner may be used subject to the Acceptance of Engineer.

.17 The following identification colors shall be used for all CT, VT and grounding connections in panel or equipment wiring:

D1

DESIGNATION	COLOUR
A phase (R)	Red
B phase (S)	Yellow
C phase (T)	Blue
AC neutral	Black
DC positive	Red
DC negative	Black
Ground	Green or Bare
Isolated Ground	Green Stripe

2.9 LOW VOLTAGE POWER AND CONTROL CABLES

D1

.1 Power cables shall be XLPE insulated TECK 90, with stranded copper conductors, aluminum interlocking armor with black PVC sheath overall and ground wire. Power cables shall be 1000 V grade.

.2 The conductors of power cables shall have a minimum size of No. 12 AWG.

D1

.3 Control cables shall be armored multi-conductors, -40°C, fire retardant FT4, TECK type PVC insulation with overall spirally shielded copper shield and gray PVC sheath overall and shall be in accordance with CSA C22.2 No. 239. Control cables shall be 600 V grade.

.4 Control cable conductors shall be stranded, annealed, soft bare copper wire in accordance with CSA C22.2 No. 239.

.5 Except for VT and CT circuits, the conductors of control cables shall be a minimum of No. 14 AWG. Current transformer circuits shall be minimum No. 8 AWG unless smaller sizes are justified by calculation as detailed in a Design Brief submitted for review and Acceptance by Engineer. The minimum for potential transformers circuits No. 12 AWG.

D1

.6 Instrument cables shall be multi-conductor, -40°C, fire retardant FT4, TECK type PVC insulation with overall spirally shielded copper shield gray PVC sheath overall and shall be in accordance with CSA C22.2 No. 239. Instrument cables shall be 600 V grade.

.7 Instrument cable conductors shall be twisted pair or triad, stranded, annealed, tinned soft bare copper wire in accordance with CSA C22.2 No. 239, with minimum size AWG 16.

.8 Each twisted pair or triad shall have individual shield, either with spirally shielded copper, or with aluminum Mylar tape and tinned and stranded copper drain wire.

.9 Cabling from devices which are not required in the various control system controllers but are defined as being required in the ECC I/O lists and require connection to the RTU shall be run directly to the telecommunication panel.

.10 Teck power and control cables shall meet CSA-C22.2 No. 131 Standard.

.11 Conductors shall be rated for a 40ºC ambient temperature, also rated according to cable spacing and other requirements of the Canadian Electrical Code.

.12 Teck cable connectors (glands) shall be watertight to CSA requirements.

.13 Cables shall be tagged at each end just before entering cubicles.

.14 Low voltage power cables shall be suitably color coded in accordance with CSA Standard.

.15 Cables shall be run in cable trays with separation between power and control and protection cables and between Group A and Group B cabling, and/or conduits.

2.10 CONDUIT

.1 Exposed conduit shall be of galvanized rigid steel conforming to CSA C22 .2 No. 45 - Rigid Conduits, and shall run parallel to the structural lines. Suitable conduit fittings and covers shall be used. The Conduit shall be fastened using malleable iron pipe straps spaced to Code requirements. Minimum size shall be 21 mm (3/4 inch).

.2 Supports for conduit, cables and fittings shall be removable and clamped to the building structure. Conduit in the powerhouse substructure shall be fastened to steel inserts in the concrete. In no circumstances shall any part of the building, steelwork or otherwise, be drilled, cut or welded without prior Acceptance by Engineer.

.3 Bends in conduit shall be made cold and the radius of bends shall not be less than nine times the conduit diameter. No bend shall be permitted to flatten the conduit.

.4 Wherever conduit crosses a structural expansion/contraction joint, accepted expansion fittings and couplings with bonding jumpers shall be provided.

2.11 CABLE TRAYS

.1 Cable tray shall be Class D1, heavy duty ladder type, galvanized steel, 300 mm rung spacing, maximum spacing of 3 meters between hangers, all bends to be made with accepted fittings.

.2 Tray covers shall be installed in dusty areas, outdoors and under grating and walkways.

.3 Separate trays shall be used for power, control and instrumentation cables. Any control cables run in trays containing power cables shall be separated by barriers (dividers). Also separate different circuits (600 volts AC, 120 volt AC, 125 volts DC) of power cables by barriers when they are in the same main runs of trays. Any 15 kV cables shall be in separate trays.

.4 Trays shall not be filled or loaded beyond seventy (70 %) percent of their ratings. Conductor ampacities shall be in accordance with cable spacing as stipulated in the Canadian Electrical Code (de-rating factors as applicable). Cable ties are required for neatness and security; ground continuity shall be maintained throughout the tray systems and associated hangers; and trays shall be fastened to the hangers. Cable trays shall meet the requirements of CSA, C22.2 No. 126.

2.12 CUBICLES AND CONTROL PANELS

.1 Cubicle and control panel enclosures shall be of sheet steel, rigid, self supporting construction and supplied with channel bases.

.2 Cubicles shall be fitted with close fitting, hinged, lift off doors and shall be capable of being opened through 180 degrees except for the rectifier cubicle door where 135 degrees is acceptable. The doors shall be provided with integral lock and master key.

.3 Cubicles and panels shall have provision for cable glands and provide adequate working clearance for the termination of cables. The cables and wiring shall enter from bottom or top as required.

.4 The cubicles and panels shall be adequately ventilated, if required, by screened vents or louvers, which shall be so placed as not to impair the overall appearance. Equipment shall be provided with suitable drainage for condensation and shall be designed to be free from pockets where moisture can collect. Cable entries shall be sealed type. An accepted UL fire stop shall be provided where cables enter enclosures.

.5 Where required, anti-condensation heaters shall be fitted in cubicles or panels containing control and/or relay equipment. They shall also be installed in all junction boxes and mechanism boxes located outdoor. The heaters shall be suitable for 120 Vac, 60 Hz operation and be controlled by humidistat. The design shall be such that when the equipment is in service, the maximum permitted rise in temperature for the equipment shall not be exceeded.

.6 For interconnections between A and B protection panels suitable fire-stops shall be installed to prevent internal panel fires spreading from one panel to the other.

.7 Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.

.8 Cubicles and panels shall be provided with a ground bus approximately 25 mm x 5 mm copper bar extending throughout the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables.

.9 All instruments, devices, buses and other equipment involving three phase circuits shall be arranged and connected in accordance with phase arrangement

(applicable CSA and EEMAC). Electrical clearances shall conform to applicable Standards.

.10 Instruments, control buttons and indicating lamps shall be flush mounted on the panels. Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.

.11 Control panels and cubicles shall be supplied with switched interior lights, socket outlets and jacks with provision for connection to the station telephone system. Modern low energy, low heat, bulbs shall be used. Compact fluorescent light (CFL) are acceptable.

D1

.12 The interior of all cubicles and panels shall have a matt white finish unless specified otherwise. Exterior finish shall be ANSI 61 light grey unless specified otherwise.

.13 Cubicles and panels shall be securely fastened or anchored.

.14 Equipment such as switchgear shall be installed level. Horizontality and flatness tolerances shall be indicated on the drawings.

2.13 LOCAL DISCONNECT SWITCHES

D1

.1 Disconnect switches in NEMA 4 enclosures, NEMA 4X for outdoor and inside Spillway and Intake Hoist houses, shall be installed within sight of motors and all equipment connected to 347/600 V and above, but not more than 9 m. The disconnect switches shall have visual confirmation and be capable of being padlocked open or closed. The disconnect switches shall also comply with Arc Flash Hazard requirements of Section 1.8.

.2 These switches shall be in accordance with the Canadian Electrical Code, and they shall have a current rating applicable for the motor.

.3 Grounding:

.1 Contractor shall provide grounding terminals on all the equipment supplied under the Contract and shall connect these terminals to the station ground grid.

.2 Cable sheaths shall be grounded in accordance with the requirements of CSA C22.1.

2.14 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with [nameplates] [and] [labels] as follows:

.1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, matt white finish face, black core, lettering accurately aligned and engraved into core, mechanically attached with self tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6mm high letters

.3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.4 Wording on nameplates and labels to be approved by Engineer prior to manufacture.

.5 Allow for minimum of twenty-five (25) letters per nameplate and label.

2.15 ALARM CONTACTS

2.15.1 All alarm contacts shall be of galvanically isolated Form C type or as otherwise accepted for example, two separate contacts (one N.O. and one N.C.). Where required, relays shall be provided as contact multipliers.

2.15.2 Electronic Equipment

.1 Electronic equipment and components shall meet applicable CSA Standards including CSA C22.2 No. 1, C22.2 No. 16, C22.2 No. 0.8.

.2 Enclosure in electrical room shall be EEMAC 1 as a minimum.

.3 All inputs to sensitive electronic equipment shall be protected per IEEE Standards, (C37.90, C37.91).

3 EXECUTION

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 and CSA C22.3 No. 7 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 INTERCONNECTION OF EQUIPMENT

.1 All interconnecting wiring shall be provided between the various items of the equipment included in this Contract.

.2 Unless otherwise specified, all cables for external connection shall be provided complete with cable glands. Contractor shall terminate these cable conductors on the terminals of equipment. Contractor shall cooperate with Company's Other Contractors of related equipment in order to ensure the correct functioning of related equipment and instrumentation.

.3 Contractor shall develop a numbering system for all interconnecting cables. Contractor shall use these cable numbers to identify the cables on the drawings and cable schedules for the equipment.

3.4 FUTURE ACCESS

.1 All equipment shall have suitable access for easy removal/replacement.

3.5 INTERFERENCE

.1 Portable communication devices such as "walkie-talkies" shall not affect the operation of any equipment supplied under this Contract.

3.6 LOCKING ARRANGEMENTS

.1 Provide any necessary interlocks for all plant and equipment that may endanger the Operator, maintenance staff or the system itself.

.2 Provide arrangements for:

.1 Locking each equipment cover, door, guard or screen in the closed position.

.2 Locking each disconnect and ground switch mechanism in the open or closed positions.

.3 Locking all switchgear shutters and withdrawable circuit breakers in the withdrawn, isolated or grounded positions.

.4 Ensure that keys for locking or padlocking each device are distinct from all other keys. If the keys are part of a master key sequence, divide by function and submit the total scheme for review and Acceptance by Engineer. Provide labels for all keys.

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.8 FIELD QUALITY CONTROL

.1 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in Exhibit 4 – Supplier Document Requirements List: phase and neutral currents on panelboards, dry-type transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests in accordance with document, MFA-SN-CD-2000-ME-SP-0002-01; Preservation, Mechanical Completion and Commissioning Requirements.

.1 Power distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: control and monitoring, water level measurement, fire alarm system and intrusion detection.

.6 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.7 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.8 Check resistance to ground before energizing.

.9 Carry out tests in presence of Engineer.

.10 Provide instruments, meters, equipment and personnel required to conduct tests.

.3 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Exhibit 4 – Supplier Documents Requirements List.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.9 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

.3 Leave work area clean at the end of each day.

.4 Final Cleaning: upon completion remove surplus material, tools and equipment.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 14**
CH0032	**POWER CABLE (25000 V and 28000 V)**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 05 014

POWER CABLE (25000 V AND 28000 V)

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 14**
CH0032	**POWER CABLE (25000 V and 28000 V)**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section: 25 05 00 – General Electrical Requirements

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 131, Type TECK 90 Cable.

.2 CAN/CSA-C61089, Round Wire Concentric Lay Overhead Electrical Stranded Conductors.

1.2.2 National Electrical Manufacturers' Association (NEMA)/Insulated Cable Engineers Association (ICEA)

.1 ICEA S-93-639/NEMA WC74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electrical Energy.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Provide submittals in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Provide product data in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.3 Quality assurance submittals: in accordance with Exhibit 4 – Supplier Document Requirements List.

1.4 DELIVERY, STORAGE AND HANDLING

1.4.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

2 PRODUCTS

2.1 CONCENTRIC NEUTRAL POWER CABLES (28000 V)

.1 Concentric neutral power cable: to ICEA S-93-639/NEMA WC74.

.2 Single copper conductor, size as indicated.

.3 Semi-conducting strand extruded shield.

.4 Class 2 compact round.

.5 Insulation: cross-linked thermosetting polyethylene material or ethelene propylene rubber rated 90ºC and 28 kV for 100% voltage level.

.6 Semi-conducting insulation shielding layer.

.7 Copper neutral wires applied helically over insulation shield equivalent to full capacity.

.8 Separator tape over neutral wires.

D1 .9 Extruded orange PVC jacket rated minus 40ºC.

2.2 TECK POWER CABLE (25000 V)

.1 Cable: to CSA-C22.2 No. 131 and in accordance with Section: 26 05 00 - General Electrical Requirements.

.2 Bare copper grounding conductor, size as indicated in CSA C22.2 No. 131 for phase conductor size.

.3 Copper circuit conductors, size and number as indicated.

.4 Strand shielding Insulation: chemically cross-linked thermosetting polyethylene rated RW90 25 kV to ICEA S-93-639/NEMA WC74.

.5 Insulation: cross linked thermosetting polyethylene material or ethylene propylene rubber rated 90°C and 25 kV for 100% voltage level.

.6 Insulation shielding: semi-conducting non-metallic tape over insulation and helical wrapped wire shield over tape to ICEA S-93-639/NEMA WC74.

.7 Separator tape over conductor assembly.

.8 Inner jacket of PVC.

.9 Interlocked aluminum armour.

D1 .10 Overall orange PVC jacket rated minus 40ºC.

3 EXECUTION

3.1 INSTALLATION

.1 Install power cable in ducts and manholes as indicated and in accordance with manufacturer's instructions.

.2 Install power cable in trenches as indicated.

.3 Provide supports and accessories for installation of high voltage power cable.

.4 Install stress cones, terminations and splices in accordance with manufacturer's instructions

.5 Install grounding in accordance with Section: 26 05 28 – Grounding - Secondary.

.6 Provide cable identification tags and identify each phase conductor of power cable.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 - General Electrical Requirements.

.2 Use of qualified tradespersons for installation, splicing, termination and testing of high voltage power cables.

.3 Use qualified personnel to test high voltage power cable. Submit test result and inspection certificate.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 20**
CH0032	**WIRE AND BOX CONNECTORS (0 – 1000 V)**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 05 20
WIRE AND BOX CONNECTORS (0-1000 V)
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 20**
CH0032	**WIRE AND BOX CONNECTORS (0 – 1000 V)**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

1.2 REFERENCES

1.2.1 CSA InternationalCAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes and Fittings.

.1 CAN/CSA-C22.2 No.65, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).

1.2.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.5.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.5.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations.

.2 Store and protect wire and box connectors from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 PRODUCTS

2.1 MATERIALS

.1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

2.1.1 Clamps or connectors TECK cable as required to: CAN/CSA-C22.2 No.18.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Remove insulation carefully from ends of conductors and cables and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.

.3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 21**
CH0032	**WIRES AND CABLES (0–1000 V)**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 05 21

WIRES AND CABLES (0 – 1000 V)

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PART .1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section: 26 05 00 – General Electrical Requirements.

.2 Section: 26 05 20 - Wire and Box Connectors - (0-1000 V).

.3 Section: 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.4 Section: 26 05 36 - Cable Trays for Electrical Systems.

.5 Section: 26 05 43.01 – Installation of Cables in Trenches and in Ducts.

1.2 REFERENCES

.1 CSA C22.2 No. 35 – Extra-low Voltage Control Circuit Cable

.2 CSA C22.2 No. 38, Thermoset-insulated Wires and Cables

.3 CSA C22.2 No. 75 – Thermoplastic-insulated Wires and Cables

.4 CSA C22.2 No. 124, Mineral-insulated Cable

.5 CSA C22.2 No. 129, Neutral Supported Cables

.6 CSA C22.2 No. 131, Type TECK 90 Cable

.7 CSA C22.2 No 239, Control and Instrumentation Cables

1.3 PRODUCT DATA

.1 Provide product data in accordance with Exhibit 4 – Supplier Document Requirements List.

PART .2 PRODUCTS

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

.3 Copper conductors: size as indicated, with thermoplastic insulation type TWH rated at 600 V.

.4 Neutral supported cable: 2 or 3 phase insulated conductors of Aluminum and one neutral conductor of Aluminum steel reinforced, size as indicated. Type: NS90 Insulation: Type NSF-2 flame retardant rated 600 V.

2.2 TECK 90 CABLE

.1 Cable: in accordance with Section: 26 05 00 - General Electrical Requirements.

2.2.1 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

2.2.2 Insulation:

.1 Cross-linked polyethylene XLPE.

.2 Rating: 600 V.

2.2.3 Inner jacket: polyvinyl chloride material.

2.2.4 Armour: interlocking aluminum.

2.2.5 Overall covering: thermoplastic polyvinyl chloride, compliant to FT-4 flame test rating.

2.2.6 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 1500 mm centers.

.3 Threaded rods: 6 mm diameter to support suspended channels.

2.2.7 Connectors:

.1 Watertight, approved for TECK cable.

2.3 MINERAL-INSULATED (MI) CABLES

.1 Conductors: solid bare soft-annealed copper, size as indicated.

.2 Insulation: compressed powdered magnesium oxide or silicon dioxide to form compact homogeneous mass throughout entire length of cable.

.3 Outer covering: annealed seamless copper, Type MI rated 600 V, 250ºC.

.4 Overall jacket: none.

.5 Two hour fire rating.

.6 Connectors: watertight factory installed and tested approved for MI cable.

.7 Termination kits: field installed approved for MI cable

2.4 CONTROL CABLES

2.4.1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:

.1 Insulation: thermoplastic.

.2 Overall covering: thermoplastic jacket.

2.4.2 Type: low energy 300 V control cable: solid or stranded annealed copper conductors sized as indicated LVT: soft annealed copper conductors, sized as indicated:

.1 Insulation: PVC.

.2 Shielding: metallized tapes over each pair.

.3 Overall covering: PVC jackets.

2.4.3 Type: 600 V stranded annealed copper conductors, sizes as indicated:

.1 TECK 90 with interlocking aluminum armour.

.2 Insulation: cross-linked polyethylene type RW90 (x-link).

.3 Shielding: metallized tapes over conductors.

D1

.4 Overall covering: grey thermoplastic jacket.

2.5 MINERAL-INSULATED (MI) HEATING CABLES

.1 All gate guide heating applications shall use factory-terminated, mineral insulated (MI) cables.

.2 MI cable shall be magnesium oxide insulated with an Incoloy 825 sheath. The heated section of the cable shall be joined to a cold lead also made of Incoloy 825.

.3 Each cable shall be factory-terminated to the required length, consisting of the lengths required for the gate guide section, plus an allowance for areas of additional heat loss such as supports, etc. plus a reasonable excess to allow for field variations. The cold lead section shall be seven feet long minimum or sufficient to reach the power connection junction box.

PART .3 EXECUTION

3.1 GENERAL CABLE INSTALLATION

.1 Install cable in trenches in accordance with Section: 26 05 43.01 – Installation of Cables in Trenches and in Ducts.

.2 Lay cable in cable trays in accordance with Section: 26 05 36 - Cable Trays for Electrical Systems.

.3 Terminate cables in accordance with Section: 26 05 20 - Wire and Box Connectors - (0-1000 V).

D1 .4 Cable Colour Coding: to Appendix 1.

.5 Conductor length for parallel feeders to be identical.

.6 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.7 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.8 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.

.9 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.2 INSTALLATION OF BUILDING WIRES

3.2.1 Install wiring as follows:

.1 In conduit systems in accordance with Section: 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 In underground ducts in accordance with Section: 26 05 43.01 – Installation of Cables in Trenches and in Ducts.

.3 Overhead service conductors in accordance with CSA C22.3 No 7 – Underground Systems.

3.3 INSTALLATION OF TECK 90 CABLE (0-1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable exposed, securely supported by straps or hangers.

3.4 INSTALLATION OF MINERAL-INSULATED CABLES

.1 Install cable exposed, securely supported by straps or hangers.

.2 Support 2 hour fire rated cables at 1 m intervals.

.3 Make cable terminations by using factory-made kits.

.4 Cable terminations: use thermoplastic sleeving over bare conductors.

.5 Where cables are buried in cast concrete or masonry, provide sleeves for cables.

.6 Do not splice cables unless indicated.

3.5 INSTALLATION OF CONTROL CABLES

.1 Install control cables in cabletrays, underground ducts or by direct burial.

.2 Ground control cable shield.

3.6 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 – General Electrical Requirements.

END OF SECTION

D1

APPENDIX 1 -
TABLE 1 - CABLE CONDUCTOR COLOURS

CABLE CONDUCTOR COLOURS	
dc Supplies	(+) - Red
	(-) - Black
	GND - Bare or Green
120Vac 2-wire single Phase Supplies	L - Black
	N - White
	GND - Bare or Green
120Vac 3-wire single Phase Supplies	L - Black
	L - Red
	N - White
	GND - Bare or Green
240Vac 2-wire single Phase Supplies	L1 - Black
	L2 - Red
	GND - Bare or Green
240Vac 3-wire single Phase Supplies	L1 - Black
	L2 - Red
	N - White
	GND - Bare or Green
208Vac 2-wire Supplies	L1 - Black
	L2 - Red
	GND - Bare or Green
Lighting Circuit “Switch Legs”	Switched Hot - Black
	Constant Hot - Red
	GND - Bare or Green
Lighting Circuit 3-way Switch “Travelling Wires”	Traveller 1 - Black
	Traveller 2 - Red
	Traveller 3- White (Note 1)
	GND - Bare or Green
Triads	1 - Black
	2 - Red
	3 - White
	Shield Drain Wire - Bare
Instrumentation Cable	1-Black

D1

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CABLE CONDUCTOR COLOURS	
(Note 2)	1- White
	Shield Drain Wire - Bare
	2-Black
	2- White
	Shield Drain Wire - Bare
	3-Black
	3- White
	Shield Drain Wire - Bare
	4-Black
	4- White
	Shield Drain Wire - Bare
Control/Indication/Alarm Circuits (Note 3)	Black
	Red
	Blue
	Orange
	Yellow
	Brown
	Red w/ Black Tracer
	Blue w/ Black Tracer
	Orange w/ Black Tracer
	Yellow w/ Black Tracer
	Brown w/ Black Tracer
	Black w/ Red Tracer
	Shield drain wire - Bare
208/600Vac 3phase Circuits	A - Red
	B - Black
	C - Blue
	N - White (if required)
	GND - Bare or Green
PT Circuits	A - Red
	B - Yellow

D1

D1

CABLE CONDUCTOR COLOURS	
(Note 4)	C - Blue
	N - Black
CT Circuits (Note 5)	A - Red
	B - Yellow
	C - Blue
	N - Black
Ground	Green or Bare
Isolated Ground	Green w/ Yellow Stripe

Notes:

1: If white wire is not a constant neutral, it shall be marked with black tape at all entrances of all switch boxes

2- Additional pairs will be numbered in increasing order

3- Additional Conductors as per Table E-2 of ANSI/ICEA S-73-532/ NEMA WC 57 - Standard for control, thermocouple extension, and instrumentation cables.

4- PT conductor colours will follow the same colour standard as 3 phase power circuits but each conductor will be clearly marked with a 1/2" visible Red band or wire marking sleeve.

5- CT conductor colours will follow the same colour standard as 3 phase power circuits but each conductor will be clearly marked with a 1/2" visible Yellow band or wire marking sleeve.

D1

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 22**
CH0032	**CONNECTORS AND TERMINATIONS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 05 22
CONNECTORS AND TERMINATIONS
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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 22**
CH0032	**CONNECTORS AND TERMINATIONS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for connectors and terminations.

1.2 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements

.2 Section 26 05 14 – Power Cable (25000 V and 28000 V).

.3 Section 26 05 21 – Wires and Cables (0-1000 V).

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No 65, Wire Connectors.

.2 CSA C22.2 No.41, Grounding and Bonding Equipment.

.2 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE Std. 48 – IEEE Standard for Testing Procedures and Requirements for Alternating Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 76k kV and Extruded Insulation Rated 2.5 kV through 500 kV.

1.4 PRODUCT DATA

.1 Submit product data in accordance with Exhibit 4 – Supplier Document Requirements List.

2 PRODUCTS

2.1 CONNECTORS AND TERMINATIONS

.1 Copper long barrel compression connectors to CSA C22.2No. 65 as required sized for conductors.

.2 Contact aid for aluminum cables where applicable.

.3 Cable terminations for shielded power cables to IEEE Std. 48 as required for voltage and sized for conductors.

2.2 CABLE CONNECTORS

.1 All Teck cable shall be terminated with aluminum, watertight, NEMA 4 cable connectors made in accordance with CSA 22.2 No. 18.3. Tech cable connectors shall be Thomas & Belts, Star Teck (ST) Series.

D1

.2 All tray cable shall be terminated with aluminum, watertight, NEMA 4 cable connectors. Tray cable connectors shall be Thomas & Belts, Silver Grip – TCF Series.

3 EXECUTION

3.1 INSTALLATION

.1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.

.2 Bond and ground as required to CSA C22.2 No.41 and Section 26 05 28 – Grounding – Secondary.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 28**
CH0032	**GROUNDING - SECONDARY**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 05 28

GROUNDING – SECONDARY

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 28**
CH0032	**GROUNDING - SECONDARY**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED SECTIONS

.1 Section: 26 05 00 – General Electrical Requirements

D1 .2 Section: 26 05 21 – Wires and Cables (0-1000 V)

1.2 REFERENCES

D1 **1.2.1** The latest revision of the Specifications, Codes and Standards at the date of Award shall be used.

1.2.2 ASTM International (ASTM)

.1 ASTM B3 Standard Specification for Soft or Annealed Copper Wire

.2 ASTM B8, Standard Specification for Concentric-Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft

.3 ASTM B187, Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes

1.2.3 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1

.2 CSA C22.2 No. 0.4, Bonding of Electrical Equipment

.3 CSA C22.2 No. 41, Grounding and Bonding Equipment

1.2.4 Institute of Electrical and Electronics Engineers (IEEE)

D1 .1 IEEE 837 Standard for Qualifying Permanent Connections Used in Substation Grounding

1.3 DEFINITIONS

D1

.1 *Primary Ground Connection*

An exposed pigtail or loop installed by the Company's Other Contractors as part of the embedded/buried grounding system.

1.4 SUBMITTALS

D1

1.4.1 Provide submittals in accordance with Section: 01 33 00 - Submittal Procedures.

1.4.2 Submit product data in accordance with Exhibit 4 – Supplier Document Requirements List.

1.4.3 Product Data

.1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4.4 Closeout Submittals

D1

.1 Submit operation and maintenance data for grounding equipment for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.5.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.5.3 Storage and Handling Requirements:

D1

.1 Materials shall be stored indoors, in dry locations and in accordance with manufacturer's recommendations.

.2 Defective or damaged materials shall be replaced with new.

2 PRODUCTS

2.1 EQUIPMENT

2.1.1 Equipment - General

D1

.1 All material shall be new and conform to the applicable ASTM, CSA and IEEE standards.

2.1.2 Conductors

.1 Bare grounding conductors, soft drawn copper, size as indicated, shall be used for embedded grounding and interconnection of metal structures and miscellaneous metals, equipment, and grounding connections.

.2 Insulated grounding conductors shall be soft drawn copper, insulation type TW, size as indicated.

.3 Conductors shall be minimum Class B stranded. Conductor stranding shall be ASTM B8 – Class C for applications subject to significant vibration or requiring frequent bending or flexing such as wiring onto hinged doors.

.4 Tinned copper conductors shall be used for grounding and bonding aluminum structures or equipment.

.5 Grounding conductors on equipment rated 600 V and higher, shall be #6 AWG minimum and shall equal or exceed that of the service ground in the cable supplying the equipment.

2.1.3 Connectors

.1 Grounding conductor connectors shall be in accordance with IEEE 837.

.2 Connectors shall be of the mechanically bolted type or compression type.

.3 Ground lugs for wire sizes #2 AWG and larger shall be of the of compression type, *NEMA 2-hole, intended for wire sizes as indicated.*

D1

D1 .4 Ground lugs for wire sizes smaller than #2 AWG shall be either NEMA 2-hole or NEMA 1-hole, and compression or mechanical type.

D1 .5 Clamps for connecting ground conductors to electrically conductive pipe shall be supplied and installed, and sized as indicated.

2.1.4 Ground Bus

D1 .1 Ground bus shall be of copper bar in accordance with ASTM B187, sizes as indicated, and be complete with insulated supports, fastenings, and connectors.

2.1.5 Grounding Hardware and Accessories

D1 .1 All accessories necessary for grounding system shall be non-corroding, and of type, size, and material as indicated. Accessories include but are not necessarily limited to:

a) Grounding and bonding bushings,

b) Protective type clamps,

c) Bonding jumpers and straps,

d) Thermite welded (exothermic) type conductor connectors, and

D1 e) Exothermic equipment: complete exothermic equipment including moulds, weld metal, crucible, mould support clamps for making all connections for ground grid and tails for all terminations for equipment to be grounded.

.2 All grounding clamps and other hardware and accessories shall be specifically designed for their intended purpose.

2.1.6 Wire Marking

.1 Green with yellow stripe conductor insulation shall be used for all isolated ground wiring.

.2 Green conductor insulation or bare conductors shall be used for all other ground wiring, and as indicated.

3 EXECUTION

3.1 INSTALLATION

D1

3.1.1 Delivery Storage and Handling

.1 Delivery, storage and handling of materials shall be carried out in order to prevent contamination, corrosion or damage to the materials.

3.1.2 Pre-Installation Examination

.1 The Contractor shall verify that the conditions of the substrate (previously installed under other Sections or Contracts) are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.

.2 The Contractor shall visually inspect substrate in the presence of the Engineer.

.3 The Contractor shall inform the Engineer of any unacceptable conditions, immediately upon discovery.

.4 The Contractor shall proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Engineer.

3.1.3 General

.1 The finished installation shall form a complete and permanent, continuous grounding and bonding system that incorporates all electrodes, conductors, connectors and accessories,

.2 The finished grounding and bonding system shall be in accordance with CSA C22.1 Part 1, CSA C22.2 No. 0.4 and the requirements of the local authority having jurisdiction.

D1 .3 Grounding connections shall be made in a radial configuration only, with connections terminating at a *Primary Ground Connection*. Loop connections are not acceptable.

D1 **3.1.4** Conductors

.1 Conductors shall be installed as shown on drawings.

D1 .2 Conductors shall be thoroughly cleaned to bright metal before making connections.

.3 Exposed grounding conductors shall be protected from mechanical injury.

.4 In order to be protected from physical injury and be able to sustain short circuit forces to which they may be subjected, grounding conductors shall be securely attached to surfaces on which they are carried using robust cable clamps and hardware, spaced at no more than 1 m intervals.

3.1.5 Connectors

.1 Connectors shall be installed in accordance with manufacturer's instructions and Section: 26 05 22 – Connectors and Terminations.

D1 .2 Mechanical connectors shall be used for making grounding connections to equipment provided with lugs.

D1 .3 Soldered joints are not acceptable.

D1 .4 Exothermic connections shall be made in accordance with the manufacturer’s instructions.

3.1.6 Grounding Bus

D1 .1 Copper grounding bus shall be mounted on insulated supports on the walls of electrical rooms and communication equipment rooms as indicated.

3.1.7 System and Circuit Grounding

.1 The Contractor shall install system and circuit grounding connections to the neutrals of secondary 600 V systems.

.2 The Contractor shall install system and circuit grounding connections to the neutrals of 600 V primary distribution transformers, and 600/347 V and 208/120 V distribution panels.

a) The neutral bus of all 3-phase, 4-wire distribution panelboards shall be connected to their grounding bus with wire sizes in accordance with CSA C22.1, Part 1.

b) On diesel generators, the neutral / wye point of the generator shall be connected to ground in accordance with Section: 26 32 13.04 – Diesel Electric Power Generating Equipment.

3.1.8 Cables and Conduits

.1 Grounding of Power Cable Shields and Armour

a) Power cable shields and armour shall be grounded at both ends for three-conductor, three-phase power cables unless otherwise specified.

b) Power cables shields and armour shall be grounded at the supply end only for single one-conductor power cables unless otherwise specified. A Non-metallic entry plate shall be provided at the load end.

.2 Grounding of Control Cable Shields and Armour

a) Control cable shields and armour shall be grounded at the signal source end only unless otherwise specified.

b) Shields and armour of control cables to field devices shall be grounded at the DCS/PLC end only.

c) Shields and armour of control cables between powerhouse and switchyard shall be grounded at both ends as indicated.

d) Data highway/digital communication cables shall be grounded in accordance with the connected equipment manufacturer's instructions.

.3 Separate, insulated ground wires shall be run in all conduits.

.4 Flexible conduits shall have bonding wires installed and connected at both ends to the grounding bushing, solder less lug, clamp or cup washer and screw. The bonding wire shall be cleated neatly to the exterior of the flexible conduit.

3.1.9 Equipment Grounding

.1 Grounding connections shall be installed to all equipment installed under this contract. Typical equipment to be grounded includes, but is not necessarily limited to:

D1

a) Service equipment,

b) Transformers,

c) Switchgear,

d) Motor control centres (MCCs),

e) Diesel Generators,

f) Distribution panelboards,

g) Cable trays.

h) Duct systems,

i) Frames of motors,

j) Starters,

k) Control panels,

l) Outdoor lighting, and

m) Building steel work.

.2 The 600 V switchgear and 600 V MCC assemblies each include an internal grounding bus complete with one (1) pad at each end for connecting secondary grounds. Each pad on the ground bus shall be connected to a *Primary Grounding Point* using a single #4/0 AWG grounding conductor. To provide redundant ground current paths, each of the two conductors shall be connected to a different *Primary Grounding Point*.

.3 Exposed metallic parts of diesel generators shall be bonded and grounded in accordance with Section: 26 32 13.04 – Diesel Electric Power Generating Equipment.

.4 Distribution transformers, rated 600-600/347 V and 600-208/120 V shall be shall be connected to a *Primary Grounding Point* using a single #2/0 AWG grounding conductor.

.5 Distribution panelboards, shall be grounded using a single grounding conductor, sized as follows:

a) 100 A panels - #6 AWG

b) 225 A panels - #2 AWG

c) 400 A panels - #2/0 AWG

D1

.6 Electrical equipment in electrical rooms and IT equipment in communication equipment rooms shall each be grounded to the ground bus with individual, bare,

stranded copper connections unless indicated otherwise. Insulated conductors (for isolated ground connections) shall be used where indicated. Grounding conductor size shall be size #2/0 AWG unless indicated otherwise.

.7 Cable trays shall include grounding conductor(s) along their full length. The grounding conductor shall be connected to a *Primary Grounding Point* at both ends and at intervals not exceeding 15 m. The cable tray shall be bonded to the grounding conductors at each end, and at intervals not exceeding three sections of cable tray. Grounding conductor size shall be in accordance with CSA C22.1 Part 1, Rule 12-2208 (b), #4/0 AWG minimum in cable tray containing power cables, and #2/0 AWG minimum in all others.

D1

.8 Flexible ground straps shall be installed across all bus duct enclosure joints, where such bonding is not inherently provided with the equipment.

.9 Separate ground conductors shall be installed and connected to all outdoor lighting standards.

.10 Metallic architectural components, including metal wall panels, door frames and doors shall be connected to ground by welding minimum #6 AWG copper conductors to them.

.11 Metallic piping (water, oil, air, etc.) shall be connected to ground at a minimum of two (2) locations and using a minimum conductor size of #2 AWG.

.12 Metallic equipment platforms and work platforms shall be grounded as follows:

a) Grounding conductors on platforms shall be #2/0 AWG minimum.

b) The periphery of each platform shall be bonded to ground. Each peripheral column shall be bonded to the ground conductor and each peripheral beam shall be bonded to the column via a jumper.

c) Individual gratings shall be bonded to a ground conductor. Individual gratings are defined as welded sections. Bolted sections of grating are not considered to be one grating. Gratings up to 1.5 meters at their largest dimension can be grounded at a single central point. Larger gratings should be grounded at two diametrically opposite corners. Bonding between platform levels must be continuous. Individual gratings may be bonded using #6 AWG minimum, providing the conductor is protected from mechanical injury.

d) All handrail sections shall be bonded to ground. Removable handrails shall be bonded using jumper from the removable section to the fixed part. This jumper must be readily removable and replaceable.

3.1.10 Communication Systems

D1 .1 Telephone grounding systems shall be as indicated and in accordance with the telephone company's requirements.

D1 .2 Grounding systems for fire alarm, communication, access control, intrusion alarm and CCTV systems shall be installed as indicated.

3.2 FIELD QUALITY CONTROL

D1 .1 Tests and checks shall be performed in accordance with Section: 26 05 00 - General Electrical Requirements.

.2 Ground continuity and resistance tests shall be performed using methods appropriate to site conditions and acceptable to the Engineer and the local authority having jurisdiction over the installation.

.3 Tests shall be performed before energizing the electrical system.

D1 .4 Ground fault indicators shall be disconnected during tests

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 29**
CH0032	**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
TABLE OF CONTENTS

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CH0032	**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – General Electrical Requirements.

.2 Section 26 05 34 – Conduits, Conduit Fastening and Conduit Fitting

.3 Section 26 05 36 – Cable Trays for Electrical Systems

2 PRODUCTS

2.1 SUPPORT CHANNELS

.1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

3 EXECUTION

3.1 INSTALLATION

.1 Secure equipment to masonry and plaster surfaces with lead anchors or nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

.7 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.

.8 Two-hole steel straps for conduits and cables larger than 50 mm.

.9 Beam clamps to secure conduit to exposed steel work.

.10 Suspended support systems:

.1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.11 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.

.12 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.13 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.14 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.15 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.

.16 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 31**
CH0032	**SPLITTERS, JUNCTION, PULL BOXES AND CABINETS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 05 31
SPLITTERS, JUNCTION, PULL BOXES AND CABINETS
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 31**
CH0032	**SPLITTERS, JUNCTION, PULL BOXES AND CABINETS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1.

.2 CSA C22.2 No. 40, Cutout, Junction and Pull Boxes.

.3 CAN/CSA C22.2 No. 76, Splitters.

.4 CAN/CSA C22.2 No. 94.1, Enclosures for Electrical Equipment, Non-environmental Considerations.

.5 CAN/CSA C22.2 No 94.2, Enclosures for Electrical Equipment, Environmental Consideration

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide shop drawings: in accordance with Exhibit 4 – Supplier Document Requirements List.

2 PRODUCTS

2.1 SPLITTERS

.1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Terminations: main and branch lugs or connection blocks to match required size and number of incoming and outgoing conductors as indicated.

.3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

.1 Construction: welded steel enclosure.

.2 Covers Flush Mounted: 25 mm minimum extension all around.

.3 Covers Surface Mounted: screw-on covers.

2.3 CABINETS

.1 Construction: welded sheet steel, aluminum, or stainless steel, hinged door, handle, lock 2 keys and catch.

.2 Type E Empty: surface return flange flush overlapping sides mounting as indicated.

.3 Type T Terminal: surface return flange or flush overlapping sides mounting as indicated containing sheet steel backboard.

3 EXECUTION

3.1 SPLITTER INSTALLATION

.1 Mount plumb, true and square to building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.

.3 Install terminal blocks as indicated in Type T cabinets.

.4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

.1 Equipment Identification: to Section 26 05 00 - General Electrical Requirements.

.2 Identification Labels: size 2 indicating voltage and phase or as indicated.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 32**
CH0032	**OUTLET BOXES, CONDUIT BOXES AND FITTINGS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 05 32
OUTLET BOXES, CONDUIT BOXES AND FITTINGS
TABLE OF CONTENTS

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REV. D2

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 32**
CH0032	**OUTLET BOXES, CONDUIT BOXES AND FITTINGS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – General Electrical Requirements

.2 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)

.1 CSA C22.1,Canadian Electrical Code, Part 1.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Exhibit 4 – Supplier Document Requirements List.

2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347 V outlet boxes for 347 V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

.1 One-piece electro-galvanized construction.

.2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.3 Utility boxes for outlets connected to surface-mounted conduit, minimum size 102 x 54 x 48 mm.

.4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.5 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

2.4.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES

.1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 73 mm for receptacles and communication outlets.

.2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 27 mm conduit. Minimum size: 73 mm deep.

2.6 CONDUIT BOXES

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.8 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.9 SERVICE FITTINGS

.1 Above floor service fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for 1 duplex receptacle. Bottom plate with two knockouts for centered or offset installation.

.2 Above floor service fitting made of 2 piece die cast aluminum with brushed aluminum housing finish to accommodate two communication/data receptacles.

3 EXECUTION

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes as required.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 34**
CH0032	**CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 05 34

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

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REV. D2

1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The work described in this Section includes the supply of all labour, equipment and materials necessary for the supply and installation of conduits, in compliance with the drawings and as specified herein or as required by the Engineer.

1.1.2 The work includes but is not limited to the following:

.1 Supply and installing the in the Powerhouse, the Spillway and the north and centre transition dams.

1.2 RELATED SECTIONS

.1 Section 03 30 00 - Cast-in-Place Concrete.

.2 Section 26 05 00 – General Electrical Requirements.

1.3 REFERENCES

1.3.1 All materials and equipment to be incorporated in the Work shall conform to the latest applicable standards and codes as specified in the Contract Documents. Where a particular standard or code is referred to, that standard or code shall, unless otherwise stated, be the edition in effect thirty (30) days prior to the closing date of submission of tenders.

.1 Canadian Standards Association

.1 CAN/CSA C22.2 No.18.1 Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2 No. 18.3 Conduit, Tubing and Cable Fittings

.3 CSA C22.2 No. 18.4 Hardware for the Support of Conduit, Tubing and Cable

.4 CSA C22.2 No.45.1 Rigid Metal Conduit - Steel.

.5 CSA C22.2 No.56 Flexible Metal Conduit and Liquid Tight Flexible Metal Conduit.

.6 CSA C22.2 No.83.1 Electrical Metallic Tubing - Steel.

.7 CSA C22.2 No.211.2 Rigid PVC (Unplasticized) Conduit.

.8 CAN/CSA C22.2 No.227.1 Electrical Nonmetallic Tubing.

.9 CAN/CSA C22.2 No.227.2.1 Liquid Tight Flexible Nonmetal Conduit.

.10 CAN/CSA C22.2 No.227.3 Nonmetallic Mechanical Protection Tubing (NMPT).

2 PRODUCTS

2.1 CONDUITS

2.1.1 Rigid metal conduit: to CSA C22.2 No.45.1, hot dipped galvanized steel threaded.

2.1.2 Epoxy coated conduit: to CSA C22.2 No.45.1, with zinc coating and corrosion resistant epoxy finish inside and outside.

2.1.3 Rigid PVC conduit: to CSA C22.2 No.211.2.

2.1.4 Liquid Tight Flexible metal conduit: to CSA C22.2 No.56, aluminum and liquid tight flexible metal.

2.1.5 Flexible PVC conduit: to CAN/CSA C22.2 No.227.3.

2.2 CONDUIT FASTENINGS

2.2.1 One-hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm

2.2.2 Channel type supports for two or more conduits at 2.5 m on centre.

2.2.3 Threaded rods, 6 mm dia., to support suspended channels.

2.3 CONDUIT FITTINGS

2.3.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit

2.3.2 Factory "ells" where 90° bends are required for 125 mm and larger conduits.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

2.4.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion

2.4.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

2.4.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

2.5.1 Material: Polypropylene

3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

3.1.1 Compliance: comply with the manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and datasheets.

3.2 INSTALLATION

3.2.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

3.2.2 Use rigid hot dipped galvanized steel threaded conduit where specified.

3.2.3 Use epoxy coated conduit above ground where indicated.

3.2.4 Use rigid PVC conduit underground and in corrosive areas where specified and /or indicated.

3.2.5 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

3.2.6 Mechanically bend steel conduit over 21 mm dia.

3.2.7 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

3.2.8 Install fish cord in empty conduits.

3.2.9 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

3.2.10 Dry conduits out before installing wire.

3.3 CONDUITS IN CAST-IN-PLACE CONCRETE

3.3.1 Locate to suit reinforcing steel. Install in centre one third of slab

3.3.2 Protect conduits from damage where they stub out of concrete.

3.3.3 Install sleeves where conduits pass through slab or wall.

3.3.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

3.3.5 Do not place conduits is slabs in which slab thickness is less than 4 times conduit diameter.

3.3.6 Encase conduits completely in concrete with minimum 40 mm concrete cover.

3.3.7 Organize conduits in slab to minimize crossovers.

3.4 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

3.4.1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab

END OF SECTION

SECTION 26 05 36
CABLE TRAYS FOR ELECTRICAL SYSTEMS
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 36**
CH0032	**CABLE TRAYS FOR ELECTRICAL SYSTEMS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – General Electrical Requirements.

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Part 1 – Canadian Electrical Code.

.2 CAN/CSA C22.1 No.126.1, Metal Cable Tray Systems.

1.2.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA VE 1, Metal Cable Tray Systems.

.2 NEMA VE 2, Cable Tray Installation Guidelines.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.

.3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.

.4 Identify types of cable trays used.

.5 Show actual cable tray installation details and suspension system.

2 PRODUCTS

2.1 CABLE TRAY

.1 Cable trays and fittings: to NEMA VE 1 and CAN/CSA C22.1 No. 126.1 and 126.2.

D1

.2 Ladder Ventilated type, Class D to CAN/CSA C22.2 No.126.1 and 126.2.

.3 Trays: galvanized steel, 150, 300, 450, 600, 750, mm wide with depth of 150 mm and 30 cm rung spacing.

.4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cable tray supplied.

D1

.1 Radii on fittings: 300 mm minimum for instrumentation and low voltage distribution cable trays and 600 mm for tray containing power cables rated at 600 V and above.

D1

.5 Solid covers shall be provided for cable trays installed outdoors on cable trays under grating walkways and for a minimum distance of 2 m above the floor cable trays installed vertically.

.6 Barriers where different voltage systems are in same cable tray.

.7 Ground cable trays with #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.

.8 Provide fire stop material at firewall penetrations.

2.2 SUPPORTS

.1 Provide splices, supports for a continuously grounded system as required.

2.3 IDENTIFICATION

D1

.1 Nameplates and labels shall be in accordance with Section: 26 05 00 – General Electrical.

.2 Cable trays shall be identified at each turn, on each side of all passages through walls and floors and stencilled every ten (10) m in 50 mm high characters.

3 EXECUTION

3.1 INSTALLATION

.1 Install complete cable tray system in accordance with NEMA VE 2.

.2 Support cable tray on one or both sides.

.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

D1

.4 The cable tray installation shall be FM Global compliant.

3.2 CABLES IN CABLE TRAY

.1 Install cables individually.

.2 Lay cables into cable tray. Use rollers when necessary to pull cables.

.3 Secure cables in cable tray at 3 m centers with nylon ties.

.4 Identify cables with size 2 nameplates at point where they enter or leave the cable tray and on both sides of wall and floor penetrations.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 43.01**
CH0032	**INSTALLATION OF CABLES IN TRENCHES AND IN DUCTS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 05 43.01
INSTALLATION OF CABLES IN TRENCHES AND IN DUCTS
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 43.01**
CH0032	**INSTALLATION OF CABLES IN TRENCHES AND IN DUCTS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Section 26 05 00 – General Electrical Requirements.

1.2 REFERENCES

.1 Canadian Standards Association, (CSA International)

.2 Insulated Cable Engineers Association, Inc. (ICEA)

2 PRODUCTS

2.1 CABLE PROTECTION

.1 38 x 140 mm planks pressure treated with copper napthenate or 5% pentachlorophenol solution, water repellent preservative.

2.2 MARKERS

.1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

.2 Wooden post type markers: 89 x 89 mm, 1.5 m long, pressure treated with copper napthenate or 5% pentachlorophenol solution, water repellent preservative, with nameplate fastened near post top, on side facing cable or conduit to indicate depth and direction of duct and cable runs.

.3 Nameplate: aluminum anodized 89 x 125 mm, 1.5 mm thick mounted on wooden post with mylar label 0.125 mm thick with words Cable, Joint or Conduit with arrows to indicate change in direction.

3 EXECUTION

3.1 DIRECT BURIAL OF CABLES

3.1.1 After sand bed specified in Section 31 23 33.01 - Excavating, Trenching and Backfilling, is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.

3.1.2 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.

3.1.3 Make termination and splice only as indicated leaving 0.6 m of surplus cable in each direction.

.1 Make splices and terminations in accordance with manufacturer's instructions using approved splicing kits.

3.1.4 Underground cable splices not acceptable.

3.1.5 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

3.1.6 Cable separation:

.1 Maintain 75 mm minimum separation between cables of different circuits.

.2 Maintain 300 mm horizontal separation between low and high voltage cables.

.3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.

.4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.

.5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.

.6 Install treated planks on lower cables 0.6 m in each direction at crossings.

3.1.7 After sand protective cover specified in Section 31 23 33.01 - Excavating, Trenching and Backfilling is in place, install continuous row of overlapping 38 x 140 mm pressure treated planks as indicated to cover length of run.

3.2 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.

.1 Do not pull spliced cables inside ducts.

.2 Install multiple cables in duct simultaneously.

.3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.5 Before pulling cable into ducts and until cables are properly terminated, seal ends of non-leaded cables with moisture seal tape.

.6 After installation of cables, seal duct ends with duct sealing compound.

3.3 MARKERS

.1 Mark cable every 150 m along cable and duct runs and changes in direction.

.2 Where markers are removed to permit installation of additional cables, reinstall existing markers.

.3 Install wooden post type markers.

.4 Lay concrete markers flat and centred over cable with top flush with finish grade.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements.

.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests.

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.3 High Potential (Hipot) Testing.

.4 Conduct hipot testing in accordance with manufacturer's recommendations.

.7 Leakage Current Testing.

.1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.

.2 Hold maximum voltage for specified time period by manufacturer.

.3 Record leakage current at each step.

.8 Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.

.9 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 80**
CH0032	**FRACTIONAL HORSEPOWER MOTORS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 05 80
FRACTIONAL HORSEPOWER MOTORS
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 80**
CH0032	**FRACTIONAL HORSEPOWER MOTORS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – General Electrical Requirements.

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 100, Motors and Generators.

1.2.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA MG1, Motors and Generators.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Product Data: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

.3 Shop drawings:

.1 Indicate dimensions, recommended installation procedure, wiring diagrams, sizes and location of mounting bolt holes and recommended support method.

.4 Quality Assurance Submittals:

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS:

1.4.1 Provide maintenance data for fractional horsepower motors for incorporation into manual specified in Exhibit 4 – Supplier Document Requirements List.

2 PRODUCTS

2.1 FRACTIONAL HORSEPOWER MOTOR

.1 Non-hazardous locations: to CSA C22.2 No. 100 and NEMA MG1.

.2 Motor with inherent overheating protectors.

3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install wiring, flexible connections and grounding.

.2 Check rotation before coupling to driven equipment.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 81**
CH0032	**MOTORS: 1 to 250 HP**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 05 81

MOTORS: 1 TO 250 HP

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 05 81**
CH0032	**MOTORS: 1 to 250 HP**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section: 26 05 00 – General Electrical Requirements.

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 100, Motors and Generators.

1.2.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA MG1, Motors and Generators

1.3 SUBMITTALS

.1 Submittals: in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Shop drawings:

.1 Indicate:

.1 Overall dimensions of motor.

.2 Shaft centreline to base dimension.

.3 Shaft extension diameter and keyway, coupling dimensions and details.

.4 Fixing support dimensions.

.5 Dimensioned position of ventilation openings. Details of ventilation duct attachments.

.6 Terminal box location and size of terminals.

.7 Arrangement and dimensions of accessories.

.8 Diagram of connections.

.9 Starting current and relative data necessary for use in design of motor starting equipment.

.10 Speed/torque characteristic.

.11 Weight.

.12 Installation data.

1.4 CLOSEOUT SUBMITTALS:

1.4.1 Provide maintenance data for motors for incorporation into manual specified in Exhibit 4 – Supplier Document Requirements List.

1.4.2 Data necessary for maintenance of motors.

1.4.3 Manufacturer's recommended list of spare parts.

2 PRODUCTS

2.1 MATERIALS

.1 Motors:

.1 Non-hazardous locations: to CSA C22.2 No. 100 and NEMA MG1.

.2 Lead markings: to NEMA MG-1.

2.2 CORROSION PREVENTION AND FINISH PAINTING

.1 Provide equipment resistant to corrosion from severe moisture conditions.

2.3 RATING

.1 Motor:

.1 Single speed: horsepower and speed as required for driven equipment.

.2 Two speed: routings as required for driven equipment.

.3 575 V, 3 phase, 60 Hz.

.4 Frame size: in accordance with NEMA MG1.

.5 Enclosure: totally enclosed fan cooled (TEFC).

.6 Operation: required for driven equipment.

2.4 MOTOR TYPE

.1 Squirrel cage, unless indicated otherwise.

2.5 DESIGN LETTERS

D1

.1 Polyphase squirrel cage induction motors design B, unless indicated in other specific sections of the technical specification.

2.6 APPLICATION

.1 Motor suitable for driving connected mechanical equipment.

2.7 PERFORMANCE CHARACTERISTICS

.1 Full load torque: as required.

.2 Locked rotor torque: as required.

.3 Pull-up torque: as required.

.4 Breakdown torque: as required.

.5 Pull-out torque: as required.

.6 Pull-in torque: as required.

.7 Efficiency: premium high efficiency.

.8 Service factor: 1.15.

.9 Time rating: continuous.

2.8 INSULATION

.1 Class: F.

.2 Ambient temperature: 40ºC.

.3 Temperature rise: Class B.

2.9 LOCKED ROTOR KVA PER HP

.1 Locked rotor kVA per hp, code letter G.

2.10 DIRECTION OF ROTATION

.1 Direction of rotation as required for driven load.

2.11 BEARINGS

.1 Antifriction type bearings, fitted with readily accessible facilities for lubrication while motor running or stationary.

2.12 MOTOR MOUNTING AND TERMINAL HOUSING

.1 Horizontal floor mounting, assembly F-1 or F-2.

.2 Vertical flange mounting with thrust bearing.

.3 Slide rails for motor mounting.

2.13 SHAFT

.1 Shaft extension to match driven load.

2.14 STARTING METHOD

.1 Terminate winding connection necessary for appropriate starting method and identify in motor terminal box.

2.15 ACCESSORIES

.1 Shaft extension: as necessary for accessories.

.2 Space heater: for hoist motors and other motors installed in outdoor environment, sized in accordance with manufacturer’s recommendation, 120 V, single phase.

.3 Include anchor devices and setting templates.

3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Dry out motor if dampness present in accordance with manufacturer's instructions.

.2 Install motor on driven machinery. Rigid, plumb and square, using only lifting facilities provided.

.3 Make wiring connections.

.1 Use liquid tight PVC jacketed flexible conduit between rigid conduit and motor.

.4 Make flexible conduit long enough to permit movement of motor over entire length of slide rails.

.5 Check for correct direction of rotation, with motor uncoupled from driven equipment.

.6 Align and couple motor to driven machinery to manufacturer's instructions, using only correct parts such as couplings, belts, sheaves, as provided by manufacturer.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 - General Electrical Requirements.

END OF SECTION

SECTION 26 09 23.01
METERING AND SWITCHBOARD INSTRUMENTS
TABLE OF CONTENTS

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PART .1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

1.2 REFERENCES

1.2.1 CSA International

.1 CAN3-C17, Alternating - Current Electricity Metering.

1.3 SUBMITTALS

1.3.1 Submit in accordance with Section Exhibit 4 – Supplier Document Requirements List.

1.3.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for metering and switchboard instruments and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Include meter and instrument, outline dimensions, panel drilling dimensions and installation cutout template.

PART .2 PRODUCTS

2.1 METER

.1 Combination energy and demand meter: to CAN3-C17.

.2 Accuracy: ±2%.

.3 Flush switchboard case.

.4 Ratings: as indicated.

.5 Register: self contained pulse contacts for transmitting signal.

.6 Allow for remote sensing.

2.2 METER SOCKET

.1 Meter socket to suit meter with automatic current transformer shorting devices when meter removed.

2.3 METERING INSTRUMENT TRANSFORMER CABINET

.1 Sheet steel CSA type 1 enclosure to accommodate potential and current transformers.

2.4 TEST TERMINAL BLOCKS

.1 Test terminal blocks: as required.

2.5 METERING TRANSDUCERS, CONVERTERS

.1 Transducers with 4 – 20 mA output for DCS as indicated.

2.6 INDICATING INSTRUMENTS

.1 Analogue or digital indicating instruments: 1% accuracy, switchboard mounting, flush, case size 87 by 112 mm rectangular 180 degrees scale, operated from instrument transformers.

.1 Ammeter: true RMS range as indicated.

.2 Voltmeter: true RMS range as indicated.

.3 Wattmeter: range as indicated.

.4 Varmeter: range as indicated.

.5 Frequency meter: 0-60 Hz.

.6 Power factor meter: 1.0 -0-1.0

.7 Synchroscope: range as indicated.

2.7 INSTRUMENT SELECTOR SWITCHES

.1 Voltmeter and Ammeter selector switches: rotary, multi-position, maintained contacts, panel mounting, round notched handle, rated to suit instruments, nameplate marked as indicated to coincide with each rotary position. Ammeter selector switches designed to preclude opening of current circuits.

.2 Four position ammeter selector switches identified "off-A-B-C".

.3 Four position voltmeter selector switches identified "A-B, B-C, C-A, off".

.4 Seven position voltmeter selector switches identified "A-B, B-C, C-A, off, A-N, B-N, C-N".

2.8 MULTI-FUNCTION POWER METERING UNITS

D1

2.8.1 Basic multi-function power metering units with the following features:

.1 Inductive voltage transformer connected voltage inputs for 600 V systems and above.

.2 Current transformer current inputs.

.3 True RMS measurement of 3 phase average 1% accuracy of:

.1 Voltage

.2 Current

.3 Frequency

.4 Power factor

.5 Active power, total and per phase

.6 Apparent power, total and per phase

.7 Reactive power, total and per phase

.8 Active energy, total and per phase

.9 Apparent energy, total and per phase

.10 Reactive energy, total and per phase

.4 Local display.

D1

2.8.2 The multi-function power metering unit shall be Schneider Electric, Power Logic ION 7300.

2.9 MULTI-FUNCTION POWER QUALITY MONITORING UNITS

2.9.1 Power metering and monitoring units for customer metering for distribution systems with the following features:

D1

.1 Inductive voltage transformer connected voltage inputs for 600 Vac systems and above.

.2 Current transformers and current inputs.

.3 True RMS measurement of 3 phase average .05% accuracy of:

.1 Voltage

.2 Current

.3 Frequency

.4 Power factor

.5 Active power, total and per phase

.6 Apparent power, total and per phase

.7 Reactive power, total and per phase

.8 Active energy, total and per phase

.9 Apparent energy, total and per phase

.10 Reactive energy, total and per phase

.11 Voltage and current harmonic distortion for total and individual harmonics.

.12 Active power demand.

.13 Apparent power demand.

.14 Relative power demand.

.4 Waveform capture.

.5 Event logging with time stopping.

.6 Trending.

.7 Communication: RS 485 Modbus RTU.

D1 **2.9.2** The Multi-function power quality monitoring unit shall be Schneider Electric, Power Logic ION 7300.

2.10 SHOP INSTALLATION

.1 Install meters and instrument transformers in separate compartment of switchboard.

.2 Install instruments on switchboard.

.3 Ensure adequate spacing between current transformers installed on each phase.

.4 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, electrical supplies.

PART .3 EXECUTION

3.1 METERING INSTALLATION

.1 Install meters and instruments in location free from vibration and shock.

.2 Make connections in accordance with diagrams.

.3 If applicable, ensure power factor corrective equipment connected on load side of meter.

.4 Connect meter and instrument transformer cabinets to ground.

.5 Locate meters within 9 m of instrument transformers. Use 32 mm conduit or armored cable for interconnections.

.1 Use separate conduit or cable for each set of current transformer connections, exclusive for metering.

3.2 FIELD QUALITY CONTROL

.1 Conduct tests in accordance with Section 26 05 00 - General Electrical Requirements and in accordance with manufacturer's recommendations.

.2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.

.3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.

.4 Perform tests to obtain correct calibration.

.5 Do not dismantle meters and instruments.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 09 24**
CH0032	**LIGHTING CONTROL DEVICES – LOW VOLTAGE**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 09 24
LIGHTING CONTROL DEVICES – LOW VOLTAGE
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 09 24**
CH0032	**LIGHTING CONTROL DEVICES – LOW VOLTAGE**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

.1 Materials and installation for low voltage control system designed to provide remote switching of lighting loads by use of:

.1 Low voltage momentary contact switches.

.2 Low voltage relays.

.3 Manual switch control

1.1.2 Related Requirements

.1 Section 26 05 00 - General Electrical Requirements.

.2 Section 26 50 00 - Lighting

1.2 SUBMITTALS

1.2.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Exhibit 4 – Supplier Document Requirements List. Include product characteristics, performance criteria, and limitations.

1.2.2 Shop Drawings:

.1 Submit shop drawings in accordance with Exhibit 4 – Supplier Document Requirements List.

1.2.3 Closeout Submittals:

.1 Submit maintenance data in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3 TEST REPORTS

.1 Submit certified test reports indicating compliance with specifications for specified performance characteristics and physical properties.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Manufacturer's Instructions: submit manufacturer's installation instructions.

2 PRODUCTS

2.1 MATERIALS

.1 Control system: by one manufacturer and assembled from compatible components.

2.2 REMOTE CONTROL SWITCHES

.1 Single pole, double throw, momentary contact, heavy duty, rated 3 A, 25 V, centre pivot rocker action with pilot lights where indicated.

2.3 LOW VOLTAGE RELAYS

.1 Electrically operated by momentary impulse, mechanically latched until activated.

.2 Two coil solenoid type with one coil to close relay contacts and one coil to open relay contacts.

.3 Operating voltage: 24 V, ac.

.4 Load contacts: 20 A, 120 or 347 V, ac.

.5 Auxiliary contacts for pilot light.

.6 Coloured pre-stripped leads.

2.4 CONTROL TRANSFORMER

.1 Low voltage power Class 2, input 120 or 347 V, AC, 60 Hz, output 35 VA at 24 V.

2.5 MANUAL CONTROL

.1 Individual remote control switches as indicated.

.2 Eight circuit manual master selector switch mounted in 100 mm square box with:

.1 Master lock-out switch.

.2 Individual red jewelled pilot lights.

.3 Nine circuit manual dial-type master selector.

.4 Twelve circuit manual dial-type master selector.

3 EXECUTION

3.1 INSTALLATION

.1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - General Electrical Requirements.

.2 Actuate control units in presence of Engineer to demonstrate lighting circuits are controlled as designated.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 12 16**
CH0032	**DRY TYPE, MEDIUM VOLTAGE TRANSFORMERS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 12 16

DRY TYPE, MEDIUM VOLTAGE TRANSFORMERS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 12 16**
CH0032	**DRY TYPE, MEDIUM VOLTAGE TRANSFORMERS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and components for dry type transformers from 1000 V up to 34.5 kV primary, equipment identification and transformer installation.

1.2 RELATED REQUIREMENTS

.1 Section: 26 05 00 – General Electrical Requirements.

1.3 REFERENCES

1.3.1 Canadian Standards Association (CSA)

.1 CAN/CSA C9, Dry-Type Transformers.

.2 CAN/CSA-C802.2, Minimum Efficiency Values for Dry Type Transformers.

.3 CAN/CSA – C6044-I, Instrument Transformers – Part 1: Current Transformers

.4 CAN/CSA - C60044-I, Instrument Transformers – Part 2: Inductive Voltage Transformers

1.3.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC GL1-3, Power Transformer and Reactor Bushings.

.2 CSA C22.1, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.

1.3.3 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE C57.12.01, General Requirements for Dry-Type Distribution and Power Transformers.

.2 IEEE C57.12.91, Test Code for Dry-Type Distribution and Power Transformers

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1.4.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List

1.4.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for transformers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4.3 Shop Drawings:

.1 Indicate on drawings:

.1 Dimensions showing enclosure, mounting devices, terminals, taps, internal and external component layout.

.2 Technical data for transformer:

.1 kVA rating.

.2 Primary and secondary voltages.

.3 Frequency.

.4 Three phase.

.5 Polarity or angular displacement.

.6 Full load efficiency.

.7 Regulation at unity pf.

.8 BIL.

.9 Insulation type.

.10 Sound rating.

1.4.4 Factory Test Submittals: submit standard factory test certificates of each transformer and type test of each transformer in accordance with CSA C9.

1.5 CLOSEOUT SUBMITTALS

1.5.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.5.2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

1.5.3 Operation and maintenance instructions to include:

.1 Tap changing.

.2 Recommended environmental conditions.

.3 Recommended periodic inspection and maintenance.

.4 Bushing replacement.

2 PRODUCTS

2.1 OPERATING CHARACTERISTICS

.1 Primary Voltage A:

.1	Nominal Operating Voltage	25kV
.2	Maximum Rated Voltage	27 kV r.m.s
.3	Nominal System Frequency	60 Hz
.4	Number of Phases	3
.5	Lightning Impulse Withstand Voltage	150 kV peak
.6	Power Frequency Withstand Voltage	50 kV r.m.s
.7	Short-circuit current	25 kA

.2 Secondary Voltage

.1	Nominal Operating Voltage (V)	600
.2	Maximum Rated Voltage (V r.m.s.)	660
.3	System Earthing	Solidly Grounded

.3 Auxiliary Power Supply

.1	AC supply voltage for motors	600 V, 3-ph, 60HZ
.2	AC supply voltage for power receptacles	120 V, 1-ph, 60 Hz
.3	DC supply voltage for protection equipment	125 V d.c.

2.2 TECHNICAL REQUIREMENTS

2.2.1 Design Considerations

.1 The transformers shall be capable of withstanding, without injury, the mechanical and thermal stresses produced by external short circuits on the terminal of any winding for duration of two (2) seconds. They shall be designed for short circuit withstand capability as per the relevant standards.

.2 In the event of sudden disconnection of the load, the transformers shall be capable of operating at a voltage approximately 25% above the rated voltage for a period of one (1) minute and 40% above the rated voltage for a period of five (5) seconds.

.3 Transformers shall be of low loss (copper and steel) design.

2.3 TECHNICAL CHARACTERISTICS

.1	Rated Power	1250 kVA
.2	Type of Cooling	ANN
.3	Number of Phases	3
.4	Nominal Frequency	60 Hz
.5	Rated Voltage:	
.1	High Voltage (H.V.) Winding	24, 940 V
.2	Low Voltage (L.V.) Winding	600 Y/347 V
D1 .6	Off load taps:	2x ± 2.5% taps (2FCAN + 2FCBN)
.7	Winding Insulation Level:	
.1	High Voltage (H.V.) Winding	125 kV BIL
.2	Low Voltage (L.V.) Winding	10 kV BIL
.8	H.V. Winding Connection	Delta
.9	L.V. Winding Connection	Star connected and neutral solidly grounded
.10	Vector Group	Dyn11

.11	Winding Insulation	Vacuum Pressure Impregnated (VPI)
.12	Insulation Class	220°C
.13	Temperature Rise	115°C
.1	H.V. CTs	One (1) set 1200/600:5A, C400
.2	L.V. Neutral CTs	One (1) 1200/600:5A, C400
.3	Transformer impedance	5.5% @ 1250 kVA

2.4 ENCLOSURE

.1 Fabricated from sheet steel with drip shield.

.2 Bolted removable panels for access to tap connections, enclosed terminals and other accessories.

.3 High Voltage Conductor entry:

.1 Entry for busbars from close coupled 25 kV Primary Switchgear.

.2 Bushings: EEMAC GL1-3.

.4 Entry for 600 V busway.

.5 Designed for floor mounting complete with mounting holes for anchor bolts.

.6 Indoor, ventilated, self cooled type. Temperature of exposed metal parts not to exceed 65ºC rise,

2.5 WINDINGS

2.5.1 Primary and secondary coils:

.1 Copper

.2 Nomex insulation, vacuum pressure impregnated with high temperature polyester resin

2.5.2 Coil and core assembly:

.1 Taps located at front of coils for accessibility.

2.5.3 Sound level: not to exceed 68 dB.

2.6 ACCESSORIES

.1 Winding temperature monitoring system, which shall include embedded temperature detectors in each winding.

.2 Wiring and terminal box for protective devices.

.3 Digital type winding temperature indicator with alarm and trip contacts.

.4 Provision only for fans for forced air cooling, with thermostat control] [with temperature indicator sequence contacts control.

.5 Two (2) grounding terminals: outside of enclosure.

.6 The core shall be grounded

D1 .7 Portable (Safety) Grounds attachment points shall be provided on the terminals of each of the three (3) high voltage windings. Attachment points shall be Maclean Power Systems 20 mm ball studs or equivalent, tested in accordance with CAN/ULC-61230, Live Working – Portable Equipment for Grounding and Bonding. The Transformer and enclosure shall be designed such that maintenance staff can easily and safely gain access to the ground attachment points while keeping all parts of their person a minimum distance of 900 mm from any part of the 25 kV circuit.

2.6.1 Suitable provision for lifting of the complete transformer and the transformer core and coils assembly (hoisting eyes) shall be incorporated in to the design. Each enclosure shall be supplied with the necessary elements for moving and maintenance, including hauling attachment points.

2.7 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section: 26 05 00 - General Electrical Requirements.

.2 Equipment labels: nameplate size 7.

3 EXECUTION

3.1 INSTALLATION

.1 Locate, install and ground transformer in accordance with manufacturer's instructions.

.2 Set and secure transformers in place, rigid plumb and square.

.3 Connect primary bushings to high voltage circuit.

.4 Connect secondary terminals to secondary feeder cable.

.5 Energize transformers and check secondary no-load voltage.

.6 Wire one set of contacts on winding temperature monitoring system to sound alarm.

.7 Wire alarm contacts on winding temperature indicator to sound alarm when excessive temperature reached.

.8 Connect sequence contacts of temperature indicator:

.1 First contact closure: start fan. (future)

.2 Second contact closure: sound alarm.

.3 Third contact closure: trip secondary breaker.

.9 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.

.10 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 - General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION:: **26 12 16.01**
CH0032	**DRY TYPE TRANSFORMERS UP TO 600 V PRIMARY**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 12 16.01

DRY TYPE TRANSFORMERS UP TO 600 V PRIMARY

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REGISTERED PROFESSIONAL ENGINEER
PEG Newfoundland and Labrador
G. W. HAINES
SIGNATURE
11-Dec-2013
DATE
NEWFOUNDLAND & LABRADOR
REV. D2

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.2 RELATED SECTIONS

.1 Section: 26 05 00 - General Electrical Requirements.

.2 Section: 26 05 22 – Connectors and Terminations.

.3 Section: 26 05 20 – Grounding - Secondary.

1.3 REFERENCES

1.3.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.47, Air-Cooled Transformers (Dry Type).

.2 CSA C9, Dry-Type Transformers.

.3 CSA C22.2, No. 94.1, Enclosures for Electrical Equipment, Non-environmental Considerations.

.4 CSA C22.2, No. 94.2, Enclosures for Electrical Equipment, Environmental Considerations.

.5 CSA C802.2, Minimum Efficiency for Dry-Type Transformers

1.3.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA TP2, Standard Test method for Measuring the Energy Consumption of Distribution Transformers.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1.4.1 Submit Product Data for each type and size of transformer indicated in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Physical: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features.

.3 Efficiency Data

1. No load and full load losses per CSA C802.2.
2. Linear load Efficiency data @ 1/6, 1/4, 1/2, 3/4, & full load.
3. Linear Load Efficiency @ 35% loading tested per NEMA TP-2.
4. Efficiency under K7 load profile at 15%, 25%, 50%, 75%, 100% of nameplate rating.

1.4.2 Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

.1 Wiring Diagrams: Power, signal, and control wiring.

1.4.3 Qualification Data: For testing agency.

1.4.4 Source quality-control test reports.

1.4.5 Field quality-control test reports.

1.4.6 Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

1.5.1 Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

1.5.2 Source Limitations: Obtain each transformer type through one source from a single manufacturer.

1.5.3 Electrical Components, Devices and Accessories: Listed and labelled as defined to Canadian Electrical Code (CEC), by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5.4 Comply with IEEE C57.12.91, “Test Code for Dry-Type Distribution and Power Transformers.”

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.7 COORDINATION

1.7.1 Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases.

1.7.2 Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 PRODUCTS

2.1 GENERAL TRANSFORMER REQUIREMENTS

.1 Description: Factory-assembled and tested, air-cooled units for 60 Hz service

.2 Cores: Grain-oriented, non-aging silicon steel.

.3 Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.2 DISTRIBUTION TRANSFORMERS

2.2.1 Type: ANN

2.2.2 Three phase, rating and voltage ratio as indicated.

2.2.3 Cores: One leg per phase.

D1 **2.2.4** Enclosure: CSA C 22.2, No. 94, Type 2 Drip Proof inside the Spillway Electrical Building and Type 3R inside Intake and Spillway Hoist Houses.

.1 Core and coils shall be impregnated within resin compound, sealing out moisture and air.

D1 **2.2.5** Transformer Enclosure Finish: Comply with CSA C22.2, No. 94.2.

.1 Finish Color: ANSI 61 Light Grey.

2.2.6 Taps for Transformers smaller than 3 kVA: None.

2.2.7 Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

2.2.8 Taps for Transformers 25 kVA and larger: Two 2.5 percent taps above and four 2.0 percent taps below normal full capacity.

2.2.9 Insulation Class: 220ºC, UL-component-recognized insulation system with a maximum of 115ºC rise above 40ºC ambient temperature.

2.2.10 K-Factor Rating: Transformers shall be K-Factor 7 or higher rated and comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.

.1 Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.

.2 Indicate value of K-factor on transformer nameplate.

2.2.11 Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize inter-winding capacitance.

.1 Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.

.2 Include special terminal for grounding the shield.

.3 Shield Effectiveness:

1. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.

2. Common-Mode Noise Attenuation: Minimum of minus 120 dB at 0.5 to 1.5 kHz; minimum of minus 65 dB at 1.5 to 100 kHz.

3. Normal-Mode Noise Attenuation: Minimum of minus 52 dB at 1.5 to 10 kHz.

2.2.12 Wall Brackets: Manufacturer's standard brackets.

2.2.13 Fungus Proofing: Permanent fungicidal treatment for coil and core.

2.2.14 Low-Sound-Level Requirements: CSA C9 standard sound levels when factory tested according to IEEE C57.12.91.

2.3 OPTIONS TO ADDRESS NFPA 70E/CSA-Z462 ARC FLASH STANDARD

2.3.1 Lockable Hinged Front Access Doors

.1 Allows safe and rapid access to the transformer without the need to undo multiple screws and handle heavy metal cover plates that are in close proximity to live electrical points.

.2 Doors shall be able to be secured using a padlock.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section: 26 05 00 – General Electrical Requirements.

.2 Label Size: 7.

.3 Nameplate wording shall include equipment tag number, voltage ratio and source circuit identification.

2.5 SOURCE QUALITY CONTROL

.1 Test and inspect transformers according to IEEE C57.12.91.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Examine conditions for compliance with enclosure and ambient temperature requirements for each transformer.

.2 Verify that field measurements are as needed to maintain working clearances required by CSA C22.1 and manufacturer's written instructions.

.3 Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

.4 Verify that ground connections are in place and requirements in Section: 26 05 28 – Grounding – Secondary have been met.

.5 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as required to meet codes applicable to project.

.2 Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project.

3.3 CONNECTIONS

.1 Ground equipment according to Section: 26 05 28 – Grounding – Secondary.

.2 Connect wiring according to Section: 26 05 22 – Connectors and Terminations.

3.4 FIELD QUALITY CONTROL

.1 Conduct tests in accordance with Section: 26 05 00 – General Electrical Requirements.

.2 Remove and replace units that do not pass tests or inspections and retest as specified above.

3.5 ADJUSTING

.1 Record transformer secondary voltage at each unit. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding name plate voltage plus 10 percent and not being lower than name plate voltage minus 3 percent at maximum load conditions.

.2 Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

.1 Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 13 17**
CH0032	**FULL LOAD INTERRUPTER SWITCHES TO 25 kV**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 13 17

FULL LOAD INTERRUPTER SWITCHES TO 25 kV

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CH0032	**FULL LOAD INTERRUPTER SWITCHES TO 25 kV**	Rev : D2
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1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section: 26 05 00 – General Electrical Requirements.

.2 Section: 26 13 18 – Primary Switchgear Assembly to 25 kV

1.2 REFERENCES

1.2.1 CSA International

.1 CSA C22.2 No.193, High-Voltage Full-Load Interrupter Switches.

1.2.2 Electrical Equipment Manufacturers Association of Canada (EEMAC)

.1 EEMAC G8-2, Switchgear Assemblies

1.3 SUBMITTALS

1.3.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for interrupter switches and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Operation and Maintenance Data: submit operation and maintenance data for interrupter switches for incorporation into manual.

2 PRODUCTS

2.1 LOAD INTERRUPTER SWITCH

.1 Load Interrupter Switch: to CSA C22.2 No.193.

.2 3-pole, quick-make, quick-break assembly, stored energy operating mechanism manual operated, assembled on welded steel base.

.3 Continuous full load rating: 600 A, load interrupting rating: 600 A, at 25 kV.

.4 Nominal voltage rating: 25 kV.

.5 Maximum rated voltage: 27 kV.

.6 Dielectric strength test voltage: 60 kV.

.7 Rated momentary current: 40 kA, asymmetrical.

.8 Rated two-second short-time current: 25 kA, symmetrical.

.9 125 kV BIL.

.10 Interphase barriers.

.11 Non-removable operating handle c/w provision for pad locking and key interlock.

.12 Power fuses: 400 A maximum.

.13 Power fuses supplied: 65E, minimum 16 kA, symmetrical interrupting capacity

D2

.14 Enclosure: CSA Enclosure Type 1 with gaskets and filters on ventilation openings..

.15 Include viewing windows that permits full view of the position of all three switch blades.

.16 Kirk key Interlocks with features as follow:

.1 Fuse is only accessible after switch is opened.

.2 Switch can be closed only after fuse access door is closed.

.3 Interlock main switch and standby supply switch to allow only one out of the two switches to be closed.

2.2 FABRICATION

.1 Factory assemble and adjust 3 pole gang operated switch, operating assembly, interphase barriers and interlocks.

3 EXECUTION

3.1 INSTALLATION

.1 Install load interrupter switches in accordance with the drawings.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 - General Electrical Requirements.

.2 Check switch contact resistance with low resistance meter.

.3 Megger switch across each pole, from pole to pole, and from pole to ground.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 13 18**
CH0032	**PRIMARY SWITCHGEAR ASSEMBLY TO 25 kV**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 13 18

PRIMARY SWITCHGEAR ASSEMBLY TO 25 kV

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1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section: 26 05 00 – General Electrical Requirements.

.2 Section: 26 12 16 – Dry Type Medium Voltage Transformers.

.3 Section: 26 13 17 – Full Load Interrupter Switches to 25 kV

1.2 REFERENCES

1.2.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C57.12, General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

1.2.2 CSA International

.1 CSA C22.2 No.14, Industrial Control Equipment.

.2 CSA C22.2 No.31, Switchgear Assemblies.

.3 CSA C22.2 No.193, High-Voltage Full-Load Interrupter Switches.

.4 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

1.2.3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC G1-1, Indoor and Outdoor Switch and Bus Insulators.

.2 EEMAC G8-3.3, Metal-Enclosed Interrupter Switchgear Assemblies.

1.2.4 National Electrical Manufacturers Association (NEMA)

1.3 SUBMITTALS

1.3.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for switchgear assembly and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Primary switchgear assembly to include:

.1 Enclosure.

.2 Load interrupter switches.

.3 Power fuses.

1.3.3 Shop Drawings:

.1 Indicate on drawings:

.1 Floor anchoring method and dimensioned foundation template. Dimensioned cable entry and exit locations.

.2 Dimensioned cable termination height.

.3 Dimensioned position and size of busbars and details of provision for extension.

.4 Dimensioned positions of main connections, including air clearances and support insulators.

.5 Layout of internal and front panel components suitably identified.

.6 Time current characteristics curves of protection devices.

1.3.4 Certificates:

.1 Submit manufacturer's test routine and type certificates.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Operation and Maintenance Data: submit operation and maintenance data for primary switchgear assembly for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Submit manufacturer's type test certificates indicating switchgear cubicles and components tested as integrated assembly.

.2 Submit test procedures, at least 10 days prior to testing.

.3 Submit production test results before equipment is shipped from factory.

1.6 EXTRA MATERIALS

1.6.1 Submit spare parts list in accordance with Exhibit 4 – Supplier Document Requirements List.

1.6.2 Include:

.1 1 set power fuses of each type installed.

.2 6 of each type of indicator light bulbs installed.

2 PRODUCTS

2.1 MATERIALS

.1 Switchgear assembly: to CSA C22.2 No.31.

.2 Steel for cubicles: to CSA G40.21.

.3 Insulators: to CSA C22.2 No.58.

.4 Enclosure finish to manufacturer's standard.

2.2 PRIMARY SWITCHGEAR

.1 Primary switchgear: indoor, 27 kV, 600 A, 3 phase, 3 wire, short circuit capacity 16 kA, BIL 125 kV.

2.3 PRIMARY ENCLOSURE

D1

.1 Primary enclosure: metal enclosed free standing, floor mounted, dead front, indoor CSA Enclosure Type 12 cubicle unit. Constructed from rolled flat steel sheets.

.2 Switchgear shall be close coupled with medium voltage transformer specified in Section: 26 12 16 and as indicated on drawings.

.3 Ventilating louvres: vermin and insect proof with easily replaceable fiberglass filters.

.4 Use non-corrosive bolts and hardware.

.5 Access from front and back.

.6 100 mm steel channel sills for base mounting in single length common to multi-cubicle switchboard.

.7 Full height outer doors, gasketted, hinges on left side, provision for multiple padlocking. Three point latch, stops, to open at least 135 degrees with viewing windows of transparent shatterproof material for inspection of disconnecting switch position.

.8 Hinge doors on same side.

.9 Gaskets on removable covers.

.10 Allow for future extension on both sides indicated of cubicle unit.

.11 Inner door: hinged and bolted mesh steel screens to prevent inadvertent contact with exposed live parts, to open at least 90 degrees.

.12 Storage container on inside surface of compartment capable of accommodating 3 spare fuses.

.13 Include spare fuses.

.14 Metal pocket with weatherproof envelope and 1 set of drawings and diagram prints on inside surface of door.

.15 Space heaters: 120 V, 250 W, 60 Hz, single phase, low watt density complete with thermostat breaker in each cubicle.

.16 Interior lamp and lampholder in each cubicle with externally mounted switch c/w wire guard.

.17 Receptacle: 120 V, single phase, 60 Hz, U-ground, duplex in each cubicle.

.18 Provide access control as follows:

.19 Equip doors providing access to interrupter switches with fuses with mechanical interlock to guard against:

.1 Opening door if interrupter switch on source side of fuse is closed.

.2 Closing interrupter switch if door is open.

2.4 BUS BARS

.1 Three phase insulated busbars, continuous current rating 600 A extending full width of multi-cubicle switchboard suitably supported on insulators.

.2 Main connections between busbars, major switching components and fuses of continuous current rating to match major switching components.

.3 High conductivity copper for busbars and main connections.

.4 Provision for extension of bus on both sides of unit without need for further drilling or field preparation.

.5 Brace busbar system including ground bus to withstand stresses resulting from short circuit currents specified.

.6 Silver surfaced joints, secured with non-corrosive bolts and Belleville washers, tightened with torque wrench in accordance with manufacturer's recommendations.

.7 Identify phases of busbars by suitable marking.

.8 Busbar connectors when switchgear shipped in more than one section.

2.5 GROUNDING

.1 Copper ground bus not smaller than 50 x 6 mm extending full width of multi-cubicle switchboard and situated at bottom.

.2 Lugs at each end for size 4/0 AWG grounding cable.

.3 Bond non-current carrying parts, including switchgear framework, enclosure and bases to ground bus.

D1

.4 Portable (Safety) Grounds attachment points shall be provided on each MV terminal. Attachment points shall be Maclean Power Systems 20 mm ball studs or equivalent, tested in accordance with CAN/ULC-61230, Live Working – Portable Equipment for Grounding and Bonding. The switchgear and enclosure shall be designed such that maintenance staff can easily and safely gain access to the ground attachment points while keeping all parts of their person a minimum distance of 900 mm from any part of the 25 kV circuit.

2.6 LOAD INTERRUPTER SWITCH

.1 Load interrupter switch in accordance with Section: 26 13 17.

2.7 INTERLOCKS

.1 Interlocks in accordance with Section: 26 18 41.

2.8 PRIMARY INSTRUMENTS

.1 Instrument in accordance with Section: 26 09 23.01.

2.9 OWNER METERING

.1 Owner metering in accordance with Section: 26 09 23.01.

2.10 INDICATOR LIGHTS

.1 Include long life LED indicator lights rated for control voltage to CSA C22.2 No.14.

.2 Include push to test lights with transparent plastic cover.

2.11 FINISHES

.1 Apply finishes in accordance with Section: 26 05 00 - General Electrical Requirements.

D1 .2 Cubicle exteriors: ANSI 61 light grey.

.3 Cubicle interiors: white.

.4 Supply two (2) spray cans touch up paint.

2.12 EQUIPMENT IDENTIFICATION

.1 Equipment identification in accordance with Section: 26 05 00 - General Electrical Requirements.

2.12.1 Nameplates:

.1 Switchgear designation: label - white plate, black letters, size 7, engraved. Individual cubicle designations: labels - white plate, black letters, size 5, engraved.

2.13 WARNING SIGNS

.1 Include warning signs in accordance with Section: 26 05 00 - General Electrical Requirements].

2.14 SOURCE QUALITY CONTROL

.1 Engineer will witness standard factory testing of complete switchgear assembly, including operation of switches and controls.

.2 Notify Engineer in writing, 10 days prior to testing, that equipment is ready for inspection.

3 EXECUTION

3.1 INSTALLATION

.1 Set and secure switchgear assembly in place on channel base, rigid, plumb and square.

.2 Make field connections in accordance with manufacturer's recommendations.

.3 Connect ground bus to building system ground.

.4 Render entire assembly rodent and insect proof by means of plates, screens, and grouting.

.5 Ensure fixed housing into which interrupter moving carriage enters, is plumb.

.6 Check factory made connections for mechanical security and electrical continuity.

.7 Check fuse sizes against shop drawings.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 - General Electrical Requirements.

.2 Operate load interrupter closing and tripping mechanisms, to verify correct functioning.

.3 Check insulation of switchgear assembly with DC Hi-Pot tester in accordance with manufacturer's approved methods. If values are not satisfactory, clean, and dry switchgear and repeat tests until readings acceptable to Engineer.

.4 Check insulation of switchgear assembly with 1000V megger. If values not satisfactory, clean, and dry switchgear and repeat tests until readings acceptable to Engineer.

.5 Check phase rotation of each feeder.

.6 Place primary switchgear in service and check meter readings to ensure proper functioning of instruments and satisfactory phase balance of loads.

.7 Check fuses for correct type and rating.

.8 Check for grounding and neutral continuity between station ground and system neutral.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 18 41**
CH0032	**INTERLOCK SYSTEMS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 18 41
INTERLOCK SYSTEMS
TABLE OF CONTENTS

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SIGNATURE
11-DEC-2012
DATE
NEWFOUNDLAND & LABRADOR
REV. D2

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 18 41**
CH0032	**INTERLOCK SYSTEMS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

.2 Section 26 13 17 - Full Load Interrupter Switches to 25 kV

.3 Section 26 13 17 - Full Load Interrupter Switches to 25 kV

.4 Section 26 13 18 - Primary Switchgear Assembly to 25 kV

.5 Section 26 23 300 – Low Voltage Switchgear

.6 Section 26 28 16.01 – Air Circuit Breakers

.7 Section 26 28 16.02 – Molded Case Circuit Breakers

.8 Section 26 23 300 – Low Voltage Switchgear

.9 Section 26 24 19 – Motor Control Centres

.10 Section 26 29 10 – Motor Starters to 600 V.

1.2 REFERENCES

1.2.1 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE C37.20.1, Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.

.2 IEEE C37.20.2, Standard for Metal-Clad and Station-Type Cubicle Switchgear.

.3 IEEE C37.35, Guide for the Application, Installation, Operation, and Maintenance of High-voltage Air Disconnecting and Interrupter Switches.

.4 IEEE 241, Recommended Practice for Electric Power Systems in Commercial Buildings.

.5 IEEE 1015, Blue Book IEEE Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

1.2.2 CSA International

.1 CSA C22.2 No.31, Switchgear Assemblies.

1.3 SUBMITTALS

1.3.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for interlock systems and include product characteristics, performance criteria, physical size, finish and limitations.

2 PRODUCTS

2.1 INTERLOCK SYSTEMS

.1 Mechanical interlocks between two power circuit breakers located in adjacent cells to prevent:

.1 Standby power breaker closing unless normal power breaker is open.

.2 Normal power breaker closing unless standby power breaker is open.

.2 Electrical interlock between normal power circuit breaker and standby power circuit breaker to prevent:

.1 Standby power breaker closing unless normal power breaker is open.

.2 Normal power breaker closing unless standby power breaker is open.

.3 Kirk key interlocks, Type F for load interrupter switch and Type D for switchgear cubicle door to prevent:

.1 Opening cubicle door for access to fuses while load interrupter is in closed position.

.2 Closing load interrupter while cubicle door is open.

.4 Kirk key interlocks, Type T, key transfer with Type F for main isolating switch and feeder circuit breakers or load interrupters to prevent:

.1 Opening isolating switch until all [circuit breakers] [load interrupters] are open.

.2 Closing any or all [circuit breakers] [load interrupters] while isolating switch is open.

.5 Kirk key interlocks, Type F for normal load interrupter switch and standby load interrupter switch to prevent:

.1 Standby power breaker closing unless normal power breaker is open.

.2 Normal power breaker closing unless standby breaker is open.

.6 Kirk key interlocks Type F for normal power breaker and standby power breaker to prevent:

.3 Standby power breaker closing unless normal power breaker is open.

.4 Normal power breaker closing unless standby breaker is open.

.7 Key interlocks mounted in switchgear so that interlocks cannot be removed when circuit breaker or load interrupter switch is in closed position.

3 EXECUTION

3.1 INSTALLATION

.1 Install interlocks in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 23 00**
CH0032	**LOW VOLTAGE SWITCHGEAR**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 23 00

LOW VOLTAGE SWITCHGEAR

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 23 00**
CH0032	**LOW VOLTAGE SWITCHGEAR**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section: 26 05 00 – General Electrical Requirements

.2 Section: 26 28 16.01 – Air Circuit Breakers

.3 Section: 26 25 00 – Enclosed Bus Assemblies

.4 Section: 26 09 23.01 – Metering and Switchboard Instruments

1.2 REFERENCES

1.2.1 CSA International

.1 CSA C22.2 No.31, Switchgear Assemblies.

.2 CAN/CSA C60044.1, Instrument Transformers – Part 1: Current Transformers.

.3 CAN/CSA C60044.2, Instrument Transformers – Part 2: Inductive Voltage Transformers.

1.2.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC G8-3.3, Metal Enclosed Interrupter Switchgear Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for low voltage switchgear and include product characteristics, performance criteria, physical size, finish and limitations.

1.3.3 Shop Drawings:

.1 Indicate on drawings:

.1 Floor anchoring method and foundation template;

.2 Dimensioned bus and cable entry and exit locations;

.3 Dimensioned position and size of bus;

.4 Overall length, height and depth of complete switchgear;

.5 Dimensioned layout of internal and front panel mounted components.

1.3.4 Certificates:

.1 Submit certified factory test results;

.2 Submit certified type test results.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Operation and Maintenance Data: submit operation and maintenance data for low voltage switchgear and components for incorporation into manual.

2 PRODUCTS

2.1 MATERIALS

.1 Switchgear assembly: to CSA C22.2 No.31.

2.2 RATING

.1 Secondary switchgear: indoor, 600 V, 3 phase, 60 Hz, minimum short circuit capacity 35 kA (rms symmetrical), current rating as indicated.

2.3 DESCRIPTION

.1 All low voltage switchgear shall be Eaton, Magnum DS.

2.4 ENCLOSURE

.1 Main incoming sections to contain:

.1 Air circuit breaker sized as indicated;

.2 Digital metering system to Section: 26 09 23.01 - Metering and Switchboard Instruments.

.2 Distribution sections to contain:

.1 Air circuit breaker sized as indicated;

.2 Copper bus, from main section to distribution sections including vertical bussing.

.3 Blanked off spaces with bus stabs and hardware for mounting future units.

.4 Metal enclosed, free standing, floor mounted, dead front, indoor, CSA Enclosure 1A cubicle unit.

.5 Ventilating louvres: vermin, insect proof with easily replaceable fibre glass filters.

.6 Access from front and rear.

.7 Steel channel sills for base mounting.

.8 Provision for future extension on right or left side as indicated.

.9 Include manually operated breaker lifting device mounted on the top of the switch gear.

.1 Where air circuit breakers are mounted in multiple cubicles, lifting device to travel on rail on top of switch board.

.10 Space heater: 120 V, 250 W, 60 Hz, single phase, in each cubicle, complete with thermostat and disconnect switch.

.11 Receptacle: 120 V, single phase, 60 Hz, duplex, U-ground, in each cubicle.

D2

.12 Infrared inspection ports shall be provided on the back of the enclosure to inspect switchgear buses.

2.5 BUSBARS

.1 Three phase and 100% rated insulated busbars, continuous current rating as indicated, self-cooled, extending full width of multi-cubicle switch board, suitably supported on insulators.

.2 Main connections between bus and major switching components to have continuous current rating to match major switching components.

.3 Busbars and main connections: 99.30% minimum conductivity copper.

.4 Allow for extension of bus on both sides of unit without need for further drilling or preparation in field.

.5 Silver surfaced joints, secured with non-corrosive bolts and Belleville washers.

.6 Identify phases of busbars by suitable marking.

.7 Busbar connectors, when switchboard shipped in more than one section.

2.6 GROUNDING

.1 Copper ground bus not smaller than 50 mm x 6 mm extending full width of multi-cubicle switchboard and situated at bottom.

.2 Lugs at each end for size 4/0 AWG grounding cable.

2.7 AIR CIRCUIT BREAKER

.1 Shall be in accordance with Section: 26 28 16.01 – Air Circuit Breakers.

2.8 MOULDED CASE CIRCUIT BREAKERS

.1 Shall be in accordance with Section: 26 28 16.02 – Moulded Case Circuit Breakers.

2.9 INSTRUMENTS

.1 Shall be in accordance with Section: 26 09 23.01 – Metering and Switchboard Instruments.

2.10 INSTRUMENT TRANSFORMERS

.1 Current Transformers shall be in accordance with CAN/CSA C60044.1.

.2 Potential Transformer shall be in accordance with CAN/CSA C60044.2.

2.11 FINISHES

.1 Apply finishes in accordance with Section: 26 05 00 - General Electrical Requirements:

.1 Cubicle exteriors ANSI 61 light grey;

.2 Cubicle interiors white.

2.12 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section: 26 05 00 - General Electrical Requirements.

.2 Nameplates:

.1 White plate, black letters, size 7;

.2 Complete switchgear labelled: equipment tag numbers, voltage, system configuration and main bus ampacity;

.3 Main cubicle labelled: "Main Breaker";

.4 Distribution units labelled with Motor Control Centre (MCC) or load equipment tag numbers.

2.13 ARC FLASH REDUCTION MAINTENANCE SYSTEM

D2

.1 Switchgear shall be provided with arc flash protection systems:

.1 Arc flash protection system shall be the Maintenance Mode Arc Flash Reduction system;

.2 A door-mounted selector switch shall be provided to arm the arc flash reduction maintenance mode;

.3 The selector switch shall be lockable;

.4 A door-mounted light shall be provided to indicate that the function is on;

.5 Dry contact shall be provided for remote supervision by the powerhouse operator.

2.14 PROVISIONS FOR ISOLATION (LOCKOUT)

2.14.1 The following provisions for isolation shall be in accordance with Section: 26 05 00 General Electrical Requirements:

.1 All circuit breakers shall be capable of being padlocked in the “disconnected” position;

.2 All circuit breakers shall be capable of being padlocked in the “test” position;

.3 All circuit breaker compartment shutters shall be capable of being padlocked in the “closed” position.

3 EXECUTION

3.1 INSTALLATION

.1 Locate switchgear assembly as indicated and bolt to floor.

.2 Connect main power supply to main breaker.

.3 Connect back up power supply to breaker.

.4 Connect load side of breakers in distribution cubicles to distribution feeders or directly to bus of close coupled MCC.

.5 Check factory made connections for mechanical security and electrical continuity.

.6 Run two grounding conductor 4/0 AWG green insulated copper from ground bus to electrical room ground bar.

.7 Check trip unit settings against co-ordination study to ensure proper working and protection of components.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 – General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 24 16.01**
CH0032	**PANELBOARDS BREAKER TYPE**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 24 16.01

PANELBOARDS BREAKER TYPE

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
G. W. HAINES
SIGNATURE
11-DEC-2013
DATE
NEWFOUNDLAND & LABRADOR
REV. D2

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 24 16.01**
CH0032	**PANELBOARDS BREAKER TYPE**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for standard and custom breaker type panelboards.

1.2 RELATED SECTIONS

.1 Section: 26 05 00 – General Electrical Requirements.

.2 Section: 26 28 21 - Moulded Case Circuit Breakers.

D1 .3 Section: 26 05 29 – Hangers and Supports for Electrical Systems

1.3 REFERENCES

1.3.1 Canadian Standards Association (CSA International)

.1 CSA C22.2No.29, Panelboards and enclosed Panelboards.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit shop drawings in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

2 PRODUCTS

2.1 PANELBOARDS

D1 .1 Panelboards: to CSA C22.2 No.29

.2 Panelboards shall be Eaton, Power-R-Line.

.3 Install circuit breakers in panelboards before shipment.

.4 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.5 250 and 600 Vac panelboards: bus and breakers rated for 14 kA, and 18 kA (symmetrical) interrupting capacity or as indicated on drawings.

.6 125 Vdc panelboards: rated 250 Vdc, bus and breakers rated for 5 kA (symmetrical) interrupting capacity or as indicated on drawings.

.7 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.8 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.9 Two keys for each panelboard and key panelboards alike.

.10 Aluminum bus with neutral of same ampere rating as mains.

.11 Mains: suitable for bolt-on breakers.

.12 Trim with concealed front bolts and hinges.

D1 .13 Trim and door finish: baked ANSI 61 light grey enamel.

2.2 CUSTOM BUILT PANELBOARD ASSEMBLIES

.1 125 mm relay section on one or both sides of panels as indicated for installation of low voltage remote control switching components.

.2 125 Vdc and 48 Vdc panelboard assemblies to include relays, meters and control devices as indicated on the drawings.

.3 Double stack panels as indicated.

.4 Contactors in mains as indicated.

.5 Feed through lugs as indicated.

2.3 BREAKERS

.1 Breakers: to Section: 26 28 26.02 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Engineer.

.5 Lock-on devices for receptacles, fire alarm, clock outlet, emergency, door supervisory, intercom, stairway, exit and night light circuits.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section: 26 05 00 – General Electrical Requirements.

.2 Nameplate for each panelboard size 4 engraved with equipment tag number and voltage.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.5 PROVISIONS FOR ISOLATION (LOCKOUT)

2.5.1 The following provisions for isolation shall be in accordance with Section: 26 05 00 - General Electrical Requirements.

D1

.1 Panelboards shall be equipped with permanently mounted devices suitable for padlocking breakers securely in the “Off” position.

.2 Panelboards for use on 600/347 Vac shall be equipped with visi-break type circuit breakers.

3 EXECUTION

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

D1

.2 Surface mounted panelboards shall be mounted on support channels in accordance with Section: 26 05 29 - Hangers and Supports for Electrical Systems. Where practical, panelboards shall be grouped on common channels.

.3 Mount panelboards to height specified in Section: 26 05 00 - Common Work Results – Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 - General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 24 19**
CH0032	**MOTOR CONTROL CENTRES**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 26 24 19
MOTOR CONTROL CENTRES

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section: 26 05 00 – General Electrical Requirements.

.2 Section: 26 09 23.01 – Metering and Switchboard Instruments.

.3 Section: 26 29 10 – Motor Starters to 600V.

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 14, Industrial Control Equipment

.2 CSA C22.2 No 234, Motor Control Centres

1.2.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1-2000 - Industrial Control and Systems: General Requirements

.2 NEMA ICS 1.1 - Safety Guidelines for the Application, Installation and Maintenance of Solid State Control

.3 NEMA ICS 1.3 - Preventive Maintenance of Industrial Control and Systems Equipment

.4 NEMA ICS 2 - Controllers, Contactors and Overload Relays Rated 600 V

.5 NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation and Maintenance of Motor Control Centers Rated Not More Than 600V

.6 NEMA ICS 2.4 - NEMA and IEC Devices for Motor Service-A Guide for Understanding the Differences

.7 NEMA ICS 4 - Application Guideline for Terminal Blocks

.8 NEMA ICS 5 - Control Circuit and Pilot Devices

.9 NEMA ICS 6 - Enclosures

.10 NEMA ICS 12.1 - Industrial Control and Systems: Profiles of Networked Industrial Devices-Part 1: General Rules

.11 NEMA ICS 18 - Motor Control Centers

.12 NEMA ICS 19 - Diagrams, Device Designations and Symbols

1.3 SUBMITTALS

.1 Provide submittals in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Submit product data sheets for sills, busbars and compartments. Include product characteristics, physical size and finish.

.3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence and cleaning procedures

.4 Submit shop drawings and indicate:

.1 Outline dimensions.

.2 Configuration of identified compartments.

.3 Floor anchoring method and dimensioned foundation template.

.4 Cable and bus duct entry and exit locations.

.5 Dimensioned position and size of busbars and details of provision for future extension.

.6 Schematic and wiring diagrams.

.5 Closeout Submittals: provide operation and maintenance data for motor control centre for incorporation into manual specified in Exhibit 4 – Supplier Document Requirements List.

.6 Include data for each type and style of starter.

1.4 EXTRA MATERIALS

.1 Provide spare parts list in accordance with Exhibit 4 – Supplier Document Requirements List.

2 PRODUCTS

2.1 SUPPLY CHARACTERISTICS

.1 600 V, 3 phase, 3 wire, with horizontal and vertical ground buses.

2.2 GENERAL DESCRIPTION

.1 All motor control centres to be products of Eaton, Freedom 2100 MCC.

.2 Compartmentalized vertical sections with common power busbars.

.3 Floor mounting, free standing, enclosed dead front.

.4 Indoor CSA Type 12 enclosure.

.5 Class 1, Type B.

.6 Motor Control Centers shall include the following features to reduce arc flash hazard:

.1 Arc-containment latches on all doors.

.2 Automatic shutters on plug-in structures.

.3 Insulating covers on horizontal and vertical bus bars.

.4 Communication port in the door.

.5 Finger safe barriers.

.6 Isolation guards for starters, fuses, transformers and disconnects.

D2

.7 Not used.

2.3 VERTICAL SECTION CONSTRUCTION

.1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

.2 Each vertical section divided into compartment units, minimum 305 mm high.

.3 Each unit to have complete top and bottom steel plate for isolation between units.

.4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

.5 Vertical wireways complete with doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

.6 Openings, with removable cover plates, in side of vertical sections for horizontal wiring between sections.

.7 Incoming cables or busway to enter at top as indicated.

.8 Provision for outgoing cables to exit via top or bottom.

.9 Removable lifting means.

.10 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.

.11 Divide assembly for shipment to site, complete with hardware and instructions for re-assembly.

2.4 SILLS

.1 Continuous 100 mm channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

2.5 BUSBARS

.1 Main horizontal and branch vertical, three phase high conductivity tin plated copper busbars in separate compartment self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:

.1 Main horizontal busbars: as indicated.

.2 Branch vertical busbars: as indicated.

.2 Branch vertical busbars for distribution of power to units in vertical sections.

.3 No other cables, wires, equipment in main and branch busbar compartments.

.4 Brace buswork to withstand effects of short-circuit current of 42 kA rms symmetrical or as indicated.

.5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

2.6 GROUND BUS

.1 Copper ground bus extending entire width of motor control centre.

.2 Vertical ground bus strap, full height of section, tied to horizontal ground bus, engaged by plug-in unit ground stab.

2.7 INCOMING SECTIONS

2.7.1 MCCs Close Coupled to Switchgear

.1 Motor Control Centres close coupled with Lower Voltage Switchgear incoming sections as indicated on drawings.

.2 Motor Control Centres shall include bus transition sections if required with bus connection between the incoming sections and the Motor Control Centre horizontal bus.

2.7.2 Standalone MMCs

.1 Standalone MCCS shall include incoming drawout moulded case circuit breakers as indicated on drawings.

.2 Incoming moulded case circuit breakers shall include facility to be padlocked in the disconnected position.

2.7.3 MCC Metering

.1 Incoming sections from all sources shall include one (1) Multi-function Power Quality Monitoring Unit in accordance with Section: 26 09 23.01 – Metering and Switchboard Instruments.

2.8 MOTOR STARTERS AND DEVICES

.1 In accordance with Section 26 29 10 – Motor Starters to 600 V.

2.9 STARTER UNIT COMPARTMENTS

.1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.

.2 Unit mounting:

.1 Engaged position - unit stabbed into vertical bus.

.2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.

.3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

.4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.

.3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 3 padlocks to lock operating handle in "off" position and lock door closed.

.4 Hinge unit doors on same side.

.5 Overload relays manually reset from front with door closed. Pushbuttons and indicating lights mounted on door front.

.6 Devices and components by one manufacturer to facilitate maintenance.

.7 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

2.10 WIRING IDENTIFICATION

.1 Provide wiring identification in accordance with Section: 26 05 00 - General Electrical Requirements.

2.11 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section: 26 05 00 - General Electrical Requirements].

.1 Motor control centre main nameplate: size No. 7, engraved with equipment name, equipment tag number and voltage.

.2 Individual compartment nameplates: size No. 5, engraved with load identification.

2.12 FINISHES

.1 Apply finishes in accordance with Section: 26 05 00 - General Electrical Requirements.

.2 Paint motor control centre exterior ANSI 61 light grey and interiors white.

2.13 SOURCE QUALITY CONTROL

.1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

.2 Engineer to witness standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.

3 EXECUTION

3.1 INSTALLATION

.1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

.2 Make field power and control connections as indicated.

.3 Ensure correct overload relay are installed and set as indicated.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 - General Electrical Requirements.

.2 Ensure moving and working parts are lubricated where required.

.3 Operate starters in sequence to prove satisfactory performance of motor control centre during 8 hours period.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 25 00**
CH0032	**ENCLOSED BUS ASSEMBLIES**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 25 00
ENCLOSED BUS ASSEMBLIES
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
G. W. HAINES
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REV. D2

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 25 00**
CH0032	**ENCLOSED BUS ASSEMBLIES**	Rev: D2
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1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

.2 Section 26 23 00 – Low Voltage Switchgear.

.3 Section 26 24 19 – Motor Control Centres.

1.2 REFERENCES

1.2.1 CSA International

.1 CSA C22.2 No.27, Busways. (Tri-national standard, with UL 857-, - NMX-J-148-ANCE).

.2 CSA C22.2 No. 38 – Thermostat-insulated Wires and Cables

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Submit in accordance with Section [01 33 00 - Submittal Procedures].

1.3.2 Product Data:

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

.1 Catalogue information and detail drawings.

1.3.3 Shop Drawings:

.1 Indicate in detail exact routing of busways throughout building and in relation to column lines and structural slabs and walls. Provide voltage drop test results for each size of busway.

2 PRODUCTS

2.1 BUSWAYS CHARACTERISTICS

.1 Full capacity neutral.

.2 Unventilated or ventilated in CSA Enclosure 1 housing.

.3 Low impedance type, or cable bus.

.4 Joints: silver-plated and of bolt type construction.

.5 Designed for one length or fitting to be removable without disturbing rest of run.

.6 Cold rolled copper bars with 98% minimum conductivity.

.7 Internal fire barriers at floor/wall penetrations complete with flanges.

.8 Expansion joints on vertical and horizontal busway runs at locations recommended by manufacturer and where busway crosses building expansion joint.

.9 Fittings, factory manufactured to suit type of busway used and as indicated transformer tap-offs, elbows, tees, offsets, flanged end connections, to switchboards and motor control centres.

.10 Hangers to suit mounting position and type of busway, edgewise, flatwise or vertical.

2.2 FEEDER TYPE BUSWAYS

2.2.1 Feeder type busways: to CSA C22.2 No.27, low impedance.

2.3 CABLE BUS

.1 Cable bus to: CSA C22.2 No. 27

.2 Current carrying conductors shall have insulation rated for 90°C in accordance with CSA C22.2 No. 38.

.3 The conductors shall be phased and supported to maintain low impedance and assure mechanical strength to prevent cable movement or damage under short circuit current.

.4 Conductors shall be of continuous length and be pulled in place after the bus enclosure is in place.

3 EXECUTION

3.1 INSTALLATION

.1 Install busway, cable bus and associated fittings, supports and accessories in accordance with manufacturer's recommendations.

.2 Space hangers in accordance with manufacturers recommendations. Maximum spacing 3 m.

.3 Tighten busway joint bolts to loading recommended by busway manufacturer.

.4 Cover busways with plastic envelope until building is clean and bus ready to be meggered and energized.

.5 Torque single bolt sandwich type busway as recommended by manufacturer. Only retorque single bolt sandwich type busway if procedure documented or approved by manufacturer in writing.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements.

.2 Megger bus duct in presence of Engineer and have readings approved.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 27 16**
CH0032	**ELECTRICAL CABINETS AND ENCLOSURES**	Rev : D1
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

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1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section: 26 05 00 – General Electrical Requirements.

1.2 REFERENCES

1.2.1 CSA International

.1 CAN/CSA C22.2 No.94.1, Enclosures for Electrical Equipment, Non Environment Considerations.

.2 CAN/CSA C22.2, No 94.2, Enclosures for Electrical Equipment, Environmental Considerations.

1.2.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for electrical cabinets and enclosures and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Operation and Maintenance Data: submit operation and maintenance data for electrical cabinets and enclosures for incorporation into manual.

2 PRODUCTS

2.1 MATERIALS

D1

.1 Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish to CAN/CSA C22.2 No. 94.2, size as indicated.

.2 CSA Type Enclosures for indoors and for outdoor installations shall be according to the following table:

Minimum Requirements for Electrical Equipment Enclosures

Equipment	Intake and Spillway Outdoor	Intake and Spillway Hoist Houses	Spillway Electrical Building
Main Switchgear/MCC	N.A.	N.A	NEMA 1A
MCCs	N.A.	NEMA 12	NEMA 12
Panelboards	N.A.	NEMA 3R	NEMA 12
600V Transformers	N.A.	NEMA 3R	NEMA 2 Drip Proof
MV Switchgear and Transformer	N.A.	N.A.	NEMA 1 type with gasket and filters on ventilation opening
Small Equipment and Enclosures	NEMA 4X	NEMA 4X	NEMA 12
Control Panel Enclosures	NEMA 4X	NEMA 4X	NEMA 12

D1

D2

.3 Removable enclosure panels with formed edges galvanized steel external fasteners removable only from inside enclosure.

.4 Equip enclosure with removable back panel for mounting terminal blocks and electrical components.

.5 Cover: tamperproof, bolt-on, domed to shed water.

.6 Door: 3 point latching, with padlocking means.

.7 Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, and vermin.

.8 Door interlocks: as indicated.

.9 Enclosure construction such as to allow configuration of single or ganged enclosures.

.10 Enclosure capable of being shipped in knocked-down condition.

3 EXECUTION

3.1 INSTALLATION

.1 Assemble enclosure in accordance with manufacturer's instructions and securely mount on building structure with channels, supports and fastenings.

.2 Mount equipment in enclosure.

.3 Label electrical cabinets and enclosure to Section: 26 05 00 - General Electrical Requirements.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 – General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 27 26**
CH0032	**WIRING DEVICES**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 27 26
WIRING DEVICES
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 27 26**
CH0032	**WIRING DEVICES**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 SECTION INCLUDES

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

1.3 REFERENCES

1.3.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No.42.1, General Use Receptacles, Attachment Plugs and Similar Devices.

.2 CSA-C22.2 No.42, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).

.3 CSA-C22.2 No.55, Special Use Switches.

.4 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit ship drawings and product data in accordance with Exhibit 4 – Supplier Document Requirements List.

2 PRODUCTS

2.1 SWITCHES

.1 15 A, 120 V and 347 V, single pole, double pole, three-way, four-way switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.

.2 Manually-operated general purpose ac switches with following features:

.1 Terminal holes approved for No. 10 AWG wire.

.2 Silver alloy contacts.

.3 Urea or melamine moulding for parts subject to carbon tracking.

.4 Suitable for back and side wiring.

.5 Ivory toggle.

.6 Specification grade.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:

.1 Ivory urea moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and rivetted grounding contacts.

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

.1 Ivory urea moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity, configuration and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

2.3 SPECIAL WIRING DEVICES

.1 Special wiring devices:

.1 Clock hanger outlets, 15 A, 125 V, 3 wire, grounding type, suitable for No. 10 AWG for installation in flush outlet box.

.2 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic lens flush type.

2.4 WIRING DEVICES FOR COMPUTER ROOMS

.1 As indicated.

2.5 COVER PLATES

.1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.

.2 Cover plates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Stainless steel, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

.5 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

.7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 00 – General Electrical Requirements.

3.1.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 00 - General Electrical Requirements.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

3.1.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements.

END OF SECTION

SECTION 26 28 13.01
FUSES – LOW VOLTAGE
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 28 13.01**
CH0032	**FUSES – LOW VOLTAGE**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – General Electrical Requirements..

.2 Section 26 28 23 – Disconnect Switches – Fused and Unfused

.3 Section 26 29 10 – Motor Starters to 600 V

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No.248.4, Low Voltage Fuses Part 4: Class CC (Bi-National Standard with, UL 248-4 (1st Edition).

.2 CSA C22.2 No.248.8, Low Voltage Fuses Part 8: Class J (Bi-National Standard with, UL 248-8 (1st Edition).

.3 CSA C22.2 No.248.10, Low Voltage Fuses Part 12: Class L (Bi-National Standard with, UL 248-10 (1st Edition).

.4 CSA C22.2 No.248.12, Low Voltage Fuses Part 12: Class R (Bi-National Standard with, UL 248-12 (1st Edition).

1.3 SUBMITTALS

1.3.1 Submit fuse performance data characteristics for each fuse type and size above 600 A. Performance data to include: average melting time-current characteristics.

1.4 DELIVERY AND STORAGE

1.4.1 Ship fuses in original containers.

1.4.2 Do not ship fuses installed in switchboard.

1.4.3 Store fuses in original containers in storage cabinet moisture free location.

1.5 MAINTENANCE MATERIALS

1.5.1 Provide spare parts in accordance with Exhibit 4 – Supplier Document Requirements List.

1.5.2 Three spare fuses of each type and size installed above 600 A.

1.5.3 Six spare fuses of each type and size installed up to and including 600 A.

2 PRODUCTS

2.1 FUSES GENERAL

2.1.1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.

2.1.2 Fuses: product of one manufacturer for entire project.

2.2 FUSE TYPES

2.2.1 Class L fuses (formerly HRC-L).

.1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Type L2, fast acting.

2.2.2 Class J fuses (formerly HRCI- J).

.1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Type J2, fast acting.

2.2.3 Class R -R fuses (formerly HRCI- R). For UL Class RK1 fuses, peak let-through current and its' peak let-through values not to exceed limits of UL 198E-1982, table 10.2.

.1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.

.2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

2.2.4 Class -CC fuses (formerly HRCII- C).

2.3 FUSE STORAGE CABINET

2.3.1 Fuse storage cabinet, manufactured from 2.0 mm thick aluminum 750 mm high, 600 mm wide, 300 mm deep, hinged, lockable front access door finished in accordance with Section 26 05 00 – General Electrical Requirements.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Install fuses in mounting devices immediately before energizing circuit. Ensure correct fuses fitted to physically matched mounting devices.

.1 Install Class R rejection clips for HRCI-R fuses.

3.1.2 Ensure correct fuses fitted to assigned electrical circuit.

3.1.3 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.

3.1.4 Install spare fuses in fuse storage cabinet.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 28 16.01**
CH0032	**AIR CIRCUIT BREAKERS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 28 16.01
AIR CIRCUIT BREAKERS
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 28 16.01**
CH0032	**AIR CIRCUIT BREAKERS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for air circuit breakers.

1.2 RELATED REQUIREMENTS

.1 Section 26 05 00 - General Electrical Requirements.

.2 Section 26 23 00 - Low Voltage Switchgear.

1.3 REFERENCES

1.3.1 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE C37.13, Low Voltage AC Power Circuit Breakers Used in Enclosures.

.2 IEEE C37.16, Preferred Ratings, Related Requirements and application Recommendations for Low-Voltage AC (635 V and below) and DC (3200 V and below)

1.3.2 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 5, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.3.3 National Electrical Manufacturers Association (NEMA)

.1 NEMA C37.50, Switchgear – Low-Voltage AC Power Circuit Breakers Used in Enclosures – Test Procedures.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1.4.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.4.2 Include time-current phase protection co- ordination characteristic curves for breakers.

1.4.3 Include type test results and certificates.

2 PRODUCTS

2.1 AIR CIRCUIT BREAKER

2.1.1 Air circuit breaker to: to IEEE C37.13.

2.1.2 Drawout type, 600 V class.

.1 Continuous current rating: as indicated.

.2 Trip rating: as indicated.

.3 Interrupting rating: as indicated kA, rms symmetrical.

.4 Solid-state tripping system consisting of 1 current sensor per pole, 1 solid-state trip unit and self-powered trip actuator. Equipped with long, short, instantaneous, ground fault function and phase overload and ground fault indication (LSIG).

.5 Breakers with normal stored energy, closing mechanism to provide quick-make operation for all ratings.

.6 Breakers with motor charged, stored energy, quick-make, closing mechanism with emergency manual spring charging handle and isolating switch to isolate power supply to spring charging motor.

.7 Breakers with on-off indicator and spring charged/discharged indicator for local indication and contacts for remote indication.

.8 Interlocks to prevent circuit breaker drawout when in closed position and to prevent closing unless fully engaged or in test position.

2.2 OPTIONAL FEATURES

.1 Shunt trip.

.2 Auxiliary switches: 4 N.O., 4 N.C.

.3 Undervoltage tripping device with instantaneous trip.

.4 Alarm switch.

.5 Pilot light.

.6 Control relays

.7 Remote close.

.8 Lockout devices.

.9 Padlocking provision.

.10 Operation counter.

D2

.11 Trip unit equipped with Arc Flash Reduction Maintenance Mode Function (ARMs).

3 EXECUTION

3.1 INSTALLATION

.1 Install air circuit breakers as indicated.

.2 Connect main secondary service to line terminals of breaker.

.3 Connect load terminals of breaker to feeders.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 28 16.02**
CH0032	**MOULDED CASE CIRCUIT BREAKERS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 28 16.02

MOULDED CASE CIRCUIT BREAKERS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 28 16.02**
CH0032	**MOULDED CASE CIRCUIT BREAKERS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section: 26 05 00 – General Electrical Requirements.

.2 Section: 26 24 16.01 – Panelboards – Breaker Type

.3 Section: 26 24 19 – Motor Control Centres

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 5, Circuit Breakers - Moulded Case Switches and Circuit Breaker Enclosures .

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers an include product characteristics, performance criteria, physical size, finish and limitations.

.2 Include time-current characteristic curves for all circuit breakers.

2 PRODUCTS

2.1 BREAKERS GENERAL

.1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40ºC ambient.

.2 Common-trip breakers: with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.4 Instantaneous trip circuit breakers (motor circuit protector) intended to provide motor short circuit only.

.5 Circuit breakers with interchangeable trips as indicated.

.6 Circuit breakers to have minimum 14 kA symmetrical rms interrupting capacity rating or as indicated on drawings.

D1 .7 Molded Case Circuit Breakers cases, on breakers rated 347 V and above, shall be equipped with viewing windows for visible verification of open contacts by maintenance and operating staff.

2.2 THERMAL MAGNETIC BREAKERS DESIGN A

2.2.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 MAGNETIC CIRCUIT BREAKERS DESIGN B

.1 Moulded case circuit breakers to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection. These devices will be used as motor circuit protectors.

2.4 CURRENT LIMITING AND SERIES RATED THERMAL MAGNETIC BREAKERS DESIGN C

.1 Thermal magnetic breakers with current limiters

.1 Time current limiting characteristics of fuses limiters coordinated with time current tripping characteristics of circuit breaker.

.2 C-ordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker.

2.5 SOLID STATE TRIP BREAKERS DESIGN C

2.5.1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous (LSIG) tripping for phase and ground fault short circuit protection.

2.6 OPTIONAL FEATURES

2.6.1 Include as indicated on drawings:

.1 Shunt trip.

.2 Auxiliary switch.

.3 Motor-operated mechanism.

.4 Under-voltage release.

.5 On-off locking device.

.6 Handle mechanism.

2.7 ENCLOSURE

.1 Mounted in CSA Type 1 enclosure, sprinkler proof as indicated.

D1

.2 Molded Case Circuit Breakers intended for use as isolating points for lockout/tagout shall be capable of being padlocked in the closed position in accordance with Section: 26 05 00 – General Electrical Requirements.

3 EXECUTION

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 – General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 28 20**
CH0032	**GROUND FAULT CIRCUIT INTERRUPTERS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 28 20
GROUNT FAULT CIRCUIT INTERRUPTERS
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 28 20**
CH0032	**GROUND FAULT CIRCUIT INTERRUPTERS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

1.2 REFERENCES

1.2.1 CSA International

.1 CAN/CSA C22.1 – Canadian Electrical Code, Part 1.

.2 CAN/CSA C22.2 No.144, Ground Fault Circuit Interrupters.

1.2.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA PG 2.2, Application Guide for Ground Fault Protection Devices for Equipment.

1.3 SUBMITTALS

1.3.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for ground fault circuit interrupters and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Operation and Maintenance Data: submit operation and maintenance data for ground fault circuit interrupters for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect ground fault circuit interrupters from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 PRODUCTS

2.1 MATERIALS

.1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA C22.2 No.144.

.2 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

.1 Single pole Class A ground fault circuit interrupter for 15 and 20 A, 120 V, 1 phase circuit c/w test and reset facilities.

.2 Single and 2-pole ground fault circuit interrupter for 15 A, 20 A, 120/208 V, 1 phase with 30 mA setting for protection of heat tracing and heater circuits.

2.3 GROUND FAULT PROTECTOR UNIT

.1 Self-contained with 15 A, 120 V Class A ground fault circuit interrupter and duplex receptacle complete with:

.1 Solid state ground sensing device.

.2 Facility for testing and reset.

.3 CSA Enclosure 1, surface or flush mounted with stainless steel face plate.

2.4 PUMP PROTECTION PANEL

.1 Ground fault personnel protection panel for submersible pump circuits rated as indicated to match pump motor rating with the following features:

.1 Test button, ground indicator light, reset button.

.2 Line and load terminal blocks and control terminal block for wiring to starter control.

.3 Unit sensitivity: 10 mA.

.4 CSA Enclosure 1, surface mounted for dry indoor applications and CSA Enclosure 4X for wet indoor or outdoor applications.

.5 Contact rating: 5 A, 120 V, 60 Hz.

.6 Fused resistive type artificial neutral.

3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for ground fault circuit interrupters installation in accordance with manufacturer's written instructions.

.2 Visually inspect substrate in presence of Engineer.

.3 Inform Engineer of unacceptable conditions immediately upon discovery.

.4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Engineer.

3.2 INSTALLATION

.1 Do not ground neutral on load side of ground fault relay. Pass phase conductors including neutral through zero sequence transformers.

.2 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Arrange for field testing of ground fault equipment by Contractor before commissioning service.

.3 Demonstrate simulated ground fault tests.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 28 23**
CH0032	**DISCONNECT SWITCHES – FUSED AND NON-FUSED**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 28 23

DISCONNECT SWITCHES – FUSED AND NON-FUSED

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NEWFOUNDLAND & LABRADOR
REV. D2

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 28 23**
CH0032	**DISCONNECT SWITCHES – FUSED AND NON-FUSED**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section: 26 05 00 – General Electrical Requirements.

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.:4, Enclosed Switches.

.2 CSA C22.2 No.:39, Fuseholder Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit product data in accordance with Exhibit 4 – Supplier Document Requirements List.

2 PRODUCTS

2.1 DISCONNECT SWITCHES

D1

.1 Fusible, and non-fusible, horsepower rated disconnect switch in CSA Enclosure to CAN/CSA C22.2 No.:4 size as indicated. Refer to Section: 26 27 16 for the minimum requirements of the electrical equipment enclosures.

.2 Provision for padlocking in on-off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated, in accordance with Section: 26 28 13.01 - Fuses - Low Voltage.

.5 Fuseholders: to CSA C22.2 No.:39 suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 Disconnect switch enclosures shall include a window to view switch blades to visually observe isolation.

.8 Disconnect switches shall include one (1) NO/NC contact for hardwired safety interlock.

.9 ON-OFF switch position indication on switch enclosure cover.

2.2 SAFETY TRANSFER SWITCHES

D1 **2.2.1** A safety transfer switch shall be provided to transfer power supply from the emergency generator to the alternate portable generator. The transfer switch shall be provided with the following characteristics:

.1 The safety transfer switch shall be an Eaton Heavy Duty, Double-Throw switch.

.2 The switch shall be 600 Vac, 800 A, double-throw switch for two-source connections and one intermediate 'OFF' position.

.3 Non-fusible horsepower rated safety disconnect switch in CSA Enclosure as indicated in Section: 26 27 16 of this technical specification.

.4 Provision for padlocking in 'OFF' position.

.5 Mechanically interlocked door to prevent opening when handle is in 'ON' position.

D1 .6 Disconnect switch enclosure shall include a window to view switch blades to visually observe isolation.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section: 26 05 00 - General Electrical Requirements.

.2 Indicate equipment tag number and name of load controlled on size 4 nameplate.

3 EXECUTION

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses as indicated.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 – General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 29 01**
CH0032	**CONTACTORS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 29 01
CONTACTORS
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 29 01**
CH0032	**CONTACTORS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements

.2 Section 26 09 03.01 – Control Devices

1.2 REFERENCES

1.2.1 CSA International

.1 CSA C22.2 No.14, Industrial Control Equipment.

1.2.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 2, Controllers, Contactors and Overload Relays Rated 600 V.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for contactors and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Operation and Maintenance Data: submit operation and maintenance data for contactors for incorporation into manual.

2 PRODUCTS

2.1 CONTACTORS

.1 Contactors: to CSA C22.2 No.14.

.2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.

.3 Fused switch combination contactor as indicated.

.4 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.

.5 Mount in CSA Enclosure 1 unless otherwise indicated.

.6 Include following options in cover:

.1 Red indicating lamp.

.2 Hand-Off-Auto selector switch.

.7 Control transformer: in accordance with Section 26 29 03.01 - Control Devices, factory wired and installed in contactor enclosure.

2.2 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section 26 05 00 - General Electrical Requirements.

.2 Size 4 nameplate indicating equipment tag number and name of load controlled as indicated.

3 EXECUTION

3.1 INSTALLATION

.1 Install contactors and connect power wires and auxiliary control devices.

.2 Identify contactors with nameplates or labels indicating panel and circuit number.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 29 03.01**
CH0032	**CONTROL DEVICES**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 29 03.01

CONTROL DEVICES

TABLE OF CONTENTS

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REV. D2

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 29 03.01**
CH0032	**CONTROL DEVICES**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements

.2 26 29 03.02 – Control and Monitoring

.3 26 29 03.03 – Control and Monitoring – Hydro-Mechanical Equipment

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No.14, Industrial Control Equipment.

1.2.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1, Industrial Control and Systems: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for control devices and include product characteristics, performance criteria, physical size, finish and limitations.

1.3.3 Shop Drawings:

.1 Include schematic, wiring, interconnection diagrams.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Operation and Maintenance Data: submit operation and maintenance data for control devices for incorporation into manual.

2 PRODUCTS

2.1 AC CONTROL RELAYS

.1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.

.2 Convertible contact type: contacts field convertible from NO to NC, electrically held with solid state timer as indicated. Coil rating: as indicated. Contact rating: as indicated.

.3 Sealed contact type: electrically held. Coil rating: as indicated. Contact rating: as indicated.

.4 Universal pole type: electrically held, convertible from NO to NC by changing wiring connections. Coil rating: as indicated. Contact rating: as indicated.

.5 Fixed contact plug-in type: general purpose low coil current. Coil rating: as indicated. Contact rating: as indicated.

2.2 RELAY ACCESSORIES

.1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

.2 Socket bases and DIN mounting rails for plug-in type relays.

2.3 OILTIGHT LIMIT SWITCHES

.1 Snap action type: roller, rod, or fork lever, top side push or wobble stick actuator, CSA type 1enclosure. Contact rating as indicated.

.2 Surface mounted.

.3 Standard contact block.

2.4 SEALED CONTACT OILTIGHT LIMIT SWITCHES

.1 Lever type switches: roller, fork or rod operated, single or double pole, double throw. Contact rating: as indicated.

.2 Push type switches: actuated by rod or plunger located on side of operating head, spring return single pole, double throw. Contact rating: [ass indicated.

.3 Wobble stick cat whisker type switches: actuated by rod or stick extending from tip of operating head. Moving rod in any direction operates contacts. Single pole, double throw. Contact rating:as indicated.

.4 Lever operated: time delay switch: adjustable time delay from 1/2 s to 15 s plus 25%. Contact rating: as indicated. Plug-in construction switches: CSA Type 4, two or four circuit, lever, push or wobble stick type, contact rating: as required.

2.5 SOLID STATE TIMING RELAYS

.1 Construction: ac operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.

.2 Operation: on-delay or off-delay.

.3 Potentiometer: self contained to provide time interval adjustment.

.4 Supply voltage: 120 or 24 V, ac, 60 Hz.

.5 Temperature range: minus 50 degrees C to plus 60 degrees C.

.6 Output contact rating: maximum voltage 300 V ac or dc. Current: as indicated.

.7 Timing ranges: minimum 0.5 s, maximum 60 s.

2.6 INSTANTANEOUS TRIP CURRENT RELAYS

.1 Enclosure: CSA Type 1

.2 Contacts: NO, NC automatic reset with adjustable tripping point.

.3 Control: 3 wire, with provision for shorting contacts during accelerating period of motor.

.4 Contact rating: as indicated.

2.7 OPERATOR CONTROL STATIONS

.1 Enclosure: CSA Type 1 or 4, surface mounting:

2.8 PUSHBUTTONS

.1 Illuminated, heavy duty. Operator type as indicated. 1-NO and 1-NC contacts rate as indicated, labels as indicated. Stop pushbuttons coloured red, mushroom head, provision for locking in depressed position labelled "emergency stop".

2.9 SELECTOR SWITCHES

.1 Maintained or spring return to neutral position, 2 or 3 position labelled as indicated heavy duty, operators wing lever, contact arrangement as indicated, rated as indicated.

2.10 INDICATING LIGHTS

.1 Standard LED type, push-to-test, lens colour: as indicated, supply voltage: as indicated, labels as indicated.

2.11 CONTROL AND RELAY PANELS

.1 CSA Type 1 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.12 CONTROL CIRCUIT TRANSFORMERS

.1 Single phase, dry type.

.2 Primary: 208 or 240 V, 60 Hz ac.

.3 Secondary: 120 V, ac.

.4 Rating: to meet control load requirements plus 50 VA.

.5 Secondary fuse: as required.

.6 Close voltage regulation as required by magnet coils and solenoid valves.

2.13 THERMOSTAT (LINE VOLTAGE)

.1 Wall mounted, for exhaust fan control.

.2 Full load rating: 8 A at 120 V AC.

.3 Temperature setting range: 10 degrees C to 30 degrees C.

.4 Thermometer Range: 10 degrees C to 30 degrees C.

.5 Markings in 5 degree increments.

.6 Differential temperature fixed at 20 degrees C.

3 EXECUTION

3.1 INSTALLATION

.1 Install pushbutton stations, control and relay panel, control devices and interconnect as indicated.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – General Electrical requirements.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

END OF SECTION

TABLE OF CONTENTS
SECTION 26 29 03.02
CONTROL AND MONITORING

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1 GENERAL

1.1 SCOPE OF WORK

1.1.1 This specification is for the requirements for control and monitoring equipment for the Muskrat Falls hydroelectric power station plant.

1.2 RELATED SECTIONS

.1 Section: 26 05 00 – General Electrical Requirements.

.2 Section: 26 29 03.01 – Control Devices

.3 Section: 26 29 03.03 – Control and Monitoring – Hydro-Mechanical Equipment

1.3 REFERENCES

1.3.1 The last revision of the Specifications, Codes and Standards at the date of Award must be used.

1.3.2 Canadian Standards Association (CSA)

1.3.3 ANSI – American National Standard Institute

.1 ANSI Y32.2 Graphic Symbols

.2 ANSI C37.90A Surge Withstand Tests for Protective Relays and Relay Systems

.3 ANSI C39.1 Indicating Instrumentation

1.3.4 IEEE - Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE C37.21 Standard for Control switchboards (ANSI)

.2 IEEE C37.90.1 Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems (ANSI).

.3 IEEE 1010 IEEE Guide for Control of Hydroelectric Power Plants

.4 IEEE 1249 IEEE Guide for Computer-Based Control for Hydroelectric Power Plant Automation

.5 IEEE 1428 Guide for Installation Methods for Fiber-Optic Cables in Electric Power Generating Stations and in Industrial Facilities

.6 IEEE 1613 Environmental and Testing Requirements for Communications Networking Devices Installed in Electric Power Substations

.7 IEEE 1646 Standard Communication Delivery Time Performance Requirements for Electric Power Substation Automation

1.3.5 IEC – International Electrotechnical Commission

.1 IEC 60414 Safety requirements for indicating and recording electrical instruments and their accessories

.2 IEC 62270 Control Systems for Hydroelectric Stations

.3 BS-89, IEC 60051 Indicating instruments

1.4 DEFINITIONS

.1 PLC – Programmable Logic Controller

.2 HMI – Human Machine Interface

1.5 SUBMITTALS

1.5.1 Provide submittals in accordance with Section: 01 33 00 - Submittal Procedures.

2 PRODUCTS

2.1 DOCUMENTATION

2.1.1 The documentation shall include the control and monitoring system configuration and points list preparation as applicable for the system being supplied, the appropriate control sequences and automated sub-routines, panel layout drawings and the AC and DC wiring diagrams and schematics necessary for the interconnection of equipment.

2.2 SYSTEM REQUIREMENTS

D2

2.2.1 Only those systems which are complete, fully integrated and have a proven field operation record shall be provided. The systems shall utilize heavy industrial/utility grade components. The PLCs shall be Allen-Bradley.

2.3 FLEXIBILITY

2.3.1 The system design shall be based on the use of functional modules leading to a flexible system which is easy to modify and reconfigure.

2.3.2 The design shall allow the addition or deletion of controls, indications, tele-metering points, alarms, etc., in a simple manner. It shall be possible to carry out system

modifications of the type defined above without removing the overall system from service.

2.3.3 To facilitate point name changes the data base structural point identifiers shall be independent of the display names used in the data logs and on the screen displays.

2.3.4 The flexibility shall extend beyond the hardware aspect, such as flexibility to provide easy and quick changes on workstation display pages, format of the loggers, etc.

2.4 RELIABILITY

2.4.1 The system shall be designed for operation under the specified ambient climatic conditions and electrical conditions. No reduction of system reliability shall occur due to system modification and expansion.

2.4.2 All systems shall be fail safe. A component failure shall not cause the issue of a false command, set point value change or instruction.

2.4.3 All system components shall have proven reliability. Mean time between failure figure shall be provided for the system and the individual components (circuit modules).

2.4.4 The control and monitoring equipment shall have a system for detection and alarm of faults in its own circuits.

2.5 COMMUNICATION PROTOCOL

2.5.1 The protocol used for communication shall be an open and proven protocol.

2.6 CONTROLLER PROGRAMMING AND PROGRAM LANGUAGES

2.6.1 The application programs shall be written in a high level functional block language and summarized on program flow charts. Each functional element shall be represented as a building block with inputs and outputs.

2.6.2 Application programming shall be performed by connecting inputs and outputs of a functional block to other functional blocks or to process I/O. It shall be possible to print graphic documentation of the applicable programs.

2.6.3 The structure of the application programs shall be based on the functional structure of the system. It shall be possible to give different program modules in one process controller different cycle times and priorities.

2.6.4 It shall be the responsibility of Contractor to develop the detailed points list, control logic, sequence logic, etc. for the system, as appropriate for the most effective operation of the system as a whole. This shall include inputs from systems supplied by Company's Other

Contractors and shall, in some cases, require the specification of data and control interfaces to those devices provided by Company's Other Contractors.

2.6.5 Contractor shall be responsible for design cooperation with all Company's Other Contractors.

2.7 SOFTWARE

2.7.1 Contractor shall be responsible for in-house software Quality Assurance. Once the software programming and testing is complete the software shall be locked (or compiled). All software development shall be done by Contractor's experienced software team. Evidence of that experience shall be supplied in the bid documents.

2.7.2 The control and monitoring equipment shall be provided completely programmed and tested at the factory to meet all functional requirements. All software required to support all hardware and all integrated system requirements shall be provided factory programmed. This shall include, but not be limited to, operating system software, communications software, application software, system configuration software, diagnostic software and support software for applications development.

2.7.3 All software shall be documented. Updates for all software shall be provided to Company without cost for five (5) years. Support for all software shall be provided to Company for fifteen (15) years after commercial acceptance. All software provided shall be licensed to Company.

2.8 POWER SUPPLY

2.8.1 All components of the control system shall be powered from dual 125 Vdc power supplies, one from each of the two station batteries. In case of devices mounted on moving equipment, each device shall have dual power supplies and can be fed from a single source (AC or DC).

2.8.2 As the station shall normally be operated remotely with minimum day staff in attendance, facilities shall be provided to shut down any non-essential loads when the station is unoccupied.

2.8.3 To save battery power all local control panel displays shall be de-activated except when local control is activated or an operator requests a display activation. In the latter case the display shall be de-activated after a set time.

2.9 EVENTS AND ALARMS LIST

2.9.1 Events and alarms on the event log display pages shall be presented in chronologically ordered lists. When on any other display page the number of alarms or status change displays shall be settable between 0 to at least 5 and shall be shown in a separate area

of the display. These events shall be circular, so that a new event overwrites the oldest one.

2.9.2 The printout of an event, when requested, shall occupy one line and include the date, time of day, signal description and signal status. The date shall be given as year, month and day and the time shall be given as hours, minutes and seconds and tens of milliseconds.

2.9.3 Digital input status changes shall be time-tagged to the nearest 10 ms after the change is sensed at the process controller's local input system. Since all controllers shall be connected to the GPS clock system used as an external time reference source, the available time precision shall be better than 10 ms but the time tag of all events listed shall be rounded to 10 ms.

2.9.4 The process alarm list shall at least contain the most recent 500 alarms. Alarms shall be removed from the alarm list when they are acknowledged by the operator and when the alarm condition has disappeared. Alarms shall also be indicated on all displays as a latest unacknowledged alarm line, and as status indications with red colour in displays with dynamic data from the object concerned. Flashing until the alarm is acknowledged, and then steady as long as the alarm condition persists.

2.9.5 Alarms shall be acknowledged by placing the cursor on the alarm line and then pressing a dedicated key. Alarms shall be acknowledged also from the process alarms list page by page.

2.10 TIME TAGGING

D1

2.10.1 General status changes sensed at the local I/O interfaces and internally generated set point "marks" shall be time tagged with an accuracy of +/- 10 ms with respect to the time reference source. Specifically identified Sequence of Events (SOE) points shall be similarly time tagged to +/- 1 ms.

2.11 ALARMS AND DISPLAYS

2.11.1 Colours

.1 Consistent use of colours is of prime importance to the operator. The colours that shall be used are suggested below. These shall be finalized during detailed design in accordance with Company's Standards:

Task	**Colour**
Response to the operator's entry on the dialog line	White
Indication of the selected equipment	White

Event and alarm blocking and error message	Yellow
Alarms	Red
Normal status	Green

2.11.2 Audible Alarms

.1 If an equipment and/or function goes to an alarm status, a buzzer shall be activated if the system is in local mode. The alarm shall be silenced by pressing a dedicated key.

2.12 CENTRAL PROCESSING UNITS

2.12.1 The process controllers shall have Central Processing Units (CPU) based on a high performance 32 or 64 bit microprocessor. The system software shall be stored in read only memory (EPROM or Flash-PROM) modules. The application software shall be stored in Read/Write Memory (RWM) with battery backup, the battery replacement schedules shall be defined. The application programs shall be executed cyclically in three priority levels. The cycle times shall normally be selectable between 10 ms and 2 s.

2.12.2 Supervisory functions shall automatically monitor system operation. Supervisory functions shall include a real time watchdog, back-plane bus supervision, memory checking and power supply voltage supervision. Faults shall be indicated with LEDs on relevant board, with system error messages reported to the HMI. The process controller shall have a real time clock and calendar. When connected to the network, the system clock shall be automatically synchronized with other nodes of the network with an accuracy of 10 ms or less.

2.13 INPUT / OUTPUT (I/O) SYSTEM

2.13.1 General

.1 All controllers shall be provided with sufficient I/O modules to cover the number and types of I/O required for each controller. Spare I/O shall also be provided as the list shall be completed only during the detailed engineering stage. The I/O modules shall provide 20% spares of each types of I/O used for each controller once design is finalized.

.2 The modules shall include analog and digital measurement and status/alarm point inputs and outputs. These modules are used to capture all the control and measurement system status and alarm point change data included in the systems supplied.

2.13.2 Measurement Data

.1 Analog Measurement Data Input

.1 Analog Inputs (AI) shall be scanned with a cycle time selectable between 100 ms and 20 s. A process dead band shall be definable for each input. If the input value has not changed more than the dead band since the previous update, no updating or further processing shall take place.

.2 Each AI shall be capable of having four unique alarm limits, two low and two high, assigned to it. These limits shall be initially entered by the database programmer, but shall be capable of being changed by the operator, online, from the HMI. The limits shall be provided with hysteresis individually definable for each input channel.

.3 The AI module shall convert analog process signals to digital values. The AI module shall include analog to digital converter and programmable gain amplifier. The input shall be 4-20 mA. An alternate signal level can be used subject to review and Acceptance by Engineer.

.4 Analog signals shall be scaled and converted to engineering units after being scanned and prior to being stored in the database.

2.13.3 Digital Data Input

.1 Digital instrumentation providing direct measurement data outputs using protocols shall have the same equivalent performance as quoted above.

.2 Digital measurement signals shall be scaled and converted to engineering units after being scanned and prior to being stored in the database.

2.13.4 Digital Status and Alarm Inputs

.1 Digital Input (DI) modules

.1 These inputs shall be from "dry", electrically independent contact circuits from various locations. The DI module shall convert contact states into digital values. Each DI module group shall have a dedicated microprocessor to support the time tagging requirements. The DI module shall include a filter to eliminate contact bounce and electromagnetic interference. The available voltage level shall be 125 Vdc for all external input functions.

.2 The updating of DI shall be event driven, meaning that only a change in state of an input shall result in updating of the database. In addition to the event driven updating, a cyclic updating every fifth second shall be provided. All status changes shall be time tagged on receipt.

.3 24 Vdc for control functions shall be acceptable only for signals passing between panels in the same line up. Dependant on a final analysis of these lower voltage I/Os, make or break contacts may need to be applied. Signals between panels at different locations, such as between the spillway and intake controllers and the associated switchgear and gate mechanism shall be 125 Vdc.

2.13.5 Digital Status and Alarm Data Input

.1 Digital equipment and IEDs providing direct status and alarm data point outputs using protocols shall have the same equivalent performance as quoted above and carry a time stamp initiated at the device appropriate to the event being monitored.

2.13.6 Analog and Digital Measurement (Set Point) and Status (Control) Outputs

.1 Analog Output (AO) modules shall have a digital to analog converter and the output shall be 4-20 mA. An alternate signal level can be used subject to review and Acceptance by Engineer as appropriate to the setpoint input on the device. Digital setpoint and command outputs using protocols shall be provided as appropriate to the equipment to be controlled.

.2 Digital Output (DO) control modules shall be relay type output contacts that shall be powered at the field devices from the 125 Vdc system. Output configuration shall provide the maximum possible separation between the DC circuit fed from the A and B battery systems. All 125 Vdc terminations shall be provided with NEMA 1 protection level with access door open.

2.14 FIBRE OPTIC CABLE AND OPTICAL DISTRIBUTION FRAME (ODF)

2.14.1 Fibre Optic Cable

.1 Where control, status and alarms points are concentrated in a separate location remote I/O modules may be used and these shall be connected to the main or subcontrollers via fibre optic cables. All cables shall be protected in buried duct raceways or conduit.

.2 The fibre optic contained in the multi-fibre cables shall be of a single mode type, G.652 standard. The construction of the cable shall be of an all-dielectric loose tube type and shall include a minimum two (2) spare fibre pairs in addition to any spares provided in the manufacturing process.

.3 The fibre optic cables shall be terminated at an ODF with an appropriate fan-out kit and ST type connectors.

2.14.2 Optic Distribution Frame (ODF)

.1 The panels shall be of a rack-mount type. All optical adapters provided within the ODFs shall be of ST type.

2.15 NETWORK SWITCHES

2.15.1 Network switches shall be ruggedized industrial grade switches, RuggedCom or equivalent accepted by Engineer.

2.16 PANELS

2.16.1 General

D1

.1 The process controllers shall be modular and mounted in 19-inch subracks. The subracks, power supplies, associated termination equipment, etc. shall be installed in panels. The panels shall be of the free standing, metal enclosed type, with a minimum protection class of NEMA-2 increasing to NEMA-4X in areas where water leakage is possible. Refer to Section: 26 27 16 for the minimum requirements for electrical equipment enclosures. The panels shall be provided with facilities for top and bottom cable access. The front of each panel section shall be furnished with a hinged metal frame with a 19-inch wide opening for equipment mounting. A full length door shall be provided on the outside of the hinged frame.

.2 All process connections wired directly to the panel shall be screw terminals located inside the panels.

.3 Remote I/O units shall be totally enclosed in junction boxes, complete with brackets for DINrail mounting. All external connections shall be plug detachable screw terminals. All remote I/O and sub-controllers shall be powered from the same 125 Vdc supply as the associated main controller.

.4 Electrical isolation type terminals shall be provided for inputs to the control equipment panels for test and maintenance purposes.

.5 The number of cables coming into each panel shall be considered during the design such as not to exceed the space available in each panel. A maximum of 40 cables and up to 500 connections per panel shall be allowed.

END OF SECTION

TABLE OF CONTENTS

SECTION 26 29 03.03

CONTROL AND MONITORING – HYDRO-MECHANICAL

1 GENERAL

1.1 SCOPE OF WORK

1.1.1 This specification describes the requirements for control and monitoring of the hydro-mechanical equipment for the Muskrat Falls hydroelectric power station plant.

1.2 RELATED SECTIONS

.1 Section: 26 05 00 – General Electrical Requirements

.2 Section: 26 29 03.01 - Control Devices;

.3 Section: 26 29 03.02 – Control and Monitoring.

.4 Section: 26 29 03.04 - Spillway Automatic Transfer and Load Management System - Functional Description

1.3 REFERENCES

1.3.1 The last revision of the Specifications, Codes and Standards at the date of Award shall be used.

1.3.2 Canadian Standards Association (CSA)

1.3.3 ANSI – American National Standard Institute

.1 ANSI Y32.2 Graphic Symbols

.2 ANSI C37.90A Surge Withstand Tests for Protective Relays and Relay Systems

.3 ANSI C39.1 Indicating Instrumentation

1.3.4 IEEE - Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE C37.21 Standard for Control switchboards (ANSI)

.2 IEEE C37.90.1 Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems (ANSI).

.3 IEEE 1010 IEEE Guide for Control of Hydroelectric Power Plants

.4 IEEE 1249 IEEE Guide for Computer-Based Control for Hydroelectric Power Plant Automation

.5 IEEE 1428 Guide for Installation Methods for Fiber-Optic Cables in Electric Power Generating Stations and in Industrial Facilities

.6 IEEE 1613 Environmental and Testing Requirements for Communications Networking Devices Installed in Electric Power Substations

.7 IEEE 1646 Standard Communication Delivery Time Performance Requirements for Electric Power Substation Automation

1.3.5 IEC – International Electrotechnical Commission

.1 IEC 60414 Safety requirements for indicating and recording electrical instruments and their accessories

.2 IEC 62270 Control Systems for Hydroelectric Stations

.3 BS-89, IEC 60051 Indicating instruments

1.4 DEFINITIONS

1.4.1 DCS – Distributed Control System.

1.4.2 ECC – Energy Control Centre.

1.4.3 HMI – Human Machine Interface.

1.4.4 MCC - Motor Control Centre.

1.4.5 PLC – Programmable Logic Controller.

1.4.6 SWC - Surge Withstand Capability.

1.4.7 TRIAC - Bidirectional triode thyristor.

1.5 SUBMITTALS

1.5.1 Provide submittals in accordance with Exhibit 4 Supplier Documents Requirements List.

2 SPILLWAY GATE CONTROL

2.1 GENERAL REQUIREMENTS

2.1.1 Each gate control shall be completely independent. The failure of an individual gate control shall have no impact on the other gates.

2.1.2 Each gate shall be controlled by a dedicated PLC.

2.1.3 Each gate shall have a local control panel at the hoist house located adjacent to the hoist. The local control panel shall control the gate through the PLC located in the spillway electrical building. The buttons and selector switches on the local control panel shall be hardwired back to the PLC panel to allow control of the gate through the PLC.

2.1.4 Safety functions, such as the slack rope detection device, shall be hardwired to the motor starter control circuit.

2.1.5 Any function which disables the hoist motor shall apply the brakes.

2.1.6 Status and commands between the spillway hoist house and the PLCs (located in the spillway electrical building) shall be through hardwired connections.

2.1.7 It shall be possible to control and monitor each gate from 5 different locations:

.1 Local control panel at the spillway hoist house;

.2 Gate PLC panel at the spillway electrical building;

.3 General spillway control panel at the spillway electrical building (supplied by Company's Other Contractor);

.4 Powerhouse control room (supplied by Company's Other Contractor);

.5 ECC (Energy Control Centre) located in St. John's, NL (supplied by Company's Other Contractor).

2.2 GATE POSITIONS

2.2.1 The following table describes the spillway gate position terminology that will be used in this section of the specification:

SPILLWAY GATE POSITIONS	
Position	**Description**
Extreme upper limit	The highest position the gate could reach. If the gate reaches this position it will be stopped by a switch operated by a counterweight hinged arm which would be hit by a striker mounted on the gate.
Maintenance upper limit	The highest position the gate could reach under normal maintenance mode. If the gate reaches this position it will be stopped by a limit switch.
Full open	Full open position under normal mode of operation, the gate is fully out of the water.
Closed	Normal closed position in which the water passage is completely blocked

	with the gate resting on the sill.

2.3 LOCAL CONTROL PANEL

2.3.1 Each gate shall have a local control panel. The local control panel shall be located adjacent to the hoist in the hoist house. The local control panel shall be insulated on all faces and heated. Heating shall be supervised.

2.3.2 A LOCAL-REMOTE-MAINTENANCE selector switch shall be located on the control panel. The LOCAL position shall allow control of the gate hoist from the local control panel. The REMOTE position shall allow control of the gate hoist from the remote locations. The MAINTENANCE position shall allow the gate to be raised beyond the full open position. The MAINTENANCE position shall also allow the cable drum to keep turning after the gate has reached the closed position.

2.3.3 The following push-buttons shall be installed on the control panel:

.1 INCREMENTAL RAISE;

.2 INCREMENTAL LOWER;

.3 STOP;

.4 JOG RAISE;

.5 JOG LOWER;

.6 OVERRIDE;

.7 HORN;

.8 EMERGENCY STOP;

.9 TEST LAMPS;

.10 RESET.

2.3.4 The INCREMENTAL RAISE and INCREMENTAL LOWER push-buttons shall raise or lower the gate by an incremental distance of 1 meter. The incremental distance shall be adjustable. The gate shall stop automatically after travelling the incremental distance without operator intervention.

2.3.5 When the JOG RAISE or JOG LOWER button is pressed, the hoist shall move as long as the button is pressed and shall stop if the button is released.

2.3.6 The EMERGENCY STOP button shall be of the mushroom type and hardwired to the motor starter. This function shall be latching and reset by pressing the RESET button on the panel. A light shall be activated on the panel to signal that the EMERGENCY STOP button was pressed.

2.3.7 When the selector switch is in the MAINTENANCE position, pressing the JOG RAISE button shall allow raising the gate past the full open position but the gate shall stop at the maintenance upper limit.

2.3.8 To permit jogging the gate past the maintenance upper limit (to test the extreme upper limit switch) or to keep turning the cable drum after the gate has reached the close position (to test the slack rope system), the selector switch shall be at the MAINTENANCE position and both the OVERRIDE button and JOG RAISE / LOWER shall be pressed at the same time. The OVERRIDE button shall only function when the selector switch is at the MAINTENANCE position. The gates cannot be raised above the extreme upper limit.

2.3.9 When the HORN button is pressed, the horn shall sound for 5 minutes (adjustable).

2.3.10 The following conditions shall be indicated by lights on the control panel:

.1 Slack rope;

.2 Hoist overload;

.3 Extreme upper limit;

.4 Maintenance upper limit;

.5 Motor overload;

.6 Hoist Energized;

.7 Gate in ‘’closed’’ position;

.8 Gate in ‘’full open’’ position;

.9 Brake Status;

.10 Unbalance wire rope load;

.11 Emergency Stop.

2.3.11 The following displays shall be mounted on the control panel:

.1 Gate position (digital indication);

.2 Total hoist load;

.3 Horn timer.

2.3.12 A mechanical gate position indicator shall be installed on each hoist and shall be mechanically connected to the wire rope drum. Its dial shall be easily readable from the local control panel location. It shall be graduated in metres and centimetres and shall indicate the position of the bottom of the gate above the sill up to its uppermost position.

2.4 GATE PLC PANEL

2.4.1 Each gate shall have a gate PLC panel. The gate PLC panel shall be located in the spillway electrical room.

2.4.2 A touch screen HMI shall be mounted on the panel. The status of gate shall be presented in the form of graphical displays, reports, alarms and event lists. Graphical diagrams shall be used for the representation of the operation of the gates. The HMI shall replicate all the functions and indications described in the previous section for the local control panel. All the functions of the heating control panel described in 3 shall also be replicated on the HMI. All indications and alarms shall continue to be displayed on the touch screen HMI when the panel is set to remote.

2.4.3 A LOCAL-REMOTE selector switch shall be located on the panel. The LOCAL position shall allow control of the gate from the touch screen HMI. The REMOTE position shall allow control of the gate from the general spillway control panel, powerhouse control room or ECC.

2.4.4 An EMERGENCY STOP push-button, mushroom type and hardwired to the motor starter, shall be provided on the panel. This function shall be latching and reset by pressing a RESET button that shall be installed on the panel. An indication on the screen shall signal that the EMERGENCY STOP button was pressed.

2.4.5 Only the INCREMENTAL RAISE and LOWER, the STOP and the HORN functions shall be available from the gate PLC panel HMI. The maintenance functions shall not be allowed from the gate PLC panel.

2.4.6 Dual (redundant) communication links shall be provided between each spillway gate controller and the general spillway controller (supplied by Company's Other Contractor). The critical alarms between each spillway gate controller and the general spillway controller shall be hardwired. The alarms to be hardwired shall be submitted for Acceptance by Engineer.

2.5 GENERAL SPILLWAY CONTROLLER

2.5.1 There will be one general spillway controller which will be located in the spillway electrical building and which will be supplied by Company's Other Contractor at the final stage of the project. The general spillway controller will not be available at the diversion stage.

2.5.2 The general spillway controller will be a microprocessor based, local monitoring and control system that will provide monitoring and control of the 5 spillway gate controllers over a redundant communication protocol link with the critical alarms hardwired.

2.5.3 The general spillway controller will communicate to the powerhouse control room all alarms and status data from each of the spillway gates.

2.5.4 The spillway alarms and indications points to be sent to the general spillway controller shall include for each gate, but not be limited to, the following:

.1 Spillway gate position indication;

.2 Spillway gate fully opened;

.3 Spillway gate fully closed;

.4 Spillway gate travelling;

.5 Emergency spillway gate stop initiated;

.6 Spillway gate slack rope;

.7 Spillway gate extreme upper limit;

.8 Spillway gate maintenance upper limit;

.9 Spillway gate hoist overload;

.10 Spillway hoist motor overload;

.11 Power failure - dc;

.12 Power failure - ac;

.13 PLC failure;

.14 Low temperature (control panel, MCC and hoist components);

.15 Gate in local control indication;

.16 Horn activated.

2.5.5 The spillway control points to be received from the general spillway controller shall include for each gate, but not be limited to, the following:

.1 Gate incremental raise command;

.2 Gate incremental lower command;

.3 Stop command;

.4 Horn.

2.5.6 Power Supply

.1 The permanent electrical supply shall be sized to feed the heating load of three (3) spillway gates, supply power to one (1) gate hoist motor and the spillway auxiliary electrical services;

.2 A diesel generator, located in a dedicated generator room next to the spillway electrical room, shall provide emergency power to the spillway critical loads. The diesel generator shall be sized to supply the heating load of two (2) spillway gates and supply power to one (1) gate hoist motor. The diesel generator shall start automatically upon loss of normal power and shut-down once normal power is restored;

.3 The general spillway controller will assign which 3 gates will be heated in normal condition and which 2 gates will be heated in emergency condition (diesel generator supply);

.4 The individual gate PLCs shall activate or deactivate the heating system based on the command received from the general spillway controller.

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.5 For a detailed functional description of the Automatic Transfer and Load Management System, refer to Section: 26 29 03.04, Spillway Automatic Transfer and Load Management System - Functional Description of this technical specification.

2.6 ECC AND POWERHOUSE CONTROL ROOM

2.6.1 The same functionalities available at the general spillway controller will be available at the powerhouse control room and at the ECC (Energy Control Centre) located in St. John’s, NL, through communication links to the general spillway controller.

2.7 INSTRUMENTATION

2.7.1 For the instrumentation requirements, refer to section 5.1.

2.8 BRAKE CONTROL

2.8.1 For the brake control requirements, refer to section 5.2.

2.9 HORN WARNING SYSTEM

2.9.1 If the INCREMENTAL RAISE button is pressed on a gate that is not already spilling (i.e. a gate which is closed), the following takes place:

.1 Step 1: INCREMENTAL RAISE button is pressed for a gate which is closed;

.2 Step 2: Horn sounds for 5 minutes (adjustable) and gate movement is blocked during this period;

.3 Step 3: After the step 2 time is completed, the gate moves the incremental amount, the horn keeps sounding while the gate is moving and the horn sounds for an additional 5 minutes (adjustable) after the gate has stopped moving.

2.9.2 If the JOG RAISE button is pressed on a gate that is not already spilling (i.e. a gate which is closed), the following takes place:

.1 Step 1: JOG RAISE button is pressed for a gate which is closed;

.2 Step 2: Horn sounds for 10 minutes (adjustable) and gate movement is initially blocked;

.3 Step 3: After a 5-minute delay (adjustable) the JOG RAISE function becomes active. The gate shall move if the JOG RAISE button is pressed but only if the horn is still sounding;

.4 Step 4: Gate moves as long as the JOG RAISE button is pressed, horn keeps sounding while the gate is moving and the horn sounds for an additional 5 minutes (adjustable) after the JOG RAISE button has been released.

2.9.3 If a gate is already spilling and a raise button is pressed (either JOG RAISE or INCREMENTAL RAISE) the gate shall move as commanded and the horns shall simultaneously sound for 5 minutes (adjustable).

2.9.4 If a subsequent raise is initiated before the 5 minutes have been completed the raise command shall be acted on but the horn shall continue sounding and the horn timer shall reset for 5 minutes (adjustable).

2.9.5 When in maintenance mode, the horn and timer shall be disabled.

3 SPILLWAY GATE HEATING CONTROL

3.1 GENERAL

3.1.1 Each gate heating control shall be completely independent. The failure of an individual gate heating control shall have no impact on the other gates.

3.1.2 Gate heating control shall be achieved through bidirectional triode thyristor (TRIAC) modules and temperature controllers.

3.1.3 The gate heating controller shall be independent from the gate PLC and shall be located in the spillway hoist house.

3.1.4 The gate heating control shall have 4 heating modes: OFF, SUMMER, AUTO and BYPASS, as described below.

3.1.5 The heating mode of the gate and of the embedded parts shall be independent; it shall be possible to assign a different heating mode to the gate and the embedded parts.

3.1.6 The gate PLC, located in the spillway electrical building, shall assign the gate heating mode.

3.1.7 Each gate shall have a heating control panel. The heating control panel shall be located adjacent to the hoist local control panel in the hoist house. The heating control panel shall allow selection of the heating mode through the gate PLC located in the spillway electrical building. The selector switches on the local control panel shall be hardwired back to the PLC panel to allow selection of the heating mode through the PLC. The heating control panel shall be insulated on all faces and heated and the heating shall be supervised.

3.1.8 A LOCAL-REMOTE selector switch shall be located on the heating control panel. The LOCAL position shall allow selection of the heating mode from the local heating control panel. The REMOTE position shall allow selection of the heating mode from the remote locations.

3.1.9 The heating control panel shall have two (2) OFF-SUMMER-AUTO-BYPASS selector switches, one for the gate heating mode selection and one for the embedded parts heating mode selection.

3.1.10 When a gate is being opened or closed, its heating system shall be disabled to limit the peak demand on the electrical supply system.

3.2 GATE HEATING

3.2.1 A temperature sensor located inside the gate shall provide the temperature measurement to the gate heating control system.

3.2.2 A backup temperature sensor shall be located inside the gate to detect a low temperature and trigger an alarm.

3.2.3 A selector switch with OFF-SUMMER-AUTO-BYPASS positions shall be provided on the heating control panel. At the OFF position the heating of the gate shall be disabled. At the SUMMER position the gate shall be heated at 10% (adjustable) power constantly no matter what the temperature is. At AUTO position the gate shall be heated with power proportional to the demand (modulated) through a TRIAC circuit. At the BYPASS position, the gates shall be heated at full power through a contactor installed in parallel with the TRIAC circuit. The BYPASS mode shall be available in case of failure of the TRIAC circuit and shall allow gate heating in case maintenance is required on the TRIAC circuit.

3.2.4 The heating control panel shall have the following indicating lights:

.1 Gate heating system energized;

.2 Gate heating in summer mode;

.3 Gate heating in auto mode;

.4 Gate heating in bypass mode;

.5 Gate heater alarm (one per heater);

.6 Gate low temperature alarm.

3.2.5 The following push-buttons will be installed on the control panel:

.1 TEST LAMPS;

.2 RESET.

3.2.6 The heating system shall send the following signals for each gate for remote monitoring, but not limited to:

.1 loss of power;

.2 loss of control power;

.3 Gate heater alarm (one per heater);

.4 High and low temperature alarms inside the gate at each heater;

.5 Position of the selector switch;

.6 Temperature reading inside the gate;

.7 Low temperature of the control panel.

3.2.7 An alarm for heating lower than 10% shall be installed to ensure that the system is functional. This alarm system shall be composed of a current transducer and a device which can detect the presence of current with a dry contact for remote alarm.

3.3 EMBEDDED PARTS HEATING

3.3.1 A temperature sensor shall be installed in contact with an embedded part to supply temperature reading to the heating control system.

3.3.2 A temperature sensor shall be installed with each heating element in order to provide an alarm in case of failure of the heating system.

3.3.3 A selector switch with OFF-SUMMER-AUTO-BYPASS positions shall be provided on the heating control panel. At the OFF position the heating of the embedded parts shall be disabled. At the SUMMER position the embedded parts shall be heated at 10% (adjustable) power constantly no matter what the temperature is. At AUTO position the embedded parts shall be heated with power proportional to the demand (modulated) through a TRIAC circuit. At the BYPASS position, the embedded parts shall be heated at full power through a contactor installed in parallel with the TRIAC circuit. The BYPASS mode shall be available in case of failure of the TRIAC circuit and shall allow embedded parts heating in case maintenance is required on the TRIAC circuit.

3.3.4 The heating control panel shall have the following indicating lights:

.1 Embedded part heating system energized;

.2 Embedded part heating in summer mode;

.3 Embedded part heating in auto mode;

.4 Embedded part heating in bypass mode;

.5 Embedded part heating system failure.

3.3.5 The following push-buttons shall be installed on the control panel:

.1 TEST LAMPS;

.2 RESET.

3.3.6 The heating system shall send the following signals for remote monitoring:

.1 Embedded part heating system failure;

.2 Loss of control power;

.3 Low temperature of the control panel;

.4 Position of the selector switch.

4 INTAKE GATE CONTROL

4.1 GENERAL REQUIREMENTS

4.1.1 A dedicated PLC shall be provided for every generating unit. Each PLC shall control the three (3) hoists related to the generating unit.

4.1.2 The control of the intake gate hoists for each generating unit shall be completely independent. The failure of a PLC shall have no impact on the other generating units.

4.1.3 Each hoist shall have a local control panel located adjacent to the hoist. The local control panel shall control the gate through the PLC. The buttons and selector switches on the local control panel shall be hardwired back to the PLC panel to allow control of the gate through the PLC.

4.1.4 Safety functions, such as the slack rope detection device, shall be hardwired to the motor starter control circuit.

4.1.5 Except for the emergency close function, any function which disables the hoist motor shall apply the brakes.

4.1.6 The emergency close protection function shall be a hardwired, 125 Vdc circuit, which shall cause all 3 intake gates associated to a generating unit to drop. The circuit shall allow for connection of trip signals from the powerhouse control and protection system.

4.1.7 It shall be possible to control and monitor each gate from 4 different locations:

.1 Local control panel adjacent to the hoist;

.2 PLC panel located in the intake gate building near the hoists;

.3 Powerhouse control room (supplied by Company's Other Contractor);

.4 ECC (Energy Control Centre) located in St. John's, NL (supplied by Company's Other Contractor).

4.2 GATE POSITIONS

4.2.1 The following table describes the intake gate position terminology that will be used in this section of the specification:

INTAKE GATE POSITIONS	
Position	**Description**
Extreme upper limit	The highest position the gate could reach. If the gate reaches this position it will be stopped by a switch operated by a counterweight hinged arm which would be hit by a striker mounted on the gate.
Maintenance upper limit	The highest position the gate could reach under normal maintenance mode. If the gate reaches this position it will be stopped by a limit switch.
Full open	Full open position under normal mode of operation, the gate is fully out of the water.
Cracked	The gate is open by a small amount to allow filling up the water passages.
Closed	Normal closed position in which the gate completely blocks the water passage.

4.3 LOCAL CONTROL PANEL

4.3.1 The local control panel shall be insulated on all faces and heated. Heating shall be supervised.

4.3.2 A LOCAL-REMOTE-MAINTENANCE selector switch shall be located on the local control panel. The LOCAL position shall allow control of the gate hoist from the local control panel. The REMOTE position shall allow control of the gate hoist from the PLC panel, powerhouse DCS or ECC. The MAINTENANCE position shall allow the gate to be raised beyond the full open position. The MAINTENANCE position shall also allow the cable drum to keep turning after the gate has reached the closed position.

4.3.3 The following push-buttons shall be installed on the control panel:

.1 RAISE;

.2 LOWER;

.3 OVERRIDE;

.4 STOP;

.5 EMERGENCY STOP;

.6 EMERGENCY CLOSE;

.7 TEST LAMPS;

.8 RESET.

4.3.4 When the selector switch is in the REMOTE position only the EMERGENCY CLOSE and EMERGENCY STOP functions shall be available at the local control panel. All other functions shall be disabled.

4.3.5 When the selector switch is in the LOCAL position, the RAISE button shall move the gate to the full open position from any position below full open. The initial filling logic described in section 4.8 shall over ride this function. The gate shall stop automatically when the full open position has been reached without operator intervention. If the gate is in full open position or above the full open position, no action shall be taken if the RAISE button is pressed.

4.3.6 When the selector switch is in the LOCAL position, the LOWER button shall move the gate to the closed position from any position. The gate shall stop automatically when the close position has been reached without operator intervention. If the gate is closed, no action shall be taken if the LOWER button is pressed.

4.3.7 When the selector switch is in MAINTENANCE position, the RAISE and LOWER buttons shall allow the gate to be jogged past the full open position but the gate shall stop at the maintenance upper limit. In MAINTENANCE mode the initial filling logic shall not apply.

4.3.8 To permit jogging the gate past the maintenance upper limit (to test the extreme upper limit switch) or to keep turning the cable drum after the gate has reached the close position (to test the slack rope system), the selector switch shall be at the MAINTENANCE positions and both the OVERRIDE button and RAISE / LOWER shall be pressed at the same time. The OVERRIDE button shall only function when the selector switch is at the MAINTENANCE position.

4.3.9 The STOP button shall only stop programmed movement, it shall not stop an emergency close command.

4.3.10 The EMERGENCY STOP button shall be of the mushroom type and hardwired to the motor starter. Emergency stopping of the three (3) intake gates shall be triggered by pressing the EMERGENCY STOP button on any of the local control panel associated to a generating unit. This function shall be latching and reset by pressing the RESET button on the panel. A light shall be activated on the panel to signal that the EMERGENCY STOP button was pressed.

4.3.11 The EMERGENCY CLOSE button shall be a covered button and hardwired to the motor starters and the brakes. Emergency closing of the three (3) intake gates shall be triggered by pressing the EMERGENCY CLOSE button on any of the local control panel associated to a generating unit. The emergency closing shall disable the hoist motors and release the brakes and shall send a signal to the unit controller to initiate a unit shutdown. The gates shall close by gravity with the lowering speed controlled by the fan brake. This function shall be latching and reset by pressing the RESET button on the panel. A light shall be activated on the panel to signal that the EMERGENCY CLOSE button was pressed.

4.3.12 The following conditions shall be indicated by lights on the control panel:

.1 Gate in ‘’closed’’ position;

.2 Initial filling completed;

.3 Gate in ‘’full open’’ position or above.

4.3.13 The following displays shall be mounted on the control panel:

.1 Gate position (digital indication);

.2 Load on the cables.

4.4 PLC PANEL

4.4.1 Four (4) PLC panels shall be installed, one per generating unit. Each PLC panel shall contain a PLC, controlling the three (3) hoists related to a generating unit. Each PLC panel shall also house an HMI touch screen to allow control and monitoring of the gate hoists.

4.4.2 The PLC panels will be located in the non-heated intake gate building, near the hoists. The PLC panels shall be insulated on all faces and heated to maintain an inside temperature adequate for the electronic equipment it contains. The PLC panels shall have an external door and all temperature sensitive equipments, such as the touch screen and PLC, shall be mounted inside the panel. A separate thermostat shall be supplied to send an alarm, with an adjustable threshold, to report a low temperature condition in the panel.

4.4.3 A LOCAL-REMOTE selector switch shall be located on the panel exterior door. The LOCAL position shall allow control of the three (3) hoists from the touch screen HMI. The REMOTE position shall allow control of the gates from the powerhouse DCS (Distributed Control System) or from the ECC.

4.4.4 An EMERGENCY STOP button shall be located at the PLC panel. An alarm on the HMI shall signal that the EMERGENCY STOP button was pressed. The EMERGENCY STOP button shall be of the mushroom type and hardwired to the motor starter. Emergency stopping of the three (3) intake gates shall be triggered by pressing the EMERGENCY STOP button associated to a generating unit. This function shall be latching and reset by pressing the RESET button on the panel.

4.4.5 An EMERGENCY CLOSE button shall be located at the PLC panel. An alarm on the HMI shall signal that the EMERGENCY CLOSE button was pressed. The EMERGENCY CLOSE button shall be a covered button and hardwired to the motor starters and the brakes. Emergency closing of the three (3) intake gates shall be triggered by pressing the EMERGENCY CLOSE button associated to a generating unit. The emergency closing shall disable the hoist motors and release the brakes and shall send a signal to the unit controller to initiate a unit shutdown. The gates shall close by gravity with the lowering speed controlled by the fan brake. This function shall be latching and reset by pressing the RESET button on the panel.

4.4.6 A touch screen HMI shall be mounted in the panel. The status of equipments, for the three (3) gates, shall be presented in the form of graphical displays, reports, alarms and event lists. Graphical diagrams shall be used for the representation of the operation of the gates.

4.4.7 The HMI shall replicate all the functions and indications described in the previous section for the local control panel. The HMI shall also display, for the three (3) gates, the following additional information, but not limited to:

.1 Status of all limit switches (position, slack rope, balanced rope, extreme upper limit, etc.);

.2 Brake status;

.3 Emergency stop status;

.4 Emergency close status;

.5 Motor starter status;

.6 Initial filling timer;

.7 Pressure readout;

.8 Local/Remote/Maintenance status;

.9 Heater status.

4.4.8 All indications and alarms shall continue to be displayed on the touch screen HMI when the panel is set to remote.

4.4.9 The Maintenance functions shall not be available from the PLC panel HMI.

4.4.10 A communication link, through fibre optic, shall be provided between each gate PLC and the unit controller (supplied by Company's Other Contractor) located in the powerhouse.

4.5 ECC AND POWERHOUSE CONTROL ROOM

4.5.1 It shall be possible to control and monitor the intake gates from the powerhouse control room or from the ECC (Energy Control Centre) located in St. John's, NL.

4.5.2 The intake gate alarms and indication points to be sent to the control room and ECC shall include for each gate, but not be limited to, the following:

.1 Intake gate position indication;

.2 Intake gate full open;

.3 Intake gate closed;

.4 Intake gate cracked;

.5 Intake gate travelling;

.6 Intake passage filling in progress;

.7 Intake gate trip isolated;

.8 Emergency Close initiated;

.9 Emergency Stop initiated;

.10 Intake gate slack rope;

.11 Intake gate extreme upper limit;

.12 Intake gate maintenance upper limit;

.13 Intake gate hoist overload;

.14 Intake hoist motor overload;

.15 Power failure - ac;

.16 Power failure - dc;

.17 Control panels low temperature;

.18 PLC failure;

.19 Local or maintenance mode selected;

.20 Heater status.

4.5.3 The intake gate control points to be received from the control room and ECC shall include for each gate, but not be limited to, the following:

.1 Intake gate emergency close to be hardwired from the protection system only;

.2 Intake gate close.

4.6 INSTRUMENTATION

4.6.1 For the instrumentation requirements, refer to section 5.1.

4.6.2 For the intake gate, the cracked position shall be controlled by the PLC using the continuous position indication. The rotary limit switch shall act as a backup to stop the gate at the cracked position in case of PLC failure.

4.7 BRAKE CONTROL

4.7.1 For the brake control requirements, refer to section 5.2.

4.7.2 There shall be an electrical interlock to prevent the gate from being raised if the brake lever is in the released position.

4.8 INITIAL FILLING

4.8.1 Initial filling of the water passage shall be accomplished by cracking one gate. It shall be possible to use any gate for initial filling. The PLC shall only act on the command from the first gate and ignore raise commands from the other gates. Upon reception of a raise command, the PLC shall open the gate to approximately 150 mm, this amount shall be adjustable. All subsequent raise commands shall be disabled on all gates. Raise commands shall only be re-enabled when 2 conditions are met: downstream pressure switch activated and 20 minute timer (adjustable). It shall only be possible to start initial filling from the local control panel or PLC panel. Once the water passage initial filling has been completed, open commands for the remaining two intake gates associated to the water passage shall bypass the initial filling sequence.

4.9 EMERGENCY CLOSE

4.9.1 When the selector switches on the local control panels and intake PLC panel are in REMOTE position, the emergency close signal from the powerhouse protection system and from the EMERGENCY CLOSE buttons located at the hoist house shall cause the gates to close.

4.9.2 When the selector switch at one of the local control panels or at the intake PLC panel is in the LOCAL position, the emergency close signal from the powerhouse protection system shall be blocked but the EMERGENCY CLOSE buttons located at the hoist house shall be enabled. The selection of the LOCAL position shall send an alarm to the powerhouse control system.

4.9.3 When the selector switch at one of the local control panels is in the MAINTENANCE position, the emergency close function shall be blocked. The selection of the MAINTENANCE position shall send an alarm to the powerhouse control system.

4.9.4 It shall not be possible to stop an emergency close command with the EMERGENCY STOP or STOP button, regardless of the position of the selector switch.

4.10 HORN

4.10.1 When the EMERGENCY CLOSE or EMERGENCY STOP button is pressed from any location a horn or buzzer shall sound in the intake building. The amount of time the horn sounds shall be adjustable.

5 SPILLWAY AND INTAKE GATES COMMON REQUIREMENTS

5.1 INSTRUMENTATION

5.1.1 Each gate shall be equipped with instrumentation to provide the following functionalities, but not limited to:

.1 Continuous position indication;

.2 Extreme upper limit detection;

.3 Maintenance upper limit detection;

.4 Full open position detection;

.5 Close position detection;

.6 Slack rope detection;

.7 Hoist load indication;

.8 Balanced wire rope loads detection.

5.1.2 For gate position indication, the following devices shall be provided:

.1 One digital absolute continuous position indicator with a minimum precision of 5 mm. The device shall be mounted in a heated weatherproof metallic enclosure;

.2 One cam-type rotary limit switch, driven through suitable gearing from the hoist drum, with a minimum of 8 adjustable contacts.

5.1.3 For the extreme upper limit, the following device shall be provided:

.1 One power limit switch, installed in the motor supply circuit. This switch shall directly de-energize the motor supply and apply the brakes when the gate has over-travelled due to a fault on the maintenance upper limit switch. The switch shall be operated by a counterweight hinged arm which will be hit by a striker mounted on the gate. The switch shall be located such that it can be reset by maintenance personnel from a safe location without requiring fall arrest protection.

5.1.4 For the maintenance upper limit position, the following device shall be provided:

.1 One device, independent from the extreme upper limit switch, which shall stop the gate if it over-travels the maintenance upper limit position. This device shall stop the gate before it reaches the extreme upper limit through a contact hardwired to the motor starter.

5.1.5 For the full open position, the following device shall be provided:

.1 The full open position shall be obtained from the position indication devices or a different device Accepted by Engineer.

5.1.6 For the close position and the hoist load, the following device shall be provided:

.1 A load cell shall be installed on each dead end or alternate location Accepted by Engineer. The load cell shall provide continuous read-out to the display on the local control panel and to the PLC. A high load setting shall be used for overload protection and shall stop the gate. The load cell shall be provided with dry contacts with adjustable thresholds and a contact shall be hardwired to the motor starter to stop the hoist on overload in case of a PLC failure. A lower limit programmable setting shall be used to detect gate close position (for example <25% normal lowering load).

5.1.7 For slack rope detection, the following device shall be provided:

.1 A slack rope detection system, independent from the load cell used for normal close position and hoist load indication, shall be installed. This system shall act as a backup to stop the gate in case of failure of the load cell. A contact shall be hardwired to the motor starter to stop the hoist in case a slack rope is detected.

5.1.8 For balanced wire rope loads, the following device shall be provided:

.1 A system shall be provided to detect load unbalance between the wire ropes. This system shall stop the hoist through a contact hardwired to the motor starter in case of load unbalance.

5.1.9 Activation of the maintenance upper limit, extreme upper limit and hoist overload limit switches shall disable any further raise signals.

5.1.10 Activation of the slack rope detection limit switch shall disable any further lowering commands.

5.2 BRAKE CONTROL

5.2.1 The brake control circuit shall be designed to minimize arcing on the contacts when the brake release coil is de-energized. If a damping circuit is used, it shall be designed such that the brake will come on immediately when the supply to the 125 Vdc brake release coil is removed.

6 DRAFT TUBE HOIST CONTROL

6.1 GENERAL

6.1.1 The draft tube hoist will be located in a sheltered non-heated space. All control components shall be designed to function in outdoors conditions.

6.1.2 The draft tube hoist shall be controlled only from a pendant control located on the upstream side of the hoist.

6.1.3 The pendant cord shall be long enough to allow the operator to stand on either side of the gate plus an extra 2 meters. A convenient place to wrap the excess length of cord and to hang the pendant shall be provided on the hoist. The pendant shall be water proof.

6.1.4 All travel and hoist functions shall be variable speed; the speed shall be controlled from the pendant.

6.1.5 The pendant shall have as a minimum the buttons described in section 9.1.

6.1.6 Any function which disables the hoist motor shall apply the brakes.

6.2 INSTRUMENTATION

6.2.1 The draft tube hoist instrumentation shall be as described in section 9.2.

6.2.2 In addition, the following device shall be supplied to detect that the hoist bridge is at the end of the rail:

.1 The movement of the bridge shall be limited at both extremities of the rails by proximity switches. The proximity switches shall prevent the bridge from hitting the bumpers at the end of the rails.

7 TRASH RACK HOIST CONTROL

7.1 GENERAL

7.1.1 The trash rack hoist will be located outside under the trash cleaner gantry structure. All control components shall be designed to function in outdoor conditions.

7.1.2 It shall be possible to control the trash rack hoist from a control panel or a radio remote control.

7.1.3 All travel and hoist functions shall be variable speed; the speed shall be controlled from the control panel or radio remote control. The north/south maximum travel speed shall be programmable.

7.1.4 An interlock shall block the hoist function unless the trash cleaner platform is parked and the boom is retracted.

7.1.5 An interlock shall block the trash cleaner function if there is a load on the hoist and the hoist is not fully raised.

7.1.6 Any function which disables the hoist motor shall apply the brakes.

7.2 CONTROL PANEL

7.2.1 The control panel shall be insulated on all faces and heated. Heating shall be supervised and shall generate an alarm in case of failure. The control panel shall be mounted inside a weatherproof and lockable enclosure.

7.2.2 The trash rack hoist control panel shall be located on a platform on the access stairway/ladder near the roadway level where the operation of the hoist can be safely viewed for all operations.

7.2.3 A 2-position selector switch (PANEL-RADIO REMOTE) shall be located on the panel to allow control from the panel or from the radio remote control.

7.2.4 A 3-position selector switch (CLEAN-OFF-HOIST) shall be supplied. The CLEAN position shall enable the trash cleaner. The HOIST position shall enable the hoist function. The OFF position shall block both the trash cleaner and the hoist functions. An identical 3-position selector switch shall be located in the trash cleaner cab. Both selector switches, in the cab and at the control panel, must have the same selection for the selection to be active.

7.2.5 The following conditions, as a minimum, shall be indicated by lights on the control panel:

.1 Slack rope;

.2 Hoist overload;

.3 Extreme upper limit;

.4 Normal upper limit;

.5 Motor overload;

.6 Hoist Energized;

.7 Unloaded position;

.8 Lower limit position;

.9 Brake Status;

.10 Unbalance wire rope load;

.11 Cab selector switch position.

7.2.6 The control panel shall have, as a minimum, the buttons described in section 9.1.

7.2.7 There shall be, in addition to the EMERGENCY STOP button on the control panel and the radio remote control, one EMERGENCY STOP button on each leg of the trash cleaner gantry. The EMERGENCY STOP buttons on each leg of the gantry shall be of the mushroom type and hardwired to the gantry drive starter. All EMERGENCY STOP buttons shall be latching and reset by pressing the RESET button on the panel. A light shall be activated on the panel to signal that the EMERGENCY STOP button was pressed.

7.3 RADIO REMOTE CONTROL

7.3.1 The radio remote control shall be stored inside the operators cab and be provided with 2 battery packs and 2 chargers.

7.3.2 The radio remote control shall have, as a minimum, the buttons described in section 9.1.

7.4 INSTRUMENTATION

7.4.1 The trash cleaner hoist instrumentation shall be as described in section 9.2. The load cell display shall be clearly visible from the operating platform and from the ground when the hoist is operated.

8 SPILLWAY HOIST BUILDING MAINTENANCE CRANE

8.1 GENERAL

8.1.1 The spillway hoist building maintenance overhead crane will be located in a sheltered non-heated space. All control components shall be designed to function in outdoors conditions.

8.1.2 The maintenance crane shall be controlled only from a pendant control.

8.1.3 All travel and hoist functions shall be variable speed; the speed shall be controlled from the pendant.

8.1.4 The pendant shall have as a minimum the buttons described in section 9.1.

8.1.5 Any function which disables the crane motor shall apply the brakes.

8.2 INSTRUMENTATION

8.2.1 The maintenance crane instrumentation shall be as described in section 9.2.

8.2.2 In addition, the following device shall be supplied to detect that the crane is at the end of the rail:

.1 The movement of the crane shall be limited at both extremities of the rails by proximity switches. The proximity switches shall prevent the crane from hitting the bumpers at the end of the rails.

9 DRAFT TUBE, TRASH CLEANER AND MAINTENANCE CRANE COMMON REQUIREMENTS

9.1 CONTROL

9.1.1 The hoist control shall have a minimum of 10 buttons/controls:

.1 ON;

.2 OFF;

.3 RAISE;

.4 LOWER;

.5 TRAVEL IN THE UPSTREAM DIRECTION;

.6 TRAVEL IN THE DOWNSTREAM DIRECTION;

.7 TRAVEL IN THE NORTH DIRECTION;

.8 TRAVEL IN THE SOUTH DIRECTION;

.9 EMERGENCY STOP;

.10 DISENGAGE HOOKS.

9.1.2 The RAISE, LOWER and all TRAVEL buttons shall be jog functions, the hoist shall move as long as the button is pressed and shall stop if the button is released.

9.1.3 The DISENGAGE HOOKS button shall, where applicable, allow freeing the lifting beam from the gate.

9.1.4 The EMERGENCY STOP button shall be of the mushroom type and hardwired to the motor starter.

9.2 INSTRUMENTATION

9.2.1 The following table describes the hoist position terminology that will be used in this section of the specification:

HOIST POSITIONS	
Position	**Description**
Extreme upper limit	The highest position the hoist could reach. If the hoist reaches this position it will be stopped by a switch operated by a counterweight hinged arm which would be hit by a striker.
Normal upper limit	The highest position the hoist could reach under normal condition. When the hoist reaches this position it will be stopped by a limit switch.
Unloaded position	Position at which there is no load on the hoist and the wire rope becomes slack. The hoist will be stopped by the slack rope detection device.
Lower limit	Lowest position the hoist is allowed to reach. A limit switch will automatically stop the hoist if this lower limit is exceeded.

9.2.2 Each hoist shall be equipped with instrumentation to provide the following functionalities, but not limited to:

.1 Extreme upper limit;

.2 Normal upper limit;

.3 Unloaded position;

.4 Lower limit;

.5 Hoist load;

.6 Slack rope;

.7 Balanced wire rope loads;

.8 Overspeed detection.

9.2.3 For the extreme upper limit, the following device shall be provided:

.1 One power limit switch, installed in the motor supply circuit. This switch shall directly de-energize the motor supply and apply the brakes when the hoist has over-travelled due to a fault on the normal upper limit switch. The switch shall be operated by a counterweight hinged arm which will be hit by a striker. The switch shall be located such that it can be reset by maintenance personnel from a safe location without requiring fall arrest protection.

9.2.4 For the normal upper limit, the following device shall be provided:

.1 One limit switch, of a type Accepted by Engineer, which shall stop the hoist when the normal upper limit position has been reached.

9.2.5 For the unloaded position and slack rope detection, the following device shall be provided:

.1 A slack rope detection system, independent from the load cell used for hoist load indication, shall be installed. This system shall automatically stop the hoist when any wire rope becomes unloaded. A contact shall be hardwired to the motor starter to stop the hoist lower function in case a slack rope is detected.

9.2.6 For the lower limit detection, the following device shall be provided:

.1 A limit switch, independent from the slack rope detection system, shall stop the hoist at the lower limit to maintain the minimum required rope wrap on the drum.

9.2.7 For the hoist load, the following device shall be provided:

.1 There shall be a load cell on each dead end or alternate location Accepted by Engineer with a large display on the hoist (100 mm characters minimum). The load cell shall have programmable thresholds that shall trigger an audible alarm and stop the hoist when the threshold is exceeded. The load cell shall be provided with dry contacts with adjustable thresholds and a contact shall be hardwired to the motor starter to stop the hoist on overload. If the hoist is stopped due to an overload condition, it shall be allowed to go down only and the overload condition must be cleared when the load reduces to 90% of the rated load.

9.2.8 If there are multiple wire ropes, the following balanced wire rope loads device shall be provided:

.1 A system shall be provided to detect load unbalance between the wire ropes. This system shall stop the hoist through a contact hardwired to the motor starter in case of load unbalance and trigger an audible alarm.

9.2.9 For overspeed detection, the following shall be provided:

.1 The hoist shall be equipped with two (2) brakes. There shall be an overspeed detector which shall automatically apply the secondary brake in case of an overspeed condition. In case of overspeed, the brake shall be latched and reset manually only.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 29 03.04**
CH0032	**SPILLWAY AUTOMATIC TRANSFER AND LOAD MANAGEMENT SYSTEM - FUNCTIONAL DESCRIPTION**	Rev. D2
POWERHOUSE AND SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD 2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 29 03.04

SPILLWAY AUTOMATIC TRANSFER AND LOAD MANAGEMENT SYSTEM - FUNCTIONAL DESCRIPTION

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL A1045B
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
G. W. HAINES
SIGNATURE
11-OCT-2013
DATE
NEWFOUNDLAND & LABRADOR
REV. D2

PART .1 GENERAL

1.1 INTRODUCTION

The objective of this document is to describe the requirements for the automatic transfer scheme and load management of the spillway loads. Three modes of operation are considered in this document:

.1 Normal operation: The Spillway Main Switchgear/MCC is supplied by the 25 kV power supply through the step down transformer.

.2 Emergency supply: The Spillway Main Switchgear/MCC is supplied by the emergency diesel generator;

.3 Diesel Generator Load Test: The Spillway Main Switchgear/MCC is supplied by the emergency diesel generator for load testing of the diesel generator.

1.2 RELATED DOCUMENTS

.1 Section: 26 09 03.04 – Control and Monitoring Hydro-Mechanical.

1.3 DEFINITIONS

1.3.1 Diversion Phase

The period during project construction that the river is diverted through the Spillway and maintained at the diversion head pond level, before the reservoir is impounded to full supply level for operation of the Powerhouse.

1.4 ABBREVIATIONS

.1 MCC – Motor Control Center

.2 PLC – Programmable Logic Controller

.3 ECC – Energy Control Center

PART .2 SPILLWAY FACILITIES

The spillway installation includes five bays of Rollway Gates. Each gate has its own hoist individually powered by a 600V MCC located in the hoist house. Each of these individual hoist MCC's are fed from the Spillway Main Switchgear/MCC installed in the Spillway electrical room. The Spillway Main Switchgear/MCC shall be fed by a normal 600V 3 phase AC source and backed up by an emergency diesel generator set installed next to the Spillway electrical room. The circuit breaker of the emergency diesel generator set is electrically interlocked with the 600 Vac normal supply circuit

breaker (reference drawing - Spillway Single Line Diagram MFA-SN-CD-2440-EL-SL-0001-01).

PART .3 INSTALLED POWER AT THE SPILLWAY

3.1 SPILLWAY MCC CONNECTED LOADS ARE AS FOLLOWS:

a. Hoisting: five (5) rollway gates;

b. Heating: All Gate's wheels, guides, service gates for five (5) bays;

c. Heating of the five (5) hoist motors & five (5) gear boxes;

d. Spillway hoist housings and electrical building heating & monorail motors;

e. Heating of the upstream and downstream stop logs & guides;

f. Spillway indoor & outdoor lighting; and

g. North RCC Dam heating/ventilation & lighting loads.

Note: The Hoist house will not be heated. Instead localized radiant type heaters will be used for the hoist house.

PART .4 SPILLWAY MANUAL/AUTOMATIC TRANSFER AND LOAD MANAGEMENT

4.1 AUTOMATIC TRANSFER SYSTEM

In normal operation the Spillway Main Switchgear/MCC is fed by the 25 kV normal power supply through the 25-0.6 kV step-down transformer. Upon unavailability of the normal power supply, an automatic transfer system shall open the normal supply incomer circuit breaker and send a signal to start the emergency diesel generator. Once the diesel generator is ready to load, the transfer system shall close the emergency supply incomer circuit breaker to supply the Main Switchgear/MCC bus. All spillway loads are de-energized during supply transfer operations. Once the emergency supply circuit breaker is closed, the spillway electrical room essential loads and the load feeders, that are not equipped with a magnetic contactor (42), are energized. After a short delay, the system shall close only the Gate MCC outgoing circuit breakers (maximum two (2) of the five (5) Gate's MCCs) that are selected for the emergency operation mode.

Upon return of the normal power supply, the automatic transfer system shall open the emergency supply incomer circuit breaker, and close the normal power supply incomer circuit breaker. After a short delay, the system shall close only the Gate MCC outgoing circuit breakers (maximum three (3) of the five (5) Gate's MCCs) that are

selected for normal operation mode. After a delay, a signal is sent to the diesel generator control panel to initiate the stop procedure.

The following conditions shall block the automatic transfer:

- Any protection trip of the incomer circuit breakers, and
- When the Manual/Auto selector switch (mounted on the Main Switchgear/MCC) of the Automatic Transfer System is on Manual.

4.2 LOAD MANAGEMENT SYSTEM

4.2.1 Normal Operation

The 25-0.6 kV step down transformer shall be sized to feed the heating of three (3) spillway gates, to supply power to one (1) gate hoist motor and to supply the spillway electrical auxiliary services. In addition to these loads, upstream and downstream stop log heating for one (1) gate shall be considered during the diversion phase plus the supply of the North Dam HVAC and lighting loads. It is the contractor's responsibility to ensure the transformer capacity fulfills the above operational requirements.

The automatic transfer system of the Main Switchgear/MCC shall also perform load management of the connected loads due to the limited size of the step down transformer. The transformer loading shall be monitored by the load management system to ensure the total load does not exceed the capacity of the transformer. If the total load reaches a certain limit, alarms shall be initiated. Automatic load shedding actions might also be required.

Load management shall be based on the gate operation mode selected by the operator. The selection of the Gate operation mode shall be possible from the gate PLC control panel. An "ON–OFF" selector shall allow for the selection of the gate operation mode.

When the gate selector is switched to the ON position, the load management system shall send a signal to close the outgoing feeder circuit breaker supplying the corresponding Gate MCC.

When the gate selector is switched to the OFF position, the load management system shall send a signal to open the outgoing feeder circuit breaker supplying the corresponding Gate MCC. A block close signal shall also be maintained on the closing circuit of the outgoing feeder circuit breaker to block remote close commands. In this mode, the Gate MCC is not supplied and only the Hoist House general loads and lighting loads will remain functional since they are fed by the Main Switchgear/MCC.

A LOCAL-REMOTE selector switch shall be located on the Gate PLC control panel of each gate. The LOCAL position shall allow selection of the gate operation mode from the Gate PLC control panel only. The REMOTE position shall allow selection of the gate operation mode from the Spillway Main Controller, the Powerhouse control room and the ECC. The Remote mode will be functional only at the final phase.

The system shall have the following functionality:

- Gate selection shall be possible from four (4) different locations as follows:

  1. Gate PLC control panel;
  2. Spillway Main Controller supplied by Company's Other Contractor;
  3. Powerhouse control room (supplied by Company's Other Contractor); and
  4. ECC (Energy Control Center) located in St John's, NL (supplied by Company's Other Contractor).

- In normal operation it shall be possible to enable (or to select) only three (3) of the five (5) Gate MCCs at the same time.

- In addition to the Spillway Main Controller, each Gate PLC controller shall provide indication of selection status of the other Gates.

- The Gate selection shall be operational at the diversion phase and remain operational at the final stage.

D2

D2

4.2.2 Emergency Operation

The diesel generator shall be sized to supply the heating of two (2) spillway gates, operation of one (1) hoist motor of the selected gates, the day tank fuel transfer pump, and other essential loads such as emergency lighting, diesel generator room heating, supply and exhaust fans, and other loads connected to essential load distribution panels in the spillway electrical room. It is the contractor's responsibility to ensure the emergency diesel generator capacity fulfills the above operational requirements.

Non essential general loads such as normal lighting, the monorail crane, and the trash cleaner gantry crane are not supplied in emergency operation mode.

Because of the limited capacity of the emergency diesel generator (approximately 600 kW), the Automatic Transfer and Load Management System shall manage the load of the emergency diesel generator to ensure it remains within the generator's capacity. The load management system of the Spillway Main Switchgear/MCC automatically switches on only those essential loads that are required for the safety of the installation.

Similar to the normal operation mode, the load management of the Gate MCCs is performed by the Automatic Transfer and Load Management System of the Main Switchgear/MCC. As for the normal operation mode, the load management shall be based on the gate operation mode selected by the operator. The selection of the Gate operation mode shall be possible from the gate PLC control panel. An "ON–OFF" selector shall allow for the selection of the gate operation mode. The same LOCAL-REMOTE selector described in section 4.2.1 controls the local/remote selection of the gates in the emergency operation mode.

In emergency operation mode, the system shall have the following functionality:

- Gate selection shall be possible from four (4) different locations as follows:

  1. Gate PLC control panel;
  2. Spillway Main Controller;
  3. Powerhouse control room (supplied by Company's Other Contractor); and
  4. ECC (Energy Control Center) located in St John's, NL (supplied by Company's Other Contractor).

D2

- In emergency operation it shall be possible to enable only two (2) of the five (5) Gate MCCs at the same time.

- In addition to the Spillway Main Controller, each Gate PLC controller shall provide indication of selection status of the other Gates.

- The Gate selection shall be operational at the diversion phase and remain operational at the final stage.

4.2.3 Diesel Generator Load Test

The diesel generator load test mode is very similar to the emergency operation mode. Essentially, the load conditions are identical to those described for the emergency mode.

The diesel generator load test shall be initiated locally from the diesel control panel.

In addition to load management, this operation mode shall initiate load transfer from the normal supply to the emergency supply.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 29 10**
CH0032	**MOTOR STARTERS TO 600 V**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 29 10
MOTOR STARTERS TO 600 V
TABLE OF CONTENTS

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical

.2 Section 26 24 19 – Motor Control Centres

.3 Section 26 29 23 – Variable Frequency Drives

.4 Section 26 09 23.01 – Metering and Switchboard Instruments

1.2 REFERENCES

1.2.1 National Electrical Manufacturers Association

.1 NEMA ICS 1-2000 - Industrial Control and Systems: General Requirements

.2 NEMA ICS 1.1 - Safety Guidelines for the Application, Installation and Maintenance of Solid State Control

.3 NEMA ICS 1.3 - Preventive Maintenance of Industrial Control and Systems Equipment

.4 NEMA ICS 2 - Controllers, Contactors and Overload Relays Rated 600 V

.5 NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation and Maintenance of Motor Control Centers Rated Not More Than 600V

.6 NEMA ICS 2.4 - NEMA and IEC Devices for Motor Service-A Guide for Understanding the Differences

.7 NEMA ICS 4 - Application Guideline for Terminal Blocks

.8 NEMA ICS 5 - Control Circuit and Pilot Devices

.9 NEMA ICS 6 - Enclosures

.10 NEMA ICS 7 - Adjustable Speed Drives

.11 NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems

.12 NEMA ICS 12.1 - Industrial Control and Systems: Profiles of Networked Industrial Devices-Part 1: General Rules

.13 NEMA ICS 14 - Application Guide for Electric Fire Pump Controllers

.14 NEMA ICS 15 - Instructions for the Handling, Installation, Operation and Maintenance of Electric Fire Pump Controllers Rated Not More Than 600 V

.15 NEMA ICS 16 - Motion/Position Control Motors, Controls and Feedback Devices

.16 NEMA ICS 18 - Motor Control Centers

.17 NEMA ICS 19 - Diagrams, Device Designations and Symbols

.18 NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems

1.3 SUBMITTALS

1.3.1 Provide submittals in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.3.3 Shop Drawings:

.1 Provide shop drawings for each type of starter to indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout and components.

.4 Enclosure types.

.5 Wiring diagram.

.6 Interconnection diagrams.

1.4 CLOSEOUT SUBMITTALS

1.4.1 Provide maintenance materials in accordance with Exhibit 4 – Supplier Document Requirements List.

1.4.2 Submit operation and maintenance data for each type and style of motorstarter for incorporation into maintenance manual.

1.4.3 Extra Materials:

.1 Provide listed spare parts for each different size and type of starter.

.1 Contacts, stationary – Quantity 3.

.2 Contacts, movable - Quantity 3.

.3 Contacts, auxiliary - Quantity 1.

.4 Control transformer[s] - . Quantity 1.

.5 Operating coil - Quantity 1.

.6 Fuses - Quantity 2.

2 PRODUCTS

2.1 MATERIALS

.1 Starters: NEMA standards.

2.2 MANUAL MOTOR STARTERS

2.2.1 Single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.

.2 One or three overload heaters or relays, manual reset, trip indicating handle.

2.2.2 Accessories:

.1 Toggle switch or pushbutton: heavy duty labelled as indicated.

.2 Indicating light: heavy duty type with LED lamps of colour as indicated.

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS (FVNR)

2.3.1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Electronic motor overload protective device in each phase, manually reset from outside enclosure.

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

2.3.2 Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control motor circuit interrupter, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

2.3.3 Accessories:

.1 Pushbuttons and selector switches: heavy duty labelled as indicated.

.2 Indicating lights: heavy duty type and color as indicated.

.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 FULL VOLTAGE REVERSING MAGNETIC STARTERS (FVR)

2.4.1 Full voltage reversing magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Two - 3 pole magnetic contactors mounted on common base.

.2 Mechanical and electrical interlocks to prevent both contactors from operating at same time.

.3 Three phase electronic overload relays manual reset.

2.4.2 Accessories:

.1 Pushbuttons and selector switches: heavy duty labelled as indicated.

.2 Indicating lights: heavy duty type with LED lamps of color as indicated.

.3 Speed control: as indicated.

2.5 FULL VOLTAGE CONTACTORS (FVC)

2.5.1 Units with magnetic contactors of size and rating and enclosure type as indicated, with components as following:

.1 Moulded case circuit breakers with door mounted operating handle locking in “OFF” position with up to three padlocks.

.2 Provision for preventing switching to “ON” position while unit door open.

.3 Contactor, solenoid operated, rapid action type.

.4 120 V control transformer.

.5 Independent locking of unit door.

2.5.2 Unit accessories

.1 Red LED light to indicate that circuit is energized.

2.6 FULL VOLTAGE FEEDER UNITS

2.6.1 Units with moulded case circuit breakers of rating indicated with the following components and features:

.1 Moulded case circuit breaker with door mounted operating handle.

.2 Locking in “OFF” position with up to three padlocks.

.3 Provision for preventing switching to “ON” position while unit door is open.

.4 Red LED light to indicate that circuit is energized.

2.7 FULL VOLTAGE HEATER CONTROL UNITS

2.7.1 Units with moulded case circuit breakers of rating indicated with the following components and features:

.1 Moulded case circuit breaker with door mounted operating handle.

.2 Locking in “OFF” position with up to three padlocks.

.3 Provision for preventing switching to “ON” position while unit door is open.

.4 Single loop temperature controller.

.5 Triac power control unit.

.6 Red LED light to indicate that circuit is energized.

2.8 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.9 ACCESSORIES

.1 Pushbutton: heavy duty, oil tight as required.

.2 Selector switches: heavy duty, oil tight as required.

.3 Indicating lights: heavy duty, oil tight, LED type and colour as indicated.

2.10 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 – General Electrical Requirements.

2.11 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - General Electrical Requirements.

.2 Magnetic starter designation label, white plate, black letters, size 5 engraved as indicated.

3 EXECUTION

3.1 INSTALLATION

.1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses installed.

.4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements and manufacturer's instructions.

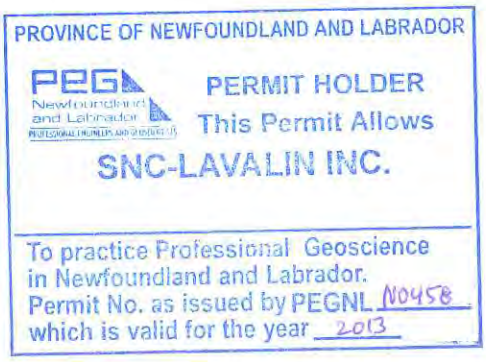
.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

SECTION 26 29 23
VARIABLE FREQUENCY DRIVES
TABLE OF CONTENTS



1 GENERAL

1.1 SCOPE

.1 This specification shall apply to the materials, design, fabrication, inspection, and testing of 600 V Variable Frequency Drives (VFD) used to control the speed and torque of NEMA design B induction motors.

.2 Ensure VFD is suitable for the motor loads of the equipment actually purchased by the Contractor.

1.2 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

.2 Section 26 24 19 – Motor Control Centres

.3 Section 26 29 00 – Motor Starters to 600 V.

1.3 REFERENCES

1.3.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 14-M91—Industrial Control Equipment

1.3.2 Institute of Electrical and Electronic Engineers (!EEE)

.1 IEEE 519-1992 – Guide for Harmonic Content and Control

1.3.3 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 7—Industrial Control and Systems Adjustable Frequency Drives

.2 NEMA ICS 7.1—Safety Standards for Construction and Guide for Selection Installation and Operation of Adjustable Frequency Drives

.3 NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems

.4 NEMA MG1—Motors and Generators

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1.4.1 Provide submittals in accordance with Exhibit 4 – Supplier Document Requirements List

1.4.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.4.3 Shop Drawings:

.1 Provide shop drawings in accordance with Exhibit 4 - Supplier Document Requirements List

.2 Dimensioned front view elevation

.3 Dimensioned f□loor plan

.4 Dimensioned top view

.5 Unit control schematics and wiring diagrams

.6 Nameplate schedule

.7 Cable entry/exit locations

.8 Assembly ratings, including short circuit, voltage, and continuous current ratings

.9 Major component ratings

.10 Minimum clearances to other equipment.

.11 Frequency spectrum for harmonic currents at line side of filter (where provided) at 50% and 100% of rated load.

.12 Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD). The VFD manufacturer shall provide calculations specific to the installation, showing total harmonic voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE electrical system standard 519. All VFDs shall include a minimum of 3% equivalent impedance reactors. VFDs shall include some form of active mitigation.

1.5 CLOSEOUT SUBMITTALS

1.5.1 Provide operation and maintenance data for VFDs for incorporation into manual.

1.5.2 Operation and maintenance manuals shall include as a minimum for each type and style of VFD.

2 PRODUCTS

2.1 GENERAL

.1 All VFDs shall be a solid state AC to AC inverter controlled device utilizing the latest isolated gate bipolar transistor (IGBT) technology. The VFD shall utilize Direct Torque Control (DTC) as the primary motor control, employing an inner loop torque control strategy that mathematically determines the optimal motor torque and flux every 25 microseconds. The VFD must also provide an optional motor control operational mode for scalar of V/Hz operation.

.2 The VFDs will be incorporated into a motor control centre (MCC) or be fed from a MCC and be protected by circuit breakers. Manufacturer shall indicate recommended breaker size.

.3 VFDs shall include:

.1 Steady state speed accuracy within 1/10th the slip without an encoder, for process repeatability.

.2 100% motor torque from zero speed available for acceleration with the VFD continuous current rating or equal in accordance with B6 to or greater then the motor full load amp rating.

.3 At and below 90% speed, 100% torque is achievable even with 10% low line voltage.

.4 Ability to limit torque to protect the mechanical system with a common single torque setting above and below field weakening.

.5 Ability to provide torque in % of motor shaft torque (with in +/- 4% linearity) on the VFD control panel, analog output or via field bus of actual.

.6 Have available the ability to operate in open loop torque control, with an ability to switch between speed and torque control on the fly with the change of state to a digital input.

.7 Have an ability to share load or speed between two or more induction AC motors connected to the same system, when those motors are controlled by separate VFDs.

2.2 RATINGS

2.2.1 The VFD shall be designed for heavy-duty applications and in accordance with applicable datasheets.

2.2.2 The VFD shall be rated to operate from 3-phase power at 600 Vac +10/-10%. The overvoltage trip level shall be a minimum of 30% over nominal, and the undervoltage trip level shall be a minimum 35% under the nominal voltage.

2.2.3 The VFD shall be rated to operate from input power from 58Hz to 63Hz.

2.2.4 Output voltage and current ratings shall match the adjustable frequency operating requirements of standard NEMA design A or NEMA design B motors.

2.2.5 The Heavy Duty overload current capacity shall be 150% of rated current for one (1) minute out of five (5) minutes.

2.2.6 The VFD efficiency shall be 98% or better of the full rated capability of the VFD at full speed and load.

2.2.7 The VFD shall be capable of starting when fed from temporary diesel generator (nominal size of 750 kVA).

2.2.8 Drive rated for a minimum fault current of 35 kA Sym. I.C.

2.3 CONSTRUCTION

2.3.1 All models shall provide a complete, ready-to-install solution.

2.3.2 IGBT power technology shall be used. This technology shall be used for all power and voltage ranges offered by the Contractor.

2.3.3 The VFD shall offer microprocessor based control logic that is isolated from power circuitry.

2.3.4 The VFD shall use the same main control board for all ratings.

2.3.5 Control connections shall remain consistent for all power ratings.

2.3.6 Include coated circuit boards as standard

2.3.7 Include integrated internal AC line reactor or DC choke

2.3.8 Offer option internally mounted braking chopper for use in dynamic braking with 100% continuous duty operation.

2.3.9 Desired optional features shall be furnished and mounted by the VFD manufacturer and shall also be available as field installable kits as an alternative. All optional features shall carry all of the necessary certifications as described above. Field installed kits shall not affect the VFD's certification.

2.3.10 Provide equipment identification in accordance with Section 26 05 00 - General Electrical Requirements. Nameplates shall be permanently attached with screws.

2.3.11 The enclosure shall have appropriate warning labels.

2.3.12 A panel mounted non-resetable elapsed-time meter to measure operating hours with a minimum 6 digits display.

2.4 OPERATOR INTERFACE

2.4.1 The VFD shall be equipped with a front mounted operator control panel consisting of a four- (4) line by 20-character back-lit alphanumeric LCD display and a keypad with keys for Run/Stop, Local/Remote, Increase/Decrease, Reset, Menu navigation and Parameter select/edit.

2.4.2 The control panel shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

2.4.3 The display of the control panel shall have the following features:

.1 The LCD display shall have contrast adjustment provisions to optimize viewing at angle.

.2 All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.

.3 During normal operation, one (1) line of the control panel shall display the speed reference, and run/stop forward/reverse and local/remote status. The remaining three (3) lines of the display shall be programmable to display the values of any three (3) operating parameters. The selection shall include at least the following values:

.1 Speed/torque in percent (%), RPM or user-scaled units

.2 Output frequency, voltage, current and torque

.3 Power and kilowatt hours

.4 Heatsink temperature and DC bus voltage

.5 Status of discrete inputs and outputs

.6 Values of analog input and output signals

.7 Values of PID controller reference, feedback and error signals

.8 The control panel shall be used for local control, for setting all parameters, and for stepping through the displays and menus.

.9 A copy function to upload and store parameter settings from an VFD and download stored parameter settings to the same VFD or to another VFD shall exist.

.10 An intelligent start-up assistant shall be provided as standard. The Start-up routine will guide the user through all necessary adjustments to optimize operation.

.1 The Start-Up routine shall include “plug and produce” operation, which automatically recognizes the addition of options and fieldbus adapters and provides the necessary adjustment assistance.

.2 The Start-Up routine shall prompt the user for Motor Nameplate Data including power, speed, voltage, frequency and current.

.3 An auto-tune function shall identify the optimal motor tuning parameters for typical applications.

.4 An auto-tune function shall also be available to tune the PID speed regulator loop. Manual adjustments shall also be allowed.

.5 A selection of at least six (6) pre-programmed application macro parameter sets shall be provided to minimize the number of parameter adjustments required during start-up. Macros offered shall include Factory Default, Hand/Auto, PID Control, and Torque Control. A selection of two (2) user defined macros shall are also be available.

.6 Selection shall be offered for both 2-wire and 3-wire Start/Stop control.

2.5 PROTECTIVE FEATURES

2.5.1 For each programmed warning and fault protection function, the VFD shall display a message in complete English words or Standard English abbreviations. The five (5) most recent fault messages and times shall be stored in the VFD’s fault history.

2.5.2 The VFD shall include internal MOV’s for phase to phase and phase to ground line voltage transient protection.

2.5.3 Output short circuit and ground fault protection rated for 35,000 amps without relying on line fuses shall be provided per UL508C.

2.5.4 Motor phase loss protection shall be provided.

2.5.5 The VFD shall provide electronic motor overload protection qualified per UL508C.

2.5.6 Protection shall be provided for ac line or dc bus overvoltage and undervoltage.

2.5.7 The VFD shall protect itself against input phase loss.

2.5.8 A power loss ride through feature shall allow the VFD to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

2.5.9 Stall protection shall be programmable to provide a warning or stop the VFD after the motor has operated above a programmed torque level for a programmed time limit.

2.5.10 Underload protection shall be programmable to provide a warning or stop the VFD after the motor has operated below a selected underload curve for a programmed time limit.

2.5.11 Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.

2.5.12 Input terminals shall be provided for connecting a motor thermistor (PTC type) to the VFD's protective monitoring circuitry. An input shall also be programmable to monitor an external relay or switch contact.

2.6 CONTROL INPUTS AND OUTPUTS

2.6.1 Discrete Inputs

.1 Minimum of six (6) discrete inputs shall be provided.

.2 A minimum of six (6) of the inputs shall be independently programmable with function selections (run/stop using 2 wire or 3 wire control, hand-off-auto, etc.).

.3 Inputs shall be designed for use with either the VFD's internal 24 Vdc supply or a customer supplied external 24 Vdc supply.

2.6.2 Discrete outputs

.1 Minimum of three (3) form C relay contact outputs shall be provided

.2 All outputs shall be independently programmable to activate with at least 30 function selections including;

.3 Operating conditions such as drive ready, drive running, reversed and at set speed

.4 General warning and fault conditions

.5 Adjustable supervision limit indications based on programmed values of operating speed, speed reference, current, torque and PID feedback.

.6 Relay contacts shall be rated to switch 2 Amps at 24 Vdc or 120 Vac.

2.6.3 Analog Inputs

.1 Minimum of two (2) analog inputs shall be provided:

.1 At least one (1) must support bi-polar voltage input

.2 Resolution of analog inputs must be at least 11bit total resolution

.2 Inputs shall be independently programmable to provide signals including speed / frequency reference, torque reference or set point, PID set point and PID feedback / actual.

.3 A differential input isolation amplifier shall be provided for each input.

.4 Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion.

.5 If the input reference is lost, the VFD shall give the user the option of the following. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.

.1 Stopping and displaying a fault

.2 Running at a programmable preset speed

.3 Hold the VFD speed based on the last good reference received

.4 Cause a warning to be issued, as selected by the user.

.6 When inputs are used as speed references, reference signal processing shall include increase/decrease floating point control and control of speed and direction using a “joystick” reference signal. Two (2) analog inputs shall be programmable to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.

2.6.4 Analog Outputs

.1 Minimum of two (2) 0 / 4-20 mA analog outputs shall be provided.

.2 Outputs shall be independently programmable to provide signals proportional to output function selections including output speed, frequency, voltage, current and power.

2.7 CONTROL FUNCTIONS AND ADJUSTMENTS

2.7.1 Output frequency shall be adjustable between 0Hz and 300Hz. Operation above motor nameplate shall require programming changes to prevent inadvertent high-speed operation.

2.7.2 Stop mode selections shall include coast to stop and ramp to stop.

2.7.3 The VFD shall be capable of controlling deceleration of a load without generating an overvoltage fault caused by excessive regenerated energy. Overvoltage control on deceleration shall extend the ramp time beyond the programmed value to keep the amount of regenerated energy below the point that causes overvoltage trip.

2.7.4 The VFD shall be capable of starting into a rotating motor with or without existing magnetic flux on the motor regardless of the motor direction. From the time the start signal is given to the VFD to the time the VFD has control of the motor shall not exceed two (2) seconds. Once the VFD has control of the motor it will than accelerate or decelerate the motor to the active reference speed without tripping or faulting or causing component damage to the VFD. The VFD shall also be capable of flux braking at start to stop a reverse spinning motor prior to ramp.

2.7.5 The VFD shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.

2.7.6 Control functions shall include two (2) sets of acceleration and deceleration ramp time adjustments with linear and an s-curve ramp time selection.

2.7.7 Speed control functions shall include:

.1 Adjustable min/max speed limits.

.2 Selection of up to 15 preset speed settings for external speed control.

.3 Three sets of critical speed lockout adjustments.

.4 A built-in PID controller to control a process variable such as pressure, flow or fluid level.

.5 Functions shall include flux optimization for optimizing energy efficiency and limit the audible noise produced by the motor by providing the optimum magnetic flux for any given speed / load operating point.

.6 The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that will allow for VFD acceleration from zero speed without signaling a false underload condition.

2.7.8 Three (3) programmable critical frequency lockout ranges shall be provided to prevent the VFD from operating the load continuously at an unstable speed.

2.7.9 The VFD shall offer software to select the VFDs action in the event of a loss of the primary speed reference.

2.7.10 The VFD shall have fifteen (15) internal adaptive programming blocks capable of twenty (20) different functions. These blocks shall be connectable to VFD's actual signals and functions allowing the user to tailor the VFD to the specific application requirements without additional hardware. These blocks shall be programmable through the standard operator panel and through the use of programming software.

2.8 COMMUNICATIONS

2.8.1 The VFD shall be capable of communicating with other VFDs or controllers via a serial communications link. A variety of communications interface modules for the typical overriding control systems shall be available.

2.8.2 The VFD shall have a Modbus/TCP interface module for remote interrogation by a DCS or PLC controller. Vendor shall indicate all drive parameters that are accessible from this interface.

2.8.3 Interface modules shall mount directly to the VFD control board or be connected via fiber optic cables to minimize interference and provide maximum throughput.

2.8.4 I/O shall be accessible through the serial communications adapter. Serial communication capabilities shall include, but not be limited to:

.1 Run-Stop control

.2 Hand-Off-Auto Control

.3 Speed Adjustment

.4 PID (proportional/integral/derivative) control adjustments

.5 Current Limit

.6 Accel/Decel time adjustments

2.8.5 The VFD shall have the capability of allowing the overriding controller to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information.

2.8.6 A connection shall also be provided for personal computer interface. Software shall be available for VFD setup, diagnostic analysis, monitoring and control. The software shall provide real time graphical displays of VFD performance.

2.9 FACTORY TESTING

2.9.1 The manufacturer's standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of CSA and NEMA standards. Results from the test shall be provided with closeout submittals.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Install in accordance with Manufacturer's installation instructions and recommendations.

3.1.2 Confirm power lugs and VFD can accommodate motor cables.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements and manufacturer's instructions.

.2 Operate switches drives and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of drives, contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 32 13.03**
CH0032	**INSTALLATION OF ELECTRIC POWER GENERATING EQUIPMENT**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 32 13.03

INSTALLATION OF ELECTRIC POWER GENERATING EQUIPMENT
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
G. W. HAINES
SIGNATURE
11-DEC-2013
DATE
NEWFOUNDLAND & LABRADOR
REV. D2

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1 GENERAL

1.1 RELATED REQUIREMENTS

D1

.1 Section 23 11 13 – Facility Fuel Oil Piping

.2 Section 23 11 14 – Fuel Storage Tank Electronic Monitoring System

.3 Section 26 05 00 – General Electrical Requirements.

.4 Section 26 32 13.04 – Diesel Electric Generating Units (Liquid Cooled)

D1

.5 Section 33 56 13 – Above Ground Fuel Storage Tanks

1.2 REFERENCES

D1

1.2.1 CCME (Canadian Council of Ministers of the Environment) Environmental Code of Practice for Above Ground and Underground Storage Tank Systems containing Petroleum and Allied Petroleum products

1.2.2 CNRL – 58/03 Storage and Handling of Gasoline and Associated Product Regulations under the Enviromental Protection Act.

1.2.3 Nalcor Energy Engineering Directive # CF-ED-004 – Diesel System Installation and Abatement Engineering Directives.

D1

1.2.4 National Fire Code of Canada (NFCC)

1.2.5 CSA International

.1 CSA B139, Installation Code for Oil-Burning Equipment.

.2 CSA C282, Emergency Electrical Power Supply for Buildings.

1.2.6 U.S. Coast Guard Equipment List (USCG)

.1 164.009, Non-Combustible Materials.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for generating equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALIFICATIONS

1.4.1 Use qualified diesel electric technician.

2 PRODUCTS

2.1 MATERIALS

2.1.1 Include materials as follows:

.1 Conduits and boxes as required.

D1

.2 Fuel lines, fittings and components as required. All materials and components in accordance with Section 23 11 13 – Facility Fuel Oil Piping.

D1

.3 Fuel oil transfer system in accordance with 23 11 13 – Facility Fuel Oil Piping.

.4 ULC automatic fire shut-off valve.

D1

.5 Fuel tank and day tank as specified in Section 33 56 13 - Aboveground Fuel Storage Tanks

.6 Primary fuel filter/water separator.

D1

.7 Fuel storage tank monitoring system as specified in Section 23 11 14 – Fuel Storage Tank Electronic Monitoring System.

.8 Insulation for exhaust system.

.9 Electrical components as indicated.

.10 Wiring material.

.11 Antifreeze, ethylene glycol.

.12 Manual IPU bypass switch. Wiring and materials, including necessary rigid steel conduits and fittings for making connections.

.13 The power circuit cables will be sized in accordance with Section 26 05 21 – Wires and Cables (0-1000 V).

.14 The control circuit cables will not be less than No. 14, RW90, conductors, colour or number coded.

.15 Electronic governor control cable shall be minimum size No. 16 stranded copper conductor, shielded complete with drain wire and overall PVC jacket.

.16 Battery cable shall be welding cable type, extra flexible, rope stranded copper conductor with neoprene oil-resistant insulation, sized to limit voltage drop to 5% at time of peak load.

2.2 INSULATION

2.2.1 Removable fibreglass jacket insulation rated for 650 degrees C minimum with stainless lacing hooks and wires.

.1 Enclose jacket on inside by stainless steel mesh with outside cover silicone coated or aluminized fibreglass cloth: to USCG approved Non-Combustible Materials No. 164.009.

2.2.2 Calcium Silicate removable insulation rated for 650 degrees C with exterior stainless steel protective cover and fastenings.

3 EXECUTION

3.1 LOCATING AND MOUNTING

3.1.1 Locate unit as indicated.

3.1.2 Fit and adjust isolators in accordance with manufacturer's installation and adjustment instruction bulletin contained in unit manual.

3.1.3 Do not bolt housings to foundation if isolator housing feet are equipped with 6 mm rubber sound pads.

3.2 ALIGNMENT CHECK

3.2.1 Since Engine-generator shaft alignment is adjusted at factory, check to ensure that no change has occurred due to shipment and handling.

3.2.2 Where engine and generator housings are close coupled and instruments at hand are not suitable for measuring alignment within confines of housings, just loosen engine and generator hold down bolts and ensure that each foot is carrying proportionate amount of weight and feet are level on base plate.

3.3 FUEL SUPPLY SYSTEM

D1

3.3.1 Fuel tanks shall be designed, constructed and installed in accordance with CSA B 139, CNRL 58/03 and NFCC.

3.3.2 Inspect thoroughly fuel tank and lines to confirm they are clean and free of foreign material before connecting fuel system.

D1

3.3.3 Install primary fuel filter/water separator, servicing shut-off valves and other system components as per Nalcor engineering directive, NFCC, CCME, CNRL – 58/03, CSA B139 requirements as well as manufacturers' recommendations. Provide 3 spare filter elements.

3.3.4 Install ULC automatic fire shut-off valve. Locate upstream of any combustible fuel system component.

3.3.5 Install supply and return fuel lines between engine and fuel day tank. Install flexible sections between the engine and fixed end of fuel lines from fuel tank, using materials supplied with unit.

D1

3.3.6 Piping, devices, fuel transfer system shall be as per Section 23 11 13 – Facility Fuel Oil Piping.

D1

3.3.7 Neatly install fuel lines parallel or perpendicular to building lines with no kinks or dents.

3.3.8 Fuel oil monitoring system shall be in accordance with Section 23 11 14 - Fuel Storage Tank Electronic Monitoring System.

D1

3.4 BATTERIES AND CHARGER

3.4.1 For dry charged batteries, activate in accordance with manufacturer's instructions manual prior to installation.

3.4.2 For wet batteries, inspect individually each battery cell and check electrolyte level.

.1 Check charge condition by measuring temperature and specific gravity of electrolyte.

.2 Consult manufacturer's instructions for recommended readings.

.3 If readings are lower, give batteries freshening charge until readings are reached.

3.4.3 Locate batteries as indicated and ensure batteries are accessible for service.

.1 Run and protect cables to starting motor using cables supplied with unit.

3.4.4 Install battery charger on wall, adjacent to batteries and make connection to batteries.

3.4.5 Clean connections and tighten securely.

3.4.6 Install removable plexiglass cover on batteries.

3.5 EXHAUST SYSTEM

3.5.1 Install exhaust pipe and silencer using material supplied with unit. Arrange silencer above and approximately in line with engine exhaust manifold with exhaust tail pipe protruding through thimble in wall.

3.5.2 Extend exhaust pipe 1 metre minimum beyond outside wall.

3.5.3 Support silencer with hangers so no weight or stress is applied to engine exhaust manifold or turbocharger.

3.5.4 Install flexible exhaust pipe between silencer and manifold.

3.5.5 Install exhaust system fireproof insulating material, after test run.

3.6 COOLING AND VENTILATION

3.6.1 Install air outlet and inlet louvres and hoods in their respective openings.

3.6.2 Install louvre motors and linkages, adjust to ensure louvres are tight in closed position and give free damper movements from fully closed to fully open.

3.6.3 Where canvas boot is not provided, maintain 13 mm clearance between radiator and air outlet duct.

3.6.4 Mount thermostat as indicated.

3.6.5 Install conduits and junction boxes and make connections from louvre motors to thermostat and to 120/24 V ac transformer.

3.6.6 Fill engine radiator with water/ethylene glycol antifreeze mix good for -50 degrees C.

3.6.7 Install remote radiator including piping, valves, fittings and pumps as indicated.

3.7 CONTROL AND TRANSFER PANEL

3.7.1 Locate panels as indicated.

3.7.2 Make control and power circuit connections as indicated.Identify cables at both ends.

3.7.3 Tag with slip-on wire maker, each wire end with number corresponding to number in panel.

3.7.4 Make terminations with self-insulated terminals of flanged fork or ring type.

3.8 ADDITIONAL WORKS

3.8.1 Complete any additional work as instructed by Engineer to:

.1 Ensure equipment is safe to operate.

.2 Provide complete and operating system.

3.9 FIELD QUALITY CONTROL

3.9.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements.

3.9.2 Qualified diesel electric technician to: inspect and verify that installation of interruptible power unit is acceptable and complete. Provide inspection report to the Engineer.

3.9.3 Commissioning: supervise site commissioning of diesel electric generator unit by qualified diesel electric technician.

3.9.4 Develop and submit commissioning report including time delay settings, operational set points and adjustment ranges.

3.10 SYSTEM STARTUP

3.10.1 Preparation: before starting unit, carry out thorough mechanical and electrical inspection of equipment, and perform following checks and adjustments:

.1 Disconnect battery cables from batteries to prevent accidental starting.

.2 Turn engine several revolutions by means of hand-barring devices to ensure parts are free and there are no obstructions to its running.

.3 Check engine/generator alignment readings to ensure they match readings attained at time of manufacture. Check fluid levels and top up as necessary. Pre-lubricate engine and turbochargers as recommended by engine manufacturer. Install drip pan beneath engine.

.4 Confirm cooling system antifreeze is effective to at least minus 40 degrees C.

.5 Check belts for correct tension and adjust as necessary.

.6 Check and grease points.

.7 Check and tighten properly nuts, bolts.

.8 Confirm safety guards are in place and properly secured.

.9 Check linkages for damage and freedom of movement.

.10 Check fuel supply system for leakage.

.11 Ensure fuel supply and fuel injection systems are properly primed.

.12 Check and tighten properly electrical connections.

.13 Check starting battery electrolyte level specific gravity and for proper installation.

.14 Check battery charger for proper operation and adjust as necessary.

.15 Carry out generator winding insulation resistance test. If reading is unacceptable, carry out recognized drying procedure. Do not start unit until satisfactory reading has been achieved.

.16 Check jacket coolant heater for proper operation.

.17 Complete additional preparations deemed necessary.

3.10.2 Performance verification: on completion of start-up preparations, take following action:

.1 Have at hand, during initial start-up, means for choking off air supply to engine air induction manifold in event of engine run away or other emergency.

.2 Reconnect starting battery cables to starting battery.

.3 Start unit only in presence of Engineer and allow to warm up. Stop unit if abnormal conditions are encountered.

.4 Check for and correct leakage from exhaust system, fuel system, cooling system, and lubricating oil system.

.5 Adjust vibration isolators.

.6 Observe and confirm lubricating oil pressure and coolant temperature are within limits and no harmful vibration or sounds are evident.

.7 Ensure voltage is within operating parameters and automatic voltage regulator is operating correctly.

.8 Ensure manual voltage control is operating correctly.

.9 Ensure frequency is within operating parameters and electronic governor is operating correctly.

.10 Check engine air ventilation system for proper operation.

.11 Check operation of engine-mounted protective sensing devices and adjust as necessary.

.12 Check phase sequence of normal power supply and ensure emergency power supply are in same sequence.

.13 Check operation of electronic controller protection, transfer, timing, metering, and annunciator functions and adjust as necessary.

.14 Check operation and calibration of analog metering and adjust as necessary.

.15 Apply electrical load, read the metres, and correlate these readings.

.16 Demonstrate:

.1 Unit start, transfer to load, retransfer to normal power, unit shutdown, on "automatic" control. Unit start, transfer to load, retransfer to normal power, unit shutdown, on "test control". Unit start and shutdown, on "engine start" control.

.2 Unit cranking, start, and shutdown by means of engine-mounted key switch.

.3 Run unit on full (nameplate) load for minimum period of 8 hours to show load-carrying capability, stability of voltage and frequency, and satisfactory performance of engine ventilating system to provide adequate cooling, exhaust system.

.4 Every 1/2 hour carry out and record readings on Test Chart.

.17 Perform additional tests as required by Engineer to confirm unit is operating satisfactorily.

END OF SECTION

TABLE OF CONTENTS

SECTION 23 32 13.04

DIESEL ELECTRIC GENERATING UNITS (LIQUID COOLED)

1 GENERAL

1.1 RELATED REQUIREMENTS

D1

.1 Section 26 05 00 – General Electrical Requirements.

.2 Section 26 06 31 – Not used.

.3 Section 26 32 13.03 – Installation of Electrical Power Generating Equipment.

.4 Section 33 56 13 – Above Ground Fuel Storage Tanks.

1.2 REFERENCES

1.2.1 Codes, Standards and Regulations

1.2.2 Design and fabricate components and equipment in accordance with the latest editions of the following authorities and technical organizations, as applicable.

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CSA	Canadian Standards Association
CWS	Canadian Welding Society
EEMAC	Electrical Equipment Manufacturers Association of Canada
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
ISO	International Organization for Standardization
NEMA	National Electric Manufacturers Association
NFPA	National Fire Protection Association
OHSA	Occupational Health and Safety Act of Newfoundland and Labrador

ULC	Underwriters' Laboratories of Canada
WHSCC	Workplace Health, Safety and Compensation Commission of Newfoundland and Labrador

1.2.3 The design and fabrication of equipment and components shall conform to the requirements of recognized standards.

1.2.4 The latest edition of a code or standard shall govern.

1.2.5 Equipment is required to carry the CSA mark with a CSA declaration of conformity provided.

1.2.6 Specific Standards

1.2.7 Unless otherwise stated in this specification, the gensets shall be designed, manufactured, tested, and supplied in accordance with the latest edition of all applicable standards listed in this specification. In case of conflict between standards, such conflicts shall be brought to the attention of the Engineer for clarification and determination.

ANSI C37.13	Low Voltage AC Power Circuit Breakers Used In Enclosures
ANSI C37.16	Preferred Ratings, Related Requirements And Application Recommendations For Low Voltage Power Circuit Breakers And AC Power Circuit Protectors
ANSI C37.17	Trip Devices For AC And General Purpose DC Low Voltage Power Circuit Breakers
CSA B139	Installation Code for Oil Burning Equipment
CSA C22.1	Canadian Electrical Code - Part I
CSA C22.2 No. 31	Switchgear Assemblies
CSA C22.2 No. 127	Equipment and lead wires
CSA C22.2, No. 100	Motors and Generators
CSA-C282	Emergency Electrical Power Supply for Buildings.

DIN 6271	Reciprocating Internal Combustion Engine Driven Alternating Current Generator Set
NEMA C37.50	Test Procedures For Low Voltage AC Power Circuit Breakers Used In Enclosures
NEMA MG-1	Motors and Generators
NEMA MG-2	Safety Standard and Guide for Selection, installation and use of Electric Motors and Generators
IEEE 112	Standard Test Procedure for Polyphase Induction Motors and Generators
IEEE 115	Guide for Test Procedures for Synchronous Machines, Parts I and II
IEEE 43	Recommended Practice for Testing of Insulation Resistance of Rotating Machinery
ISO 8528	Reciprocating Internal Combustion Engine Driven Alternating Current Generator Set Performance
ISO 9000 Series	Quality System Standards
ISO 3046	Reciprocating Internal Combustion Engines - Performance
ANSI/MH 5.1	Basic Requirements for Cargo Containers
ISO/TC 104	Requirements for Cargo Containers
Newfoundland and Labrador Regulations	Storage and Handling of Gasoline and Associated Products Regulations, 2003

1.3 OPERATING REQUIREMENTS

1.3.1 The environmental conditions at the Muskrat Falls site under which the equipment is required to operate satisfactory are as follows:

Elevation	Less than 100 m ASL			
Temperatures	Outdoors	Minimum:	- 48°C	Design - 50°C Design + 40°C
		Maximum:	30°C	
		Daily Average (July)	15.4°C	
		Daily Average (Jan)	-18.1°C	
		Average:	- 4°C	
	Indoors	Minimum	5°C	Design 5°C
		Maximum	40°C	Design 40°C
Seismic Level	Peak Ground Acceleration (PGA) 0.091g			Design PGA = 0.091g
Wind and Icing	Maximum wind speed Radial ice			Design – 160 km/hr Design – 25 mm

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1.4.1 Submit submittals in accordance with Exhibit 4 – Supplier Document Requirements List.

1.4.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and data sheets for generating units and include product characteristics, performance criteria, physical size, finish and limitations.

D1

1.4.3 Not used.

1.4.4 Shop Drawings

.1 Submit general outline drawing of complete assembly showing engine, radiator and generator mounting, exhaust, recirculating and intake air louvre arrangement, exhaust gas silencer and pipe arrangement, locations of fuel and lubricating oil filters, fuel supply and return line connections, lubricating oil drain valve, radiator and coolant drain valves, air cleaner, engine instrument panel, starting motor, power and control junction boxes, engine and generator mounting feet. Indicate on drawings:

.1 Horizontal and vertical dimensions.

.2 Minimum door opening required for moving unit.

.3 Head room required for removal of piston and connecting rod.

.4 Weight of engine, generator, baseplate, radiator and exhaust silencer.

.2 Identify exact locations and details where necessary of interconnecting services to permit final engineering by Engineer.

.3 Baseplate construction details and materials.

.4 Transfer and bypass system: make, model, type.

.5 Outline and layout of panels.

.6 Schematic and wiring diagrams of engine, generator, control panel, complete with interconnecting wiring diagrams.

.7 Single line diagram showing all breakers, switches, metering and protective relays.

.8 Field wiring diagrams.

.9 Complete bill of materials, including manufacturer's name, catalogue numbers and capacity.

1.5 CLOSEOUT SUBMITTALS

1.5.1 Provide maintenance data for diesel generating units for incorporation into manual specified in Exhibit 4 – Supplier Document Requirements List.

1.5.2 Provide in English for incorporation into instruction manuals as follows:

.1 Complete set of accepted shop drawings.

.2 Factory test data of engine, generator, exciter, control logic, metering and other pertinent test data.

.3 Maintenance and operation bulletins for:

.1 Engine and Accessories.

.2 Generator.

.3 Voltage Regulator and Accessories.

.4 Exciter.

.5 Permanent magnet generator if installed.

.6 Battery charger.

.7 Speed Governor.

.8 Starting Motor.

.9 Batteries.

.10 Ventilating Equipment.

.11 Timers, Relays, Meters.

.12 Power Circuit Breakers.

.13 Controller, Contactors.

.14 Other Accessories.

.4 Submit original brochures; photocopies are not acceptable.

.1 Include technically relevant data.

.5 Complete sequence of system operation.

.6 Complete bill of materials including nameplate data of equipment and accessories.

1.5.3 Forward, two weeks prior to factory tests, one copy of instruction manual to Engineer.

1.6 MAINTENANCE MATERIAL SUBMITTALS

1.6.1 Provide maintenance spare parts list in accordance with Exhibit 4 – Supplier Document Requirements List.

.1 Extra Material/Spare Parts: provide the following:

.1 One spare control circuit breaker per rating.

.2 Twenty four spare indicating light bulbs per rating.

.3 One spare control relay and socket per rating and contact arrangement.

.4 One spare contactor operating coil.

.5 One set of contacts (3) for transfer contactor.

.6 Six fuel filter elements for each type of fuel filter/water separator.

.7 Six lubricating oil filter elements.

.8 Three air cleaner elements.

1.6.2 Provide conclusive evidence that Canadian distributor has been established and will stock in Canada spare parts likely to be required during normal life of engine.

1.6.3 Tools:

.1 Supply suitable engine barring device and battery manufacturer's standard set of tools for battery service.

.1 Battery service tools to include hydrometer, one plastic bottle for topping up purposes and one insulated battery terminal wrench.

.2 Provide complete set of specialized tools required for proper care, adjustment and maintenance of equipment supplied.

2 PRODUCTS

2.1 DIESEL GENERATOR SETS

2.1.1 General Requirements

.1 The diesel gensets will be used as a stand-by power system for the spillway for the Muskrat Falls hydroelectric power station. The diesel gensets will be used as prime power supply for the spillway during periods when the 25 kV construction power supply is unavailable and as a standby power supply after permanent power has been installed. The diesel gensets shall be suitable for operation in parallel with other generators. We have specified diesel gensets for Prime Running Power which is defined as supplying power to varying electrical load for unlimited hours. Prime Running Power (PRP) is in accordance with ISO 8528.

.2 Consequently, reliable, fast starting with rapid load capabilities is of prime importance. Diesel gensets shall be capable of supplying 100% load within 30 seconds.

.3 The diesel gensets shall be designed for demand load of 600 kW.

.4 This specification identifies the minimum requirements, and does not in any way relieve the Supplier of the responsibility to provide the design and equipment for a safe code compliant reliable operating system. The design will include, but not be limited to:

.1 Engine, generator and accessory modules;

.2 A local generator control panel;

.3 A radiator and cooling system;

.4 Fuel day tank;

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.5 Provide diesel gensets capable of delivering rated kW at 0.8 pf under the specified load conditions, and an overload capability of 10% for one hour in each consecutive 12-hour period in accordance with ISO 3046-1.

.6 Main fuel oil storage tank.

.7 Fuel oil storage tank monitoring system.

.8 Fuel oil piping distribution system.

.9 Fuel oil pumping system to transfer fuel from main tank on spillway up to day tank within the spillway generator room.

D1

2.2 DUTY AND THROUGHPUT

2.2.1 Gensets covered under this specification are intended to be used in limited stand-by duty, meaning they will essentially operate as a reliable backup power source in case of temporary outage of the normal power source.

2.2.2 To be rated for Prime Running Power (PRP) duty, a generator set shall meet the conditions listed below, under the manufacturer's recommended maintenance schedule and overhaul schedule.

2.2.3 Capable of operating continuously at 100% of its rated power while supplying a variable electrical load while operating for an unlimited number of hours per year .

2.2.4 The permissible average power output over 24 hr operation shall not exceed 70% of PRP.

2.2.5 The generator set shall accept 100% of rated load in one step.

2.3 MOUNTING

2.3.1 Provide a common base for generator and engine, rigid heavy duty steel, machined pads, capable of maintaining alignment during transportation, installation and operation. If necessary, accommodate crankcase oil drainpipe.

2.3.2 Vibration isolators shall support the base and assembly and shall be steel spring type, complete with levelling bolts, externally adjustable mechanical side snubbers and sound dampening pads as required.

2.3.3 Install the cooling radiator in one end of the container, complete with louvers as required for weather protection and devices to deflect the hot air in an upward direction.

2.3.4 Mount the Generator Control Panel in a control compartment of the enclosure.

2.3.5 A day tank shall be installed inside the Spillway Generator Room.

2.3.6 Provide suitable facilities for the exit of the power cables and control wiring from the container.

2.3.7 Provide readily available fuel connections on the outside of the container, individually tagged or marked.

2.3.8 The main fuel oil storage tank and pumping system shall be located on the spillway.

2.4 CONTROLS

2.4.1 The diesel generator set shall be arranged for:

1. Remote start and shutdown of the gensets by means of remote signal initiated by dry contacts.

2. Manual start and shutdown of the gensets by means of local switches on the generator control panel.

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3. Outputs and alarms annunciated locally on the generator control panel, with outputs for the following:

   .1 Warning of generator set abnormal conditions;

   .2 Alarms for device or function failure; and

   .3 Warning of generator set critical alarms and shutdown for annunciation on remote control systems.

2.5 LIFTING LUGS

2.5.1 Provide all assemblies and components with suitable lifting lugs to allow for easy off-loading and installation at site.

2.5.2 It is intended that the generator set be shipped as a complete unit in its container. Items such as silencer or other such devices or equipment which must be shipped loose shall be provided with lifting lugs as required for field handling and installation.

2.5.3 All lifting lugs shall be load tested.

2.5.4 Provide lifting instructions and drawings to prevent damage to the enclosure and equipment when lifting.

2.6 NOISE CONTROL REQUIREMENT

2.6.1 The noise level of the equipment shall not exceed 75 dBA as measured at any point 15.25 m (50 feet) from the outdoor enclosures when operating at 100% of rated load.

2.7 DETAILED TECHNICAL REQUIREMENTS

2.7.1 Engine Requirements

.1 Provide the diesel engine of the four-stroke, cold start, compression ignition type, turbo-charged where indicated, running at the speed indicated, complete with SAE flywheel. The engine shall drive the generator directly through a flexible coupling.

.2 Supply a direct injection engine suitable for starting in the ambient conditions indicated in article 1.5.

.3 Provide jacket water heaters to circulate heat to the engine when the engine is shut down, so that the engine is warm at all times and suitable for quick start after signal initiation.

.4 The diesel generator set shall be capable of delivering rated kW at 0.8 power factor under the conditions indicated, and for the service duty specified. The rated power specified shall be considered a minimum value. Supplier shall use the data and requirements listed herein to determine the recommended power rating. The equipment proposed by Supplier shall have the largest rating of the two; either the specified minimum rating or the Supplier's recommended rating.

.5 Confirm the stated power rating by engine manufacturer's published data and performance curves.

.6 The engine to be capable of operating continuously, without detrimental effect to the engine, with loads down to 30% of rated capacity for extended periods of time.

.7 Size the engine to drive all the engine auxiliaries and the generator at the required speed and output over the full range of ambient conditions.

.8 The engine shall start reliably without manual priming under all temperature conditions. The engine shall be capable of delivering full power within no more than 30 seconds of start-up.

.9 Supply all standard accessories and gauges. The accessories shall include but shall not be limited to those listed in subsequent sections.

.10 Provide engine oil drip trays, minimum 1.5 mm thick galvanized steel, with 50 mm lip, located between the base and the vibration isolators, extended to protect floor.

2.7.2 Speed Control

.1 Provide the engine with an electronic speed governor, Woodward or approved equivalent, which shall bring the engine up to rated speed as soon as the engine starts and after start, control the speed of the engine so that the frequency regulation of the generator is not exceeded, from no-load to full load. Steady state speed band shall be +/-0.25% with no-load to full load speed droop of 0% (isochronous). Speed droop shall be manually adjustable over 0 to 10% range to permit load sharing in a manual parallel operation with capability for isolated or multiple engine parallel operation. Provide input for remote adjustment of speed droop.

.2 Provide the engine with a separate over-speed device, to stop the engine in the event the governor is not able to keep the speed below the allowable safe speed for the engine and generator.

2.7.3 Fuel Oil System

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.1 Main fuel storage tank and day tank shall be in accordance with Section 33 56 13 – Aboveground Fuel Storage Tanks. Fuel oil system shall be in accordance with Section 23 11 13 – Facility Fuel Oil Piping. Fuel oil monitoring system shall be in accordance with Section 23 11 14 – Fuel Storage Tank Electronic Monitoring System

.2 Main tank shall be sized for three (3) days operation of 600 kV diesel genset at prime running power 75% load. Fuel storage is for spillway diesel generating unit.

.3 Provide the individual double walled fuel day tank for generator, of sufficient capacity for at least 8 hours of continuous running at Standby 75% load rating. Provide flexible piping for connection to the tank. Day tank shall include leak detection system.

.4 Main tank and day tank shall be ULC and CSA certified and entire fuel system must meet the Newfoundland Storage and Handling of Gasoline and Associated Products (GAP) Regulations 2003, National Fire Code of Canada, CSA B139 Installation Code for Oil Burning Equipment and Canadian Council of Ministers of the Enviroment (CCME) Enviromental Code of Practice for Aboveground and Underground Storage Tank System containing Petroleum and Allied Petroleum Products requirements. Fuel system shall be tested in accordance with section 28 of GAP Regulations prior to initial operation or as elsewhere specified, whichever is more stringent.

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.5 Provide the main fuel storage tank and day tanks with the following accessories and gauges:

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.1 Fuel oil flow meter;

.2 Normal and emergency vents;

.3 Overflow;

.4 Drain connection with manual isolation valve;

.5 Magnestrictive type fuel tank level indicator;

.6 Nipple in top of tank suitable sized to accommodaet the fuel tank level indicator;

.7 Dip port;

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.8 Fuel tank low level switch.

.9 Fuel spill containment sump

.10 Overfill protection device

.11 Interstitial space monitor well and monitoring device;

.12 Foot Valve

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.13 Other accessories as specified in NFCC, CSA B139 and CCME documents.

.6 Provide data outlining the type and size of fuel piping connections required along with required fuel flow rate and fuel supply pressure and calculations demonstrating the fuel consumption rates per hour for operation under normal operating conditions.

.7 Provide the engine with an engine mounted fuel oil strainer, replaceable filter, with sediment catchment, fuel pressure gauge and fuel pump to provide fuel from the day tank to the engine.

.8 Engine shall be equipped with individual, high pressure unit injectors. Engines with rotary distributor fuel injection pumps shall not be accepted.

.9 Fuel supply lines from the fuel pump to the injectors shall be of heavy wall design and secured to the engine to prevent damage from chafing or vibration.

.10 All other rigid fuel lines shall be of high grade steel tubing.

.11 Flexible fuel lines shall be service rated for not less than 150ºC and the greater of 150 psi or 1.25 times the maximum developed fuel pressure. Hoses shall be "Parker Paraflex" 4690 flexible metal hose with braided stainless steel cover or approved equal. Fuel lines shall be routed and secured to minimize stresses and prevent fuel line abrasion or fatigue failure when subjected to engine vibration.

.12 Fusible link shut-off valve shall be provided on each unit that automatically closes in the event of a fire.

D1

.13 Solenoid valve shall be provided on the main fuel tank. Solenoid valve shall be electrically rated to suit the hazard application.

2.7.4 Fuel Specification

.1 Engines shall be approved by manufacturer for the continuous use of low sulphur, low lubricity Type "A" fuel as specified in CAN/CGSB-3.517.Design the engines to provide rated performance utilizing this fuel.

2.7.5 Lubricating Oil System

.1 Engines shall be compatible and warranted for use with a standard API Service, SAE viscosity grade of crankcase lubricating oil. Where lubricating oils must meet additional manufacturer specifications, approved oils shall be available in Canada from major suppliers. A list of specifications and approved manufacturers shall be provided by the Supplier,

.2 Include the following equipment for the lubricating oil system:

.1 Engine driven oil pump;

.2 Full flow lubricating oil filter with removable element and spring return bypass valve and centrifugal oil cleaner capable of removing grit and carbon as small as 0.1 µm;

.3 Oil cooler;

.4 Oil sump of adequate capacity, with oil drains line and valve;

.5 First filling of lubricating oil, shipped in separate containers;

.6 Sump to capture any oil/diesel leakage; and

.7 Oil fill port shall be accessible without removal of any components and shall allow addition of oil while engine is running.

.3 Size the oil cooler to provide an adequate supply of cooled oil to the engine when the engine is fully loaded and the ambient temperature is at its maximum.

.4 Provide the lubrication system with an engine mounted pressure gauge with alarm contact. A second contact shall shut the engine down and provide an alarm on loss of oil pressure.

.5 The engine shall be kept in a state of readiness for rapid starting and, if required, low-density engine and/or oil heaters shall be provided, complete with control thermostats.

2.7.6 Engine Cooling System

.1 Provide an outdoor type radiator mounted on the generator set base, suitable for cooling 110% of engine load in a 40°C ambient with a 20% fouling factor when using a 50/50 glycol-water coolant mixture, c/w all necessary valves and fittings.

.2 Radiator cores shall be constructed using copper finned, brass or copper tubes and be capable of withstanding at least 150 kPa internal pressure. The core shall include suitable connections for draining.

.3 Size the cooling system and engine driven circulating pump to provide adequate cooling for the engine under the conditions of full load and maximum ambient temperature.

.4 Provide an automatic temperature-regulating valve with bypass feature, located in the jacket cooling outlet manifold, AMOT or approved equal, and a temperature gauge c/w alarm and trip contacts.

.5 Provide water pipes, flexible hoses, support brackets, etc. and drain cocks to permit the complete system to be drained.

.6 Cooling system shall include aftercooler if required.

.7 Jacket water cooling lines shall be of rigid pipe. Rubber coolant hoses shall be replaced with custom fit seamless, schedule 10 stainless steel pipe with beaded ends and flexible couplings.

.8 Flexible couplings shall be of reinforced, high temperature materials. The design of connections shall prevent separation by internal pressure.

.9 Piping and temperature control valves for intercooler and oil cooler.

.10 Engine coolant heater shall be provided.

.11 Thermometers as required for monitoring.

2.7.7 Exhaust System

.1 Include a critical grade silencer exhaust system with all required flanges, flexible bellows between the exhaust manifold and silencer, condensate drain cock and plug, spark arrester, complete with flexible connections to exhaust vent.

.2 Any necessary 304 stainless steel exhaust piping of a Y configuration to combine dual exhaust manifolds, if so equipped, into a single outlet complete with flexible pipe to accommodate thermal expansion between branches (slip joints on any portion of the exhaust are not acceptable).

.3 Exhaust outlet shall be fitted with an ISO class 150 flange for connection to exhaust stack, or provided with an ISO adapter.

.4 Provide an insulating blanket or open mesh safety guard for operator protection on the exhaust manifold, piping and other hot surfaces.

.5 Size the silencer so that back pressure on the engine, operating at full load will not exceed the engine manufacturer's recommended value.

2.7.8 Air Intake System

.1 Provide dry type, replaceable, heavy-duty intake air filter with pre-cleaner, complete with flexible connections.

.2 Provide a control system with relays as required to open the enclosure air intake louvers for combustion, and cooling air required by the generator set.

2.7.9 Engine Starting and Stopping System

.1 Provide the engine with an electric dc starting motor equipped with a positive solenoid-operated engaging gear. Locate the starter in an accessible location.

.2 Provide the engine with a suitable battery charger and 24 Vdc heavy-duty lead acid battery with hard rubber case and corrosion resistant battery rack with supporting legs. Size the battery capacity to permit 5 consecutive cold start attempts, in an ambient temperature of 5°C, without battery voltage reduction below 75% of rated output. Provide the cable connection between the battery and the engine, a hydrometer and a bracket.

.3 Control system shall include manual and automatic starting. Upon receipt of the remote starting signal, the starting system shall automatically crank the engine. If the engine has not started after 3 successive cranking cycles, with 30 second rest between each cranking cycle, the starting system shall automatically shut-down, and give a malfunction alarm locally and to the remote control system.

.4 Mount meters, circuit breakers and control switches on the front of the generator control panel.

2.7.10 Engine Instrument Panel

.1 Mount the instrument panel on the engine, equipped with indicating, alarm/shutdown devices and operator devices with functions required by the Specification. Vibration isolators shall be provided.

.2 All sensors shall be adjustable type with settings sealed by locknuts, directly accessible for ease of maintenance and replacement. Solid-state speed switch shall be direct mechanical drive from the generator. Provide cranking cut-out back-up protection utilizing an oil pressure sensor.

.3 All operator devices (switches, push buttons, and LED type indicating lights with a common push-to-test pushbutton) shall be heavy duty, oil-tight.

2.7.11 Engine Wiring and Terminal Box

.1 Provide heat and oil resistant wiring for engine safety and control devices, run in harnesses secured to the engine, and terminated in an engine mounted terminal box. Identify all wires at each termination, corresponding to schematic and wiring diagrams, with wire markers by Panduit or approved equal.

.2 All control wiring on the engine shall be #14 AWG stranded copper, type TEW, 600 V rating with black insulation, UL listed AWM (Style 1015). All wiring shall be run in automatic loom wiring trough and securely mounted to prevent contact with hot engine parts. All engine wiring shall be clearly labelled to correspond with the wiring diagrams.

.3 The wiring for all RTD interconnections on the engine shall be #16 AWG (7W) soft tinned stranded copper, 1 pair triad, 300 V rated c/w shield wire and PVC jacket rated for 100°C.

.4 The wiring for thermocouple interconnection on the engine shall be #20 AWG (7W) soft tinned stranded copper, c/w duplex insulated brown Teflon jacket rated for 260°C. The wire shall be designated as ANSI Type K with conductor insulation colour coded accordingly. Both a male and female, high temperature connector, Omega Type HST-K, shall be used for connection between the thermocouple wire and the Type K thermocouple.

.5 Engine junction box shall be minimum 450 x 450 mm square and 150 mm deep, NEMA 4, oil tight c/w captive screws. It shall be located at the generator end, right side as viewed from the generator end and shall not interfere with engine/generator maintenance. Location shall be confirmed at the drawing review stage. Wire raceways to the engine junction box shall be provided with enough slack in order to mount it, if necessary, on a separate stand at the generator end of the genset skid.

.6 Furnish separate junction boxes for 24 Vdc and 120 Vac powered circuits.

2.7.12 Drive Coupling

.1 Provide a torsionally rigid flexible steel disc type coupling for connecting the single bearing generator to the engine with SAE housing. Provide details of the coupling in the Tender.

2.8 AC GENERATOR REQUIREMENTS

2.8.1 Rating and Characteristics

.1 Generator output voltage shall be 600 V.

D2

.2 Not used.

2.8.2 Power Connections

.1 The windings shall be star connected. The phase and neutral ends of the windings shall be brought to a terminal box, where the neutral connection shall be made. The neutral of the generator shall be solidly grounded.

2.8.3 Construction

.1 Provide a brushless type synchronous generator with salient poles, damper (amortisseur) windings, drip-proof enclosure and protective screen. It shall be of the single bearing type designed for connection to the engine flywheel by means of a flexible disc type coupling. The bearings shall be anti-friction type, 100,000 hours minimum.

.2 Stator and rotor windings insulation shall be minimum NEMA Class H and rated for 105°C temperature rise at +40°C ambient temperature. All winding insulation shall include vacuum pressure impregnation (VPI).

.3 The stator shall be provided with a single phase anti-condensation space heater.

.4 Six 100-Ω platinum type resistance temperature detectors (RTD's) shall be provided and equally spaced around the stator winding.

.5 Design the generator to be capable of withstanding, in an emergency, the maximum speed that can be reached before the over-speed device shuts down the engine. Design for a maximum over-speed of 25% for 2 minutes.

2.8.4 Excitation System

.1 Provide the excitation system of the brushless type, utilizing a rotating rectifier assembly mounted on the generator shaft. The diodes shall be field removable. Provide a permanent magnet type pilot exciter to give assured voltage build-up without field flashing.

.2 In the event of a short circuit on the output of the generator, the excitation system shall provide sufficient field current so that the level of the fault current is sufficiently high (300% minimum for 10 seconds) to operate the protective relays. Series boosting shall be provided.

.3 Control the excitation system automatically by a solid state, automatic voltage regulator, and manually from a potentiometer. Both modes of operation shall have the range to control the output of the generator to the specified % of rated voltage over the complete load range, from no load to full load condition. When the switch is in the automatic position, the generator shall build up voltage automatically as soon as the generator approaches synchronous speed.

.4 Provide a Manual/Auto Switch for the excitation system, and a DC Field voltmeter.

2.8.5 Voltage Regulator

.1 Provide an automatic voltage regulator (AVR), solid-state type, with fail-safe feature to ensure that no over-voltage will occur if the regulator fails. Include three phase sensing, protection against fault during under-speed running, and capable of voltage build-up without batteries.

.2 Steady state voltage regulation shall be ± 0.5%.

.3 Generator and AVR shall be suitable for supplying loads with significant harmonic content such as variable frequency drives, solid state starters and similar items.

.4 Provide the AVR with digital controls mounted on the front of the Generator Control Panel.

.5 Design the AVR to control the output voltage of the generator to within a set point accuracy range as indicated for a change in load from no load to full load at rated power factor. The voltage regulator shall restore the generator output voltage to steady state operation within two (2) seconds following a sudden load change.

.6 The voltage regulator shall be suitable for paralleling of multiple diesel gensets without requiring any interconnecting wires between regulators.

.7 Protect the automatic voltage regulator and excitation system with fuses and breakers.

.8 Locate the AVR inside the generator control panel.

2.8.6 Voltage Harmonic Distortion

.1 The ac generator shall be so designed to create very low distortion on the output voltage waveform.

.2 The deviation factor of the open-circuit line-to-line terminal voltage of synchronous generators shall not exceed 0.1.

.3 The balanced telephone influence factor (TIF) based on the weighting factors given in NEMA MG 1 article 32.11.3 shall not exceed 150.

2.9 GENERATOR CONTROL PANEL

2.9.1 Construction

.1 Provide a generator control panel, located on the generating unit or for separate mounting, to include all control, protection, metering, communication and alarms required for the proper control and safety functions required.

.2 Control panel constructed of minimum 2 mm thick sheet steel, dead front, weather proof construction, and provide hinged, gasketted, pad-lockable, front access doors, 120° opening arc, or a desk-type panel with vertical panels for instruments, annunciators and metering.

.3 Provide a full width, tin plated copper ground bus at the bottom of the panel.

2.9.2 Controls and Metering

.1 Provide the panel with all controls, metering, protective devices and alarms, necessary for the safe and proper operation of the system. All devices shall be completely accessible from the front of the panel.

.2 The following protective functions shall be provided:

.1 Generator over and under voltage;

.1 Generator over current;

.2 Loss of voltage sensing;

.3 Generator over load; and

.4 Generator over excitation.

.3 Connect the protective devices to numbered terminal blocks. Include in the alarm system an alarm horn, silence and reset buttons and one main contact for remote annunciation signifying that an alarm is present. Design the alarm system to operate from the diesel starting battery.

.4 Provide the electrical system meters of digital design with metric scales, flush mounted on the front of the Generator Control Panel, readily removable. The elapsed time meter shall be 5-digit, calibrated in hours and tenths of an hour.

.5 Provide a normally open contact which shall instantaneously close when the diesel set is ready to accept load. Wire the contact to a terminal blocks.

2.9.3 Wiring

.1 Wire the generator control panel, with all points for external connections brought out to numbered terminal blocks. All control wiring minimum #14 AWG stranded copper, type TEW, 600 V rating with black insulation, UL listed AWM (Style 1015) in accordance with CSA C22.2 No. 127. Wiring shall be not smaller than #12 AWG for power and #10 AWG for CT wiring, complete with heat and flame resistant type insulation. Insulation colour shall be black for all panel wiring except ground connections which shall be green.

.2 Use extra flexible conductors for wiring to door mounted equipment.

.3 Arrange wiring in neat bundles, with adequate wrapping and supports, or install in wiring duct as required. Maintain 120 Vac and 24 Vdc wiring in separate bundles or wiring duct. Number the end of each wire in accordance with the wiring diagrams, using suitable oil resistant indelible tags or ferrules.

.4 Provide the necessary terminal blocks, including 20% spares, on the generator set and the Generator Control Panel for the termination of all external wiring.

2.9.4 Power Supply for Auxiliaries

.1 A 208 V, 3-phase ac power shall be provided. This supply shall be utilized by the Supplier to distribute power to the various auxiliary devices, including heaters, lights, etc.

2.9.5 Identification and Labelling

.1 Provide engraved Lamicoid nameplates, white background with 5 mm minimum black letters for internal and external components, secured with stainless steel screws. Stick-on labels are not acceptable.

.2 Warning signs shall be engraved Lamicoid, red background with 12 mm minimum white letters, indicating sources of supply, points of isolation and that engine may start automatically at any time. Secure with stainless steel screws.

2.10 REMOTE ALARM/STATUS CONTACTS

.1 The following alarm and status contacts shall be provided for remote equipment use. All contacts shall be type Form C, rated 10 A @ 120/240 Vac or 30 Vdc resistive maximum, and shall be wired to suitably sized terminal blocks for customer use:

.1	Engine Running	Quantity 2
.2	Engine Generator Common Fail Alarm	Quantity 2
.3	Gnerator Breaker Position (open/closed)	Quantity 2

2.11 SURFACE TREATMENT

.1 Treat all metallic surfaces to prevent corrosion due to the presence of surface moisture.

.2 Prior to painting remove all rust, scale and grease. Apply two coats of primer to all surfaces except those otherwise corrosion treated, finished or machined.

.3 Shop paint surfaces in accordance with the manufacturer's standard for the conditions specified. Do not paint rubber and PVC hoses, wiring harnesses or machined surfaces.

.4 Painting of the equipment shall be Supplier's standard for the conditions specified.

.5 Do not apply paint to any stainless steel or galvanized part.

.6 Supply a quantity of finish pain for field touch-up.

2.12 EQUIPMENT IDENTIFICATION, MARKING AND LABELLING

.1 Fit and assemble work in the shop, where possible. Where final assembly in the shop is not possible, part assemble in the shop and match-mark the component parts to ensure proper assembly on site.

.2 Identify individual pieces in accordance with the identification schedule used on the shop drawings and bill of materials to clearly indicate their location in the work for installation.

.3 Main fuel storage tank and day tanks shall include ULC label. Provide the generator set with a stainless steel nameplate including The Company's equipment number, the manufacturer, model no., serial no., year of manufacture, design code, size/rating, speed, power supply, etc. These overall assembly nameplates are in addition to the individual component labels.

3 EXECUTION

3.1 NOT USED

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 33 16**
CH0032	**BATTERIES AND BATTERY RACKS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 33 16
BATTERIES AND BATTERY RACKS
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEG Newfoundland and Labrador
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This Permit Allows
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Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEG Newfoundland and Labrador
G. W. HAINES
SIGNATURE
29-JAN-2013
DATE
NEWFOUNDLAND & LABRADOR
REV. D2

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 33 16**
CH0032	**BATTERIES AND BATTERY RACKS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

.1 Materials and installation for storage batteries and racks.

1.1.2 Related Sections:

.1 Section 26 05 00 – General Electrical Requirements.

.2 Section 26 33 43 – Battery Chargers

1.2 REFERENCES

1.2.1 American National Standards Institute (ANSI)/Underwriters Laboratories (UL).

.1 ANSI/UL 94, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.2.2 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.1, Canadian Electrical Code Part 1 – Safety Standard for Electrical Instsallations.

.2 CAN/CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

1.2.3 Institute of Electrical and Electronic Engineers (IEEE).

.1 IEEE 484, IEEE Recommended Practices for Installation Design and Implementation of Vented Lead-Acid Batteries for Stationary Applications.

.2 IEEE 485, IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications.

.3 IEEE 450, Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Submittals in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Submit shop drawings and product data to include:

.1 Dimensioned sketch showing battery rack, individual battery cells, recommended aisle space, headroom, assembly and anchoring of rack.

.2 Shipping weights.

.3 Individual battery cells, type, size, Ahr capacity at 2 hours discharge rate, electrolyte, materials for container, cover, separators, retainers, posts and inter-cell connectors.

.4 Specific gravity at full charge and 25 degrees C.

.5 Cell charge and discharge curves of voltage, current, time and capacity.

.6 Derating factor for temperature range (plus 5 degrees C to plus 35 degrees C).

.7 Maximum short circuit current.

.8 Maximum charging current recommended for fully discharged condition.

.9 Full charge voltage per cell.

.10 Fully discharged voltage per cell.

.11 Hydrogen generation and ventilation requirements.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for storage batteries and racks for incorporation into manual specified in Exhibit 4 – Supplier Document Requirements List.

.2 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance and repair.

.3 Installation details of battery rack, individual cells, inter-cell connectors.

.4 Replacement instructions for individual cells.

.5 Electrolyte handling.

.6 Parts lists with catalogue numbers, and names and addresses of suppliers.

.7 Factory test records.

D2

1.5 NOT USED

2 PRODUCTS

2.1 MATERIALS

.1 Steel for battery racks: to CAN/CSA-G40.20.

2.2 BATTERY CHARACTERISTICS

.1 Nominal battery voltage, full charge, 125 V.

.2 Designed to supply load current of 40 A for 2 hours.

.3 Minimum end voltage: 1.75 V per cell after discharge at rated load for period specified.

.4 Capable of being recharged in period of 12 hours to not less than 95% full charge after supplying rated load for period specified, with no harmful effects on battery, including leaking or foaming of electrolyte.

.5 Battery to deliver specified output at 25 degrees C, in ambient temperature from 5 degrees C to 35 degrees C.

2.3 LEAD ACID BATTERIES

.1 Type: Absorptive glass microfibre (AGM) valve regulated lead acid (VRLA).

.2 Electrolyte: solution of sulphuric acid.

.3 Cell containers: transparent plastic fire retardant.

.4 Electrolyte level lines: high and low on container surfaces.

.5 Cover: one piece molded plastic, flame retardant to ANSI/UL 94.

.6 Plate retainers: fibreglass.

.7 Plate separators: fibreglass.

.8 Vents: plastic screw flame arrestor type.

.9 Posts: bolted type with 2 stainless steel nuts and bolts per cell.

.10 Inter-cell connectors: lead plated copper, bolted to battery posts.

.11 Bolt holes slightly oversized to facilitate cell replacement.

.12 Connectors, bolts and nuts: corrosion resistant.

.13 Cells: of identical construction and from same production run.

.14 Batteries: in clean state with no evidence of electrolyte on outside of cell containers.

2.4 ACCESSORIES

.1 Two (2) spare intercell connectors, nuts and bolts.

2.5 BATTERY RACK

.1 One (1) tier, size as indicated. Bottom tier minimum 120 mm above floor.

.2 Frames: angle iron with welded joints ground smooth.

.3 Rails: steel channels, bolted to frames.

.4 Insulate rails from cells.

.5 Insulated from ground and floor.

.6 Free standing - not bolted to floor.

.7 Primed and epoxy painted to prevent corrosion.

.8 Corrosion resistant bolts and hardware.

.9 Configuration permitting any one cell to be removed without removing any other cell.

.10 Dimensions of space available as indicated.

3 EXECUTION

3.1 INSTALLATION

.1 Install battery rack as indicated on drawings.

.2 Install battery cells on rack.

.3 Clean posts and connectors and apply no-oxide grease.

.4 Install inter-cell connectors, and hand tighten nuts in accordance with manufacturer's instructions.

.5 Using torque wrenches, tighten nuts in accordance with manufacturer's recommended value.

.6 Connect battery to load circuit.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with section 26 05 00 – General Electrical Requirements.

.2 Check battery voltage of each cell or units in accordance with manufacturer's instructions.

.3 Float charge battery for 16 hours to ensure battery fully charged and in stable condition.

.4 Discharge battery at rated load for 2 hours.

.5 Check battery voltage at terminals and voltage of each cell or units.

.6 Recharge battery to full charge.

.7 Check battery voltage and voltage of each cell or units.

.8 Leave battery in fully charged state.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 33 43**
CH0032	**BATTERY CHARGERS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 33 43

BATTERY CHARGERS

TABLE OF CONTENTS

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REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
G. W. HAINES
SIGNATURE
11-25-2013
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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 33 43**
CH0032	**BATTERY CHARGERS**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

.2 Section 26 33 16 – Batteries and Battery Racks

1.2 REFERENCES

1.2.1 CSA International

.1 CAN/CSA C22.2 No.107.2, Battery Chargers.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for battery chargers and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Charger data: type and capacity, battery charging sequence, current-time data for Silicon Controlled Rectifier (SCR) protective devices, estimated noise level, metering, alarms, controls and efficiency.

1.4 CLOSEOUT SUBMITTALS

1.4.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.4.2 Operation and Maintenance Data: submit operation and maintenance data for battery chargers for incorporation into manual.

1.4.3 Operation and maintenance instructions covering design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance and repair.

1.4.4 Copy of approved shop drawings.

1.4.5 Technical description of components.

1.4.6 Parts lists with catalogue numbers and names and addresses of suppliers.

2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

.1 Automatically maintain battery in fully charged state while mains power available. Maintain DC float voltage within plus or minus 1% of setting.

.2 Float charging rate such that after battery has provided full power output for specified duration, charger returns battery to 95% of fully charged state in 12 hours, while supplying normal battery load.

.3 Manually initiated equalize charging feature with automatic timer adjustable from 0 to 24 hours, to return unit to float charge.

.4 Manual adjustment of float charge voltage with range plus or minus 5%.

.5 Manual adjustment of equalizing charge voltage.

.6 Automatic current limiting adjustable between 80 and 120% of normal rating.

.7 Audible noise level not to exceed 65 dBA at 1.5 m.

2.2 CHARGER CHARACTERISTICS

.1 Battery charger: to CAN/CSA C22.2 No.107.2.

.2 Input: 600 Vac, 3 phase, 4 wire, 60Hz.

.3 Output: TBA A, DC at 125 V, DC, ripple voltage less than 2 %.

2.3 ACCESSORIES

.1 AC voltmeter: switchboard type, accuracy plus or minus 2% of full scale, to measure rectifier input voltage.

.2 DC voltmeter: switchboard type, accuracy plus or minus 2% of full scale, to measure rectifier output voltage.

.3 AC ammeter: switchboard type, accuracy plus or minus 2% of full scale, to measure rectifier output current.

.4 DC ammeter: switchboard type, accuracy plus or minus 2% of full scale, to measure rectifier output current.

.5 Relay and alarm for ac power failure with time delay to prevent alarm during short power outages.

.6 Low DC voltage alarm.

.7 High DC voltage alarm and high DC voltage automatic shutdown.

.8 Ground detector relay and alarm.

.9 Equalizing timer: automatic reset type for unattended stations, 28 day period.

.10 LEDs mounted on front to indicate: failure AC power, low DC voltage, high DC voltage, and no rectifier output.

.11 Alarms: audible alarm when any LED indicates trouble. Silence pushbutton not to extinguish trouble light.

.12 Common LED, test switch and one common Form C alarm contact.

.13 Temperature compensation system for voltage output, including remote, battery mounted, temperature sensor.

.14 DC output voltage and DC output current transducer with 4-20 mA output.

2.4 ENCLOSURE

.1 Dead front free standing sheet steel, 2.5 mm thick minimum CSA Enclosure Type 1.

.2 Access from front.

.3 Convection ventilated.

.4 Meters, indicating lamps and controls group mounted on front panel.

.5 Allow for handling by forklift or sling.

.6 Apply finish in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.5 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Use size 4 nameplates for major components such as input breakers, output breaker.

.3 Use size 2 nameplates for mode lights alarms, meters.

3 EXECUTION

3.1 INSTALLATION

.1 Locate and install battery charger as indicated.

.2 Connect input terminals to AC mains.

.3 Connect output terminals to battery.

3.2 FIELD QUALITY CONTROL

.1 Perform Tests in accordance with Section 26 05 00 – General Electrical Requirements.

.2 Energize battery charger and operate until battery shows full charge.

.3 Discharge battery to full discharge condition.

.4 Recharge battery, recording DC voltage and current once per hour for 8 hours. Test battery to ensure it has reached at least 95% full charge.

.5 Continue charging to ensure charger changes from bulk rate to float charge rate.

.6 Demonstrate that automatic timer controls charging and correctly transfers from equalize to float charge after selected period.

.7 Simulate faults to demonstrate that alarm lights and audible alarms are performing as designed.

.8 At end of tests, with battery in fully charged condition, operate charger on "float" for minimum period of 24 hours to ensure stable condition is reached and held.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 33 53**
CH0032	**UNINTERRUPTIBLE POWER SYSTEMS STATIC (UPS)**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 33 53

UNINTERRUPTIBLE POWER SYSTEMS STATIC (UPS)

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REGISTERED PROFESSIONAL ENGINEER
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G. W. HAINES
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1 GENERAL

1.1 SECTION INCLUDES

.1 120 Vac Uninterruptible Power System (UPS) consisting of an inverter and bypass facilities. UPS will be fed from the station battery.

1.2 RELATED REQUIREMENTS

.1 Section: 26 05 00 – General Electrical Requirements.

.2 Section: 26 33 16 – Batteries and Battery Racks.

1.3 REFERENCES

1.3.1 CSA International

.1 CAN/CSA-C813.1, Performance Test Method for Uninterruptible Power Supplies.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1.4.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.4.2 Product Data: include information as follows:

.1 Catalogue information.

.2 Shipping weight.

.3 Schematic diagram showing interconnection of rectifier, inverter, battery, bypass switch, meters, controls and indicating lamps.

.4 Description of system operation, referenced to schematic diagram, for:

.1 Manual control during initial start-up and load transfer to bypass and back to inverter output.

.2 Inverter.

.3 Bypass.

.5 Estimate with supporting data for Mean Time to Repair factor (MTTR).

.6 Full load kVA output at 0.8% lagging power factor.

.7 Efficiency of system at 25%, 50%, 75% and 100% rated load.

.8 Type of ventilation: natural or forced.

.9 Inverter:

.1 Type and catalogue number.

.2 DC current at minimum battery voltage to produce full load AC output.

.10 Heat losses at no load, 25%, 50%, 75% and 100% of rated output, in kW.

.11 Cooling air required in m^3/s.

.12 List of recommended spare parts, tools and instruments with catalogue numbers and current prices.

1.4.3 Shop Drawings:

.1 Include outline schematics showing arrangement of cubicles, meters, controls, recommended aisle spaces, battery rack, battery arrangement and dimensions.

1.5 PROTECTION OF SYSTEMS

1.5.1 Circuit breakers in system used to isolate it from load and from 125 Vdc battery input for safe working on equipment, and for manual blocking of bypass automatic control to prevent inadvertent operation of bypass during Work on inverter.

1.5.2 Automatic circuit breakers and protection included in:

.1 DC input to inverter.

.2 AC input to bypass.

.3 Inverter output.

1.5.3 Surge suppressors:

.1 To protect system against supply voltage switching transients.

.2 To protect internal circuits where necessary against voltage transients.

1.5.4 Current limiting devices, with panel front indication of device operation, to protect inverter SCR's.

1.5.5 Failure of circuit or component not to cause equipment to operate in dangerous or uncontrolled mode.

1.6 CLOSEOUT SUBMITTALS

1.6.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.6.2 Operation and Maintenance Data: submit operation and maintenance data for uninterruptible power systems static (UPS) for incorporation into manual.

1.7 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit spare parts list in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Include:

.1 Four (4) sets of each type and size of fuses used.

.2 Four (4) sets indicating lamps.

2 PRODUCTS

2.1 SYSTEM DESCRIPTION

D1

.1 All UPS equipment to be products of Gentec.

2.1.1 System to consist of:

.1 Invertor Cubicle.

.2 Bypass Switch.

.3 Controls and meters.

2.1.2 Ensure system uses normal power supply mains and battery to provide continuous, regulated AC power to isolated load.

2.1.3 Equipment: capable of operating continuously and unattended.

2.1.4 Ensure that Uninterruptible Power Systems (UPS) is compatible with equipment that it feeds.

2.2 PERFORMANCE

2.2.1 Normal operation:

.1 System operates on 125 Vdc station battery power when battery voltage is within +/-10 % of nominal value.

2.2.2 AC Emergency Operation:

.1 System transfers automatically:

.1 When manually selected at control panel.

.2 When 125 Vdc power fails.

.3 When battery voltage varies more than 10 % from nominal.

.4 When 125 Vdc power is restored and battery voltage is within 10 % of nominal, system automatically supplies loads from the inverter and resynchronizes with AC supply emergency;

.5 Slew rate of frequency during transition period of system output automatically synchronizing with AC supply emergency and return to its internal frequency to be set between 0.5 to 1.0 Hz per second.

2.2.3 Internal Static Bypass operation:

.1 Ensure system can be bypassed for maintenance purposes, automatically by manual selection at control panel to connect load directly to AC supply. Transfer without load interruption and leaving inverter energized.

.2 Load transfer from AC emergency supply back to system automatically by manual selection at control panel when maintenance completed.

.3 Automatic transfer of load to AC emergency supply in not more than 1/4 cycle including sensing with inverter left energized but disconnected from load in case of:

.1 Inverter overloaded.

.2 Short circuit in load.

.4 Automatic retransfer of load to system without load interruption when above conditions disappear.

.5 Automatic transfer of load to AC transfer supply in not more than 1/4 cycle including sensing and shutdown of inverter in case of inverter internal malfunctions.

.6 Automatic transfer of load to AC emergency supply without load interruption and inverter shutdown in case of:

.1 Over temperature harmful to system

.2 Loss of forced ventilation

.3 Low voltage of DC supply to ventilator

.7 Bypass capable of closing onto and withstanding momentary fault current of 800% of rating for 0.01 s.

2.3 UNINTERRUPTIBLE POWER SYSTEM

2.3.1 Input power:

.1 125 Vdc.

.2 Normal supply from 125 Vdc station battery.

.3 Emergency supply from 120/208 Vac emergency panel board.

2.3.2 Output power:

.1 Single phase, 125 Vac, 2 wire, grounded neutral, 60 Hz.

.2 Full load output at 0.8 power factor lagging 5 kVA.

.3 Overload capability: 125% of rated full load current at 0.8 power factor and rated voltage for 10 minutes.

.4 Frequency - nominal 60 Hz:

.1 Adjustable from 58.5 to 61.5 Hz.

.2 Maximum variation from set value under load changes, including transients, 0.3 Hz maximum.

.3 Drift from set value - after two months normal operation within ambient temperature range of 0ºC to 40ºC, not to exceed 0.6 Hz.

.5 Output voltage control:

.1 Continuously adjustable on load at least 5% from rated value.

.2 Voltage regulation: voltage not to change by more than 2% as load increases gradually from zero to 100%, or for specified duration of full load after mains failure.

.3 Transient voltage change not to exceed +/-10% of rated voltage upon 50% sudden load change, loss or return of AC input voltage to system when fully loaded or transfer of full load from inverter to bypass and vice versa, and return to normal within [3] Hz.

.4 Harmonics over entire load range:

.1 Total RMS value not to exceed 5% RMS value of total output voltage.

.2 Single harmonic not to exceed 3% of total output voltage.

.5 Proper angular phase relation maintained within 4 electrical degrees at up to 20% load unbalance.

.6 Efficiency: Overall system efficiency at rated load not less than 90%.

.7 Interference suppression:

.1 If UPS equipment generates electromagnetic rf interference at levels which adversely affects other equipment in vicinity, install suppression circuits or shielding as required to eliminate such interference.

.2 If harmonics reflected back to mains from rectifier adversely affect other loads connected to same bus, install suppression circuits to prevent that condition.

2.4 ELECTRICAL REQUIREMENTS

2.4.1 In accordance with Section: 26 05 00 – General Electrical Requirements.

.1 Provide test required for on-site alignment, for determination of faulty sub-assemblies or printed circuit cards, including indication of oscillator pulse and operation of voltage control.

.2 No battery other than main battery input incorporated in design.

.3 Wires number tagged or colour coded with same designation on drawings. Tags: non deteriorating type.

.4 Variable resistors: fine adjustment, rheostat type.

.5 Phasing marked on input and output terminals, viewed from front of equipment:

.1 Left to right.

.2 Top to bottom.

.3 Front to back.

.6 Indicator lamps: long life LED or neon, rated for continuous duty.

.7 Solid state circuits used where more reliable than mechanical timers or control relays.

.8 Standard components available from commercial sources used throughout, with 10 years minimum shelf life.

.9 Arrangement to permit easy removal of defective components to facilitate servicing, by replacing with stock spares.

.10 Small components, related to specific function, removable plug-in modular sub-assembly or printed circuit card.

.11 Heavy sub-assemblies easily accessible, or slide on runners of anti-friction material, and have flexible leads and bolted connections.

.12 Components and sub-assemblies accurately made for interchangeability.

2.5 ENCLOSURE

.1 Dead front free standing sheet steel 2.5 mm minimum thick, CSA Enclosure 1.

.2 Access from front only.

.3 Meters, indicating lamps and controls group mounted in panel front.

.4 Panel front enclosed by hinged doors to prevent tampering and to protect instruments and controls during shipping.

.5 Doors formed wrap-around type, rigid, to open and close smoothly, locking type handle with 2 keys.

.6 Hinges to permit doors to be lifted off cubicle.

.7 Cubicle height: 1.8 m maximum.

.8 External cable connections at top of cubicle through bolted plate for drilling at site to suit.

.9 Ambient temperature range during operation +5ºC to +35ºC. Natural or forced ventilation as required.

.10 For forced ventilation power from inverter output and fan directly driven by single phase motor mounted on vibration isolators.

.11 Each enclosure to have redundant fans, with fan failures alarmed. Air inlet and outlet openings protected with screens and metal guards.

.12 Disposable air filters on fan cooled enclosures. Method of attachment and opening locations to make removal convenient and safe.

.13 Maximum operating sound level not to exceed 80 db(A) as measured on sound level meter with A weighting and slow response, at distance of 1.8 m.

.14 Enclosure frames interconnected by ground bus with ground lug for connection to ground.

2.6 INVERTER

2.6.1 One (1) 5 kVA DC to AC inverters are required to supply power to the 120 Vac essential service panelboards as indicated.

2.6.2 The inverter unit shall be solid-state, fully automatic, having DC input compensation, DC to AC isolation, load regulation and inherent current limiting.

2.6.3 Inverter shall comprise a static transfer switch and a ‘no-break’ DC to AC static inverter suitable for operation for the normal/alternate voltages. Transfer to and from the 125 Vdc supply shall be automatic and bumpless.

2.6.4 The DC input shall be monitored by a DC-fused voltmeter and a shunt-operated DC ammeter. The essential services power supply AC output shall be monitored by an AC voltmeter, an AC ammeter and a frequency meter. There should be an indication on each inverter panel and an analog signal for remote indication.

2.6.5 Alarm contacts connected to separate terminals shall be provided for annunciation of the following conditions:

.1 inverter failure;

.2 static transfer switch failure;

.3 total loss of output voltage (on manual bypass);

.4 overload;

.5 under voltage / overvoltage.

2.6.6 Meters:

.1 AC voltmeter: switchboard type, accuracy +/-2% of full scale, to measure inverter output voltage with [7] position selector switch to select phase to neutral, [phase to phase], off.

.2 AC ammeter: switchboard type, accuracy +/-2% of full scale, to measure inverter output current with [4] position selector switch to select [each] phase and off.

.3 Wattmeter: switchboard type, accuracy +/-2% of full scale to measure inverter load.

.4 Frequency meter: switchboard type, scale 58 to 62 Hz, pointer type, to measure inverter output frequency.

.5 Synchroscope: with switch to check inverter output potential against supply mains potential.

2.6.7 Output disconnect: bolt-on, moulded case, single pole circuit breaker, quick make, quick break type, for manual or automatic operation, temperature compensated for 40ºC ambient, magnetic instantaneous trip element.

2.6.8 Meters and controls: grouped on front panel.

2.7 STATIC BYPASS SWITCH

.1 Solid state closed circuit automatic transfer switch.

.2 Logic unit with normal source voltage sensors, which monitor overvoltage under voltage and loss of voltage.

.3 High speed automatic transfer from normal voltage to alternate source when:

.1 Normal source voltage lost: transfer time and sensing 1/4 cycle;

.2 Normal source: under voltage at 80% of nominal value; adjustable.

.3 Normal source: over voltage at 110% of nominal value.

.4 Loss of normal source static switch continuity.

.5 Short circuit on normal source [blows normal source fuse] [trips normal source breaker].

.4 Return to normal source:

.1 When normal source remains within return voltage limits of 95% to 110% of nominal value (adjustable) for approximately 1 s timing interval, circuit checks voltage balance and phase synchronization, then initiates return with zero switching time.

.5 Switch position lights and contacts.

.6 Synchronizing verification light.

.7 Manual reset pushbutton.

.8 Transfer test switch.

.9 Alternate power source monitor light.

.10 Accessories:

.1 Manual bypass switch for maintenance and testing without load disturbance.

.2 Continuity monitor: automatic transfer to alternate source in event of static switch discontinuity.

.3 Alternate power source loss alarm contacts.

2.8 FINISHES

2.8.1 Apply finishes in accordance with Section: 26 05 00 – General Electrical Requirements.

2.8.2 Cubicles:

.1 Inside finish: white.

.2 Exterior finish: [manufacturer's standard color].

.3 Exterior hardware and trim: corrosion resistant and not requiring painting such as stainless steel or aluminum.

2.9 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section: 26 05 00 - General Electrical Requirements

.2 For major components such as AC input breaker, inverter breakers, bypass switch: size 4 nameplates.

.3 For mode lights, alarms, meters: size 2 nameplates

3 EXECUTION

3.1 INSTALLATION

.1 Locate UPS cubicles, as indicated.

.2 Assemble and interconnect components to provide complete UPS as specified.

.3 Connect 125 Vdc station battery to main input terminal.

.4 Connect UPS output to load.

.5 Start-up UPS and make preliminary tests to ensure satisfactory performance.

3.2 FIELD QUALITY CONTROL

3.2.1 Perform tests in accordance with Section: 26 05 00 - General Electrical Requirements and CAN/CSA-C813.1.

3.2.2 Provide:

.1 Competent field personnel to perform test, adjustments and instruction on UPS equipment.

.2 Dummy load adjustable to 150% of system rated output.

3.2.3 Notify Engineer 10 working days in advance of test date.

3.2.4 Tests:

.1 Inspection of cubicles.

.2 Inspection of electrical connections.

.3 Inspection of installation of remote mode lights and alarms.

.4 Demonstration of system start-up and shut-down.

.5 Run UPS for minimum period of 4 hours at full rated load to demonstrate proper operation with 125 Vdc station input, Emergency 120 Vdc supply and no 120 Vac emergency supply.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 50 00**
CH0032	**LIGHTING**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 50 00
LIGHTING
TABLE OF CONTENTS

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1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

1.2 REFERENCES

1.2.1 American National Standards Institute (ANSI)

.1 ANSI C82.1, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.

.2 ANSI C82.4, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.

1.2.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits.

1.2.3 American Society for Testing and Materials (ASTM)

.1 ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

1.2.4 United States of America, Federal Communications Commission (FCC)

.1 FCC (CFR47) EM and RF Interference Suppression.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Engineer.

1.3.2 Photometric data to include: VCP Table and spacing criterion and luminaire coefficient of utilization (CU) tables.

1.3.3 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 ACCEPTABLE PRODUCTS

1.4.1 Luminaires described in drawings identify quality, performance criteria and other parameters, as indicated for this Contract. Named fixtures are acceptable with modifications and accessories, as indicated.

1.4.2 Fixtures from other manufacturers may be acceptable provided:

.1 Appearance and lighting performance are similar.

.2 Quality is equal or better.

.3 Lamp and ballast criteria remain the same.

.4 The fixture is provided with modifications and accessories to provide a complete product in keeping with the intent of the project.

.5 Approval in writing is obtained from the Engineer for substitution.

2 PRODUCTS

.1 High pressure sodium lamps to be - clear, ED18, 150, 400 Watt, mogul base, 30,000 hour lamp life, 54,000 initial lumens; or as indicated.

.2 Fluorescent lamps to be - T8, 32 Watt, medium bi-pin, rapid or instant start to suit application, 4100 K, 30,000 hour lamp life, 2950 initial lumens, CRI 80; or as indicated.

.3 Metal halide lamps to be - clear, BT37, 400 Watt, mogul base, horizontal burn, 4100 K, 15,000 hour lamp life, 36,000 initial lumens, CRI65, open or enclosed type to suit the luminaire; or as indicated.

.4 Compact fluorescent lamps to be - 18 Watt, G24q-2 base, 12,000 hour lamp life, 12,000 initial lumens, 4100 K, CRI 80; or as indicated.

2.1 BALLASTS

2.1.1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic.

.1 Rating: 120 or 347 V, 60 Hz, as indicated, for use with 2-32W, T8 octron imperial lamps.

.2 RFI/EMI suppression circuit to: FCC (CFR47) Part 18, sub-part C, Class A and Part 15, sub-part B, Class B.

.3 Totally encased and designed for 40 °C ambient temperature.

.4 Power factor: minimum 98 % with 98% of rated lamp lumens.

.5 Crest factor: 1.5 maximum.

.6 Capacitor: thermally protected.

.7 Thermal protection: non-resettable on coil.

.8 Harmonics: 10 % maximum THD.

.9 Operating frequency of electronic ballast: 20 khz minimum.

.10 Total Circuit Power: 62 Watts.

.11 Ballast Factor: greater than 0.90.

.12 Sound rated: Class A.

.13 Mounting: integral with luminaire.

.14 Be warranted by manufacturer for five years.

2.1.2 Metal halide ballast:

.1 Rating: 60 Hz voltage as indicated, for use with metal halide lamp as indicated. Provide circuitry for standby light to provide light for starting and restart.

.2 Totally encased and designed for 40 °C ambient temperature.

.3 Power factor: minimum 95 % with 95% of rated lamp lumens.

.4 Type: constant wattage auto-transformer or solid state.

.5 Input voltage range: plus or minus 10% of nominal.

.6 Minimum starting temperature: minus 29 °C at 90% line voltage.

.7 Mounting: outdoor integral with luminaire.

.8 Current crest factor: 1.7 maximum current.

2.1.3 High pressure sodium ballast: to ANSI C82.4.

.1 Rating: 60Hz voltage as indicated, for use with high pressure sodium lamps, as indicated.

.2 Totally encased and designed for 40 °C ambient temperature.

.3 Power factor: minimum 95 % with 95% of rated lamp lumens.

.4 Type: reactor or solid state with matching igniter as recommended by manufacturer.

.5 Input voltage range: plus 10% to minus 10% of nominal.

.6 Minimum starting temperature: minus 34 °C at 90% line voltage.

.7 Mounting: outdoor integral with luminaire.

.8 Current crest factor: 1.7 maximum current.

2.2 FINISHES

.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.3 LUMINAIRES

.1 As indicated on drawings. Provide 10% spare lamps of each type.

2.4 OPTICAL CONTROL DEVICES

2.4.1 As indicated in luminaire schedule on drawings.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Locate and install luminaires as indicated. Install lamps in all fixtures.

.1 Provide adequate support to suit ceiling system.

3.2 WIRING

3.2.1 Connect luminaires to lighting circuits.

.1 Install flexible conduit for vertical power supply drop to luminaires as indicated. Horizontal wiring using flexible conduit is not permitted.

3.3 LUMINAIRE SUPPORTS

3.3.1 For suspended ceiling installations support luminaires from ceiling grid in accordance with local inspection requirements.

3.4 LUMINAIRE ALIGNMENT

3.4.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

3.4.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 FIELD QUALITY CONTROL

3.5.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 52 00**
CH0032	**EMERGENCY LIGHTING**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 50 00
EMERGENCY LIGHTING
TABLE OF CONTENTS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 52 00**
CH0032	**EMERGENCY LIGHTING**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

.2

.3 Section 26 33 53 – Uninterruptible Power Systems Static (UPS)

.4

1.2 REFERENCES

1.2.1 CSA International

.1 CSA C22.2 No.141, Emergency Lighting Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

.2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

D2

1.5 NOT USED

2 PRODUCTS

2.1 EQUIPMENT

.1 Emergency lighting equipment: to CSA C22.2 No.141.

.2 Supply voltage: 600 V, 3 phase, AC.

.3 Output voltage: 347 V, single phase, AC.

.4 Operating time: 90 minutes.

.5 Battery: sealed, maintenance free.

.6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.

.7 Solid state transfer circuit.

.8 Battery disconnect: solid state, modular, operates at 80% battery output voltage.

.9 Signal lights: solid state, for 'AC Power ON'.

.10 Lamp heads: emergency lighting will use identical luminaries to those used for normal lighting.

.11 Cabinet: floor mounted for CSA Type 1 enclosure. Removable or hinged front panel for easy access to batteries.

.12 Finish: Manufacturer's standard.

.13 Auxiliary equipment:

.1 Ammeter.

.2 Voltmeter.

.3 Test switch.

.4 Time delay relay.

.5 Battery disconnect device.

.6 ac input and ac output terminal blocks inside cabinet.

.7 RFI suppressors.

2.2 WIRING OF EMERGENCY LUMINARIES

.1 Conduit: type in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Conductors: type in accordance with Section 26 05 21 - Wires and Cables (0-1000 V), sized as indicated.

3 EXECUTION

3.1 INSTALLATION

.1 Install unit equipment and remote mounted fixtures.

.2 Direct heads.

.3 Connect exit lights to unit equipment.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 53 00**
CH0032	**EXIT SIGNS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS

SECTION 26 53 00

EXIT SIGNS

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Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 53 00**
CH0032	**EXIT SIGNS**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section: 26 05 00 – General Electrical Requirements.

.2 Section: 26 52 00 – Emergency Lighting.

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.

.2 CSA C860, Performance of Internally-Lighted Exit Signs.

1.2.2 National Fire Protection Association (NFPA)

.1 NFPA 101, Life Safety Code.

1.3 ACTION AND INFORMATONAL SUBMITTALS

.1 Provide submittals in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.3.2 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and disposal.

2 PRODUCTS

2.1 STANDARD UNITS

.1 Exit lights: to CSA C22.2 No.141 and CSA C860.

.2 Housing: cold rolled steel minimum 1.0 mm thick, satin aluminum enamel finish.

.3 Face and back plates: extruded aluminum.

.4 Lamps: multiple LED, 347 V over 500,000 hours with an average brightness of 3000 candela.

.5 Operation: designed for 25 years of continuous operation without relamping.

.6 Include “running man” pictograms in accordance with CSA C22.2 No. 141, Annex B and with directional arrows as indicated.

.7 Downlight: white glass in bottom of unit.

.8 Face plate to remain captive for relamping.

2.2 SELF-POWERED UNITS

.1 Exit lights: to CSA C22.2 No.141 and CSA C860.

.2 Housing: cold rolled steel minimum 1.0 mm thick, satin aluminum enamel finish.

.3 Face and back plates: extruded aluminum.

.4 Lamps: multiple LED, 347 V over 500,000 hours.

.5 Operation: designed for 25 years of continuous operation without relamping.

D1

.6 Include “running man” pictograms in accordance with CSA C22.2 No. 141, Annex B and with directional arrows as indicated.

.7 Downlight: white glass in bottom of unit.

.8 Face plate to remain captive for relamping.

.9 Supply voltage: 347 Vac.

.10 Output voltage: 12 or 24 Vdc.

.11 Operating time: 90 minutes minimum.

.12 Recharge time: 12 hours

.13 Battery: sealed, maintenance free.

.14 Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.

.15 Solid state transfer circuit.

.16 Signal lights: solid state, for 'AC Power ON' condition.

.17 Lamp heads: integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment.

.1 Lamp type: as indicated.

.18 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit.

.1 Removable or hinged front panel for easy access to batteries.

.19 Cabinet: finish: standard.

.20 Auxiliary equipment:

.1 Lamp disconnect switch.

.2 Test switch.

.3 AC/DC output terminal blocks inside cabinet.

.4 RFI suppressor.

.5 Cord and single twist-lock plug connection for AC power supply.

2.3 SELF-LUMINOUS SIGNS

2.3.1 Exit lights:

.1 No power source or wiring required, spark free.

.2 Constructed: metal and plastic.

.3 Source of energy: tritium gas emits constant low energy beta particles to excite phosphor coating on inside of tube.

.4 Viewing distance: in accordance with NFPA.

.5 Dispose of lights at end of lifespan as Hazardous Waste.

2.4 DESIGN

.1 Recessed wall, end to wall, ceiling mounting.

.2 Single or double face with face plate to remain captive for relamping.

.3 Arrow: right or left as indicated.

.4 Wireguard.

3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.

.2 Connect fixtures to exit light circuits.

.3 Connect emergency lamp sockets to emergency circuits.

.4 Ensure that exit light circuit breaker is locked in on position.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section: 26 05 00 – General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **26 56 19**
CH0032	**ROADWAY LIGHTING**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 26 56 19
ROADWAY LIGHTING
TABLE OF CONTENTS

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CH0032	**ROADWAY LIGHTING**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

.2 Section 26 50 00 - Lighting

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)

.1 CSA A14, Concrete Poles.

.2 CSA C22.2No.206, Lighting Poles.

.3 CAN/CSA-O15-[90(R1999], Wood Utility Poles and Reinforcing Stubs.

.4 CSA O80 Series-[97], Wood Preservation.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit product data in accordance with Exhibit 4 – Supplier Document Requirements List.

2 PRODUCTS

2.1 STEEL POLES

2.1.1 Steel poles: to CSA C22.2No.206 designed for underground wiring and:

.1 Mounting on concrete anchor base.

.2 Style: monotube, minimum 6.0 mm thick, tapered round.

.3 Tenon-top, galvanized steel suitable for two luminaire mounting brackets.

.4 Access handhole 1000 mm above pole base for wiring connections, with welded-on reinforcing frame and bolted-on cover. Hand hole size: 50 x 125 mm

.5 Size: as indicated.

.6 Anchor bolts: four (4) steel with “L” bend, shims, nuts and covers, dimensioned as indicated on drawings.

.7 Finish: polyester powder coat. Colour to be advised during shop drawing review.

.8 Grounding lug inside hand hole.

.9 Load ratings for combined assembly of pole, based on luminaire:

.1 Maximum wind load 160 kph @ 1.3 gust factor, no ice.

.2 Maximum ice load: 38 mm radial, no wind.

.3 Combined load: 120 kph wind 2 1,3 gust factor and 25 mm radial ice.

2.2 LUMINAIRE MOUNTING BRACKETS

2.2.1 Mounting brackets steel for specified luminaires:

.1 Tenon-top for number of luminaires as indicated.

.2 Tenon-top 101 mm diameter or as required by luminaire, height as required by the luminaire.

2.3 LUMINAIRES

2.3.1 Luminaire with cast aluminum weatherproof housing and:

.1 Lamp type: HPS, wattage: 150 W.

.2 Ballast: 347 V, one lamp, in accordance with Section 26 50 00 - Lighting.

.3 Optical assembly:

.1 For high pressure sodium lamps:

.1 Reflector: sheet aluminum with Alzak finish.

.2 Refractor: one piece prismatic glass.

.3 Gasket: seal between refractor and housing.

.4 Light Distribution:

.1 By adjusting position of lamp socket.

.5 Self-locking latches of stainless steel and aluminum.

.6 Factory wired including integral ballast terminated at terminal block.

3 EXECUTION

3.1 INSTALLATION

.1 Install poles true and plumb, complete with brackets in accordance with manufacturer's instructions.

.2 Install luminaires on pole and install lamps.

.3 Check luminaire orientation, level and tilt.

.4 Connect luminaire to lighting circuit. Perform tests in accordance with Section 26 05 00 - General Electrical Requirements.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - General Electrical Requirements.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **28 16 00**
CH0032	**INTRUSION DETECTION**	Rev : D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

SECTION 28 16 00
INTRUSION DETECTION
TABLE OF CONTENTS

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1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

1.2 REFERENCES

1.2.1 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S304, Signal Receiving Centre and Premise Burglar Alarm Control Units.

.2 CAN/ULC-S306, Intrusion Detection Units.

.3 ULC-S318, Standard for Power Supplies for Burglar Alarm Systems.

.4 ULC-C634, Guide for the Investigation of Connectors and Switches for Use with Burglar Alarm Systems.

1.2.2 Underwriters' Laboratories (UL)

.1 UL 603, Power Supplies For Use With Burglar-Alarm Systems.

1.3 SUBMITTALS

1.3.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for control panels, detection accessory devices and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit:

.1 Functional description of equipment.

.2 Technical data for devices.

.3 Device location plans and cable lists.

.4 Devices mounting location detail drawings.

.5 Typical devices connection detail drawings.

1.3.3 Shop Drawings:

.1 Shop drawings to indicate project layout, mounting heights and locations, wiring diagrams, detection device coverage patterns, contact operating gaps,.

.2 Submit zone layout drawing indicating number and location of zones and areas covered.

1.3.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.1 Submit UL Product Safety Certificates.

1.3.5 Test and Evaluation Reports:

.1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

1.4.1 Operation and Maintenance Data: submit maintenance data for incorporation into manual specified in Section [01 78 00 - Closeout Submittals].

.1 Include:

.1 System configuration and equipment physical layout.

.2 Functional description of equipment.

.3 Instructions of operation of equipment.

.4 Illustrations and diagrams to supplement procedures.

.5 Operation instructions provided by manufacturer.

.6 Cleaning instructions.

2 PRODUCTS

2.1 MATERIALS

2.1.1 Design Criteria:

.1 Design intrusion detection system using only ULC/UL listed products.

.2 Design intrusion detection system as a non certified alarm system.

.3 Design system as a modular access control, alarm monitoring system expandable, and easily modified for inputs, outputs and remote control stations.

.1 Design components in accordance with CAN/ULC-S306 and be capable of:

.1 Annunciating undesirable, abnormal or dangerous condition.

.2 Prioritizing alarms by alarm type; i.e. panic/duress, intrusion and tamper.

.3 Determining zone where alarm occurred.

.4 Annunciating power failure and power restoration.

.5 Annunciating low battery condition.

.6 Operate continuously for minimum period of 4 hours in the event of a power failure.

.4 Equip control panels with continuous tamper detection on door and wall.

.1 Tamper detection to trigger alarm.

.5 Design system with:

.1 Alarm masking.

.2 Remote maintenance or diagnostics with password activation and callback modem.

.3 Unique identifier for each authorized person.

.4 Arming and disarming capabilities: manual and automatic by time of day, day of week, or by operator command.

.5 Support both manual and automatic responses to alarms entering system.

.6 Each alarm capable of initiating different functions of camera, homing, and activation of remote devices, audio switching, door control and card or pin validation.

.7 Zone or alarm location annunciated at monitoring station.

.6 Communications link: security level of I to CAN/ULC-S304.

.7 Signal link: security level of I to CAN/ULC-S304.

.8 Alarm condition: design system to provide maximum time for an alarm to be communicated of 90 seconds from alarm initiation to annunciation at remote monitoring location.

.9 Junction boxes: tamper proof with continuous tamper-detection capability.

.10 Design system power supplies rated to provide cumulative load of all systems components plus safety factor of 50% or greater.

2.1.2 Control Panel: ULC approved, expandable [and designed for multiplexed expansion].

.1 Zones (protection inputs): 8.

.2 Fixed zones: 8.

.3 Expandable: 8 - 32 zones.

.4 Number of user codes required: 10.

.5 Number of areas/partitions required: 10.

.6 Keypads: LCD (liquid crystal display).

.7 Alarm: monitored.

.8 System: wired.

.9 Integrated with sub systems access control.

.10 Number of programmable outputs required: 5.

.11 System supervision: telephone line, battery and AC powered.

.12 Siren output.

.13 Number of devices per zone: as required.

2.1.3 Detection Accessories:

.1 Passive Infrared Detectors (PIR's): ULC approved, digital.

.1 Coverage pattern: as required/indicated.

.2 Temperature requirement: as required/indicated.

.3 Tamper switch.

.4 Mounting: wall or ceiling.

.2 Glass break detector: ULC approved, complete with tamperproof switch and be designed to meet temperature and mounting requirements of project.

.1 Coverage pattern: as required/indicated.

.3 Dual passive infrared and microwave: ULC approved, complete with tamperproof switch, and be designed to meet temperature and mounting requirements of project.

.1 Coverage pattern: as required/indicated.

.4 Contacts : ULC approved.

.1 Mounting: surface.

.2 Mounting locations: door, window, or overhead door.

.3 Operating gap: 9.5 mm.

.4 Security level: [high security] [biased].

.5 Type: magnetic [biased] [balanced].

.5 Vibration or shock sensors: as required/indicated.

.6 Photo electric beams: as required/indicated.

.7 Notification devices:

.1 Siren: 15 watt.

.2 Speaker complete with driver voice annunciator.

2.1.4 Communications: telephone line digital dialer.

2.1.5 Environmental monitoring: design system for detection of smoke/heat, temperature humidity and flood.

2.1.6 Connectors and switches: to ULC-C634.

2.1.7 Power supplies: to ULC-S318 or UL 603.

3 EXECUTION

3.1 INSTALLATION

.1 Install panels, intrusion detection system and components in accordance with manufacturer's written installation instructions to locations, heights and surfaces shown on reviewed shop drawings.

.2 Install panels, intrusion detection system and components secure to walls, ceilings or other substrates.

.3 Install required boxes in inconspicuous accessible locations.

.4 Conceal conduit and wiring.

3.2 FIELD QUALITY CONTROL

3.2.1 Perform verification inspections and test in the presence of Engineer.

.1 Perform tests in accordance with Section 26 05 00 – General Electrical Requirements.

.2 Provide necessary tools, ladders and equipment.

.3 Ensure appropriate subcontractors, manufacturer's representatives and security specialists are present for verification.

3.2.2 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:

.1 Sturdiness of equipment fastening.

.2 Non-existence of installation related damages.

.3 Compliance of device locations with reviewed shop drawings.

.4 Compatibility of equipment installation with physical environment.

.5 Inclusion of all accessories.

.6 Device and cabling identification.

.7 Application and location of ULC approval decals.

3.2.3 Technical verification: purpose to ensure that all systems and devices are properly install and free of defects and damage. Technical verification includes:

.1 Measurements of coverage patterns

.2 Connecting joints and equipment fastening.

.3 Compliance with manufacturer's specification, product literature and installation instructions.

3.2.4 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:

.1 Operation of each device individually and within its environment.

.2 Operation of each device in relation with programmable schedule and or/specific functions.

3.3 ADJUSTING

.1 Adjust all components for correct function.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **28 31 00.01**
CH0032	**MULTIPLEX FIRE ALARM SYSTEM**	Rev: D2
Powerhouse and Spillway Hydro-Mechanical Equipment		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION: 28 31 00.01
MULTIPLEX FIRE ALARM SYSTEM

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL No 458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
PEGNL Newfoundland and Labrador
G. W. HAINES
SIGNATURE
11-DEC-2013
DATE
NEWFOUNDLAND & LABRADOR
REV. D2

1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – General Electrical Requirements.

.2 Section 26 05 21 – Wires and Electrical Cables (0 – 1000 V).

.3 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

1.2.1 Government of Canada

.1 National Building Code of Canada

1.2.2 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.

.2 CAN/ULC-S526, Visible Signal Devices for Fire Alarm Systems, Including Accessories.

.3 CAN/ULC-S527, Standard for Control Units for Fire Alarm Systems.

.4 CAN/ULC-S528, Manual Stations for Fire Alarm Systems, Including Accessories.

.5 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems.

.6 CAN/ULC-S530, Heat Actuated Fire Detectors for Fire Alarm Systems.

.7 CAN/ULC-S531, Standard for Smoke Alarms.

.8 CAN/ULC-S537, Standard for the Verification of Fire Alarm Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List.

1.3.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for multiplex fire alarm system and include product characteristics, performance criteria, physical size, finish and limitations.

1.3.3 Shop Drawings:

.1 Indicate on shop drawings:

.1 Detail assembly and internal wiring diagrams for control units.

.2 Overall system wiring diagram identifying initiating zones, and signaling circuits; terminations, terminal numbers, conductors and raceways.

.3 Details for devices.

.4 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.

.5 Step-by-step operating sequence, cross referenced to logic flow diagram.

1.4 CLOSEOUT SUBMITTALS

1.4.1 Submit in accordance with Exhibit 4 – Supplier Document Requirements List..

1.4.2 Operation and Maintenance Data: submit operation and maintenance data for fire alarm system for incorporation into manual. Include:

.1 Instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Technical data - illustrated parts lists with parts catalogue numbers.

.3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.

.4 List of recommended spare parts for system.

2 PRODUCTS

2.1 DESCRIPTION

2.1.1 Fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital, and multiplexing techniques for data transmission.

2.1.2 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating general alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signalling to control room.

2.1.3 Zoned, non-coded single stage].

2.1.4 Modular in design to allow for future expansion.

2.1.5 Operation of system shall not require personnel with special computer skills.

2.1.6 System to include:

.1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signalling.

.2 Power supplies.

.3 Initiating/input circuits.

.4 Output circuits.

.5 Auxiliary circuits.

.6 Wiring.

.7 Manual and automatic initiating devices.

.8 Audible and visual signalling devices.

.9 End-of-line resistors if required.

.10 Local annunciator.

.11 Historic event recorder.

2.1.7 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.

2.1.8 Power supply: to CAN/ULC-S524.

2.1.9 Audible signal devices: to CAN/ULC-S524.

2.1.10 Visual signal devices: to CAN/ULC-S526.

2.1.11 Control unit: to CAN/ULC-S527.

2.1.12 Manual pull stations: to CAN/ULC-S528.

2.1.13 Thermal detectors: to CAN/ULC-S530.

2.1.14 Smoke detectors: to CAN/ULC-S529.

2.1.15 Smoke alarms: to CAN/ULC-S531.

2.1.16 Regulatory Requirements:

.1 Subject to Provincial Fire Commissioner approval.

.2 Subject to FC inspection for final acceptance.

.3 Electrical inspection approval.

.4 System components: listed by ULC and comply with applicable provisions of NBCC, and meet requirements of local authority having jurisdiction.

2.2 SYSTEM OPERATION: SINGLE STAGE - SIGNALS ONLY

2.2.1 Actuation of any alarm initiating device to:

.1 Cause electronic latch to lock-in alarm state at central control.

.2 Indicate zone of alarm at central control unit.

.3 Cause audible signalling devices to sound continuously throughout building and at central control unit.

.4 Transmit signal to fire control room.

.5 Cause air conditioning and ventilation fans to shut down or to function to provide required control of smoke movement.

.6 Cause fire doors and smoke control doors, if normally held open, to close automatically.

.7 Cause elevators to return to floor of egress, or to alternate floor, as required.

2.2.2 Acknowledging alarm: indicated at central control unit.

2.2.3 Ensure that it is possible to silence signals by "alarm silence" switch at control unit, after 60 seconds period of operation.

2.2.4 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.

2.2.5 Actuation of supervisory devices to:

.1 Cause electronic latch to lock-in supervisory state at central control unit [and data gathering panel/transponder].

.2 Indicate respective supervisory zone at central control unit and at [remote annunciator] [display].

.3 Cause audible signal at central control unit to sound.

.4 Activate common supervisory sequence.

2.2.6 Resetting alarm or supervisory device not to return system indications/functions back to normal until control unit has been reset.

2.2.7 Trouble on system to:

.1 Indicate circuit in trouble at central control unit.

.2 Activate "system trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.

2.2.8 Trouble on system: suppressed during course of alarm.

2.2.9 Trouble condition on any circuit in system not to initiate alarm conditions.

2.3 CONTROL PANEL

2.3.1 Central control unit (CCU).

.1 Suitable for DCLA communication style: to CAN/ULC-S524.

.2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.

.3 Minimum capacity of 250 addressable monitoring and 250 addressable control/signal points.

.4 System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for troubles. Possible to assign control priorities to control points in system to guarantee operation or allow emergency override as required.

.5 Integral power supply, battery charger and standby batteries.

.6 Basic life safety software: retained in non volatile Erasable Programmable Read-Only-Memory (EPROM). Extra memory chips: easily field-installed. Random-Access-Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions (i.e. zone labels, priorities) and changing of system operation software.

.7 Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.

.8 Communication between nodes in networked system to be supervised, DCLA. Should communications fail between any 2 nodes, other nodes on loop to continue to communicate with each other and programmed functions on communicating nodes to continue operating. Support up to 2 RS-232-C I/O ports. CCU output: parallel ASCII.

.9 Equipped with software routines to provide Event-Initiated-Programs (EIP); change is status of one or more monitor points, may be programmed to operate any or all of system's control points.

.10 Software and hardware to maintain time of day, day of week, day of month, month and year.

2.4 POWER SUPPLIES

2.4.1 120 V, 60 Hz as primary source of power for system.

2.4.2 Voltage regulated, current limited distributed system power.

2.4.3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.

2.4.4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.

2.4.5 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.

2.4.6 Standby batteries: sealed, maintenance free.

2.4.7 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

2.5 INITIATING/INPUT CIRCUITS

2.5.1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLA configuration to central control unit.

2.5.2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.

2.5.3 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".

2.5.4 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLA configuration to central control unit.

2.5.5 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".

2.6 ALARM OUTPUT CIRCUITS

2.6.1 Alarm output circuit: connected to signals, wired in class B configuration to central control unit.

.1 Signal circuits' operation to follow system programming; capable of sounding horns] continuously]. Each signal circuit: rated at 2 A, 24 VDC; fuse-protected from overloading/overcurrent.

.2 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

2.7 AUXILIARY CIRCUITS

2.7.1 Auxiliary contacts for control functions.

2.7.2 Actual status indication (positive feedback) from controlled device.

2.7.3 Alarm on system to cause operation of programmed auxiliary output circuits.

2.7.4 2 sets of separate contacts for elevator capture to main floor of egress and to alternate floor of egress.

2.7.5 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.

2.7.6 Fans: stagger-started upon system reset; timing circuit to separate starting of each fan or set of fans connected to auxiliary contact on system.

.1 Timing circuit: controlled by CCU.

2.7.7 Auxiliary circuits: rated at 2 A, 24 Vdc or 120 Vac, fuse-protected.

2.8 WIRING

2.8.1 Multi-conductor cable assemblies with dedicated bonding wire CSA FAS 105 and FT4 rated. Standard of Acceptance: Nexans Securex II.

2.8.2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.

2.8.3 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.

2.8.4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.

2.8.5 Fire alarm cables to be run in EMT conduit unless indicated otherwise.

2.9 MANUAL ALARM STATIONS

2.9.1 Addressable manual pull station.

.1 Pull lever, break glass rod, surface or semi-flush wall mounted type, single action, single stage, electronics to communicate station's status to addressable module/transponder over 2 wires and to supply power to station. Station address to be set on station in field.

2.10 AUTOMATIC ALARM INITIATING DEVICES

2.10.1 Heat detectors, fixed temperature, non- restorable, rated 57 degrees C.

2.10.2 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57 degrees C, rate of rise 8.3 degrees C per minute.

.1 Electronics to communicate detector's status to addressable module/transponder.

.2 Detector address to be set on detector in field.

2.10.3 Addressable smoke detector.

.1 Ionization and photo-electric type.

.2 Electronics to communicate detector's status to addressable module/transponder.

.3 Detector address to be set on detector in field.

2.10.4 Addressable variable-sensitivity smoke detectors.

.1 Ionization and photo-electric] type.Electronics to communicate detector's status to addressable module/transponder.

.2 Detector address to be set on detector in field.

.3 Sensitivity settings: 3 settings, determined and operated by control panel. No shifting in detector sensitivity due to atmospheric conditions (dust, dirt) within certain parameters.

.4 Ability to annunciate minimum of 2 levels of detector contamination automatically with trouble condition at control panel.

2.11 AUDIBLE SIGNAL DEVICES

2.11.1 Horns: 94 db, semi-flush mounted in finished areas, 24 V dc.

2.11.2 Exterior horns to be weatherproof design, mounted in PVC yard hood.

2.12 VISUAL ALARM SIGNAL DEVICES

2.12.1 Strobe type: flashing white, 24 V dc.

2.12.2 Designed for surface mounting on [ceiling] [walls] [as indicated].

2.12.3 Semi-flush mounted in finished areas.

2.13 END-OF-LINE DEVICES

2.13.1 End-of-line devices to control supervisory current in signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel.

2.14 REMOTE ANNUNCIATORS

2.14.1 LCD remote type annunciator providing information similar to that on control panel display. Locate as indicated.

2.15 GRAPHIC DISPLAY

2.15.1 Provide passive graphic display, to be mounted adjacent to the main fire alarm control panel. Plastic laminate type, black artwork on white background; approximate size: 600x600 mm.

2.16 AS-BUILT RISER DIAGRAM

2.16.1 Fire alarm system riser diagram: in glazed frame minimum size 600 x 600 mm.

2.16.2 Provide complete riser diagram indicating all devices in relative position on communications loop. Indicate each device location by grid reference and room name.

2.16.3 Locate riser diagram in electrical room.

2.17 ADDRESSABLE CONTROL/MONITOR MODULES

2.17.1 Addressable modules with address set in the field for control/monitoring of external circuits.

2.17.2 Applications: ventilation unit shut down, sprinkler device monitoring

2.18 ISOLATION MODULES

2.18.1 Isolation modules for segmenting of fire detecting loops if required.

2.19 ACCEPTABLE MANUFACTURERS

2.19.1 Acceptable manufacturers shall be:

.1 Mircom

.2 Simplex Grinnell

.3 Edwards

.4 Notifier

3 EXECUTION

3.1 INSTALLATION

3.1.1 Install systems in accordance with CAN/ULC-S524.

3.1.2 Run all fire alarm wiring in conduit.

3.1.3 Install central control unit and connect to ac power supply, standby power.

3.1.4 Install manual alarm stations and connect to alarm circuit wiring.

3.1.5 Locate and install detectors and connect to alarm circuit wiring. Mount detectors more than 1 m from air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.

3.1.6 Connect alarm circuits to main control panel.

3.1.7 Install horns and visual signal devices and connect to signalling circuits.

3.1.8 Connect signalling circuits to main control panel.

3.1.9 Install end-of-line devices at end of signalling circuits.

3.1.10 Install remote annunciator panels if required and connect to annunciator circuit wiring.

3.1.11 Install door releasing devices if required.

3.1.12 Install remote relay units to control fan shut down.

3.1.13 Sprinkler system: wire alarm and supervisory switches and connect to control panel.

3.1.14 Room detection system.

.1 Install detectors. Make necessary connections between room detection panel and main fire alarm panel.

.2 Locate and install audible signals and visual alarms.

.3 Connect fire suppression systems to control panel.

3.1.15 Splices are not permitted.

3.1.16 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.

3.1.17 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.

3.1.18 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.

3.2 FIELD QUALITY CONTROL

3.2.1 Perform tests in accordance with Section 26 05 00 - General Electrical Requirements and CAN/ULC-S537.

3.2.2 Fire alarm system:

.1 Test such device and alarm circuit to ensure manual stations, thermal and smoke detectors and sprinkler system transmit alarm to control panel and actuate [general alarm and ancillary devices.

.2 Check annunciator panels to ensure zones are shown correctly.

.3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems.

.4 Addressable circuits system style DCLA:

.1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

.2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

END OF SECTION

SECTION 33 56 13
ABOVEGROUND FUEL STORAGE TANKS
TABLE OF CONTENTS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGL Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

REGISTERED PROFESSIONAL ENGINEER
K.H.Q. JEWER
SIGNATURE
Dec 6, 2013
DATE
PROVINCE OF NEWFOUNDLAND

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 23 11 13 – Facility Fuel-Oil piping

.2 Section 23 11 14 – Fuel Storage Tank Electronic Monitoring Systems.

.3 Section 26 05 00 – General Electrical Requirements.

.4 Section 26 05 28 – Grounding – Secondary.

1.2 REFERENCES

1.2.1 American National Standards Institute (ANSI):

1.2.1.1 ANSI/NFPA-329, Handling Underground Releases of Flammable and Combustible Liquids.

1.2.1.2 ANSI/API 650, Welded Steel Tanks for Oil Storage.

1.2.2 American Petroleum Institute (API):

1.2.2.1 API STD 653, Tank Inspection, Repair, Alteration, and Reconstruction.

1.2.3 Canadian Council of Ministers of the Environment (CCME):

1.2.3.1 CCME-PN1326, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.

1.2.4 Department of Justice Canada (Jus):

1.2.4.1 Canadian Environmental Protection Act,(CEPA).

1.2.5 Canadian Standards Association (CSA)/CSA International:

1.2.5.1 CAN/CSA-B139, Installation Code for Oil Burning Equipment.

1.2.6 The Master Painters Institute (MPI):

1.2.6.1 Architectural Painting Specification Manual.

1.2.7 Nalcor Energy Engineering Directive # CF-ED-004 – Diesel System Installation and Abandonment Engineering Directive.

1.2.8 National Research Council/Institute for Research in Construction:

1.2.8.1 NRCC 38727, National Fire Code of Canada (NFC).

1.2.9 Newfoundland and Labrador:

1.2.9.1 Regulation 58/03, Storage and Handling of Gasoline and Associated Products Regulations.

1.2.10 Transport Canada (TC):

1.2.10.1 Transportation of Dangerous Goods Act (TDGA).

1.2.11 Underwriters' Laboratories of Canada (ULC):

1.2.11.1 ULC/ORD. C 142.5 “Concrete Encased Steel Aboveground Tank Assemblies for Flammable and Combustible Liquids”.

1.2.11.2 ULC-S601, Aboveground Horizontal Shop Fabricated Steel Tanks.

1.2.11.3 CAN/ULC-S602, Aboveground Steel Tanks for Fuel Oil and Lubricating Oil.

1.2.11.4 CAN/ULC – S653 “Aboveground Steel Contained Tank Assemblies for Flammable and Combustible Liquids”.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Submit shop drawings in accordance with Exhibit 4 – supplier Document Requirements List.

1.3.2 Indicate details of construction, appurtenances, installation, and leakage detection system.

1.3.3 Shop drawings to detail and indicate following as applicable to project requirements. Submit manufacturers product data to supplement shop drawings.

1.3.3.1 Size, materials and locations of ladders, ladder cages, catwalks and lifting lugs.

1.3.3.2 Tank capacity, size and location of fittings.

1.3.3.3 Environmental compliance package accessories.

1.3.3.4 Decals, type size and location.

1.3.3.5 Accessories: provide details and manufacturers product data.

1.3.3.6 Size, material and location of manholes.

1.3.3.7 Size, materials and locations of railings, stairs, ladders and walkways.

1.3.3.8 Finishes.

1.3.3.9 Electronic accessories: provide details and manufacturers product data.

1.3.3.10 Insulation types, locations and RSI values.

1.3.3.11 Piping, values and fittings: type, materials, sizes, piping connection details, valve shut-off type and location.

1.3.3.12 Anchors: description, material, size and locations.

1.3.3.13 Level gauging: type and locations.

1.3.3.14 Ancillary devices: provide details and manufacturer's product data.

1.3.3.15 Leak detection system, type and locations, and alarm system.

1.3.3.16 Grounding and bonding: provide details of design, type, materials and locations.

1.3.3.17 Corrosion protection: provide details of design, type, materials and locations.

1.3.3.18 Field-erected AST overfill-protection systems: provide details of design, type, materials and locations.

1.3.3.19 Containment system for spills and overfills: provide details, materials used, and locations.

1.3.4 Provide maintenance data for tank appurtenances and leakage detection system for incorporation into manual specified in Exhibit 4 – Supplier Document Requirements List.

PART 2 PRODUCTS

2.1 CONCRETE ENCASED STEEL ABOVEGROUND FUEL OIL STORAGE TANK (DOUBLE WALL)

2.1.1 Provide packaged, factory fabricated and tested fuel oil storage tank, as specified.

2.1.2 Fuel oil storage tank and fuel transfer piping shall meet the requirements of Newfoundland and Labrador Regulation 58/03, Storage and Handling of Gasoline and Associated Products Regulations, CCME and National Fire Code.

2.1.3 Tank shall be tested and listed in accordance with the following:

2.1.3.1 UL-142, aboveground steel tanks for flammable and combustible liquids.

2.1.3.2 UL-2085, two-hour furnace fire test and two hour simulated pool fire test for insulated and protected tanks.

2.1.3.3 UL-2085 and UFC test Standard (Article 79 or Appendix # A-II-F-1, for both Vehicle Impact Protection and Projectile Resistance).

2.1.3.4 UL-2085, Protected aboveground tanks for flammable and combustible liquids.

2.1.3.5 UL-2085, Non-Metallic Secondary Containment protected tanks for flammable and combustible liquids with secondary containment Emergency Venting by “Form of Construction”.

2.1.3.6 CAN/ULC – S601 (ORD – 142.18), Standard for shop fabricated steel aboveground horizontal tanks for flammable and combustible liquids.

2.1.3.7 CAN/ULC – S655 (ORD – C 142.16) standard for protected aboveground tank assemblies for flammable and combustible liquids.

2.1.3.8 CAN/ULC – (ORD – C 142.5), Standard for concrete encased aboveground tank assemblies for flammable and combustible liquids.

2.1.3.9 CAN/ULC – (ORD – C 142.16), the furnace burn requirements for two hour fire rating.

2.1.3.10 CAN/ULC – (ORD – C 142.25), the open (pool) fire testing for two-hour flammable liquid fire test.

2.1.3.11 CAN/ULC – (ORD – C 142.23), for aboveground tanks for used oil.

2.1.3.12 The requirement for Uniform Fire Code (UFC) for two-hour (firewall) test.

2.1.3.13 To be tested and certified by the California Air Resources Board (CARB) for Balance Phase 1 and Phase II Vapor Recovery including methanol and ethanol.

2.1.3.14 High Explosive (HE) Blast Resistance: The tank system design shall be the subject of a Blast Effects Analysis (BEA) for resistance under the following blast load scenarios:

2.1.3.14.1 22.7 kg HE man-portable improvised explosive device (MPIED) at the standoff distance of 1.52 meters.

2.1.3.14.2 227 kg HE vehicle-born improvised explosive device (VBIED) at the standoff distance of 6.1 meters.

2.13.14.3 A vapor cloud explosive (VCE) with a load of 68.95 kPa.

2.13.14.4 The BEA shall conclude that the tank system will resist the explosive loads and remain intact, without failure of the primary tank or expectation of leakage. Movement of the tank shall not exceed 50 mm. The engineering consultants performing the BEA shall be a nationally recognized firm with over 10 years' experience offering comprehensive services related to blast and impact effects analysis, explosive safety design, vulnerability assessments and threat mitigation.

2.1.4 Tank Construction:

2.1.4.1 The primary steel tank shall be rectangular in shape and have continuous welds on all exterior seams, manufactured in accordance with UL listing requirements and UL standard 142.

2.1.4.2 The primary steel tank shall be pressure tested at 34.5 kPa for 24 to 48 hours.

2.1.4.3 The primary steel tanks shall have normal and emergency vent system as per NFPA 30 Code Requirements and National Fire Code Requirements.

2.1.4.4 The protected and insulated AST system shall have a thru-tank leak detector tube to allow for physical checkup monitoring capability between the primary and the secondary containment. The leak detector tube shall be capable of accepting an interstitial leak detection sensor from the fuel storage tank electronic monitoring system specified in section 23 11 14. – Fuel Storage Tank Electronic Monitoring Systems.

2.1.4.5 The primary steel tank shall be pressurized at 34.5 kPa during concrete encasement.

2.1.4.6 The outer surface of the primary steel tank shall be covered by a minimum of 6.4mm thick Styrofoam insulation panels.

2.1.4.7 The secondary containment shall be impervious to corrosion, including damage or failure due to microbial infestation. The secondary containment shall consist of a 0.76mm thick High-Density Polyethylene membrane enclosing the steel tank and insulation material.

2.1.4.8 The primary steel tank and the secondary containment shall be encased in 150mm monolithic reinforced concrete, with minimum design strength of 27.5 and 34.5 MPa at 28 days depending on the tank size. The concrete design shall include the following for long-term durability: air entertainment, water reducing admixture, and steel reinforcement. Concrete encasements with seams will not be approved.

2.1.4.9 The protected and insulated AST system shall be of concrete exterior and a continuous and visually verifiable monolithic pour on top, bottom, ends, and sides and contain no cold joints or heat sinks. The AST must be shop fabricated and tested in accordance with the UL listing.

2.1.4.10 No steel or insulating material shall come in contact with the concrete or other corrosive material.

2.1.4.11 All openings shall be from the top only.

2.1.4.12 All exposed metal with the exception of stainless steel must be powder coated to inhibit corrosion.

2.1.4.13 The protected and insulated AST system shall include a 56.7 liter powder coated or stainless steel, UL listed spill containment sump, and shall include a normally closed valve to release spilled product into the primary steel tank. Spill containment which routes the spilled product into the interstitial area will not be approved. Containment sump shall be designed, built and approved in conformance with ORD C 107.21 – Under Dispenser Sumps. Spill containment shall also include a fill port with a tight fitting, locking fill cap. Fill port shall be equipped for attachment of a liquid/vapor tight connection when filling.

2.1.4.14 The protected and insulated AST system shall have a coated concrete exterior to resist weather and reflect sunlight.

2.1.4.15 The protected and insulated tank system shall be warranted by the manufacturer against defects in material or workmanship for 30 years following the delivery of the tank.

2.1.4.16 The protected and insulated AST systems design shall have been in use for a minimum of twenty (20) years.

2.1.4.17 The protected and insulated AST system shall have two (2) bolts for connecting grounding conductors for lightning protection in accordance with NFPA 780 and the National Fire Code of Canada.

2.1.4.18 Tank shall be equipped with an overfill protection device suitable for aboveground fuel oil storage tanks supplied under pressure by hose and nozzle from a fuel oil pumper truck. Device shall be in accordance with CCME and ORDC 58.15 “Overfill Protection Devices for Flammable Liquid Storage Tanks”.

2.1.4.19 Tank shall be suitable for and shall be equipped with monitoring ports for electronic fuel oil leak detection of the interstitial space and shall include a nipple suitably sized to accept a magnestrictive probe for level sensing and inventory control. Tank shall also be equipped with a separate port for the level sensing switch as monitored by the duplex pumping system. This port shall accept a 2” Male NPT fitting.

2.1.4.20 Liquid shall be able to be removed from the interstitial space.

2.1.4.21 Tank shall come equipped with a foot valve, drop tube and electric solenoid valve. The solenoid valve shall be controlled along with the duplex fuel oil pumping package by the liquid level in the fuel oil day tank located in the spillway generator building.

2.1.5 Accessories:

2.1.5.1 Access stair/platform c/w handrail for filling and inspection of tank.

2.1.5.2 Level gauge.

2.1.5.3 Emergency vent.

2.1.5.4 Dipstick and gauge chart. Dipstick to be tank mounted in lockable enclosure.

2.1.5.5 Lifting lugs.

2.1.5.6 Pipe support brackets on ends and top of tank.

2.1.5.7 600mm diameter inspection manway.

2.1.5.8 Normal vent.

2.1.6 Capacity:

2.1.6.1 Tank shall be sized for three (3) days operation of a 600kv diesel generator at prime running power 75% load.

2.1.6.2 Storage volume shall be 11,370 liters minimum.

2.1.7 Dimensions/Weight:

2.1.7.1 Length: 3429mm.

2.1.7.2 Width: 2438mm.

2.1.7.3 Height: 2222mm.

2.1.7.4 Weight (dry): 16136 kg.

2.1.8 Acceptable manufacturers: Convault 3000 LP or approved equal.

2.2 DOUBLE WALL DAY TANK

2.2.1 General:

2.2.1.1 Summary:

2.2.1.1.1 These specifications describe requirements for a fuel day tank system consisting of an indoor fuel tank and an Electronic Control module (ECM) to monitor the fuel level within the day tank. The fuel day tank system shall monitor the fuel level and provide alarms where specified within. The manufacturer shall design and furnish all materials and equipment to be fully compatible with electrical, environmental and space conditions of the site. It shall include all equipment to safely support the full demands of the generator set and be designed for unattended operation.

2.2.1.2 Codes and Standards:

2.2.1.2.1 The fuel day tank and all associated equipment and components shall be manufactured in accordance with the following applicable standards:

2.2.1.2.1.1 UL-142 Aboveground Flammable Liquid Tanks.

2.2.1.2.1.2 CAN/ULC-S601-07 Steel Aboveground Tanks for Flammable Combustible Liquids.

2.2.1.2.1.3 UL-508 Industrial Control Equipment (ECM).

2.2.1.2.1.4 American Welding Society (AWS) – Welders certified AWS standards D 1.1 / D 1.1M.

2.2.1.2.1.5 The day tank and all associated equipment and component shall be in accordance with CSA B139, and NFCC.

2.2.1.3 Manufacturer shall warrant material and workmanship for a minimum of 1 year from date of shipment.

2.2.2 Size:

2.2.2.1 Tank shall be sized for 8 hours operation of the generator set at standby 75% load rating. Refer to specification Section 23 32 13.04 – Diesel Electric Generating Units (Liquid Cooled) for Generator Details.

2.2.2.2 Capacity: 1325 Litres minimum.

2.2.3 Construction:

2.2.3.1 Fuel Day Tank shall be made of heavy gauge steel construction. Tank shall include welded steel top cover. Tank shall be coated with rust inhibitor within the inner tank, primed and finish painted on the external tank. The installing contractor shall provide schedule 40, ASTM A 53, black iron pipe connections to the day tank fittings. All connections to be made with pipe union to facilitate tank service/removal. The tank shall include at a minimum the following fittings:

2.2.3.1.1 1” NPT generator supply.

2.2.3.1.2 1” NPT generator return.

2.2.3.1.3 NPT fitting for emergency vent, sized per the requirements of NFPA 30 and UL-142/ULC-S601.

2.2.3.1.4 1” NPT Overflow. (Return to main tank).

2.2.3.1.5 2” NPT normal vent.

2.2.3.1.6 4 ½ square inspection port with manual fuel level gauge and manual fill cap.

2.2.3.1.7 1” NPT basin drain.

2.2.3.1.8 1” NPT fuel oil inlet from main tank.

2.2.3.1.9 Day tank shall have a drop tube for generator supply connection.

2.2.3.1.4 Day tank shall be equipped with two ports to each accept a 2" MNPT fitting for the level control switches that control the duplex pumping system.

2.2.3.2 The tank shall be provided with atmospheric (normal) vent cap with screen and emergency pressure relief vent sized per the requirements of NFPA 30 and UL 142 / ULC S601.

2.2.3.2.1 Emergency vent cap shall be spring-pressure operated. Opening Pressure shall be 3.45kPa: full opening pressure 17.2 kPa. Flow rate shall be marked on top of each vent.

2.2.4 Design Requirements:

2.2.4.1 Fuel Day Tank Control and Status Display:

2.2.4.1.1 The microprocessor-based electronic control module (ECM) shall be supplied with the tank. The day tank fuel level control shall be completed by level sensing devices supplied with the duplex pumping system. The day tank ECM shall indicate fuel level and alarms only. The ECM shall receive a signal from a single electrical analog float sensor. The ECM shall be provided with the following indication: fuel level, alarm, function and existing warning and shutdown conditions and be located within a Type 1 zinc-plated enclosure for indoor use. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. All warnings shall be provided with normally open and normally closed, dry contacts for remote annunciation.

2.2.4.1.2 The following alarm and status conditions are required as a minimum:

2.2.4.1.2.1 Fuel Level Display.

2.2.4.1.2.1.1 Full – 100% Green LED Indicator.

2.2.4.1.2.1.2 95% - Green LED Indicator.

2.2.4.1.2.1.3 85% - Green LED Indicator.

2.2.4.1.2.1.4 75% - Yellow LED Indicator.

2.2.4.1.2.1.5 50% - Yellow LED Indicator.

2.2.4.1.2.1.6 25% - Yellow LED Indicator.

2.2.4.1.2.1.7 10% - Yellow LED Indicator.

2.2.4.1.2.1.8 Empty – 6% - Red LED Indicator.

2.2.4.1.3 Alarm Display:

2.2.4.1.3.1.1 High Fuel – 106% or greater capacity.

2.2.4.1.3.1.2 Low Fuel – 62% of Capacity.

2.2.4.1.3.1.3 Critical Low Fuel – 6% of Capacity.

2.2.4.1.3.1.4 Fuel within containment.

2.2.4.1.3.1.5 ECM Functional – Tank Fault.

2.2.4.1.3.2 Function Display:

2.2.4.1.3.2.1 Power on – This button activates the ECM after the Off button has been depressed. On any initial power up condition, after a power outage, the ECM shall be in an on condition.

2.2.4.1.3.3 Remote Contact Connections.

2.2.4.1.2.4.1 Tank Fault (ECM Functional)/Fuel in Containment (Shared) / Loss of Power.

2.2.4.1.2.4.2 Critical High Fuel – 106% or greater capacity.

2.2.4.1.2.4.3 Pump Running Option – Indicating supply pump is in operation.

2.2.4.1.2.4.4 High Fuel – 106% if capacity.

2.2.4.1.2.4.5 Low Fuel – 62% of capacity.

2.2.4.1.2.4.6 Critical Low Fuel – 6% of capacity.

2.2.4.1.2.4.7 Pump control for remote mounted pumps.

2.2.4.1.2.4.8 Shut down of remote mounted pumps at 90% of capacity.

2.2.4.1.2.5 Mode:

2.2.4.1.2.5.1 On – Power available to ECM.

2.2.4.1.2.5.2 Off – Turns off power with ECM.

2.2.4.1.2.6 Start-up test switch shall test contacts for high, low, critical low, ECM functional and containment switch to assure wiring of remote contacts is correct.

2.2.5 Fuel Containment:

2.2.5.1 The fuel day tank shall include a welded steel containment basin to prevent escape of fuel in the event of a tank rupture, sized at a minimum of 150% of the tank capacity. The basin shall be primed and finish painted.

2.2.5.1.1 Containment Basin:

2.2.5.1.1.1 The containment basin shall consist of a welded heavy gauge steel structure. The containment tank shall feature a welded steel top with an emergency pressure relief vent sized per the requirements of NFPA 30, UL 142 / ULC S601 and NFC. Emergency vent cap shall be spring-pressure operated. Opening pressure shall be 3.45 kPa; full opening pressure shall be 17.2 kPa. Limits shall be marked on top of each vent. Leak detection switch shall be wired into the electronic control module (ECM). This shall indicate an alarm condition and will shut down the remote supply pump(s) in case of a fuel leak into the containment basin.

2.2.6 Acceptable manufacturers: Tramont TRS or approved equal. Provide day tank package with control panel and without integral pump.

2.3 GROUNDING AND BONDING

2.3.1 Provide grounding for tank.

2.3.2 To Section 26 05 28 – Common Grounding - Secondary.

2.4 FOOT VALVE

2.4.1 To be provided within main tank and day tank.

2.4.2 As specified in Specification Section 23 11 13 – Facility Fuel-Oil Piping.

2.5 METALLIC PIPING, VALVES, AND FITTINGS

2.5.1 In accordance with Section 23 11 13 – Facility Fuel-Oil Piping.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Install main and day tank and all piping, fittings, accessories and associated systems in accordance with Nalcor Engineering Directive and National Fire Code of Canada, CCME, CSA B139 (as applicable), Newfoundland and Labrador Regulation 58/03, Storage and Handling of Gasoline and Associated

Products Regulations, provincial regulations and manufacturer's recommendations.

3.1.2 Position tank(s) using lifting lugs and hooks, and where necessary use spreader bars. Do not use chain in contact with tank walls.

3.1.3 Provide all registrations and permits as required by Provincial regulations.

3.1.4 All tank venting shall terminate outside the building and in accordance with CCME, NFC, CSA B139 and CNRL 58/03.

3.2 FIELD QUALITY CONTROL

3.2.1 Test tank(s) in accordance with Newfoundland and Labrador Regulation 58/03, Storage and Handling of Gasoline and Associated Products Regulations.

3.2.2 Test tank(s) for leaks to requirements of authority having jurisdiction and in presence of authority having jurisdiction.

3.2.3 Commission in accordance with Section 26 05 00-General Electrical Requirements.

3.3 TOUCH-UP

3.3.1 Where coating is damaged touch-up original coating material.

3.4 LEVEL GAUGE SYSTEM

3.4.1 Provide leak and vapour proof caulking at connections.

3.4.2 Calibrate system.

3.5 LEAK DETECTION SYSTEM

3.5.1 Install in accordance with manufacturer's recommendations. Refer to specification Section 23 11 14 – Fuel Storage Tank Electronic Monitoring Systems.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 48 13 10
CH0032	**GENERAL MECHANICAL REQUIREMENTS**	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 48 13 10
GENERAL MECHANICAL REQUIREMENTS

APPENDICES:

APPENDIX A – EQUIPMENT NUMBERS

PART 1 GENERAL

1.1 DESCRIPTION AND SCOPE OF WORK

1.1.1 This specification details the general technical requirements for the supply and install of the Powerhouse and Spillway Hydro-Mechanical Equipment for the Muskrat Falls hydroelectric power station.

1.1.2 This document shall be read in conjunction with “Lower Churchill Project Muskrat Falls Hydroelectric Development – CH0032 - Supply and Install Powerhouse and Spillway Hydro-Mechanical Equipment - Scope of Work - MFA-SN-CD-2000-ME-SP-0001-01/505573-3321-45EW-0001”, Part 2, Exhibit 1.

1.2 DEFINITIONS

1.2.1 Diversion Phase

.1 The period during project construction that the river is diverted through the Spillway and maintained at the diversion headpond level, before the reservoir is impounded to full supply level for operation of the Powerhouse;

1.2.2 Full Supply Level (FSL)

.1 Operating reservoir level;

1.2.3 Diversion Headpond Level (DHL)

.1 The reservoir water level that is maintained during the Diversion Phase while the facility is constructed;

1.2.4 Probable Maximum Flood (PMF)

.1 The maximum flood the Muskrat Falls facility is designed for;

1.2.5 Tailwater Level (TWL)

.1 The range of water levels in the river downstream of the facility;

1.2.6 Gate or Stoplog Orientation

.1 With the water passage dewatered;

.1 an upstream seal or skinplate is located on the wet side,

.2 a downstream seal or skinplate is located on the dry side.

1.3 ABBREVIATIONS

AAIST	Association for Iron and Steel Technology
ABMA	American Bearing Manufacturers Association
AGMA	American Gear Manufacturers Association
AISC	American Institute of Steel Construction
AISE	Association of Iron and Steel Engineers
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASD	Allowable Stress Design
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BHN	Brinell Hardness Number
CAD	Computer Aided Drafting
CCTV	Closed Circuit Television
CEMA	Canadian Electrical Manufacturer's Association
CGSB	Canadian Government Specifications Board
CMAA	Crane Manufacturers Association of America
COG	Center of Gravity
CP	Corrosion Protection
CRN	Change Request Notice
CSA	Canadian Standards Association
CWB	Canadian Welding Bureau
DHL	Diversion Headpond Level

DPR	Daily Progress Reports
EEMAC	Electrical and Electronic Manufacturers Association of Canada
FAT	Factory Acceptance Test
FMEA	Failure Mode and Effects Analyses
FSL	Full Supply Level
HDPE	High Density Polyethylene
HIRA	Hazard Identification Risk Assessment
HS&E	Health, Safety, and Environmental
IEEE	Institute of Electrical and Electronics Engineers
IRN	Inspection Release Note
ISO	International Organization for Standardization
IT	Information Technology
ITP	Inspection and Test Plan
LCP	Lower Churchill Project
LSD	Limit States Design
LSL	Low Supply Level
MCC	Mechanical Completion Certificate
MCITR	Mechanical Completion Inspection Test Records
MOC	Management of Change
MSDS	Material Safety Data Sheet
NBCC	National Building Code of Canada
NCR	Non-conformance Report
NDT	Non-Destructive Testing
NEMA	National Electrical Manufacturers Association

NLOHS	NL Occupational Health and Safety
NPT	National Pipe Thread
OSHA	Occupational Safety and Health Administration
PHA	Process Hazard Analysis
PMF	Probable Maximum Flood
PTFE	Polytetrafluoroethylene
RAM	Reliability and Maintainability
RTD	Resistance Temperature Detectors
S.I.	Systeme International
SAE	Society of Automotive Engineers
SCM	Supply Chain Management
SDRL	Contract Data Requirements List
SIT	System Integration Testing
SSPC	Steel Structures Painting Council
USACE	US Army Corp of Engineers

1.4 DOCUMENTATION

.1 Documentation shall comply with Part 2, Exhibit 4 - Supplier Document Requirement List and as described below.

D2 **1.4.1** Not used.

1.5 RESPONSIBILITY

D2 **1.5.1** The specifications are not intended to describe in complete detail the methods of construction of the various parts of the work, and remains the responsibility of Contractor, to furnish equipment which shall meet the requirements of the Agreement.

1.5.2 Engineer has determined the general arrangement of the facility including water passage dimensions, the type and location of gates, their mode of operation, the first stage concrete blockout dimensions, and the type and general arrangement of the hoisting mechanisms, which shall not be modified.

1.5.3 Contractor shall carry out final design of the equipment described in these Specifications and supply all necessary engineering for fabrication, erection and commissioning until final acceptance of equipment.

1.5.4 The design and fabrication, erection, testing, commissioning, and operation shall conform to the basic criteria, codes and standards described herein and shall not be modified without acceptance of Engineer.

1.5.5 The dimensions of pockets or slots provided in the first stage concrete and all other dimensions of the structure shall not be modified.

D1 **1.5.6** The location and the physical characteristics of the anchors placed in the first stage concrete shall be determined by Contractor and coordinated with the Engineer, and first stage (primary) concrete and reinforcing drawings before the first stage concrete anchor concept is finalized and Accepted by the Engineer.

D2 **1.5.7** Not used.

1.6 ENGINEERING CERTIFICATION

D1 **1.6.1** All design drawings and documents shall be sealed by a professional engineer registered in the Province of Newfoundland and Labrador.

1.6.2 All temporary installation electrical drawings shall be submitted for Engineer's review and Acceptance.

1.6.3 All design drawings and documents; for Site construction work, such as formwork, scaffolding, tooling and rigging, lift plans etc., for all permanent platforms/walkways/handrails, for all fall restraint/protection, for spillway towers, shall be sealed by a professional engineer who is a member of Newfoundland and Labrador Professional Engineers and Geoscientists Association.

PART 2 DESIGN REQUIREMENTS

2.1 APPLICABLE STANDARDS

2.1.1 Codes and Standards

.1 All Work shall be designed, manufactured, tested and supplied in accordance with the latest edition of all applicable Standards and Regulations listed in the relevant sections. In case of any conflict between Standards, such conflict shall be brought to the attention of Engineer for clarification and determination.

.2 Contractor shall be responsible for bringing to the attention of Engineer the impact of any subsequent revisions or published amendments to the referenced codes, standards and regulations, which have a bearing on execution of the Work.

.3 In addition, the layouts shall comply with any laws or regulations of local authorities, and in the event of conflicting requirements, the most stringent shall apply.

2.2 HYDRAULIC DATA AND GENERAL DIMENSIONS

2.2.1 Main Hydrologic and Hydraulic Parameters. The main hydrologic and hydraulic parameters used for the project are as follows:

.1	Design Flow – Probable maximum flood:	25,060 m³/s
.2	Reservoir level for PMF:	El. 45.10 m
.3	Reservoir Full Supply Level (FSL):	El. 39.0 m
.4	Reservoir Low Supply Level (LSL):	El. 38.50 m
.5	Reservoir level for landside generated wave (from FSL):	El. 41.00 m
.6	Reservoir level when overtopping North Dam (from FSL): (at plant rated flow with Spillway Gates closed)	El. 41.5 m
.7	Diversion Phase reservoir Headpond Level (DHL) winter:	El. 25.00 m
.8	Diversion Phase reservoir Headpond Level (DHL) summer:	El. 24.00 m
.9	Minimum tailwater level:	El. 1.44 m
.10	Maximum normal Tailwater Level (TWL) (open water):	El. 3.64 m
.11	Maximum tailwater level (winter with ice cover):	El. 7.00 m
.12	Tailwater level for PMF:	El. 12.28 m

2.2.2 Spillway Structure (River Diversion Phase)

.1	Water passage width at gates:	10.50 m
.2	Top of embedded guide's elevation:	El. 45.50 m (nominal)
.3	Furthest upstream Stoplog sill elevation:	El. 5.00 m

.4	Upstream Stoplog sill elevation:	Not Installed
.5	Spillway Gate sill elevation:	El. 5.00 m
.6	Downstream Stoplog sill elevation:	El. 4.10 m
.7	Top of furthest upstream stoplogs elevation (DHL):	El. 28.50 m
.8	Top of furthest upstream stoplogs elevation (FSL):	El. 40.95 m

2.2.3 Spillway Structure (Operation Phase)

.1	Water passage width at Intake Gates:	10.50 m
.2	Top of embedded guide's elevation:	El. 45.50 m (nominal)
.3	Upstream Stoplog sill elevation:	El. 17.80 m
.4	Spillway Gate sill elevation:	El. 18.00 m
.5	Downstream Stoplog sill elevation:	El. 4.10 m
.6	Top of upstream stoplogs elevation:	El. 41.10 m
.7	Top of Spillway Gate elevation:	El. 41.00 m
.8	Top of downstream stoplogs elevation:	El. 15.00 m

2.2.4 Powerhouse Intake Structure

.1	Number of turbine/generator units:	4
.2	Number of intake hydraulic passages per unit:	3
.3	Width of structure:	142.00 m
.4	Unit spacing:	35.50 m
.5	Deck elevation:	El.45.50 m

.6 Unit rated flow: 640 m³/s

2.2.5 Intake Trashracks

.1 Width of hydraulic passages at trashrack: 7.05 m

.2 Sill elevation: El.-2.20 m

.3 Top of embedded guides elevation: El. 45.50 m

.4 Velocity at gross area of trashracks: 1.1 m/s

.5 Top of embedded guide's elevation: El. 45.50 m (nominal)

2.2.6 Intake Gates

.1 Width of hydraulic passages at Intake Gates: 6.50

.2 Sill elevation: El. -6.08 m

.3 Top of embedded guide's elevation: El. 45.50 m (nominal)

2.2.7 Intake Bulkhead Gates

.1 Width of hydraulic passages at bulkhead gates: 6.50

.2 Sill elevation: El. -3.70 m

.3 Top of embedded guide's elevation: El. 45.50 m (nominal)

2.2.8 Powerhouse Draft Tube Structure

.1 Number of Draft Tube hydraulic passages per unit: 2

.2 Width of hydraulic passages at stoplogs: 11.3125 m

.3 Sill elevation: El. -27.45 m

D2

.4 Lintel elevation (J seal bulb centre): El. -17.08

.5	Top of embedded guide's elevation:	El. 6.50 m (nominal)
.6	Top of maintenance gallery elevation:	El. 8.00 m (nominal)
.7	Top of walkway elevation:	El. 9.00 m (nominal)
.8	Length of Draft Tube gallery	156.60 m
.9	Powerhouse crane rail elevation	El. 12.20 m
.10	Crane rail centre distance	7.5 m

2.3 DESIGN LIFE

2.3.1 The hydro-mechanical equipment shall be conservatively designed to have the following minimum operating time before replacement:

.1	Protection, control and remote control equipment	20 years
.2	Ancillary mechanical and electrical systems	30 years
.3	Hoists, structures, and major components	50 years

2.4 ALLOWABLE STRESSES AND DEFLECTIONS

2.4.1 General

.1 Contractor shall be responsible for design of all components to the relevant standards, and prudent utility practice, for spillways and hydro-electric facilities but the following design criteria shall be used as a minimum guideline.

.2 All design criteria is this document is based on Allowable Stress Design (ASD) methodology. If Contractor would like to use Limit States Design (LSD) methodology as an alternative to ASD for some or all the design work then Contractor shall submit a proposal for Acceptance by Engineer explaining for each component methodology and all design criteria, with justification demonstrating that the proposed methodology and criteria meets all this specifications intended requirements. The LSD shall be based on CSA S16, CSA W59 and NBCC.

.3 Allowable stresses shall be based on the von Mises-Hencky criteria.

D1 **2.4.2** Not Used

D1 **2.4.3** Not Used

2.4.4 Not Used

2.5 CLIMATIC DESIGN CRITERIA

2.5.1 The following climatic data shall be used for the design of the Hydro-Mechanical Equipment unless indicated otherwise in the Technical Specifications.

Temperature	Air	Water
	Maximum: +40°C Minimum: -40°C	Maximum: +25°C Minimum: 0°C
Humidity	100%	
Snow Load	2.5 kN/ m^2	
Ice Cover on Exposed Surface	25 mm thick	
Wind Velocity for Structure Design (max.)	130 km/h	

2.5.2 Other Climatological Data is included in Exhibit 11 Company Supplied Documents, for reference.

2.6 NOISE LEVEL

2.6.1 D1 For permanently installed equipment such as hoist components, noise levels on individual equipment shall not exceed 80 dBA continuous (as opposed to impulsive noise or impact noise) measured at 1 meter from the equipment.

2.6.2 D1 When multiple pieces of equipment producing high noise level are required to be in close proximity and the resulting combined noise levels are above 85 dBA, engineered noise reduction enclosures shall be required to reduce overall noise levels to the permissible level of 85 dBA. Attenuation measures shall be proposed including acoustic enclosures, signs and barriers to ensure noise exposure meets the requirements of the CCOHS for the jurisdiction of Newfoundland and Labrador.

2.7 MAINTENANCE

2.7.1 The design of the hydro-mechanical equipment shall be such that replacement and general maintenance may be undertaken with a minimum of time and expense.

2.7.2 The layout of equipment shall be such that for routine maintenance the inspection, lubrication, adjustments and light repairs can be performed without the need of special equipment/tools, scaffolding, person lifts, etc., or disassembly of other equipment/structures to gain access.

2.8 EQUIPMENT LOCKOUT AND ISOLATION

2.8.1 All devices that could conceivably be required to be isolated for maintenance, protection of personal, access to equipment etc. shall be designed to be lockable and that the lockable location itself is safe to access. All energy sources related to the equipment to be maintained shall designed to be isolated and locked out.

2.8.2 Every device capable of being isolated and locked out shall be capable of being locked with a standard size padlock or a standard size scissor clip even if the device has a built in key lock. Each of these lockout points shall be capable of supporting the weight of many pad locks and scissor clips.

2.8.3 Devices that do have built in locks shall be provided with 4 sets of keys.

2.8.4 Where a blocking device is required as part of the isolation and lockout of equipment this device shall be design to withstand 150% of any load that could inadvertently be applied to it.

2.9 INTERCHANGEABILITY

2.9.1 The components serving the same functions shall be interchangeable.

2.9.2 This interchangeability shall be possible without refinishing of the replacement elements.

2.9.3 All mechanical and electrical apparatus and accessories serving the same functions shall be purchased from the same manufacturer.

2.10 PACKAGING AND TRANSPORT

2.10.1 Packaging and transport shall comply with Documentation, Packaging, Marking and Shipping Instructions, GP-5500-FO-01-E, in Part 2, Exhibit 11 – Company Supplied Documents and as specified below.

2.10.2 Handling and shipping requirements shall be taken into account during the design, and the parts shall be reinforced using cross bracing in order to avoid deformation during shipping, handling and installation.

2.10.3 All machined surfaces shall be protected against inadvertent damage during shipping, handling and installation.

2.10.4 All machined carbon steel surfaces shall be coated with a suitable rust preventative.

2.10.5 The design of components shall be such that these components can be fabricated in sections which conform to the shipping requirements of the Ministry of Transport or those of the railway companies, whichever is applicable.

2.10.6 All components shall be suitably indentified to facilitate delivery, off loading and possible temporary storage at site.

2.10.7 Small components being supplied and delivered for installation by Company's Other Contractor shall be crated with the part descriptions and quantities clearly indicated on the outside of the crate.

2.11 NAMEPLATES, EQUIPMENT MARKING AND TAGGING

2.11.1 General

.1 All equipment including gates, stoplogs, trashrack panels; as well as ancillary equipment, such as electrical panels, junction boxes, doors, fans/heaters etc. shall be identified and labelled, and shall be provided with equipment numbers to be provided by Company.

2.11.2 Hoists and Ancillary Equipment

.1 A nameplate shall be supplied for all hoisting equipment and mounted in a location Accepted by Engineer. The nameplate shall be easy to read and clearly show the following information:

.1 Contractor's name,

.2 Name or identification of equipment (to be provided by Company),

.3 Year of manufacture or installation,

.4 Rating particulars, hoisting limits, and general dimensions where applicable.

.2 In addition for all traveling hoists the rated loads shall be displayed on the hoists and sheave blocks in large characters visible from both sides.

.3 In addition to their nameplate all lifting beams and/or hook blocks shall have their Working Load Limit (WLL) displayed in large characters on both sides that are easily readable from the floor level or operating walkways.

.4 All information and instructions shall be in English.

.5 Hoist ratings shall be in metric tonnes and shall be spelled out in full on all devices.

2.11.3 Gates, Stoplogs, and Trashrack Nameplates

.1 Nameplates shall be provided and attached to the gates, stoplogs and trashrack panels.

.2 The nameplate shall be designed as follows:

(EQUIPMENT NAME/DESIGNATION)
(Equipment Number)
Weight _____tonnes
Serial No. ____ – Part No. ____
(Manufacturing Date) YYYY-MM

.3 Equipment shall have equipment numbers as provided by the Engineer.

.4 The nameplate shall be 0.5 mm stainless steel plates a minimum of 105 mm long by 60 mm high, with 4.5 mm high stamped lettering, and securely anchored to the equipment in a location that is easily accessible, but protected from damage due to operation or outside weather conditions when stored or when being transported.

.5 Nameplate lists shall be submitted to the Engineer for review and acceptance prior to manufacture of the nameplates.

.6 Where components must be installed in a specific order, the components shall be so identified with raised characters (by welding or bolted on) on the component side most likely to be visible to the installation crews, and the characters shall be a minimum of 150 mm high and painted to contrast the background.

2.11.4 Gates, Stoplogs and Trashrack Panel Marking

.1 In addition to the above nameplate the component designation for all gates and stoplogs shall be painted on with stencils on the side of the component most likely visible during normal operation with 150 mm high characters.

.2 For temporary equipment the designation, number, weight, installation sequence, and match mark lettering, shall be painted on with stencils using 150 mm high characters.

2.12 SPARE PARTS

.1 Contractor shall provide, maintain, and replenish all required capital spares and agreed recommended spares as required for completion of the Work, including commissioning spares.

.2 All spares as delivered to the Worksite shall be delivered to Company on completion of Work.

.3 A complete list of recommended spares shall be provided by Contractor for Acceptance by Engineer prior to supply.

.4 Required capital spares, as provided in accordance with the Technical Specification, shall be subject to replacement by Contractor at Contractor's sole cost should such capital spares be required for use in the completion of Work.

.5 All spare parts shall be interchangeable, with and of the same materials and quality, as the corresponding original parts as described in the specifications.

.6 Spares shall be complete with instruction manuals for the equipment, and for installation of all spares and accessories.

.7 All spare parts shall be suitably packaged and crated for long-term storage. Contractor shall provide storage instructions and an estimated shelf life for every part.

.8 Any fasteners/seals/keepers etc. that are required for the installation of the spare shall be provided with the spares.

2.13 CONSENTS, AUTHORIZATION AND PERMITS

.1 Contractor shall perform Work in compliance with the requirements of Exhibit 6 - Environment and Regulatory Compliance Requirements.

.2 Contractor shall obtain and maintain all other authorizations, permits, dispensations, consents and licenses, required by Applicable Laws to enable it to perform the Work and which are required to be or can be obtained in Contractor's name.

.3 In accordance with the Agreement, Contractor shall be responsible for customs clearance, import permits, Work validations, Work permits and operating licenses, and other requirements that are essential to the Work during all phases of the Work.

2.14 INTERFACES AND COORDINATION

.1 Contractor shall, as part of the services related to interface management, manage and coordinate all interfaces both internally and externally with Engineer, Contractors, Subcontractors and Company’s Other Contractors.

.2 Contractor shall appoint a technical interface coordinator who shall be responsible for management of interface activities as the Contractor’s focal point for interface coordination, communication, response, close out and reporting.

.3 The Engineer and Contractor coordinators shall manage all hard and soft interfaces during execution of the Work.

.4 Contractor shall establish a document control procedures defining how interface information is collected, maintained, tracked, controlled and documented.

.5 Contractor shall also provide standard formats for documents regarding interface management.

.6 Contractor shall be responsible for preparation and management of all interface documentation, including procedures, minutes of meetings, interface registers, datasheets and drawings.

.7 Contractor will ensure that interface management requirements outlined herein are included in all Subcontracts, such that the all interfaces provided by Subcontractors are properly coordinated.

2.15 SCHEDULING AND PLANNING

2.15.1 Contractor shall meet all planning and scheduling requirements for all Work in accordance with and as otherwise defined in the requirements of Exhibit 3 – Coordination Procedure.

D2 **2.15.2** The Contractor shall coordinate through the Engineer the execution of the Work and that of its Subcontractors with Company's Other Contractors involved in close proximity of its assigned work area. To this effect, Contractor shall review its schedule and make provisions for coordination of the Work to avoid any interference with the work of Company's Other Contractors and with the general orderly progress of the project.

2.15.3 When planning and executing the Work, Contractor shall take into consideration the following work by Company's Other Contractors:

.1 All civil works;

.2 All embedded elements required during the first phase of reinforced concrete placement;

.3 All balance of plant (BoP), erection of equipment, conduits, cables and piping not included in the Work; and

.4 All concurrent installation of plant electrical and mechanical equipment not included in the Work.

2.15.4 As may be required for execution of the project, Engineer may, from time to time, issue instructions to Contractor to ensure adequate coordination of the Work as a whole.

2.15.5 Contractor shall allow access at all times on the loading areas, and in close proximity of its assigned work area, for Company's Other Contractors.

2.16 LOGISTICS

D2 **2.16.1** Contractor shall be responsible for shipment and transportation of all Contractor's Items, material, equipment, Contractor Personnel, cargo and freight in Contractor's care, custody and control.

2.16.2 Contractor shall be responsible for logistics support during all phases of the Work in accordance with the Agreement, including the requirements of Exhibit 12 - Muskrat Falls Worksite Conditions.

D2 **2.16.3** Not used,

2.17 COMPANY SUPPLIED ITEMS

2.17.1 Contractor shall take receipt of Company supplied items defined in Exhibit 12 –Muskrat Falls Worksite Conditions prior to commencement of installation.

2.18 INSTALLATION CONSTRAINTS

2.18.1 Contractor shall comply with all of Engineer's requirements for construction at the Muskrat Falls Worksite and in accordance with Exhibit 12 – Muskrat Falls Worksite Conditions.

2.19 ELECTRICAL REQUIREMENTS

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2.19.1 Design to be completed in accordance with requirements of;

.1 Electrical divisions, supplemented by this section; and

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.2 CSA C22.1 and CSA C22.2.

PART 3 ENGINEERING

3.1 ENGINEERING - GENERAL

3.1.1 Contractor shall manage engineering activities in accordance with documentation included in Exhibit 3 – Coordination Procedure.

3.1.2 Contractor shall perform all design/engineering as required and provide all engineering documents, drawings, specifications, engineering data, reports, analyses, studies and anything necessary for the completion of the Work, including:

.1 Work required to enable Contractor and its Subcontractors to design, procure materials and equipment, and to fabricate, assemble, inspect, test, preserve, store, transport, offload, loadout, install and commission the Work in accordance with the requirements set forth in the Agreement;

.2 Verify that all Work to be Delivered meets the requirements set forth in the Agreement;

.3 Perform constructability analyses, hazard analyses and other such risk assessments as necessary to complete the Work;

.4 Provide all required procedures for testing, mobilization, installation, commissioning, demobilization, start-up, maintenance and operation;

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.5 Provide to Engineer all information required for interfaces;

.6 Provide all documentation and engineering data requested by Engineer;

.7 Acceptance of Company Supplied Documents including the documentation provided in Exhibit 11 – Company Provided Documents.

3.1.3 All engineering of the Work shall be performed by qualified Personnel and Contractor shall use the necessary tools, such as computers and recognized and verified computer programs, to perform the engineering Work in a professional and timely manner and in accordance with the Agreement, Applicable Laws and Good Utility Practice.

3.1.4 Engineer may, at its sole discretion Accept any or all of Contractor's engineering in accordance with the provisions of the Agreement however such Acceptance or lack thereof does not relieve Contractor of any of its obligations.

3.1.5 All engineering performed by Contractor and Subcontractors shall adhere to the requirements of the professional engineering body, "Professional Engineers and Geoscientists Newfoundland and Labrador".

D2 **3.2 NOT USED**

3.3 SYSTEM ENGINEERING

3.3.1 Contractor shall support system engineering for the Work. This will include:

.1 Co-ordination and verification of interfaces between Contractor, Subcontractors, Engineer and Company's Other Contractors;

D2 .2 Verification that the Work is free of defects; and

.3 Ensure that the Work is in compliance with the Agreement requirements.

3.3.2 Contractor shall clearly identify all internal interdependencies and all interdependencies between Engineer and Company's Other Contractors involved in the Work and comprising of matters pertaining to Delivery from one Worksite to another, installation and inter-discipline design documentation compatibility.

3.3.3 Contractor shall perform system engineering to verify system integrity when changes to the design occur.

3.3.4 Contractor shall ensure that Personnel in key positions, including, project engineers and the construction manager(s) specific to Worksite are participants in all phases of the Work. Contractor shall establish an effective engineering review process to achieve same.

3.3.5 Contractor shall verify the suitability of all tooling, installation aids and ancillary equipment, via analytical means and system integration testing.

3.4 DETAILED ENGINEERING

3.4.1 General

.1 Contractor shall perform all analyses and design required for completion of the Work, and shall produce all required engineering documents.

.2 Detailed engineering shall also include, all analyses required by Authorities and Engineer, in accordance with Agreement as necessary to ensure the Work is technically acceptable and fulfills all obligations of the Agreement.

.3 Any design changes required due to a failure to meet specification, shall be implemented as part of the Work and shall not constitute Change to the Work.

.4 Contractor shall prepare detailed specifications for the Work as a part of Contractor's detailed engineering.

.5 Contractor shall perform detailed engineering analysis at extreme and nominal conditions to support its designs and ensure that all criteria are met.

3.4.2 Tools

.1 Contractor shall develop, design and supply the required tools, necessary to perform the Work, as well as provide all documentation required for said tooling, all in accordance with the requirements of Appendix A - Technical Specifications of this Exhibit 1.

.2 All tools required for operation and maintenance of the Work shall become property of the Company on completion of the Work.

.3 Contractor shall ensure that all tools are fully refurbished prior to completion and handover of the Work to Company.

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3.4.3 Materials

.1 Not used.

.2 If material selection for specific components is not covered by the requirements outlined in Exhibit 1 – Scope of Work and its associated Appendices, Contractor is responsible for selection of a suitable material which is subject to Engineer Acceptance.

.3 Any substitution for the materials described by the listed standards shall be proven by a series of tests to be equal or superior to the standardized materials, and shall be subject to Acceptance by Engineer.

.4 Contractor shall provide, for Engineer review and Acceptance, details of records to be provided by Contractor to demonstrate that materials supplied meet Engineer's and Contractor's requirements.

3.4.4 Safety, Environmental Compliance and Reliability Analysis

.1 Contractor shall undertake safety, environmental compliance and reliability analysis of the Work to achieve the following objectives:

.1 Demonstrate that the Work is conducted in a safe manner and fulfills all obligations and requirements set forth by the Applicable Laws and the Agreement;

.2 Demonstrate that the Work is conducted in compliance with Applicable Laws and guidelines and conditions of environmental assessment release;

.3 Support detailed design decisions in the cases where alternative designs are considered or where the detailed design alters from original plans; and

.4 Identify critical components for specific follow-up or specific safety qualification programs.

.2 Contractor shall submit plans and procedures to demonstrate that safety and environmental considerations are built into the Work. The plans and procedures shall include, but not be limited to:

.1 Implementation and verification of all safety and environmental requirements into the Work through all phases of the Work including, installation, commissioning, start-up and operation; and

.2 Internal checklist and procedures for safety design review.

.3 Contractor shall conduct failure mode and effects analyses (FMEAs) on the Work.

.4 Contractor shall conduct reliability and maintainability (RAM) analysis for the Work.

.5 Contractor shall perform and attend preliminary hazard analysis (PHA), operability reviews, hazard identification and risk assessment (HIRA) and any other safety risk assessments as necessary for the Work. Such activities shall also meet the requirements of Company defined action tracking system.

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3.5 NOT USED

PART 4 STORAGE, PRESERVATION AND PREPARATION

4.1 STORAGE SECURITY AND PROTECTION

4.1.1 Contractor shall be responsible for all storage and security of the Work.

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4.1.2 Not used.

4.1.3 Contractor shall also provide protection to avoid damage to the Work during manufacturing, testing, loadout, transport, storage, lifting, and installation.

4.2 PRESERVATION AND MAINTENANCE

4.2.1 Contractor shall perform all tasks required to ensure preservation and maintenance of the Work.

4.2.2 Contractor shall develop preservation procedures and perform preservation activities for the Work.

4.2.3 Contractor shall ensure the preservation requirements of Subcontractors' equipment are maintained.

4.2.4 Contractor shall monitor the implementation and results of Contractor's and Subcontractors' preservation programs.

4.2.5 Contractor shall include requirements of preservation to Work performed by Subcontractors to ensure that Subcontractors provide the necessary information for preservation, storage, protection and maintenance of preservation for the equipment supplied.

4.3 PREPARATION FOR TRANSPORTATION

4.3.1 Contractor shall obtain Acceptance from Engineer prior to shipment of Work or any part thereof.

4.3.2 Contractor shall carry out packing and preparation prior to shipping and ensure that all equipment and tools are secured in a safe manner.

4.3.3 The equipment, accessories and all other spare and ancillary equipment shall be packed and shipped to allow installation sequence and operational flexibility.

4.4 TRANSPORTATION OF EQUIPMENT

4.4.1 Contractor shall be responsible for transportation equipment, including logistics, management and transportation between all Worksites.

4.4.2 Engineer or Company's Other Contractors will have the right to stop any lift or load-out if, in their opinion, operations are or could be unsafe, are outside of the procedure parameters or damage to the Work could occur.

4.4.3 Contractor shall be responsible for loadout and seafastening of the Work as required for shipping and shall perform all design, engineering, supply of material, fabrication and installation required for the loadout and seafastening.

4.4.4 Contractor shall also perform all design and engineering related to offloading the Work at the location for mobilization nominated by Contractor.

4.4.5 Contractor shall satisfy the requirements of the marine warranty surveyor and independent verifying body, Authorities and Engineer, as required.

4.4.6 Contractor shall transfer the Work onto the Contractor shipping equipment or vessel in accordance with the accepted mobilization manual.

4.4.7 Contractor shall, at all times, be responsible for organizing, managing and executing the loadout and offloading operations.

4.4.8 Contractor shall carry out all necessary voyage protection of the Work to prevent transit damage during transportation to and offloading at the location for mobilization nominated by Contractor.

4.4.9 Contractor shall develop criteria and procedures for voyage protection, which shall be submitted to Engineer for Acceptance.

4.4.10 Contractor shall be responsible for transportation equipment, including logistics, management and transportation between all Worksites and the location for mobilization nominated by Contractor.

4.5 LIFTING DEVICES FOR SHIPPING AND INSTALLATION

4.5.1 Contractor shall provide all lifting devices for all equipment for shipping and installation, and shall include certified lifting aid arrangements, lifting slings and shackles.

4.5.2 Lifting devices shall be in accordance with the requirements of the applicable local regulations, or as detailed in these specifications whichever is more stringent.

PART 5 MATERIALS, FABRICATION AND INSPECTION

5.1 MATERIALS

5.1.1 General

.1 Materials used for the fabrication of all permanent elements shall be new.

.2 All materials shall conform to the standards specified herein or to similar standards proposed by Contractor and Accepted by Engineer.

.3 Before the fabrication begins, Contractor shall submit to Engineer, all mill test certificates for the material supplied.

.4 If Contractor fails to produce such certificates, Contractor shall have similar tests made, at its own expense, in a laboratory Accepted by Engineer.

.5 The material of each component shall be specified on the drawings, and the accepted standard identified, the number of this standard, the grade or class used, the alloy or

pertinent chemical analysis and any special requirements concerning heat treatment and tests.

.6 The mechanical and chemical characteristics of the materials shall be determined in accordance with the requirements of the chosen standards and in accordance with the special requirements specified in this specification and on the drawings Accepted by Engineer.

.7 Contractor shall prepare and deliver to Engineer without additional cost, any specimen representative of the materials which Engineer may require before or during fabrication and during erection of the equipment at Site.

.8 Acceptance by Engineer of the materials proposed for the fabrication of the equipment in no way relieves Contractor from the obligation to satisfy all requirements of these specifications and does not eliminate the possibility of subsequent rejection of materials judged defective.

.9 For sliding pieces which are in contact, it is not permitted to use stainless steel on stainless steel or stainless steel on carbon steel, or vice versa.

5.1.2 Low Temperature and Impact Energy

.1 CSA G40.20/G40.21 Type WT - Weldable Notch-Tough Steel, shall have minimum impact values for Charpy Vee notched specimens of 27 Joules at -20° C.

5.1.3 Fasteners

.1 A design torque or tension shall be established and documented on drawings or in manuals for all fasteners including anchors and shall be recorded during assembly and installation.

.2 The design torque or tension of all fasteners shall take into consideration the uncertainty in the chosen torquing or tensioning method.

.3 As a minimum a chemical thread lock shall be applied to all fasteners. Fasteners subject to rotation, such as on wheels or sheaves, shall also be mechanically locked. Lockwashers do not meet this criterion.

.4 For stainless steel threads where the Contractor does not recommend using a chemical locking compound some form of anti-galling lubricant, such as "Loctite nickel anti-seize 771" shall be used.

5.2 FABRICATION

5.2.1 General Requirements

.1 The fabrication of any component of Contractor's supply shall conform to the fabrication drawings Accepted by Engineer.

5.2.2 Cast Steel

.1 All casting shall be true to pattern, well finished, homogeneous and free from blow holes, porosity, hard spots, shrinkage defects, cracks or other visible defects.

.2 Castings shall be cleaned to the satisfaction of Engineer.

.3 Un-machined casting surfaces shall be free from foundry irregularities such as projections, ridges, hollows, honey-combing, and pockmarks or chip marks so that they will not require surface smoothing operations prior to painting.

.4 All surface finishes of castings, machined or not, as well as special requirements with respect to general or local non-destructive testing shall be indicated on Contractor detail drawings.

.5 Samples prepared for mechanical testing shall be attached to each casting.

.6 The number and dimensions of the test samples and the areas for removal the samples shall be subject to Acceptance of Engineer.

.7 Casting shall not be repaired without Acceptance of Engineer, and such Acceptance can be given only if it is evident that, once repaired, the defect will not affect the strength, the machining or the end use of the component.

.8 Casting repair shall be by welding only, but no weld repair shall be made following final stress relief.

.9 If there is doubt as to its quality with respect to the specifications and drawings, Engineer may require non-destructive tests on any component.

.10 Any component presenting too many segregation of impurities or alloys at critical points will be rejected.

5.2.3 Forged Steel

.1 Ingots used for forgings shall be free from all defects which may affect their strength and durability such as welds, flaws, pipes, cracks, scales, fins, porosity, hard spots, non-metallic inclusions and segregation.

.2 If there are any doubts as to the quality of the ingots, Engineer may require non-destructive testing of all ingots to be used in the forging operations.

.3 The largest permissible fillets shall be used at each change of section.

.4 All surface finishes of forgings, machined or not, shall be indicated on Contractor detail drawings.

.5 Forgings shall have their heat number stamped in such a way as to be easily readable after assembly.

.6 Contractor shall submit to Engineer all reports of chemical analyses and mechanical tests when the materials are received at the shop.

5.2.4 Welding

.1 All welding shall conform to CSA W59.

.2 All welding on load carrying members shall be carried out in the shop.

.3 In general, only seal welding shall be permitted at Site.

.4 No full penetration welding will be allowed at site.

.5 Any field welding shall receive prior Acceptance by Engineer.

.6 Welding procedures and welders shall have been Accepted by Engineer and qualified by the Canadian Welding Bureau in accordance with the requirements of CSA W47.1.

.7 Contractor shall submit welding procedures with proof that qualification tests have been carried out for each type of joint.

.8 No work shall be undertaken prior to Engineer's Acceptance of the welding procedures, the welding machine operators and the welders.

.9 Welding electrodes shall conform to the requirements of CSA W48.1.

.10 Low hydrogen electrodes shall be used.

.11 Electrodes having absorbed moisture shall be rejected.

.12 Plates to be welded shall be carefully cut in size.

.13 The dimensions and the shape of the edges to be welded shall be such that they permit proper fusion and full penetration.

.14 Exposed parts shall be continuously welded on all sides.

.15 Welding shall not be carried out when the temperature of the base metal is below 10°C.

.16 If the base material is below 10°C, all surfaces within a radius of 75 mm of the point to be welded shall be preheated in accordance with CSA W59 and maintained at this temperature throughout the operation.

.17 Preheat temperatures shall be measured using tempilsticks or other means Accepted by Engineer.

.18 Peening of welds will not be permitted.

.19 A strip 50 mm wide on each side of the joint to be welded shall be cleaned to eliminate all rust, grease and scale.

.20 Welded construction parts having machined surfaces to ensure a correct alignment, shall be stress relieved by heat treatment or vibratory stress relief before machining.

.21 The stress relief procedure for welded components shall be specified in the welding procedure or on the drawings and shall be submitted to Engineer for Acceptance.

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.22 Galvanized components shall be seal welded. Where design of weldment to be galvanized does not require a continuous weld for the integrity of the joint, a seal weld shall be employed to seal the remainder of the joint.

5.2.5 Weld Inspection Requirements

.1 Contractor shall carry out, at his own expense, the following inspections:

Type of Weld	Type of Inspection	Extent of Inspection
All welds	Visual	100%
Tension flange butt welds	Radiographic	20%
Compression flange butt welds and skin plate acting as a beam flange	Radiographic	5%
Web splice butt welds	Magnetic particle or dye penetrant test	10%
Fillet welds	Magnetic particle or dye penetrant test	10%

.2 All unacceptable defects shall be removed to sound metal.

.3 All weld repairs shall be 100% inspected by the method used originally.

.4 If defects are found the untested area shall be tested to the same Extent of Inspection as indicated above and repeated as necessary until no defects are found.

5.2.6 Fabrication Tolerances

.1 Fabrication tolerances shall be such that they permit easy installation and adjustment of the parts according to the erection tolerances specified in these specifications, without modification at Site, but the fabrication tolerances shall not exceed half of the specified final tolerances after installation in all cases where parts concerned are adjusted at Site.

.2 Inspection of the machining tolerances shall be independent of the machining methods.

.3 Machining equipment shall only be used to inspect the tolerances, if validity of this method has been demonstrated to, and accepted by, Engineer.

.4 Surface machining shall be checked based on readings taken at least every 300 mm.

5.2.7 Coating and Galvanizing

.1 General Requirements

.1 All permanent equipment included in Contractor's supply shall be coated with paint or hot dip galvanized as specified hereafter.

.2 All temporary equipment shall be de-greased, all loose scale removed, and a shop primer applied as per coating manufacturer’s recommendations.

.3 Contractor shall take all the necessary measures in the stage of design and fabrication methods, that the surfaces to be coated should have sufficient access to enable the preparation on the surface, application of paint and quality control in accordance with this specification.

.4 All surface preparation and coating shall be carried out in the shop.

.5 Any area damaged during handling, transportation and erection shall be touched-up at Site by Contractor and shall meet the requirements of these specifications.

5.2.8 Surface Preparation and Coating

.1 Surface Preparation

.1 Painted and coated surfaces shall be prepared to manufacturer's recommendation, or as specified below, whichever is more stringent, as Accepted by Engineer.

.2 Rough welds and sharp edges shall be smoothed by grinding and weld spatter shall be removed.

.3 The surfaces shall be blast cleaned to the finish specified for each paint system in the clause 5.2.8.2.2 below.

.4 The sand blasted surfaces shall be inspected to visual standard SSPC-VIS 1.

.2 Coating

.1 The prepared coated surfaces shall receive a minimum of two (2) coats of high build epoxy paint.

.2 The approved coating systems shall be as follows:

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.1 Interior Structural Steel: Refer to Section 09 90 00

.2 Exterior Structural Steel: Refer to Section 09 90 00

.3 Immersion Service (gates, stoplogs, embedded parts):

.1 Surface Preparation: Abrasive Blast to SSPC-SP-10 Near White Metal;
.2 Primer: One coat Amercoat 240 Surface Tolerant Multi-Purpose Epoxy Coating at 250 – 300 um DFT;
.3 Topcoat: One coat Amercoat 240 Surface Tolerant Multi-Purpose Epoxy Coating at 250 – 300 um DFT.

.4 Interior of Gates (Spillway):

.1 Surface Preparation: Abrasive Blast to SSPC-SP-10 Near White Metal;
.2 Primer: One coat Amercoat 68HS Zinc Epoxy Primer at 50 – 75 um DFT;
.3 Topcoat: One coat Amerlock 2 Surface Tolerant Epoxy Coating at 150 – 200 um DFT.

.3 The application and the drying time shall comply with the paint manufacturer's recommendations.

.4 All coating used for a system shall come from the same manufacturer.

.5 Not used.

.6 Method of coating shall assure the uniform coating, and shall avoid any excess of coating due to local accumulations and drips.

.7 If problems of excess coating arise, and no action is taken to improve the method of application, Engineer can require removing all coatings and recoating and shall be at Contractor's expense.

.8 The first coat shall be of a different colour than the finishing coat to make the application easier.

.9 Instrument calibration, measurement of the dry film thickness, and the acceptance criteria, shall be performed according to SSPC-PA2.

5.2.9 Coating Touch-ups

.1 All coating touch-ups shall be done according to the coating system and the requirements detailed in this technical specification, except with regards to surface preparation and visual inspection.

.2 The surface preparation shall be done by power tool according to the requirements of SSPC-SP3.

.3 Visual inspection shall be done according to the requirements of SSPC-VIS 1 ST-3.

.4 In the case of major touch-up to be done on Site, Engineer may require that surface preparation be done by sand blasting.

.5 For coating touch-ups after final completion, Contractor shall supply to Engineer twenty (20) litres of each type and colour of the same paint as used.

5.2.10 Inspection

.1 Surface preparation inspection shall be done immediately prior to the coating application in the presence of an authorized representative of Engineer.

.2 For each coating layer, Contractor shall obtain authorization from Engineer before proceeding with its application.

.3 The coated surface, after all coating is completed, is subject to Acceptance by Engineer.

5.2.11 Galvanising

.1 Components to be galvanized shall be prepared and hot dip galvanized in accordance with CSA G164, ASTM A384 and A385.

.2 Touch-up of galvanized components shall be carried out with Galvicon, or an equivalent Accepted by Engineer.

5.3 INSPECTION

5.3.1 Standards for Non-Destructive Testing

.1 Unless otherwise requested by Contractor and Accepted by Engineer, all non destructive testing of materials shall be carried out in accordance with the following specifications:

5.3.2 Welded Components

.1	Radiographic Method:	- Procedure as per CSA W59
		- Acceptance criteria as per CSA W59
.2	Ultrasonic Method:	- Procedure as per CSA W59
		- Acceptance criteria as per CSA W59
.3	Magnetic Particle Method:	- Procedure as per ASTM E709
		- Acceptance criteria as per CSA W59
.4	Dye Penetrant Method:	- Procedure as per ASTM E165
		- Acceptance criteria as per CSA W59
.5	Visual control:	- Acceptance criteria as per CSA W59

5.3.3 Casting Components

.1	Radiographic Method:	- Procedure as per ASTM E94
		- Acceptance criteria as per ASTM E186, E280 and E446
.2	Ultrasonic Method:	- Procedure as per ASTM E114
		- Acceptance criteria as per ASTM A609 Level II

.3 Magnetic Particle Method: - Procedure as per ASTM E709

- Acceptance criteria as per ASTM E125 Type 1, 2, 3, 4 and 5.

.4 Liquid Penetrant Method: - Procedure as per ASTM E165

- Acceptance criteria as per ASTM E433, permissible surface indication NIL

5.3.4 Forged Components

.1 Ultrasonic Method: - Procedure as per ASTM A388

.2 Magnetic particle Method: - Procedure as per ASTM A275

.3 Contractor shall supply Engineer with the testing methods, and prove by preliminary tests that these conform to the effectiveness and validity of each method.

.4 All non-destructive test requirements shall be clearly specified by Contractor on its drawings.

5.3.5 Radiographic Inspections

.1 Radiographic inspection with X-ray machines or radioactive isotopes will be permitted.

.2 Limitations in the use of each method are outlined in ASTM, ASME and CSA W59 standards.

.3 X-ray machines shall be used in preference to isotope cameras whenever possible.

.4 Single control kilovolt-milliampere X-ray machines shall not be used without the express Acceptance of Engineer.

.5 All operators and technicians of levels I, II and III shall hold a certificate of competence issued by CGSB, but this certificate is only valid if renewed each year.

.6 Radiographic plates shall be interpreted only by a specialist certified by CGSB.

.7 The specialist shall be classified at least at level II and shall have relevant experience on NDT techniques and the interpretations of the related results, but shall be responsible for interpretation only, as the final decision on Acceptability shall rest with Engineer.

.8 Radiographic plates will be accepted once they comply with the conditions specified in ASTM E94.

.9 All welds which are rejected on the basis of this standard shall be repaired or replaced by an acceptable weld.

5.3.6 Ultrasonic Inspections

.1 Ultrasonic inspection of cast, forged and welded parts, as a substitution or completion for radiographic inspection is acceptable if an inspection program is presented together with evidence to prove the validity of the proposed method, all subject to Engineer's prior Acceptance.

.2 Whenever radiographic inspection of welds is not possible, as in the case of welds on certain angular and back-plated parts, Contractor shall demonstrate the validity of the ultrasonic method by inspecting a test sample which has been prepared by identical methods.

.3 Ultrasonic testing shall only be acceptable if carried out with equipment of recognized brand.

.4 Welds, castings and forgings shall be inspected by direct contact of the probe with the surface.

.5 Under special conditions, ultrasonic inspection by immersion of forged parts may be required.

.6 Whenever angled probing is used, the angle of incidence shall be suitable for the thickness of the part, and shall be as recommended in ASTM or CSA W59 Standards.

.7 Equipment shall be calibrated regularly on a test sample containing flaws similar to those being sought.

.8 The ultrasonic method shall not be used until technical literature describing the process, proposed methods, equipment sensitivity, probes, etc., is submitted to Engineer together with proof of the competence of Contractor's technicians.

.9 Inspection reports with supporting drawings, sketches and photographs shall be submitted to Engineer, together with all details, needed, to reproduce accurately any ultrasonic test, at any time.

.10 Preparation of ultrasonic inspection procedures shall only be carried out by technicians who hold a competence certificate under the category CGSB - Level III.

.11 Technicians of CGSB - Level II and Level III are competent to interpret the test results, but then the final decision on Acceptance will remain with Engineer.

5.3.7 Complementary Inspections

.1 Complementary inspection of castings, forgings and welded joints may be carried out using magnetic particle and dye penetrant methods.

.2 Magnetic particle and dye penetrant methods shall conform to the requirements of CSA W59 and ASTM E165.

.3 Magnetic particle and dye penetrant methods are only acceptable for detection of flaws on the surface of component or welds.

.4 Striations and irregularities shall be removed before testing.

.5 For dye penetrant examination, the surface shall be conditioned or effectively cleaned before the application of the penetrant.

.6 Magnetic particle examination shall be so conducted that surface deterioration or burning does not occur at electrode contact points.

.7 Current intensity, duration of application and orientation of the magnetic field shall be according to standards.

.8 A magnetic field intensity meter shall be used regularly.

.9 Provision shall be made for demagnetization for components if residual magnetism is a potential problem.

.10 Tests shall be conducted and results interpreted only by operators and technicians Accepted and certified by CGSB.

.11 Final Acceptance rests with Engineer.

5.3.8 Inspection of Welded Components

.1 All welds shall be inspected in accordance with the requirements of these specifications.

.2 If, for a given case, radiographic inspection is impossible because of difficulties of access, ultrasonic examinations Accepted by Engineer may be used.

.3 Neither incomplete penetration nor lack of fusion shall be accepted.

.4 For all statically and dynamically loaded welds, porosity or inclusions shall not exceed the limits imposed by CSA W59.

.5 Welding flaws exceeding the limits specified shall be gouged to sound metal and the gouged sections shall be checked by non-destructive testing (magnetic particle or other procedure) to Engineer's satisfaction.

.6 Repair welding will only be permitted after the flaw has been shown to be completely eliminated.

.7 All repair welds shall be completely radiographed.

.8 The welding inspector shall be qualified according to CSA W178.2 and shall be of the proper level to perform the inspection.

5.3.9 Inspection of Castings

.1 Castings of all major components shall be inspected in the foundry after cleaning and removal of all flaws, and before commencement of any repair welding.

.2 Cast parts shall also be inspected following repairs and heat treatments, and during and after machining.

5.3.10 Inspection of Forgings

.1 Forgings of all major components shall be inspected at the forging plant in the ingot stage and after forming, cleaning and removal of defects, but prior to any repair welding.

.2 The forgings shall also be inspected following repairs and heat treatments, and during and after machining.

5.3.11 Shop Assembly and Tests

.1 Prior to shipment, the equipment shall be fully shop assembled to demonstrate to the satisfaction of Engineer that all requirements of the specifications and of the design and fabrication indicated on the drawings Accepted by Engineer have been satisfied, and a shipping release has been provided by Engineer to the Contractor for each assembly. Where full assembly is not practical due to shop space limitations, all interfaces shall be proven by completing sub-assemblies or dimensional survey of completed components and preparation of an as-built model. Verification shall be subject to Engineer's Acceptance. All alignment critical equipment must be factory assembled and tested (rotating equipment etc.)

D1

.2 Following Engineer's Acceptance, these assemblies will be dismantled to satisfy the transportation requirements.

.3 The components shall be match-marked and doweled to facilitate reassembly in the field.

.4 The number of bolts and dowels shipped to Site shall exceed by at least 4% the calculated requirements in the shop.

.5 Each piece of equipment shall be subjected to the necessary shop tests to demonstrate proper operation of all components prior to Engineer's Acceptance for shipment to Site.

.6 These tests shall include at least one motorized test for a minimum duration of one hour in order to demonstrate the operating ability of all mechanisms and gearings.

.7 In addition, stalling tests shall be carried out on the hoists.

.8 In case of damage during the shop testing Contractor shall improve the concept and repeat the test prior to shipment.

.9 Prior to the tests described above, Contractor shall submit for Engineer's Acceptance a detailed procedure including a description of the assembly and the sequence of operations.

.10 Following the tests, Contractor shall submit the results to Engineer for Acceptance.

.11 All equipment not included in the supply but necessary for carrying out the tests shall be supplied by Contractor.

.12 Shipping to Site shall be authorized only once the equipment has undergone all the required tests.

.13 Engineer's Acceptance to ship does not relieve Contractor of his responsibilities in regard to final Acceptance.

.14 Any malfunction of the equipment following field erection will remain Contractor's sole responsibility, and Contractor shall carry out any necessary repairs or adjustments, after having received Engineer's Acceptance to do so.

PART 6 INSPECTION AND VERIFICATION

6.1 INSPECTION

.1 The Work shall be subject to inspection by Engineer and Company’s Other Contractors.

.2 Contractor shall prepare inspection and test plans to cover the full range of activities required to complete the Work, including all manufacturing, installation and testing activities. ITP’s shall identify:

.1 The specific verification activities planned for each process activity, including the characteristics to be inspected and tested at each point;

.2 The procedures and acceptance criteria to be used; and

.3 Any special tools, techniques or Personnel required.

6.1.2 Company’s independent verifying body, supplier and purchaser surveillance levels shall be indicated by use of hold, witness and review points on ITP’s.

6.1.3 Contractor shall submit ITP’s to Engineer for Acceptance in accordance with the requirements of the Agreement.

PART 7 PRESERVATION, MECHANICAL COMPLETION & COMMISSIONING REQUIREMENTS

7.1.1 Preservation, Mechanical Completion & Commissioning Requirements noted herein are defined in MFA-SN-CD-2000-ME-SP-0002-01 Preservation, Mechanical Completion & Commissioning Requirements.

PART 8 QUALITY MANAGEMENT

8.1.1 Contractor shall comply with all quality requirements of Exhibit 11 - Company Provided Documents and Exhibit 7 – Quality Requirements.

8.1.2 Contractor shall have an effectively implemented quality management system that shall, as a minimum, be compliant with the requirements of ISO 9001: 2008 – Quality Management System Requirements.

8.1.3 Contractor shall retain complete records that demonstrate the Work provided meets all the specified requirements and that the quality management system is effective, all in accordance with the requirements outlined in Exhibit 7 – Quality Requirements.

8.1.4 Contractor shall report all non-conformances generated in the engineering, manufacturing, fabrication, installation, and service delivery process in accordance with the requirements outlined in Exhibit 7 – Quality Requirements.

8.1.5 Engineer may at its sole discretion, perform surveillance and use other verification tools to verify the performance of Contractor Group to ensure compliance with relevant quality requirements in all areas during the execution of the Work.

PART 9 HEALTH, SAFETY, ENVIRONMENT AND SECURITY

9.1.1 Contractor shall comply with all environment, health, safety and security requirements of Exhibit 5 – Health and Safety Requirements and Exhibit 6 - Environment and Regulatory Compliance Requirements.

9.1.2 Contractor shall have an effectively implemented safety management system that shall, as a minimum, meet the requirements of the Agreement.

9.1.3 Engineer shall have the right to perform surveillance and use other verification tools to verify the performance of Contractor Group to ensure compliance with relevant HS&E and security requirements in all areas during the execution of the Work.

END OF SECTION

APPENDIX A

EQUIPMENT NUMBERS

PART 10 APPENDIX A – EQUIPMENT NUMBERS

10.1 A1 INTRODUCTION

To be provided by Engineer.

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 48 13 20
CH0032	**Gates, Stoplogs & Trashracks**	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

REGISTERED PROFESSIONAL ENGINEER
PEG Newfoundland and Labrador
RANDOLPH D. KOOB
28 Nov 2013
NEWFOUNDLAND & LABRADOR

TABLE OF CONTENTS
SECTION 48 13 20
GATES, STOPLOGS AND TRASHRACKS

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEG Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience
in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

PART 1 GENERAL

1.1 DESCRIPTION AND SCOPE OF WORK

1.1.1 This section of the specification details the requirements for gates, stoplogs, trashracks and embedded parts for the Muskrat Falls Hydroelectric Development.

1.1.2 This document shall be read in conjunction with “Lower Churchill Project Muskrat Falls Hydroelectric Development – CH0032 - Supply and Install Powerhouse and Spillway Hydro-Mechanical Equipment - Scope of Work - MFA-SN-CD-2000-ME-SP-0001-01/505573-3321-45EW-0001”, Part 2, Exhibit 1.

1.2 RELATED SECTIONS

D1 .1 Section 03 30 00 Cast In Place Concrete

.2 Section 03 60 40 Grout

.3 Section 48 13 10; General Mechanical Requirements

.4 Section 48 13 21; Hoist and Cranes

.5 Section 48 13 22; Trash Cleaning System

D1 .6 MFA-SN-CD-2000-ME-SP-0002-01; Preservation, Mechanical Completion & Commissioning Requirements

D1 .7 Section 23 82 33.05; Gate Guide Heaters

D1 .8 Section 26 29 03.03; Control and Monitoring – Hydro-Mechanical

PART 2 DESIGN REQUIREMENTS

2.1 APPLICABLE STANDARDS

2.1.1 Codes and Standards

The following standards shall apply to the Work described in this document.

.1	ANSI Standard B4a	Tolerances, Allowances and Gauges for Metal Fits
.2	ANSI C42.30	Definitions of Electrical Terms
.3	ANSI/ABMA STD 9	Load Ratings and Fatigue Life for Ball Bearings
.4	ANSI/ABMA STD 11	Load Ratings and Fatigue Life for Roller Bearings

.5	ASME B1.1	Unified Inch Screw Threads
.6	ASME B1.13	Metric Screw Threads: M Profile
.7	ASTM A275	Standard Practice for Magnetic Particle Examination of Steel Forgings
.8	ASTM A384	Standard Practice for Safeguarding Against Warpage and Distortion during Hot-Dip Galvanizing of Steel Assemblies
.9	ASTM A385	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
.10	ASTM A388	Standard Practice for Ultrasonic Examination of Steel Forgings
.11	ASTM A609	Standard Practice for Castings, Carbon, Low Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof
.12	ASTM E94	Standard Guide for Radiographic Examination
.13	ASTM E114	Standard Practice for Ultrasonic Pulse-Echo Straight-Beam Contact Testing
.14	ASTM E125	Standard Reference Photographs for Magnetic Particle Indications on Ferrous Castings
.15	ASTM E165	Standard Practice for Liquid Penetrant Examination for General Industry
.16	ASTM E186	Standard Reference Radiographs for Heavy-Walled (2 to 4½-in. (50.8 to 114-mm)) Steel Castings
.17	ASTM E280	Standard Reference Radiographs for Heavy-Walled (4½ to 12-in. (114 to 305-mm)) Steel Castings
.18	ASTM E433	Standard Reference Photographs for Liquid Penetrant Inspection
.19	ASTM E446	Standard Reference Radiographs for Steel Castings up to 2 in. (50.8 mm) in Thickness
.20	ASTM E709	Standard Guide for Magnetic Particle Testing
.21	AWS D1.1	Structural Welding Code
.22	CAN/CGSB 48.9712	Non-destructive Testing; Qualification and Certification of Personnel

.23	CGSB 1-GP-12C	Standard Paint Colors
.24	CSA A-23.1	Concrete Materials and Methods of Concrete Construction
.25	CSA A-23.2	Test Methods and Standard Practices for Concrete
.26	CSA A-23.3	Design of Concrete Structures
.27	CSA C22.1	Canadian Electrical Code
.28	CSA C22.2	Safety Standards for Electrical Equipment
.29	CSA G164	Hot Dip Galvanizing of Irregularly Shaped Articles Metals and Metal Products
.30	CSA S16	Design of Steel Structures
.31	CSA S269.3	Concrete Formwork
.32	CSA W47.1	Certification of companies for fusion welding of steel
.33	CSA W48	Filler Metals and Allied Materials for Metal Arc Welding
.34	CSA W59	Welded Steel Construction - Metal Arc Welding
.35	CSA W178.2	Certification of Welding Inspectors
.36	CSA Z85	Abbreviations for Scientific and Engineering Terms
.37	NBCC	National Building Code of Canada
.38	NLOHS	Occupational Health and Safety Regulation of Newfoundland & Labrador
.39	SSPC PA2	Procedure for Determining Conformance to Dry Coating Thickness Requirements
.40	SSPC SP3	Power Tool Cleaning
.41	SSPC SP10	Near-White Metal Blast Cleaning
.42	SSPC VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
.43	ANSI/ASSE Z359.4	Fall Protection Code: Safety Requirements for Assisted-Rescue and Self-Rescue Systems.

D1

2.1.2 References

.1 Hydraulic Design Chart, 212/1, USACE, (http://chl.erdc.usace.army.hdc)

2.1.3 Materials

All materials used in the different elements of the supply shall conform to the standards identified below.

.1	Bolts, studs, nuts, anchors	ASTM A307 ASTM A325 ASTM A193 Type B7, A194
D1 .2	Bronze Bushings	ASTM B505, B584
.3	Bronze subject to stress (such as bolts and nuts)	ASTM B21, Alloy 464, Semi Hard
.4	Castings	ASTM A27
.5	Forgings	ASTM A668
.6	Guide Rollers	CSA G40.20/G40.21 700 QT
.7	Guide Roller Axles	AISI 430 or ASTM A276, type 304
.8	Helical Springs	AE 5160
.9	Piping	ASTM A53
.10	Main Wheels	ASTM A504, Class C
.11	Main Wheel Axles	AISI 3140, 4140, 4340
.12	Main Wheel or Guide Roller Paths	ASTM A514 Grade F or Q
.13	Stainless Steel Shafts	ASTM A473, ASTM A564, AISI 431
.14	Structural Steel	ASTM A36 ASTM A992
.15	Gates and Stoplogs	CSA G40.20-04/G40.21-04

D1

		Type W Submerged or embedded elements
		Type WT cold temperature exposed elements
.16	Stainless Steel Fasteners	ASTM F593
.17	Stainless Steel Tubing	ASTM A269
.18	Stainless Steel	ASTM A176
		ASTM A240
		ASTM A276
.19	Tie-rods, washers and nuts for load carrying anchors (1 in. and 1 1/4 in. diameter)	ASTM A325 ASTM 307
		ASTM A193 Type B7
.20	Concrete	CSA A-23.1

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2.2 ALLOWABLE STRESSES AND DEFLECTIONS

2.2.1 General

.1 Contractor shall be responsible for design of all components to the relevant standards, and prudent utility practice, for spillways and hydro-electric facilities but the following design criteria shall be used as a minimum guideline.

.2 All design criteria is this document is based on Allowable Stress Design (ASD) methodology. If Contractor would like to use Limit States Design (LSD) methodology as an alternative to ASD for some or all the design work then Contractor shall submit a proposal for Acceptance by Engineer explaining, for each component, methodology and all design criteria, with justification demonstrating that the proposed methodology and criteria meets all this specifications intended requirements. The LSD shall be based on CSA S16, CSA W59 and NBCC.

.3 Allowable stresses shall be based on the von Mises-Hencky criteria.

2.2.2 Allowable Stresses - Normal Conditions

.1 General Mechanical and Structural Design

.1 For all the normal loading conditions specified in this document, the allowable stresses on equipment and their support structures shall not exceed 90% of the allowable stresses given in CSA S16-1969 and CSA W59 for all permanent works, and shall not exceed 100% of the allowable stresses given in CSA S16-1969 and CSA W59 for all temporary works.

.2 Gate Wheels and Wheel Paths

.3 The Hertz contact stresses between the gate wheels and the wheel paths shall satisfy the following requirements:

.1 The maximum compressive stresses, shall not exceed the lesser of 6.9 times the minimum Brinell hardness of the softer material BHN x 6.9 = MPa (or 1725 MPa);

.2 The maximum shear stresses, shall not exceed the lesser of 2.4 times the minimum Brinell hardness of the softer material BHN x 2.4 = MPa (or 620 MPa) ;

.2 Concrete

.1 The allowable stresses shall not exceed 90% of those specified in standards CSA A-23.3 or the requirements below whichever is more conservative.

.2 The bearing pressure transmitted to the concrete by the downstream flange of the embedded beam supporting the wheel path for wheeled gates, or the bearing bar for non-wheeled gates and stoplogs, shall not exceed the following values:

.1 If L > L'/4, the bearing pressure allowed is 13.2 MPa

.2 If L < L'/4, the bearing pressure allowed is 8.8 MPa

.3 Where:

.1 L = the minimum distance measured in line parallel with the downstream bearing face of the rear flange between the edge of the flange and the water passage.

.2 L' = the width of the rear flange assuming a uniform and symmetrical load distribution about the web of the beam.

.4 The above assumes:

.1 The effective rear flange width shall be limited by the allowable bending stress at the intersection of the flange with the web,

.2 100% of the wheel load is transferred to the downstream embedded flange,

.3 Wheel load is distributed vertically at 45 degrees from the point of contact with the track to the downstream side of the embedded flange.

.3 Gate and Stoplog Skin Plate

.1 The maximum combined stress resulting from the combined action of the skin plate and the beams and stiffeners to which it is welded shall not exceed 120% of the allowable stress, however, the bending and shear stresses taken individually shall not exceed 100% of the allowable stresses.

.4 Welded Joints

.1 Shop Welds

.1 The strength of a full penetration butt welded joint shall be such that the stresses in the weld do not exceed the following percentage of the permissible stresses in the weakest of the materials to be welded:

.1 100% of the allowable stresses in the lower strength material when the joint is subjected to thermal heat treatment and 100% radiography;

.2 95% of the allowable stresses in the lower strength material when the joint is subjected only to 100% radiography;

.3 90% of the allowable stresses in the lower strength material when the joint is subjected only to the thermal heat treatment;

.4 85% of the allowable stresses in the lower strength material when the joint is neither radiographed nor thermally heat treated.

.2 Field Welds

.1 For all field welded joints the stresses in the welds shall not exceed 80% of those permitted for Shop Welds as listed above, unless 100% NDT has been performed and Accepted by Engineer.

.5 Other Components

.1 The average stresses in bushings shall not exceed 20 MPa.

.2 For elements not covered by a specific standard the allowable stresses shall not exceed 33% of the yield strength or 20% of the ultimate strength of the material whichever is the most conservative.

2.2.3 Allowable Stresses – Abnormal Conditions

.1 Extreme Water Levels and Seismic Events

.1 For extreme water levels and seismic events the allowable stresses on the structural elements may be increased by up to 33% above those specified in Clause 2.2.2, but in no case exceeds 90% of the yield strength of the material, whichever is the most conservative.

.2 Concrete: The allowable stresses shall not exceed 90% of those specified in standards CSA A-23.3, but concrete bearing stresses shall not exceed 23.6 MPa in any case.

.2 Gate, Stoplog or Trashrack Jamming

.1 In the case where a component jams in its respective guides for whatever reason the maximum stresses induced in the equipment shall not exceed the following:

.1 75 % of the yield strength of the material when the load is applied to all lifting points;

.1 90 % of the yield strength of the material when there is a partial failure of the hoisting mechanism (for example broken wire rope) or lifting device; (Note, depending on design of the hoist this may be the result of a symmetric or asymmetric load case.)

.2 Bearing pressure of 19.3 MPa on the second stage concrete.

.3 Dogging Device Overload

.1 When only one dogging device is engaged, the stresses shall not exceed those given in clause 2.2.2.5. Operationally, applying the full load to a single dogging device is considered an abnormal condition; however, no increase in allowable stress is permitted.

2.2.4 Allowable Deflections

.1 The deflections in the various components under the normal loading conditions shall not exceed 1/800 of span.

.2 In addition to the above for all top seal applications, for the worst case hydrostatic loading condition, the deflection at the seal location shall not; exceed the allowable seal deformation, cause the seal to be crushed, and result in transmission of loads to the embedded parts.

2.3 FLOW INDUCED VIBRATION

.1 The Contractor shall demonstrate that there is at least a 2:1 factor of safety against flow induced vibration exciting the natural frequency of any component for all operating conditions.

2.4 ICE LOAD

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.1 The ice load shall be a line load of 150 kN/m over the width of the gate applied to the gate at any depth up to 600 mm down from the water surface at the most conservative point for all possible water levels. The ice load shall be applied as part of the normal loading to the Spillway gates and all Spillway stoplogs.

2.5 SEISMIC LOADS

.1 The seismic loads that are to be applied to all gates and permanent stop logs shall be calculated using the equations established by Westergaard in “Hydrodynamic Pressures on Dams Due to Horizontal Earthquake Effects“, US Bureau of Reclamation, Engineering Monograph 11.

.2 The equipment shall be designed to withstand seismic horizontal acceleration of 0.091 g.

2.6 MINIMUM MATERIAL THICKNESSES

.1 The minimum material thickness of the equipment components shall be:

.1 Gates, Stoplogs, and Trashracks

.1 Structural element: 10 mm

.1 Non-structural elements: 8 mm

.2 Seal mounting bars after machining: 10 mm

.3 Seal clamping bars: 10 mm

.2 Embedded Parts

.1 Exposed or partially exposed embedded parts: 12 mm

.2 Structural embedded parts: 8 mm

.3 Non-structural embedded parts: 6 mm

.4 Stainless steel sealing strip after machining: 10 mm

2.7 FRICTION COEFFICIENTS

.1 The following minimum friction coefficients shall be used in calculations of vertical loads acting on the gate or stoplog:

Material	Static	Dynamic
Self-lubricated bushings*:	0.15	0.10
Anti-friction bearing:	0.02	0.01
Rubber seals on stainless steel:	1.50	0.80
PTFE coated seals on stainless steel*	0.15	0.10
Wet steel on wet steel (non-lubricated)	0.40	0.20
Rolling friction	0.75 mm	0.75 mm

* Or the manufacturer's recommended value, whichever is higher.

.2 The friction coefficient for PTFE and rubber seals on stainless steel shall be used to determine the normal capacity of the lifting equipment as follows:

.1 For Intake Gate hoists: PTFE seal friction on 90% of the seals and rubber seal friction on the lower 10% of the seals;

.2 For Spillway Gate hoists: PTFE seal friction on 80% of the seals and rubber seal friction on the lower 20% of the seals;

.3 For other gates and stoplogs: rubber seal friction.

2.8 COMPONENT DESIGN REQUIREMENTS

2.8.1 General

.1 The gates and the embedded parts shall be designed such that the deformations, deflections, elongations, oscillations and vibrations, under the action of the loads to which they are submitted, shall not result in a malfunction, deterioration or a permanent deformation of the loaded components or assemblies.

.2 Anchor design including size, spacing, length and installation sequence shall be coordinated with the Engineer, concrete and reinforcing, and concrete contractor before the first stage concrete anchor concept is finalized and Accepted by the Engineer.

2.8.2 Embedded Parts

.1 Design Loads

.1 Guides for Gates, Stoplogs, and Trashracks

.1 All embedded parts, including the tie rods to the primary anchors, shall be designed to resist the most unfavourable combination of loading conditions described below:

.1 All normal and abnormal loads exerted on to the embedded parts;

.2 Any additional hydrodynamic loads caused by flowing water;

.3 All possible lifting and friction loads;

.4 All forces due to the worst combination of tolerances;

.5 Wheeled gate embedded parts, including the anchors and the tie-rods connected to the anchors, shall be designed to withstand a load equal to 100% of the maximum load exerted by the wheels and induced by breaking of the concrete under the embedded beams supporting the wheels, along a frictionless 45° plane with respect to the centerline of the wheel path distributed over a 90° cone from the point of wheel contact with the track up to the depth where overlap occurs;

.6 All other embedded parts, including the tie-rods which connect them to the anchors, shall be designed to withstand a lateral load equal to 30% of the maximum normal and abnormal hydrostatic loads exerted by the wheels or bearing bars;

.7 Loads exerted by the seepage of water between first stage and second stage concrete under the maximum steady state head applied on tie-rods and embedded parts;

.8 Loads exerted by the seepage of water between second stage concrete and the embedded parts under the maximum steady state head applied on tie-rods and embedded parts;

.9 Loads exerted by a jammed gate or stoplogs when raising or lowering;

.10 The embedded parts, including tie-rods and anchors, shall be designed to withstand the forces induced during concreting by a fluid concrete pressure assuming the height of lift not to exceed 2 m and the concrete density to be 2400 kg/m3 (not be combined with any other loading condition);

.11 Mass of all the components;

.12 Impact loads.

.2 Spillway Steel Water Passage Liners

.1 The steel water passage liners and anchors installed on the spillway walls and rollway shall be designed to resist the most unfavourable combination of loading conditions described below;

.1 Loads exerted by the seepage of water between second stage concrete and the steel liner under the maximum steady state head;

.2 Loads induced during concreting by a fluid concrete pressure;

.3 Any additional hydrodynamic loads caused by flowing water;

.2 If the steel water passage liner is not self supporting, and is relying on some other component for support, then these support loads shall be added to the design loads for the respective components.

.3 The steel water passage liner shall be sufficiently anchored in first stage concrete to avoid deformation under the specified conditions.

.4 Embedded angle assemblies shall be provided, to be turned over to the Engineer and installed by Company's Other Contracot in the first stage concrete, to anchor the downstream end of the Spillway transition plates and the upstream ends of the Spillway steel water passage liners before second stage concrete is poured.

.5 Downstream transition plates shall be designed to be welded to the embedded gate guide liner plate and the embedded angles placed in the first stage concrete.

.2 Anchor Assemblies

.1 General

.1 Anchor assemblies include all components required to be embedded, or to facilitate embedment, in first stage and second stage concrete for all embedded parts including but not limited to side guides, sill beams, lintel beams, and steel liners.

.2 Contractor shall design and supply the first stage concrete anchorage system to resist the loads imposed by the trashracks, bulkhead gates, intake gates, draft tube stoplogs, spillway gates and spillway temporary and permanent stoplogs through their respective embedded parts. The loading cases and assumptions are defined in the Sections dedicated to each type of equipment.

.3 The anchoring system shall be appropriate for the installation and alignment of the embedded guides within the specified tolerances before and after embedment in the second stage concrete.

.4 The embedment depth of the all anchors shall be in accordance with Appendix D of the National Building Code of Canada (NBCC).

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.5 The anchor material and associated hardware shall be ASTM A307 or ASTM A325 or equivalent. ASTM A193 Type B7 is an acceptable equivalent for high strength embedded rods and its associated hardware. Higher grades of steel such as ASTM A490 are not permitted.

.6 Contractor shall supply all bolts, screws, nuts and washers required to attach the anchors to the embedded guides and to the formworks.

.7 Detail drawings of the anchors and calculations of the capacity of the anchorage system shall be submitted to Engineer for review and acceptance.

.8 Anchor design including size, spacing, length and installation sequence shall be coordinated with the Engineer and concrete contractor before the first stage concrete anchor concept is finalized and Accepted by the Engineer

.2 First Stage Concrete

.1 The number of anchors, and fasteners shipped to Site shall be at least 4% in excess of the number calculated from the drawings.

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.2 Contractor shall provide all anchors and related components, for embedment in first stage concrete by Company's other contractor, including primary anchors, steel templates, and fasteners to mount the anchors/templates to the formwork.

.3 In order to facilitate the alignment of the embedded guides, the load carrying anchors shall be of the adjustable hairpin type, allowing for an angular adjustment of ±5 degrees in all directions of the tie rods and ensuring the transmission of the load in pure tension in the tie rods. The anchor design shall take into account that the primary anchors will be installed within a tolerance of ± 6 mm. Typical anchor arrangements are shown on the drawings for information.

.4 For positioning anchors, «U» or «J» type anchors are acceptable,

.5 The anchor spacing shall not exceed 600 mm. The horizontal and vertical anchor spacing shall not be less than 250 mm.

.6 The anchors and tie rods shall not be less than 22 mm in diameter. Anchors and tie rods of a given diameter shall be of the same material and capacity to ensure compatibility and avoid confusion during installation.

.7 Mechanical or chemical anchors are not permitted for anchoring of the temporary and permanent equipment

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.8 Contractor shall shall provide technical assistance during the installation of the anchors in first stage concrete and accepting the Work of Company's Other Contractor to proceed with placement of first stage concrete.

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.9 Contractor shall protect the threads of anchors supplied for primary concrete from concrete contamination during first stage concrete pour.

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.10 The primary anchors to be installed in first stage concrete shall be mounted on steel templates (plates or channels) designed to install a series of anchors at the correct spacing, and to be mounted on the formwork for ease of installation in first stage concrete by Company's Other Contractor. The steel templates shall be approximately 3 m in length for handling and for use over one concrete pours. Sequential templates shall bolt together, and shall be match marked.

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.11 The primary anchors to be embedded in first stage concrete shall be designed to be installed by Company's other contractor within tolerances of ± 6 mm.

.12 The installation of any reinforcing, dowelling, or anchors into first stage concrete, after first stage concrete has been poured, and before second stage concrete is poured, shall be provided and installed by Contractor.

.3 Second Stage Concrete

.1 Contractor shall supply and install all tie-rods, spherical nuts and washers required for attaching embedded parts to primary anchors in first stage concrete and adjusting the embedded parts.

.2 Contractor shall supply and install any additional anchors that the design requires to be embedded in second stage concrete and/or to be drilled into first stage concrete.

.3 The design of second stage concrete shall indicate whether additional reinforcing is needed in second stage concrete.

.4 Forms for placing second stage concrete shall be designed to be supported by first stage concrete, or if the forms are designed to be attached to the embedded parts then the embedded parts shall be specifically designed to support the concrete forms.

.4 Water stops

D1 .1 Water stops shall be provided on the pressurized side of the second stage concrete interface with the embedded steel part for the spillway gate side guides and sill beams and lintel beams.

D1 .2 Water stops shall be comprised of non-bentonite, modified chloroprene rubber and self expanding when exposed to water and, suitable for the design head, complete with an appropriate adhesive, Acceptable to the Engineer.

.3 Guides

.1 General

.1 The guides shall consist of upper guides, lower guides, sill and lintel beams, and steel liners and all shall be of welded construction.

.2 The choice of the materials for the sliding, rolling, guiding, sealing and contact faces on the guides shall be such that there will be no risk of any jamming or galling on any component.

.3 The seal paths, wheel and bearing bar paths, guide roller paths, shoe/bumper paths and lintel beams, shall all have adequate transitions to allow the gate or stoplog to enter into, and move in, the guides without damage or wear to any component.

.4 The gates and stoplogs shall be fully guided over the entire height of the guides and sufficiently constrained to eliminate damage to seals or any other

component, jamming, and excessive movement due to external forces, such as currents, wind etc., when hanging free.

.5 All splices in the guides, connections between sill beams and lintel beams to the guides, steel liner plates, and any others joints requiring proper alignment, shall be bolted connections with machined flanged mating faces. All joints exposed to the water passage shall be seal welded.

.6 All welded joints shall be ground flush for joints in the main water passage and on rolling, sliding and contact surfaces.

.7 Final machining of the guides shall be performed after all fabrication has been completed and after all components have been stress relieved.

.2 Lower Guides

.1 The lower guides shall consist of the steel liner, sill beam, embedded side guides, lintel beam where applicable, seal paths, wheel and guide roller paths, and bumper paths.

.2 The lower side guide seal paths, wheel and guide roller paths and bumper paths shall extend over the entire height of the lower guides and shall be fully machined.

.3 The hydraulic profile transition downstream of the guides in the water passages shall be offset to limit cavitation with a transition as described in USACE Hydraulic Design Chart 212-1/1 (http://chl.erdc.usace.army.mil/hdc), and as shown on the Drawings.

.4 The lower guide slots shall be completely steel lined over their entire height. The guide slot steel lining shall have a radius ending tangent to the adjacent water passage profile.

.5 Upper Guides

.1 Upper guides that are embedded in concrete are not required to be fully steel lined. However, if not fully steel lined, adequate means shall be provided to ensure proper installation and alignment.

.2 Upper guides that are required to extend beyond the concrete shall be designed as a rigid structure such that any deflections do not impede the operation of the gate or stoplog.

.6 Wheel Paths

.1 The wheel paths shall be corrosion resistant alloy steel with hardness between 235 and 270 BHN. These roller paths shall be machined over their

full length. The wheel paths shall be at least 12 mm wider on each side than the width of the contact ellipse between the wheel and the wheel path calculated for the maximum load condition.

.7 Seal Path

.1 All seal paths and seating strips shall consist of stainless steel machined over their entire length with a minimum of 10 mm thickness of material remaining after machining.

.2 The seal paths and seating strips shall be seal welded along their entire length on all sides.

.8 Guide Heaters

.1 Where heating of the guides is specified, the guides shall have embedded heating element ducts in each of the side guides over the full length of the embedded guide designed to receive tubular heating elements of a standard size and positioned to keep the guides clear of ice.

.2 A minimum of three (3) heating element ducts shall be provided in each side guide; one (1) for heating the guide on the wet side and two (2) for heating the guide on the dry side.

.3 These heating element ducts shall be designed to be watertight with a water tight cover.

.4 At the junction of two heater duct sections, the ducts shall have an overlap section to provide a backing for the seal welds.

.5 The bottom end of the heater ducts shall be provided with a drain accessible from the dry side.

.6 The required tubular heating elements shall each have a heating capacity of 500 Watts per lineal meter.

.7 Each guide shall be equipped with a temperature measurement duct capable of holding a standard sized RTD for temperature measurement and the duct shall extend at least 3 m down the guides below the FSL. The duct shall be attached in such a way to ensure good thermal conductivity between the guide and duct. The duct shall be located on the side of the guide that contains the single heating element duct.

.4 Lintel Beam

.1 There shall be a smooth transition on the top edge of the lintel beam and seating strip to permit gradual engagement of the top seal such that there is no risk of being damaged.

.2 The lintel beam shall be installed in second stage concrete.

.5 Sill Beam

.1 The upper surface of the sill beams shall be stainless steel, shall nominally be flush with the finished concrete surface except for the seal and weight supporting faces which shall be horizontal in the flow direction. In no case shall any part protrude above the nominal hydraulic profile.

.2 The sill beams shall be installed in second stage concrete.

.3 For the spillway the sill beam shall be continuously welded to the steel downstream water passage liners.

.6 Grouting

.1 All embedded components shall have provisions for venting air during grouting and concrete pouring, and shall be plugged and seal welded after completion of the installation.

.2 Voids shall be injected with a non-shrink cement grout Accepted by Engineer.

.3 All bases for ancillary equipment, such as storage devices, platforms, dogging devices etc., anchored to the concrete deck shall be grouted.

2.8.3 Gate and Stoplog

.1 Normal Design Load Conditions

.1 All gates and stoplogs shall be designed in such a way that the stresses in each component are less than the maximum permissible stresses for the most unfavourable combination of loading conditions described below: Normal loading condition shall consist of the following loads applied simultaneously:

.1 hydrostatic pressure as specified for the specific component;

.2 mass of the component itself and all components acting on it,

.3 all possible lifting and friction loads acting during normal (not jammed) raising or lowering;

.4 ice loading as described in Clause 2.4 for spillway gates and stoplogs only;

.5 for Spillway gates and stoplogs an allowance for the accumulation of ice and debris on the gates;

.6 for Spillway gates and stoplogs ice loading caused by freezing in the guides on unheated gates and guides;

.7 lateral loads from wheels or bumper bars;

.8 for Spillway and Intake gates all hydrodynamic forces acting on the gate in motion, during normal (not jammed) opening and closing throughout the range of upstream and downstream water levels;

.9 a corrosion allowance of 1.5 mm minimum shall be added to the thickness of the skinplates on the Intake and Spillway gates, but the corrosion allowance shall not be used in the design of the structure.

.2 The design of gates and stoplogs on the spillway shall take into account deflections and loading due to movement of the piers for normal combined pier deflections of +/-13 mm from flow in adjacent spillway bays with one water passage isolated.

.2 Abnormal Design Load Conditions

.1 Abnormal loading condition shall consist of the following loads applied independently:

.1 Abnormal hydrostatic pressure as specified for the specific component and if overtopped, taking into account any additional adverse hydrostatic or hydrodynamic forces (flow, negative pressure, etc.) acting on the downstream side.

.1 Added pressure exerted by the water on the gate in the event of an earthquake corresponding to a normal load condition reservoir level.

.2 All forces resulting from possible jamming of the component in the guides with the hoist motor producing its maximum breakdown torque, operating at rated voltage, and assuming a 100% mechanical efficiency of the hoist.

.3 For the Spillway and Intake gates this load shall be applied simultaneously with the normal hydrostatic pressure.

.4 The locations where the jamming forces are applied shall consider the component and hoist specific designs taking into account all possible scenarios as broken wire rope, failed guiding system on component or

lifting device, debris etc. The resulting load case may result in symmetric or asymmetric loading.

.2 The design of guiding devices on the spillway shall take into account deflections and loading due to movement of the piers for abnormal combined pier deflections of +/-17 mm with the addition of earthquake forces.

.3 General Design Requirements

.1 Gates and stoplogs shall be designed in such a way that the stresses in each component are less than the maximum permissible stresses for the most unfavourable combination of loading conditions.

.2 All gates and stoplogs (components) shall be of the welded construction type and be watertight in every respect.

.3 The horizontal beams shall be so spaced that each carries an equal hydrostatic load.

.4 The skin plate and horizontal main beams shall be connected at each end to vertical end girders. Diaphragms and stiffeners shall be used, as required, to stiffen the gate structure.

.5 All welding shall be continuous.

.6 The design shall ensure that the skin plate acts in conjunction with the main beams and the stiffeners to which it is welded.

.7 A minimum of four 100 mm diameter drainage holes shall be provided in the web of each horizontal beam, and the bottom plate, to ensure the drainage. If the beam web is divided by stiffeners then there shall be at least one drain per section.

.8 Where gates are required to be sectionalised for shipping the individual gate sections shall be assembled on Site by bolted connections, with fitted bolts or dowels for alignment, and sealed with a watertight weld.

.9 In the event of a failure of a wire rope the component shall be capable of being lowered to a safe position, including dogging devices or the sill, for repair.

.4 Gate Bottom

.1 If the gate or stoplog is installed where the waterway invert hydraulic profile is sloping, the lower section(s) shall be designed to accommodate the sloping face both physically and hydraulically.

.2 For the Intake and Spillway gates, the bottom of the gates shall be designed to avoid harmful hydrodynamic loads and extreme downpull forces, including the use of vents in the gate bottom plate.

.3 The lower lip (contact face) of the Intake and Spillway gates shall have a machined stainless steel layer with a minimum thickness of 3 mm.

2.8.4 Trashracks

.1 Design Load Conditions

.1 All trashrack components shall be designed to withstand, without exceeding the allowable stresses, the most unfavourable combination of loading conditions described below:

	Loading Condition	Description
.1	A	Mass of the trashrack and its accessories
.2	B	Weight of trash
.3	C	All possible lifting and friction forces
.4	D	All forces resulting from possible jamming (see Clause 2.9.3.2)
.5	E	Uniform hydrostatic pressure differential corresponding to 6 m of water corresponding to a partial blockage of the trashracks
.6	F	Horizontal impact of 16 kN, applied simultaneously on four (4) bars at any location of the trashrack surface
.7	G	Vibration due to water flow velocity through the bars
.8	H	Loads imposed by a trash cleaning system
.9	I	Accumulation of 5 mm of frazil ice on all surfaces

.2 Load Cases

.1 Load Case 1: Normal Load A + E + F + G + H

.2 Load Case 2: Normal Load A + E + F + G + I

.3 Load Case 3: Normal Load A + B + C

.4 Load Case 4: Abnormal Load A + B + C + D

.3 General Design Requirements

.1 The design of the trashracks shall include calculations of stresses, deflections, buckling and vibration for all loading cases taking into account the following criteria:

.1 The design flow velocity (flow/net opening area) between trashrack bars under clean conditions shall not exceed 1.5 m/s at rated flow.

.1 The weight of the trashracks shall exceed all forces resisting installation, including friction and buoyancy by a minimum of 25%.

.2 The formation of frazil ice shall be considered in the design.

.3 Calculations for trashrack bars shall include a check for lateral buckling.

.4 Bars shall be spaced to have a clearance of 100 mm between each bar.

.5 The nose of bars shall be rounded to reduce frictional forces and frazil ice formation.

.6 Trashrack bar thickness shall not be less than 10 mm and a depth not less than 110 mm.

.7 The depth of bar section shall not be more than 12 times its thickness.

.8 A corrosion allowance of 1.5 mm minimum shall be used in the design of the trashrack bars.

.2 Trashrack bars and horizontal stiffeners shall de designed to eliminate interference with the trash rake.

.3 The structure of the trashracks shall be designed to withstand a lateral load of 30% of the maximum hydraulic load exerted on them.

.4 A vibration analysis shall be performed both with and without the corrosion allowance and with and without 5 mm of frazil ice covering all surfaces. Turbine maximum discharge of 640 m3/s plus 20%, or 768 m3/s, shall be used to verify vibration parameters through the trashrack bars.

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.5 The maximum weight of any component shall not exceed 18,000 kg including the weight of the lifting beam and friction forces.

.4 Head Losses

.1 The trashracks shall be designed to minimize head losses across the trashracks.

.2 The Contractor shall provide calculations and/or test data from prior installations, to be submitted for Acceptance by Engineer, for the expected head loss demonstrating that it is within the value provided with the bid.

2.8.5 Wheel Assemblies

.1 General Requirements

.1 Wheel assemblies consist of; wheel rim, eccentric axles, axle locking device, anti-friction bearings, seals, greasing point, bearing cover, and any other hardware required for the wheel to function such as fasteners, washers, etc.

.2 The number of wheels and their spacing shall be fixed in such a way that each wheel carries an equal hydrostatic load for the normal loading conditions.

.3 The wheel assembly shall permit easy operation of the gate without undue deflection, vibration, or overstress.

.4 All wheel assemblies shall be designed to resist the stresses generated by:

.1 The worst possible combination of loads acting on the gates;

.2 A simultaneous lateral thrust of 30% of the maximum radial wheel load, applied at the wheel periphery.

.3 Failure of a single wheel axle locking device at any location, allowing the eccentric axle to rotate, shall not cause adjacent wheel locking devices to fail, or result in permanent deformation of the gate structure.

.4 Failure/seizure of a single wheel bearing shall not prevent the gate from being raised for repairs.

.2 Wheel Rims

.1 The main wheels shall be of ASTM A504 forged steel construction with the rolling surface hardened to between 321 and 363 BHN.

.2 Wheel rims shall be 50 BHN points higher than the wheel paths.

.3 The hardening depth of the wheel rim shall be greater than or equal to twice the depth of the maximum shear stresses location.

.4 The wheel rim width shall not be less than the value given by the following formula:

$$W = \frac{P}{F_P \cdot D}$$

Where: W = wheel rim width in mm

P = wheel load in N

D = wheel diameter in mm

F_p = Maximum allowable stresses on the wheel projection in MPa. F_p may be increased by 33% for abnormal wheel load conditions.

Where:

$$F_P = \frac{0.169 \cdot (BHN) - 15.169}{3}$$

BHN = Brinell hardness number

.5 However, the width W shall not be less than the length of the major axis of the ellipse of contact plus 25 mm, taking into account the deflection of the gate.

.6 The rolling surface of the wheels shall be crowned sufficiently to accommodate the worst case deflection of the gates.

.7 The ratio of the curvature radius of the wheel crowned surface to the radius of the wheel shall not be greater than eight (8), and the value of the curvature radius shall not be greater than 3,000 mm.

.3 Anti-Friction Bearings

.1 All main wheels shall be mounted on conical roller bearings fabricated by a reputable manufacturer.

.2 The roller bearings shall be kept in place and be protected on each side of the wheel by removable steel covers having watertight seals to both contain the wheel bearing grease and to prevent water ingress around the cover and axle. The covers shall be stainless steel.

.3 The bearing assembly (wheel, bearing, and axle) shall be designed to accommodate the design lateral loading.

.4 Wheel Axles

.1 The wheels shall be mounted on fixed axles held mechanically in the vertical end girders of the gates.

.2 The wheel axles shall be machined with no less than 3.0 mm eccentricity relative to the machined bearing surface to permit alignment of the wheels during assembly.

.3 Following adjustment of the wheels, the axles shall be mechanically fixed to prevent rotation and loss of adjustment.

.5 Lubrication

.1 All wheels axles shall have provisions for greasing the bearings.

.2 The wheel bearing grease points shall have stainless steel tubes connecting them to two central banks of fittings easily accessible from the top of each gate.

.3 A means of flushing the grease through the entire assembly shall be provided.

.4 In order to prevent any damage from vibration, the grease tubes must be supported and protected along their entire length by a channel or other structural element.

2.8.6 Bearing Bars

.1 Gate sections and stoplogs, that do not have wheels, and trashrack panels, shall be provided with bearing bars that cover the full height of the section and transmit the load to the bearing surface of the embedded parts.

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.2 The material for the bearing bars shall be selected as to ensure that no galling takes place between the bearing bar and the bearing surface of the embedded parts. A non-corrosive material shall be used for bearing bars on permanent gates or stoplogs, however, steel may be used for bearing bars on temporary gates or stoplogs. Submitted calculations shall show the bearing bar material does not gall with the slots' bearing surface.

.3 The bearing bars shall have a radius to accommodate gate deflection.

.4 The design of the bearing bars shall include a lateral side thrust equal to 30% of the normal condition loading applied to each side.

2.8.7 Guiding Devices

.1 General

.1 All components (which includes gates, stoplogs, and trashrack sections), shall be provided with guiding devices that control and guide the assembly throughout their entire range of travel to prevent jamming during normal raising and lowering, to prevent inadvertent contact with other equipment or structures, and to help keep the assembly centred laterally in the guides.

.2 The design of all guiding devices shall take into account loading due to worst case sliding friction, impact loads, seized wheel or guide roller, jamming while raising or lowering, indirect loads such as ice, and a simultaneous side load equal to 100% of the highest in plane load applied where the device contacts the guide.

.3 The design of lateral guiding devices on the spillway shall take into account deflections and loading due to lateral movement of the piers and be operable for normal combined lateral pier deflections of +/-13 mm from flow in adjacent spillway bays with one water passage isolated, and for abnormal combined lateral pier deflections of +/- 17 mm with the addition of earthquake forces, and be capable of withstanding those defections without damage.

.4 Anywhere there is the possibility of sliding contact, the materials used shall be selected to minimise friction and to eliminate the possibility of galling.

.5 For the purpose of design of the guiding device itself, jamming during lowering or raising, due to debris, seized wheels or high sliding friction possibly due to damaged seals, and failed wire rope, shall be considered as a normal loading condition.

.6 In the case of a jammed component, regardless of what caused the jam including a failed wire rope, the guiding device shall permit the component to be lowered to a safe position (dogging devices and/or sill).

.2 Lateral Guide Rollers and Guide Shoes

.1 Guiding devices shall be provided as a minimum at the four (4) corners on all individual assemblies to properly guide the component laterally in the guides and reduce the possibility of jamming. The guiding devices shall be designed to accommodate the worst case lateral loading as described for the guiding devices above.

.2 The Intake and Spillway Gates shall be provided with lateral guide rollers assemblies that use preloaded springs to effectively guide the gate during its descent, keep the gate vertical, keep the gate centred, and ensuring that the bottom of the gate makes good contact with the sill.

.3 Guide roller assemblies shall consist of carbon steel rollers, stainless steel axles, self lubricated bushings and thrust mechanisms, stainless steel thrust surfaces, and axle seals.

.4 The self lubricated bushings shall be one of Orkot, Kamatics, or Delrin. The Contractor may propose an alternate material and submit to the Engineer for Acceptance.

.5 The spring guide roller assemblies shall have a range of motion of +/-6 mm under normal operating conditions where “zero” corresponds to the gate centred in the guides with the guide rollers contacting the guides, and shall be capable of bottoming out on guide shoes without damage.

.6 As a minimum guide shoes shall be provided for all other gates, gate sections, stoplogs, and trashrack panels to limit the lateral movement of the assembly to 6 mm from the centred position but guide roller assemblies may also be used.

.7 The lateral guide shoes sliding surfaces shall be a suitable bronze or HDPE material, and Accepted by the Engineer.

.3 Upstream/Downstream Guide Shoes and Springs

.1 Guiding devices shall be provided as a minimum at the four (4) corners on all individual assemblies to properly guide the component in the guides and reduce the possibility of jamming.

.2 For all Bulkhead Gate sections and stoplogs with seals located on the downstream side, the guiding devices shall have leaf springs located on the upstream side to pre-load the seals against the guides, and the force applied by the leaf springs shall be sufficient to ensure there is at least 95% contact of the seal with the guides.

.3 Guide shoes shall be provided to limit the spring compression so the springs are not damaged by over-compression.

.4 For all gate sections and stoplogs with seals located on the upstream side, guide shoes shall be provided on the upstream side of each section to prevent damage to the seals and galling of the seal clamp bars on the embedded guide sliding surfaces.

.5 The guide shoes sliding surfaces shall be a suitable bronze of HDPE material, and Accepted by the Engineer.

2.8.8 Seal Assemblies

.1 Seal Type and Configuration

.1 The Bulkhead gate and stoplog side and lintel (for those components that have lintels) seals shall be elastomeric bulb J-seals.

.2 The bottom seals of multi-section gates or stoplogs shall be elastomeric bulb J-seals.

.3 Lintel seals for the Intake Gates shall be double stem bulb seals

.4 The bottom gate seals, in contact with the sill, shall be an elastomeric flat seal.

.5 For Spillway gates, the bottom gate seals shall be located downstream of the skin plate. In this case the side and sill seals shall be connected with a block of sealing rubber.

.6 Sealing between individual gate sections and between stoplogs shall use elastomeric bulb J-seals.

.7 See Appendix A for details on seals properties.

.2 Contact Faces

.1 All seal contact faces (side guides, lintel beams, sill beams, and joints between gate and stoplog sections) shall be stainless steel and fully machined.

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.3 Seal Attachment

.1 The seals shall be securely fastened to the component sections by stainless steel clamping plates, stainless steel seating plates and stainless steel bolts, nuts and washers.

.2 The diameter of the bolts shall be a minimum of 16 mm and they shall be spaced between 75 and 100 mm.

.3 The clamp bolts shall be Nitronic 60 type stainless steel fasteners.

.4 The seal attachment/clamping plates shall be designed to provide the required pre-load to prevent movement of the seal within the clamping mechanism, permit free movement of the seal to minimize leakage, and still provide adequate support to the seal to counteract hydraulic and friction forces.

.5 The seals shall have a minimum of4.5 mm initial unloaded deflection with the gate or stoplog installed in the guides.

.6 The bottom of the side and sill seals shall have 3 mm compression.

.7 The edges of the clamp plates and skinplate shall be chamfered to prevent damage to the seals.

.8 The seating plates to which the seals are bolted shall be fully machined.

.4 Seal Leakage

.1 The seal leakage shall not exceed 3 L/min/metre of total seal length (around perimeter and between sections) on each water passage assembly.

.5 Seal Jointing

.1 Joints to be made by Contractor either in the shop or at Site shall be reduced to the minimum and shall be limited to joints which cannot be made by the seal manufacturer because of transportation limitations.

.2 Bulb seal corners shall be moulded by the seal manufacturer.

.3 Detailed drawings showing the location of the joints and describing the jointing procedure shall be submitted to Engineer for Acceptance.

.4 The joints shall be hot vulcanized, and made according to the specifications by the seal manufacturer.

.5 Joints shall be clear of any holes in the leg of the seal provided for attaching the seal to the gate.

.6 Vulcanization shall be carried out with the two (2) extremities secured in an alignment die.

2.8.9 Dogging Devices

.1 The dogging mechanism shall be designed in such a way as to ensure personnel safety during operations and maintenance of all equipment and shall be lockable in both the extended and retracted positions.

.2 As a minimum the dogging devices shall be designed to support 125% of the maximum possible dead weight distributed to both sides evenly as a normal load case and 100% of the maximum possible dead weight acting on one side only as an abnormal load case.

.3 All dogging devices shall be designed such that they can be easily installed and removed, and safely performed by one person.

.4 Anchors for the dogging beams can be embedded in second stage concrete, or if embedded in first stage concrete shall be provided to Engineer for installation by Company's Other Contractor.

.5 The dogging beam supports shall be design as to not point load the edge of the concrete. The dogging beam supports shall either be located sufficiently away from the edge to avoid shearing the corner of the concrete edge or be provided with additional plates and reinforcement to be included in first stage concrete.

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.6 Systems using cantilever gate wheels as dogging devices are not acceptable.

2.8.10 Lifting Points

.1 For use in Guides

.1 All lifting points for use with lifting devices and/or hoists with component in guides shall be designed for the maximum normal and abnormal design hoisting loads. The resulting design load, regardless of origin, shall be assessed as a normal load.

.2 All lifting points shall be designed with due consideration for their respective lifting devices and/or hoists.

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.3 The lifting points shall be located within 5 mm of the component centre of gravity when hanging freely. Design briefs shall be provided to demonstrate that all the gate weights and centre of gravity of the fully assembled gate is within five (5) mm of the lifting point's vertical plane.

.2 For General Handling

.1 A minimum of two lifting lugs shall be provided on each component section for general handling during transportation, off loading and erection, when the gate is vertical or horizontal with the intent that a minimum of 2 lifting lugs would be used for any lift.

.2 The design load for each individual lug shall be 100% of the dead weight taking into consideration appropriate lifting and sling angles.

.3 Lifting points that are to be used for hanging the gate or stoplog vertically shall be located within 5 mm of the gate or stoplog centre of gravity when hanging freely.

2.8.11 Fasteners and Dowelling

.1 Bolted connections shall be design according to CSA S16 Standard. Bolted connections maybe either friction or shear type except as detailed below.

.2 Where fastener torque is critical the design of the fastener, or joint, shall take into consideration the uncertainty in the selected torquing or tensioning method.

.3 Where components are to be removed, and are part of routine or reasonably expected maintenance, the fastener design shall be of the shear type and designed such that precise torquing or tensioning of the fastener is not required. All other connections shall be friction type.

.4 All joints where alignment is critical shall incorporate locating dowels or fitted fasteners.

.5 Use of ASTM A490 bolts are not allowed where moisture is present.

2.8.12 Storage Provisions

.1 Gate and stoplogs sections that require storage on the ground or in a stand when not in use shall have a convenient means of being placed in the storage location and shall be designed to be stable without the need for additional blocking or lateral supports.

.2 Gate and stoplogs that are not stored in their respective guides shall be provided with lateral supports to prevent accidental overturning as an additional safety precaution.

.3 The contact point between the component and the ground or stand shall be HDPE or rubber bolted to the component.

.4 Gate and stoplogs sections shall be provided with a means to prevent the seals from being compressed or damaged during handling or storage.

2.8.13 Greasing System

.1 For all components to be greased the greasing nipples shall be Alemite button head type, No. 1186 with 1/4 inch NPT. Bearings/axles shall incorporate grooves to ensure proper distribution of the grease. The greasing shall be designed for a pressure of 13.5 MPa.

.2 Two (2) battery powered grease guns, complete with battery chargers and spare batteries for each, shall be provided that are suitable for lubricating all greasing points on all equipment supplied for this contract and capable of operating at a minimum of 48.5 MPa.

.3 The battery powered grease guns shall be heavy duty industrial grade using high voltage lithium-ion batteries.

2.8.14 Spare Parts

.1 Required Spare Parts shall include the following:

.1 Two (2) complete wheel assemblies of each type;

.2 Four (4) sets of anti-friction bearings of each type in addition to bearings provided with wheel assemblies;

.3 Two (2) complete guide roller assemblies of each type including springs;

.4 One (1) leaf spring of each type;

.5 Length of J seal of each type sufficient for one (1) complete gate or stoplog requiring the longest seal;

.6 Length of flat seal of each type sufficient for two (2) complete gates or stoplogs requiring the longest seal;

.7 Four (4) moulded J -seal corners of each type;

.8 One (1) Spillway gate blower/heater.

.9 One (1) complete set (six (6) heaters) of Spillway gate side guide heaters.

.2 Contractor shall provide a list of Recommended Spare Parts that Contractor would recommend Company purchase as an option.

2.8.15 Tooling

.1 Contractor shall design and supply maintenance tooling and jigs necessary to safely remove wheel assemblies, and replace wheel bearings, for both the Spillway and Intake gates.

PART 3 TECHNICAL REQUIREMENTS

3.1 SPILLWAY GATES

3.1.1 Hydrostatic Design Load Conditions

.1 Normal Load: Hydrostatic pressure corresponding to a reservoir level of El. 39.0 m.

D2

.2 Abnormal Load: Hydrostatic pressure corresponding to a water level of El. 41.5 m.

3.1.2 General Design Criteria

.1 The Spillway gates shall have fixed wheels, with upstream skin plates and seals, and operated by wire rope hoists.

.2 The Spillway gates shall be designed to open and close against flow and operate continuously at any opening, and at any reservoir elevation up to the maximum level.

.3 The Spillway gates shall be designed so that they can be closed from any opening, at any reservoir elevation, under 80% of their own weight considering the worst combination of all opposing forces.

.4 The Spillway gates and guides shall be designed so that the gate can be repeatedly closed at emergency closure speed (on the fan brake only), in the wet or dry, such that there is no damage.

.5 The Spillway gate guide sill elevation will initially be at El. 5.0 m during the diversion phase of the project and raised to El. 18.0 m as part of the final rollway construction.

.6 Each Spillway gate shall be provided with heaters for winter operation of the gates but shall be designed such that the gates can be left unheated year round without any deterioration.

.7 The Spillway gates shall be designed to withstand 0.5 m overtopping of the gates without structural damage to the gates or lower sheave blocks.

.8 A corrosion allowance of 1.5 mm minimum shall be added to the skinplate on the Spillway gates.

3.1.3 Guides

D1

.1 The lower guides shall extend from the sill beam to the top of the embedded guides. The lower guides shall be steel lined over their entire height, steel liners on the transition walls downstream of the embedded guides in the water passages shall be welded to the downstream face of the embedded guides and the steel angles embedded in downstream corner in primary concrete as shown on the drawings.

.2 The hydraulic profile transition specified in Clause 2.8.2.3.2.3 shall be fabricated in steel for the entire height of the lower guides and shall be an integral part of the lower guides complete with stiffeners and welded to angles embedded in first stage concrete.

.3 The upper guides shall extend up the hoist towers such that the gates are adequately guided in all directions when opening up to their maximum elevation and shall be designed for all possible loading conditions such as, but not limited to,

hydraulic loads due to a partially opened gate, wind loads, seismic loads, jamming loads, tower deflections etc.

.4 The upper guides shall be designed such that a gate could be completely removed without cutting or grinding components or welds.

.5 The upper guides shall include conveniently removable sections and other such provisions for performing maintenance on the gates such as wheel removal and repair, guiding device removal and repair, gate seals replacement etc.

3.1.4 Steel Liners

.1 The final concrete rollways downstream of all Spillway gates shall be lined with steel over 3 metres in the downstream direction on the rollway and up the piers to a height of 3 metres above the sill.

.2 The steel liner on the rollway shall conform to the parabolic hydraulic profile of the rollway.

.3 The steel liner shall have stiffeners and anchors as required to meet all the design requirements and shall be continuously welded to the guides and sill beam, and shall be ground smooth after welding.

.4 The steel liner shall be flush with the concrete surface.

.5 The steel liner shall be a minimum of 19 mm thick.

3.1.5 Spillway Gate Heating

.1 The Spillway gates shall be heated a minimum of 500 W per square metre of projected gate area (estimated 121 kW per gate).

.2 The Spillway gates shall be enclosed and sealed on the downstream face with panels, consisting of insulated coated metal cladding, so that the gates can be heated.

.3 Contractor shall submit details on panel materials to Engineer for Acceptance.

.4 The panel insulation shall be a minimum 38 mm thick of water resistant, non-inflammable, non-toxic rigid insulation attached by studs.

.5 The installation shall be airtight and watertight such that rain, mist, and splashing cannot get into the heated enclosure and there is minimal uncontrolled air leakage.

.6 The panel design shall minimize any thermal bridging.

.7 The panels shall be designed to withstand 0.5 m overtopping of the gates.

.8 The top horizontal beam shall have insulation of the same type as the downstream face, and shall have mechanical protection over the entire surface to allow access to the top of the gate for maintenance, and to the access hatch, without causing damage to the insulation.

.9 The inside of the gates shall have permanent heating using a minimum of two (2) blower heater units located in the upper part of the gate and capable of maintaining a minimum temperature of 5°C at any point in the gate. The blower heater units shall be equipped with thermal overloads.

.10 Two (2) temperature sensors shall be provided in each gate to control the separate heaters and the temperature sensors shall provide temperature indication and heater status to the gate PLC for remote monitoring. Temperature sensors in the gates shall be designed for operation in a moist environment.

.11 Ventilation ducts provided with adjustable outlets shall ensure the distribution of hot air from the heaters to maintain the required temperature throughout the gate and to re-circulate hot air around each wheel assembly. Wheel assemblies shall have rubber baffles to minimize heat loss.

.12 Two 100 mm diameter pipe intake air vents shall be installed equally spaced on top of the gate, one at each end, to reduce condensation build up inside the gate. Each vent shall be equipped with a 180 degree elbow to prevent ingress of precipitation.

.13 Heated exhaust air shall be directed to the sheave assemblies located at the top of the gate.

.14 The heater's electrical terminals shall be accessible from inside the gate or by removing a watertight cover.

.15 Maintenance and repairs of the heaters shall be from inside or through sealed waterproof panels.

.16 The top of the sheaves shall be closed and sealed around cables to conserve heat.

.17 Due to concerns of ice build up during the Diversion Phase, insulation panels shall not be installed on the bottom 2 m as a temporary measure. Instead a removable waterproof metal plate of sufficient thickness to resist downstream ice load forces shall be used to replace the bottom 2 m of insulated panels. The permanent bottom 2 m of insulated panels shall be installed after each rollway has been completed. Contractor shall be responsible for installing additional temporary heaters in the lower section of the Spillway gates that maybe necessary to keep the gates from freezing during the Diversion Phase.

D1 .18 Design to be completed in accordance with requirements of;

.1 Electrical Divisions, supplemented by this section.

.2 CSA C22.1 and CSA C22.2.

3.1.6 Spillway Gate Guide Heating

.1 The guides shall be provided with heating element ducts and permanent heaters in all of the ducts. Each heating element shall be equipped with a thermocouple for temperature measurement.

3.1.7 Dogging Devices

D1 .1 The gate dogging devices shall be designed and provided to suspend the gate at multiple elevations, to allow inspection and replacement of each set of wheels, and inspect the lower lip of the gate at a comfortable level, all from the spillway deck at El. 45.5 m and without the use of scaffolding. Systems using cantilever gate wheels as dogging devices are not acceptable.

3.1.8 Miscellaneous Devices and Accessories

.1 In addition to the main elements already described, Contractor shall provide all necessary devices and accessories for the optimum operation of the gate, in order to satisfy the requirements of these specifications including, but not limited to:

.1 The Spillway gates shall be provided with attachment points for fall arrest personnel safety equipment for use during gate maintenance, including one at the top of each gate ladder.

.2 The gates shall be provided with bolted on guard rails going all around the top of the gates to give a safe access for maintenance including convenient gated access points.

.3 Bolted permanent bases for a portable davit arm shall be provided on the top of gate, near the access hatches and ladders, capable of injured worker extraction from inside the gate.

.4 Each gate shall be supplied with a ladder inside the gate to permit access over the entire height of the gate.

.5 The ladder shall be fabricated in sections; each separate section shall be installed in an offset pattern between the webs.

.6 A manhole shall be provided in the web of each horizontal beam with the uppermost one having a watertight cover.

.7 The webs shall be adequately reinforced around the ladder openings.

.8 One access door with watertight cover shall be supplied on the lower part of the downstream plate of each gate to provide access to the rollway when the gate is closed, or to provide entry to the gate from El. 45.5 m when the gate is fully raised to the maintenance position.

.9 All bolting holding the manhole and access door cover seals shall be stainless steel, and all parts subject to removal shall be non-corrosive materials.

.10 Covers for the manholes and access doors shall be hinged, lockable, capable of being opened without help of tools, have no loose pieces, and be capable of being latched in the open position.

.11 Wind seals shall be provided, made of oil resistant, reinforced rubber; having a minimum thickness of 12 mm; designed to close the gap between the downstream end-girder and the embedded parts over the full height, and over the top of the gate wheels, in order to reduce heat losses;

.12 Wind seals shall be mounted on brackets welded downstream of the gate.

.13 All gate and sheave components shall be of sufficient strength to withstand 0.5 m overtopping of the gates without damage.

3.2 SPILLWAY STOPLOGS

3.2.1 Hydrostatic Design Load Conditions

.1 Spillway Stoplogs Upstream of Spillway Gates

.1 Normal Load: Hydrostatic pressure corresponding to a water level of El. 39.0 m.

.2 Abnormal Load: Hydrostatic pressure corresponding to a water level of El. 41.5 m.

.2 Spillway Stoplogs Downstream of Spillway Gates

D2

.1 Normal Load: Hydrostatic pressure corresponding to a water level of El. 12.50 m.

3.2.2 General Design Criteria

.1 Permanent Stoplogs Located Upstream of Spillway Gates (type S1 on drawings)

.1 During the diversion phase of the project these stoplogs shall be designed and configured with upstream skinplates and seals, and will only be used in the farthest upstream stoplog guides, and then after the rollway construction has been completed, they shall be converted to downstream skinplates and seals

and thereafter will only be used in the guides closest to the upstream side of the Spillway gates.

.2 The stoplog guides immediately upstream of the Spillway gates shall be equipped with a dogging device that permits two stoplogs to be stored at the very top of each guide.

.3 Handling of these stoplogs in both sets of guides shall be by the trash cleaner's underhung travelling hoist using a lifting beam.

.2 Temporary Stoplogs Located Upstream of Spillway Gates (types S2 and S3 on drawings)

.1 These stoplogs shall be designed with upstream skinplates and seals (wet side), and will only be used in the farthest upstream stoplog guides.

.2 These stoplogs do not require any stainless steel components or fabrications.

.3 Handling of these stoplogs shall be by the trash cleaner's underhung travelling hoist using a lifting beam.

.3 Permanent Stoplogs Located Downstream of Spillway Gates (type S4 on drawings)

.1 These stoplogs shall be designed with upstream skinplates and seals (wet side), and will only be used in the farthest downstream stoplog guides.

.2 Handling of these downstream stoplogs shall be by mobile crane using a lifting beam.

.3 The stoplog guides shall be equipped with a dogging device that permits one stoplog to be stored at the very top of each guide such that the bottom of the stoplog does not protrude below the bottom of the permanent downstream bridge.

.4 Temporary Stoplogs Located Downstream of Spillway Gates (type S4 on drawings)

.1 Same requirements as 3.2.2.3 except these stoplogs do not require any stainless steel components or fabrications.

.2 A storage location and method shall be provided for storing the temporary stoplogs when not in use, and shall be Acceptable to Engineer.

3.2.3 Guides

.1 All stoplog guides shall be considered permanent works and all design criteria for permanent works shall apply.

D1

.2 All lower guides shall extend from the sill beam to the top of the embedded guides. All permanent and temporary spillway lower guides shall be steel lined over their entire height, steel liners on the transition walls downstream of the embedded guides in the water passages shall be welded to the downstream face of the embedded guides and the steel angles embedded in downstream corner in primary concrete as shown on the drawings, the upstream permanent spillway stoplog embedded parts require steel liners on the downstream transitions above El. 17.8 m.

.3 The downstream stoplogs shall have guide extensions above the concrete up to El. 20.0 m to facilitate stoplog installation and storage.

.4 All stoplog guides shall have embedded heating element ducts with the ability to install heating elements as needed.

3.3 INTAKE GATES

3.3.1 Hydrostatic Design Load Conditions

.1 Normal Load: Hydrostatic pressure corresponding to a reservoir level of El. 39.0 m.

.2 Abnormal Load: Hydrostatic pressure corresponding to a water level of El. 45.1 m resulting from a PMF.

3.3.2 General Design Criteria

.1 The Intake gate shall be a fixed wheeled gate with upstream skin plate and seals and operated by wire rope hoists.

.2 The Intake gates will normally be raised and lowered under no flow conditions; however, the gates shall be designed so that they can be closed individually or simultaneously against maximum flow and maximum head under 80% of their own weight considering the worst combination of all opposing forces.

.3 The Intake gates and guides shall be designed so that the gate can be repeatedly closed at emergency speed (on the fan brake only), in the wet or dry, such that there is no damage.

.4 The maximum expected flow through each generating unit is approximately 1035 m3/s and occurs during turbine runaway.

.5 The filling of the water passage shall be done by cracking one gate open to about 150 mm.

.6 The Intake gate shaft will be used as the air vent during water passage filling, dewatering, and closure at maximum flow.

.7 The gate shall be provided with bolted on guard rails going all around the top of the gate to give a safe access for maintenance.

.8 A corrosion allowance of 1.5 mm minimum shall be added to the skinplate of the Intake Gates.

.9 The gate shall be provided with attachment points for fall arrest personnel safety equipment for use during gate maintenance, and shall be provided at the top, as well as the bottom, of the gate ladders.

.10 A permanent base for a davit arm shall be provided on the top of gate, near the ladders.

.11 A davit arm, rated for injured worker extraction, shall be provided.

3.3.3 Guides

D1

.1 The lower guides shall extend from the sill beam to the floor of the inspection gallery (El. 23.0 m). The lower guides shall be steel lined over their entire height, steel liners on the transition walls downstream of the embedded guides in the water passages shall be welded to the downstream face of the embedded guides and the steel angles embedded in downstream corner in primary concrete as shown on the drawings.

3.3.4 Dogging Devices

.1 Dogging devices shall be provided to dog the Intake gates at 2 locations: with the first dogging device located at El. 42.5 m in the upper maintenance position; and the second at El. 23.0 m at the maintenance gallery.

.2 At El. 42.5 m, the gate and dogging device shall be capable of being dogged to facilitate work on the hoist including disconnection of the sheaves.

D1

.3 At El. 23.0 m, the gate and dogging device shall be designed and provided to suspend the gate at multiple levels such that each wheel can be easily serviced including being removed, and the gate seals accessed and replaced without the use of scaffolding. Systems using cantilever gate wheels as dogging devices are not acceptable.

3.4 INTAKE BULHEAD GATE

3.4.1 Hydrostatic Design Load Conditions

.1 Normal Load: Hydrostatic pressure corresponding to a reservoir level of El. 39.0 m.

.2 Abnormal Load: Hydrostatic pressure corresponding to a water level of

El. 41.5 m.

3.4.2 General Design Criteria

.1 The Bulkhead Gates shall be of the sliding type with downstream skin plate and downstream seals.

.2 The Bulkhead gates shall be sectionalised and designed for installation and removal under hydraulically balanced conditions using the trash cleaner's underhung travelling hoist and a lifting beam.

.3 The top section of the gate shall include a filler valve operated by the lifting beam's own weight to equalize the water pressure on both sides of the gate prior to opening.

.4 The filler valve shall be 300 mm diameter.

.5 The air vent between the Bulkhead Gate and the Intake Gate will be provided by Company's Other Contractor.

3.4.3 Guides

D1 .1 The Intake bulkhead lower guides shall extend from the sill to a minimum of 300 mm above the lintel. The lower guides shall be steel lined over their entire height, steel liners on the transition walls downstream of the embedded guides in the water passages shall be welded on the downstream face of the embedded guides and the steel angles embedded in downstream corner in primary concrete as shown on the drawings.

3.4.4 Dogging Devices

.1 Dogging devices shall be provided to dog each of the Bulkhead gate sections, and the Bulkhead gate lift beam, in the Bulkhead Gate shafts below the deck hatches.

.2 The dogging device shall be designed to facilitate installation and removal, and when not in use the individual gate sections shall be dogged in separate guides.

3.5 POWERHOUSE DRAFT TUBE STOPLOGS

3.5.1 Hydrostatic Design Load Conditions

D2 .1 Normal Load: Hydrostatic pressure corresponding to a water level of El. 7.00 m.

D2 .2 Abnormal Load: Hydrostatic pressure corresponding to a PMF water level of El 12.50 m.

3.5.2 General Design Criteria

.1 The draft tube stoplogs shall be of the sliding type with downstream (dry side) skin plate and seals.

.2 Each bay will consist of four sections: a bottom section; two (2) intermediate sections; and a top section with a lintel seal.

.3 The stoplog sections shall be designed for installation and removal in hydraulically balanced conditions.

.4 Two (2) seating plates shall be welded on the bottom of each upper stoplog section to ensure that the stoplog sections are vertically aligned in the gate slots and the lintel seal engages.

.5 The embedded guides shall have matching supports installed for the top stoplog seating plates.

.6 The draft tube stoplogs shall be stored on storage supports above the water passage in the draft tube gallery upstream of the guides.

.7 The draft tube gallery will be housed in a concrete structure under the transformer deck with a floor level at El. 6.50 m, with the overhead crane and the lifting beam.

.8 The draft tube stoplogs sections shall be raised and lowered by means of an under-running crane and a dedicated lifting beam, and operating on rails provided by Company's Other Contractor.

3.5.3 Guides

D1

.1 The draft tube stoplog lower guides shall extend from the sill to a minimum of 300 mm above the lintel. The lower guides shall be steel lined over their entire height, steel liners on the transition walls downstream of the embedded guides in the water passages shall be welded to the downstream face of the embedded guides and the steel angles embedded in downstream corner in primary concrete as shown on the drawings.

.2 The draft tube stoplog upper guides shall extend from the top of the lower guides up to El. 6.5 m, and the top of the lower guides shall be designed with transitions to accept the stoplogs with operators located on the walkways at El. 9.0 m.

3.5.4 Storage Devices

.1 For the storage of the stoplogs, sixteen support sets (two per hydraulic passage) shall be provided.

.2 The storage supports shall be anchored on the generator side of the embedded stoplog guides on the pier walls.

.3 The supports shall hold the stoplog vertically and shall protect the seals.

.4 The supports shall be designed to facilitate handling of the stoplog sections by the overhead crane.

.5 Support surfaces in contact with stoplog sections shall have a thick plastic or rubber pad attached to it.

.6 Stainless steel expansion type anchors and bolts, Accepted by the Engineer, shall be used for installation of the supports and rubber bumpers.

.7 Support plates shall be welded on the bottom of each stoplog section to support the stoplogs on storage supports.

.8 The support plates shall have adequate dimensions to prevent the overturning of the stoplog section.

.9 A portable support stand shall be provided to support the bottom stoplogs sections when set on a flat surface, or for service in the maintenance gallery.

3.5.5 Lockout

.1 Lockable protection device shall be provided to prevent the Draft Tube stoplogs from being removed after they are installed in the guides and the device shall be safe and convenient to apply from the walkway level at El. 9.00 m.

.2 The protection device could consist of some form of hinged device that covers one or both sides of the side guides to prevent the lifting beam from being installed.

.3 The protection device shall not prevent the lifting beam or hoist from being used on another unit.

3.6 TRASHRACKS

3.6.1 General

.1 As a minimum Trashrack bars shall be rectangular with a rounded nose (more hydraulically efficient shapes may be used) and be uniformly spaced.

.2 The Trashracks in each bay shall consist of a series of smaller sections (panels) stacked vertically.

.3 Each Trashrack panel shall be a welded steel fabrication.

.4 All Trashrack sections, except the top, shall be identical and interchangeable.

.5 The top of the upper Trashrack section shall be sloped at a minimum 45º, as shown on the Drawings, to provide a smooth hydraulic transition and reduce the likelihood of debris accumulation.

.6 Each section of the Trashracks shall consist of horizontal beams between vertical side plates.

D1

.7 The top Trashrack panels shall have the horizontal beams inclined 30 degrees down from horizontal to reduce resistance to flow.

.8 Secondary horizontal support members shall be provided as necessary to reduce the lateral support distance between the vertical bars to meet vibration criteria.

.9 The vertical Trashrack bars shall be chamfered at each end so that Trash Cleaner will smoothly transition from panel to panel.

.10 Trashrack panels shall include alignment pins, or equivalent, to ensure once installed the vertical bars are aligned in both planes between panels.

.11 Closed sections shall have a 1.5 mm corrosion allowance on all interior surfaces.

.12 Trashrack sections will be installed and removed using a mobile crane and lifting beam.

.13 The trashrack guides shall be designed to centre the bottom panel in the guide to ensure the panels stack correctly.

3.6.2 Guides

.1 The Trashrack guides shall include a rounded nose on the upstream side that matches, and is tangent and flush to, the rounded concrete pier nose.

.2 The rounded nose shall extend laterally to meet a projected plane extending from the back of the slot.

.3 The rounded nose shall have sufficient ribs to maintain rigidity of the structure with holes to facilitate concrete placement.

3.7 DRAFT TUBE GALLERY MAINTENANCE AREA WATER STOP GATES

3.7.1 General

.1 The Draft Tube gallery water stop gates shall be designed to withstand a transient tailwater level up to EL 9.3 m that can occur during a plant full load rejection.

3.7.2 Anchors

.1 The water stop gates shall be mounted on the first stage concrete wall with concrete anchors, or embedded anchors in first stage concrete, and shall be submitted to and Accepted by the Engineer.

D2

.2 If first stage concrete anchors are used, they shall be provided to Engineer for installation by Company's Other Contractor, with technical assistance during installation by Contractor.

3.7.3 Criteria

.1 Not used.

.2 The water stop gates shall be hinged and shall provide adequate sealing around the gate that the water level in the maintenance area during a tailwater surge is safe for personnel working in the maintenance area.

.3 The water stop gates shall have secure latches to withstand maximum water levels, and shall be designed to be opened for passage of the stoplogs.

.4 Fall restraint anchors shall be provided on both sides of the gate for worker protection when the gates are opened.

3.8 COATINGS SCHEDULE

.1 Coatings shall be as follows:

Gates, Stoplogs, Trashracks	All surfaces Epoxy paint colour XXX (colour)
Embedded Parts - Surfaces in contact with the concrete	Uncoated
Embedded Parts - Surfaces exposed	All surfaces Epoxy paint colour XXX (colour)
All accessories, such as ladders, walkways, platforms, handrails/guard rails and all hardware, not forming integral part of the main structure and liable of being dismantled, such as connection bolts, supports, heating equipment, pipes, etc.	Hot dip galvanized

3.9 SHOP ASSEMBLY AND TESTS

.1 Prior to shipment, the gates shall be shop assembled to demonstrate to the satisfaction of Engineer that all requirements of the specifications and of the design and fabrication indicated on the drawings Accepted by Engineer have been satisfied.

.2 The gates (includes stoplogs) and the embedded parts shall be shop assembled as follows:

.1 Gates: complete assembly of each gate including wheels, guiding assemblies, and seals;

.2 Not Used.

.3 Embedded parts: complete assembly of each full length side guide.

.3 Following Engineer's Acceptance, these assemblies shall be dismantled to satisfy the transportation requirements.

.4 The components shall be match-marked and doweled to facilitate reassembly in the field.

.5 The number of bolts and dowels shipped to Site shall exceed by at least 4% the calculated requirements in the shop.

.6 In case of damage during the shop testing Contractor shall improve the concept and repeat the test prior to shipment.

.7 Prior to the tests described above, Contractor shall submit for Engineer's Acceptance a detailed procedure including a description of the assembly and the sequence of operations.

.8 Following the tests, Contractor shall submit the results to Engineer for Acceptance.

.9 All equipment not included in the supply but necessary for carrying out the tests shall be supplied by Contractor.

.10 Shipping to Site shall be authorized only once the equipment has undergone all the required tests.

.11 Engineer's Acceptance to ship does not relieve Contractor of his responsibilities in regard to final acceptance.

D2 .12 Not used.

D2 .13 Not used.

PART 4 ERECTION, CONCRETING AND FIELD TESTS

4.1 GENERAL

.1 All the equipment covered by these specifications shall be installed, concreted, pre-commissioned and subjected to the required contractual tests by Contractor.

.2 Contractor is fully responsible for the execution of all works according to the tolerances required and according to the drawings, installation procedures and verification previously established and submitted to Engineer's Acceptance.

.3 Contractor shall supply all necessary equipment such as portable cranes, slings, jacks, tooling, welding equipment, structures, bracings and temporary shelters, formworks, instrumentation and test equipment, spares, and all the other necessary equipment to complete all installation and all required tests.

.4 All measurements taken as part of the installation of Contractor's work shall be submitted to Engineer for Acceptance.

.5 Any of the surface work whose tolerances have not been maintained after concreting shall be corrected by grinding or by any other means Accepted by Engineer in such a way as to bring the dimensions to within the specified tolerances, however, no correction shall be carried out without the Acceptance of Engineer.

.6 Contractor shall also provide the necessary supplies in order to perform second stage concreting of embedded parts, and shall perform the required testing.

.7 Contractor shall supply and place the grout, necessary for the concrete embedment.

.8 All modifications, re-work, repairs etc. required by Contractor to complete the work shall be subject to the Engineer’s Acceptance prior to the start of the work.

.9 When selecting the erection methods, Contractor shall be responsible to take into account the load limitations imposed by the roads, structures, and bridges.

4.1.1 Installation of Embedded Parts

.1 All embedded parts shall be cleaned thoroughly by Contractor before being placed.

.2 Any grease, paint or other substances that may affect the proper curing of concrete shall be removed.

.3 Contractor shall witness the installation of the primary anchors in first stage concrete, and shall sign off on the acceptability of the anchors before embedded in each concrete pour.

.4 Contractor shall install and carry out the general alignment of all embedded parts of gates and stoplogs to be embedded in second stage concrete.

.5 In the event the anchors are not in compliance with specified tolerances after concrete embedment, Contractor shall propose an appropriate and economical corrective method.

.6 In case of conflict, Engineer reserves the right to impose a corrective method on Contractor to modify the embedded parts, at Company's expense, to match to the primary anchor design.

.7 Contractor shall carry out complete measurements of the embedded parts before and after concreting, in order to show to Engineer's satisfaction that the tolerances have been met before and after concreting.

.8 No concreting shall be undertaken before the Acceptance of Engineer.

.9 All measurements and dimensions of the work carried out by Contractor shall be submitted to Engineer for verification.

.10 Engineer shall carry out control measurements before giving authorization for concreting and before final acceptance of the Work.

.11 As soon as Contractor obtains authorization from Engineer, Contractor shall start concreting without any delay.

.12 After all concrete has been placed Contractor shall check for, and fill, all voids behind embedded parts using a procedure, and grout, accepted by Engineer.

.13 Contractor shall submit for Acceptance, fabrication control methods for embedded parts and show to the satisfaction of Engineer that the tolerances specified will be met during assembly and after concreting.

.14 Machined surfaces shall be checked based on readings taken at least every 300 mm.

.15 Surfaces for which the specified tolerances are less than 1 mm shall be checked based on readings taken at least every 300 mm.

.16 For other surfaces for which the tolerance was specified, tolerances shall be checked based on readings taken at least every 600 mm.

4.1.2 Concrete Works

.1 The concrete works shall include, without being limited to, the following activities:

.1 The preparation of first stage concrete surfaces before second stage concreting, and before the installation of embedded parts;

.2 The handling, the positioning, the consolidation, the finishing of surfaces including the construction, the erection, the maintenance and the removal of all formwork and scaffolding required for the installation and second stage concreting for embedded parts.

.2 The concrete works shall conform to CSA Standard A-23.1, A-23.2, A-23.3, A-269.3.

4.1.3 Preparation of the Surfaces before Concreting

D1

.1 Following the roughening performed by Company's other contractor, Contractor shall carefully clean and wash the first stage concrete surfaces which will come in contact with second stage concrete, and cleaning shall be done until the surfaces are completely clean and free from particles and debris.

.2 Nuts of the bolts shall be free of any dirt.

.3 Anchor bolts shall be cleaned and oiled to facilitate the adjustment of the embedded parts.

.4 Oiling of forms shall be carried out with precaution to not contaminate the concrete.

4.1.4 Concreting and Formworks

D1

.1 The concrete for concreting of the embedded parts shall be of Class A-3, as specified in the Section 03 30 00.

.2 Contractor shall advise Engineer before each concrete pour, at least 48 hours in advance.

.3 Concrete of Class A-3 shall not be replaced to favour the use of special construction technique.

.4 Admixtures shall not be added to the concrete without the prior Acceptance of Engineer.

.5 Not less than 30 days prior to the installation of embedded parts, Contractor shall submit to Engineer for Acceptance a complete set of drawings of the formwork together with a detailed description of the proposed methods of handling and placing of second stage concrete.

.6 Second stage concrete shall be placed in such a way as to limit shrinkage of concrete and avoid displacement of embedded parts.

.7 The rate of pouring shall never exceed 350 mm/hour for the lower lateral guides and 500 mm/hour for upper lateral guides.

.8 Engineer reserves the right to stop concreting any time if it is obvious that embedded parts have been or are in danger of being displaced.

.9 The minimum delay before removal of the formworks shall be at least 48 hours.

.10 Vibrators of 50 mm diameter shall be used during concrete pours.

.11 There shall be no contact between vibrator and embedded parts, supports and anchors.

.12 Engineer can also reduce the rate of pouring to allow Contractor execution or work of a good quality.

.13 All concrete which has not been placed in conformity with the requirements of Engineer must be removed and replaced at Contractor's expense.

.14 Contractor shall choose his equipment in such a way as to be able to place concrete Class A-3.

.15 All formwork shall be Class F-4, made of sound wood, free of knots and irregularities.

.16 Formwork shall be firmly attached in place, braced, and supported to resist the loads on which it is exposed keeping its alignment and shape.

.17 Formwork shall be tight and shall not permit leakage of grout.

.18 Formwork shall be supported by adjacent first stage concrete, but shall never be attached to the embedded parts, embedded parts anchors, or tie-rods.

D1 .19 The finish required for form surfaces shall be Class F-4, and must conform to the requirements and tolerances specified in Section 03 30 00, Table 7.

D1 .20 Not Used

.21 All defects must be repaired by Contractor as stipulated in the same specification.

4.1.5 Field Control of Concrete Quality

.1 All concrete tests shall be by Engineer or by its representative.

.2 Samples of fresh concrete will be obtained at the placement site by Engineer.

.3 Contractor shall provide assistance as required by Engineer in securing and transporting samples. Contractor shall supply all concrete to the extent needed for testing by Engineer.

4.1.6 Grouting

D1 .1 Grouting shall be carried out according to Technical specification Sections 48 13 21 and 03 60 40.

4.2 FINAL TOLERANCES AFTER INSTALLATION OF GATE AND STOPLOG EMBEDDED PARTS AND GATES

4.2.1 Tolerances specified in the Appendix B shall be met after the final installation of embedded parts and gates.

4.2.2 Machined surfaces shall be smooth and free of any scratches.

4.2.3 Damaged surfaces shall be repaired so as to meet the specified tolerances.

4.2.4 At the joint between different sections of the embedded parts, the guide and the adjacent surfaces shall be smooth.

PART 5 PRESERVATION, MECHANICAL COMPLETION & COMMISSIONING REQUIREMENTS

5.1 GENERAL

D1

5.1.1 Preservation, Mechanical Completion & Commissioning Requirements noted herein are defined in MFA-SN-CD-2000-ME-SP-0002-01 Preservation, Mechanical Completion & Commissioning Requirements.

5.1.2 END OF SECTION

APPENDIX A

GATE AND STOPLOG SEALS

1 GATE AND STOPLOG SEALS

1.1 INTRODUCTION

1.1.1 This document applies to the design, manufacture, handling and storage of the elastomeric type seals for all the gates and stoplogs.

1.2 GENERAL REQUIREMENTS

1.2.1 All gate seals shall be manufactured in moulds of the correct cross section. Extruded seals will not be permitted;

1.2.2 Single and double stem seals shall have a solid bulb.

D2

1.2.3 The side and top seals for the Intake Gates, Spillway Gates, Upper Bulkhead Gates and Upper Draft Tube Stoplogs shall be provided with a coating of fluorocarbon (PTFE) sheath bonded to the sealing surface of the bulb and the external surface of the sheath shall be free of adhering or bonded rubber;

1.2.4 Where it is not possible to provide seals in one length, the separate component lengths shall be tight butted in the shop. The fraying ends shall be cut at right angles, and dressed slightly longer than required to ensure a tight joint;

1.2.5 The horizontal bottom seals on each gate section shall be designed and installed with a tolerance of ± 0.5 mm straightness over the full length.

1.2.6 Dimensional tolerances of the joint, in section, must be ± 5% relative to the dimensions specified. For a given gate or stoplog, the dimensional tolerances of the joint, in section, should not vary by more than 2% over the entire length of the joint.

1.2.7 All the corner pieces must be one piece moulded pre-cast in the factory by the manufacturer of the seals. The length of each branch of the angle shall be approximately 300 mm.

1.3 MATERIALS

1.3.1 Elastomer

.1 Seals shall be manufactured of a vulcanized elastomeric material without cloth or other fibre internal reinforcement. Their composition should include components (agents) to help the resistance to immersion, weather (climatic) conditions, abrasion and aging.

.1 Seals must have the following physical properties when tested in accordance with the latest revision of the corresponding ASTM Standard:

Property:	Limit:	ASTM Method of Testing:
Tensile strength	21 MPa	D412
Ultimate elongation	450% minimum	D412
Durometer hardness (Shore Type A)	60 to 70 40 to 50 rectangular	D883 D2240
Water absorption (70°C) for 48 hours	3% maximum by weight	D471
Compression set	30% maximum	D395
Tensile strength after Oxygen Bomb Ageing	80% minimum of original tensile strength	D572

1.3.2 Fluorocarbon (PTFE) Coating

.1 Fluorocarbon cladding shall be permanently fixed to the rubber joint. The minimal thickness of the cladding shall be 1.5 mm.

.2 The fluorocarbon shall have the following properties:

.1 Tensile strength 14 MPa minimum

.2 Elongation 250% minimum

.3 Friction coefficient 0.15 maximum

.3 A sample of one of the extremities of each section of the moulded seal covered of fluorocarbon cladding shall be subjected to an adhesion test according to ASTM D413 (using either the machine method or the deadweight method):

.4 Cladding shall be able to withstand a minimum load of 53 N per cm of width.

.5 Load shall be applied to an angle of 90 degrees of the elastomeric surface.

1.4 CONNECTIONS (JOINTS)

1.4.1 General Requirements

.1 Joints shall be designed to avoid, or at least minimize, the number of connections to be performed, both in the workshop and to Site.

.2 The transition pieces between different parts such as the angles shall be hot vulcanized to one of the straight portions, by one of the branches, and shall be done by the manufacturer of the seals.

.3 Straight portions shall be provided wherever possible and in one piece.

.4 Detailed drawings showing the location and type of joints to be executed by Contractor, both in the workshop or at Site, shall be submitted to the Engineer for review and acceptance prior to the commencement of work.

1.4.2 Vulcanized Connections

.1 All connections performed by Contractor and manufacturer of the seals shall be hot vulcanized.

.2 The two ends to be connected shall be cut at 90° with respect to the thickness and width.

.3 The cut shall avoid holes in the legs of the seal where ever possible to allow attachment to the gate.

.4 The vulcanization shall be executed by holding firmly the two ends to be connected in a jig designed for that purpose.

1.5 HANDLING AND TRANSPORTATION

1.5.1 Special care shall be taken during handling and transport of seals to avoid damage to the fluorocarbon coating.

1.5.2 Folding of seals is permitted only on the manufacturer's written recommendation.

1.5.3 The joints shall be handled or shipped in straight lengths and securely fastened to rigid packaging to prevent accidental folding during handling.

1.6 STORAGE

1.6.1 Seals supplied as spares shall be suitably packaged and crated for long-term storage. Contractor shall provide storage instructions and an estimated shelf life

.

APPENDIX B

TOLERANCES

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **48 13 20**
CH0032	**Gates, Stoplogs & Trashracks**	Rev: D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

D2 Table 1: Tolerances of embedded parts before and after secondary concrete installation - Intake and Spillway Gates

Embedded Parts	**Position or Dimension (mm)**	**Verticality T (mm/height)**	**Horizontally T (mm/length)**	**Flatness T (mm)**	**Straightness T (mm/m)**	**Parallelism T (mm)**	**Perpendicularity (mm)**
• Sill Beams ❖ Sealing surfaces	± 2 (*)		0.25 (**)		0.1/2.0		
• Lateral Guides ❖ Guiding surfaces for main wheels. ❖ Sealing surfaces. ❖ Lateral surfaces for the main wheel paths and the seal sealing plates. ❖ Upstream, downstream and lateral guiding surfaces.	± 2 (*) ± 2 (*) ± 2 (*) ± 2 (*)	0.75 0.75 1.5 3.0			0.15/2.0 0.1/2.0 1.5/3.0		
• Lintels ❖ Sealing Surface	± 2 (*)				0.25/2.0 0.75/Length		
Gates	**Position or Dimension (mm)**	**Verticality T (mm/height)**	**Horizontally T (mm/length)**	**Flatness T (mm)**	**Straightness T (mm/m)**	**Parallelism T (mm)**	**Perpendicularity (mm)**
• Contact points of the main wheels for any position of wheels.					0.2 .01/length		
• Sealing surfaces.				3.0 (at the 4 corners)	0.15/2.0 0.4/length		
• Bottom edge (steel).					0.1/length	0.15	1.0 (***)
• Gap between edge and sill.	0.15						

(*) The position tolerances are established with respect to the axes of the opening and shall be respected throughout the entire length of the embedded parts.
(**) This tolerance applies to the longitudinal and transversal directions.
(***) This tolerance of perpendicularity is defined in respect to the line linking the contact points of the main wheels.

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **48 13 20**
CH0032	**Gates, Stoplogs & Trashracks**	Rev: D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

D2 **Table 2: Tolerances of embedded parts before and after secondary concrete installation- Stoplogs and Bulkhead Gates**

Embedded Parts	Position or Dimension (mm)	Verticality T (mm/height)	Horizontally T (mm/length)	Flatness T (mm)	Straightness T (mm/m)	Parallelism T (mm)
• Sill Beams ❖ Sealing surfaces. ❖ Bearing support vs. sealing surfaces	± 2 (*) + 0.25; -0		0.25 (**)		0.15/2.0	
• Lateral Guides ❖ Sealing surfaces. ❖ Guiding surfaces for the bearing bars. ❖ Guiding surfaces of the bearing paths for lateral guide shoes. ❖ Guiding surfaces for the leaf springs and the upstream guiding shoes.	± 2.0 (*) ± 2.0 (*) ± 2.0 (*) ± 2.0 (*)	0.75 0.75 3.0 3.0			0.25/2.0 0.25/2.0 1.5/3.0 1.5/3.0	
• Lintels ❖ Sealing surfaces.	± 2.0 (*)				0.25/2.0 0.75/Length	

Gates and Stoplogs	Position or Dimension (mm)	Verticality T (mm/height)	Horizontally T (mm/length)	Flatness T (mm)	Straightness T (mm/m)	Parallelism T (mm)
• Bearing bars					0.4/length	
• Surfaces for attachment of seals.					0.4/length	
• Surfaces of the bearing bars vs. machined surface for the seals						. 0.75
• Gate corner measured at the bearing bars extremities				3.0		

(*) The position tolerances are established with respect to the axes of the opening and shall be respected throughout the entire length of the embedded parts.
(**) This tolerance applies to the longitudinal and transversal directions.

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 48 13 21
CH0032	**HOISTS AND CRANES**	Rev. D2
POWERHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

REGISTERED PROFESSIONAL ENGINEER PEGNL Newfoundland and Labrador RANDOLPH D. KOOB 6 Dec 2013 NEWFOUNDLAND & LABRADOR

TABLE OF CONTENTS
SECTION 48 13 21
HOISTS AND CRANES

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL 10458
which is valid for the year 2013

PART 1 GENERAL

1.1 DESCRIPTION AND SCOPE OF WORK

1.1.1 This section of the specification details the requirements for hoist and cranes and associated equipment for the Muskrat Falls Hydroelectric Development.

1.1.2 This document shall be read in conjunction with “Lower Churchill Project Muskrat Falls Hydroelectric Development – CH0032 - Supply and Install Powerhouse and Spillway Hydro-Mechanical Equipment - Scope of Work - MFA-SN-CD-2000-ME-SP-0001-01/505573-3321-45EW-0001”, Part 2, Exhibit 1.

1.2 RELATED SECTIONS

D1

.1 Section 05 12 00 Structural Steel

.2 Section 05 50 10 Miscellaneous Metals and Embedded Parts

.3 Section; 48 13 10 General Mechanical Requirements

.4 Section; 48 13 20 Gates, Stoplogs and Trashracks

.5 Section; 48 13 22 Trash Cleaning System

.6 Section; 11 08 00 Mechanical Completion, Commissioning & Turn-Over Requirements

D1

.7 Section; 26 29 03.03 Control and Monitoring – Hydro-Mechanical

1.3 GENERAL CONDITIONS

D1

1.3.1 Contractor shall be responsible for the final design of the hoists and cranes. However, the design, manufacture, operation and erection shall conform to the basic criteria, requirements, codes and standards detailed in these Specifications, and especially to the CSA B167 Standard and, for the details this standard does not specifically cover, to the recommendations of CMAA No. 70 Specifications.

1.3.2 The clearances, hook approaches and elevations shown on the drawings for some elements of the hoist are the minimum acceptable limits and Contractor’s design, insofar as possible, shall provide increased clearances and reduced hook approaches regarding equipment and physical limits, as well as additional vertical hoist travel.

1.3.3 All hoists shall be designed to maximise the lifting height within the available headroom and as such shall consider the load being lifted, such as lifting beam, gate etc. and design the hoist to accommodate its overall shape.

1.3.4 All electrical equipment, and mechanical equipment that is not designed to be submerged, shall be protected from the weather considering both precipitation and wind.

1.3.5 The hoists shall be able to operate under full load without excessive noise and undue vibration. All movements shall be continuous and smooth. Slipping of the load shall not occur at any time. The hoists shall be designed in such a way that it will not endanger personnel and nearby installations.

1.3.6 Safety and lock out requirements shall be taken into account in all aspects of Contract's design and implementation.

1.3.7 Without in any way detracting from performance, the hoists shall have an aesthetic appearance with clean lines and a neat and tidy arrangement of cables and mechanisms, and enclosed where ever possible.

D1

1.3.8 All construction details shall be elaborated so that there be no accumulation of water or debris on the structures, and so that all surfaces can be easily accessible for inspection and maintenance. Use of enclosed steel sections (HSS), instead of open steel section (WF or C), minimizes water and debris accumulation areas within the hoist structure.

1.3.9 All lubricated equipment located over water shall have drip trays or another means acceptable to Engineer to prevent any leakage entering the waterways.

PART 2 DESIGN REQUIREMENTS

2.1 APPLICABLE STANDARDS

2.1.1 Codes and Standards

The following standards shall apply to the Work described in this document.

.1	AGMA 260.02	Design of Components – Enclosed Gear Drives – Bearings, Bolting, Keys and Shafting
.2	AGMA 420.04	American Gear Manufacturers Association Standard
.3	AGMA 6001-E08	Design and Selection of Components for Enclosed Gear
.4	Drives	

.5	AISE No 7	Technical Report No. 7, Specifications for Ladle Hooks
.6	ANSI Standard B4a	Tolerances, Allowances and Gauges for Metal Fits
.7	ANSI C42.30	Definitions of Electrical Terms
.8	ANSI/AGMA 2001 C95	Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
.9	ANSI/ASME HST-4	Performance Standard of Overhead Electric Wire Rope Hoists
.10	ANSI/ABMA STD 9	Load Ratings and Fatigue Life for Ball Bearings
.11	ANSI/ABMA STD 11	Load Ratings and Fatigue Life for Roller Bearings
.12	ASME B1.1	Unified Inch Screw Threads
.13	ASME B1.13	Metric Screw Threads: M Profile
.14	ASME B15.1	Safety Standard for Mechanical Power Transmission
.15	ASME B30.2	Overhead and Gantry Cranes
.16	ASME B30.7	Winches (formerly Base Mounted Drum Hoists)
.17	ASME B30.20	Below the Hook Lifting Devices
.18	ASME BTH-1	Design of Below the Hook Lifting Devices
.19	ASTM A275	Standard Practice for Magnetic Particle Examination of Steel Forgings
.20	ASTM A384	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
.21	ASTM A385	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
.22	ASTM A388	Standard Practice for Ultrasonic Examination of Steel Forgings
.23	ASTM A609	Standard Practice for Castings, Carbon, Low Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof

.24	ASTM E94	Standard Guide for Radiographic Examination
.25	ASTM E114	Standard Practice for Ultrasonic Pulse-Echo Straight-Beam Contact Testing
.26	ASTM E125	Standard Reference Photographs for Magnetic Particle Indications on Ferrous Castings
.27	ASTM E165	Standard Practice for Liquid Penetrant Examination for General Industry
.28	ASTM E186	Standard Reference Radiographs for Heavy-Walled (2 to 4½-in. (50.8 to 114-mm)) Steel Castings
.29	ASTM E280	Standard Reference Radiographs for Heavy-Walled (4½ to 12-in. (114 to 305-mm)) Steel Castings
.30	ASTM E433	Standard Reference Photographs for Liquid Penetrant Inspection
.31	ASTM E446	Standard Reference Radiographs for Steel Castings Up to 2 in. (50.8 mm) in Thickness
.32	ASTM E709	Standard Guide for Magnetic Particle Testing
.33	AWS D1.1	Structural Welding Code
.34	CAN/CGSB 48.9712	Non-destructive Testing; Qualification and Certification of Personnel
.35	CGSB 1-GP-12C	Standard Paint Colors
.36	CMAA 70	Specifications for Top Running Bridge and Gantry type Multi Girder Electric Overhead Travelling Hoists
.37	CMAA 74	Specifications for Top Running and Under Running Single Girder Electric Overhead Cranes
.38	CSA A-23.3	Design of Concrete Structures
.39	CSA B167	Overhead travelling hoists: Design, inspection, testing, maintenance, and safe operation
.40	CSA C22.1	Canadian Electrical Code

.41	CSA C22.2	Safety Standards for Electrical Equipment
.42	CSA G4	Steel Wire Rope for General Purpose and for Mine Hoisting and Mine Haulage
.43	CSA G164	Hot Dip Galvanizing of Irregularly Shaped Articles Metals and Metal Products
.44	CSA S16	Design of Steel Structures
.45	CSA W47.1	Certification of companies for fusion welding of steel
.46	CSA W48	Filler Metals and Allied Materials for Metal Arc Welding
.47	CSA W59	Welded Steel Construction - Metal Arc Welding
.48	CSA W178.2	Certification of Welding Inspectors
.49	CSA Z85	Abbreviations for Scientific and Engineering Terms
.50	NBCC	National Building Code of Canada
.51	NLOHS	Occupational Health and Safety Regulation of Newfoundland Labrador
.52	SSPC PA2	Procedure for Determining Conformance to Dry Coating Thickness Requirements
.53	SSPC SP3	Power Tool Cleaning
.54	SSPC SP10	Near-White Metal Blast Cleaning
.55	SSPC VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
.56	ANSI/ASSE Z359.4	Fall Protection Code: Safety Requirements for Assisted-Rescue and Self-Rescue Systems.

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2.1.2 Materials

All materials used in the different elements of the supply shall conform to the standards identified below:

.1	Anchors for Towers	ASTM A320 Type L7, 4140 or ASTM A193 Type B7
.2	Bolts, studs and nuts	ASTM A307, ASTM A325, ASTM A193, A194

.3	Bronze Bushings	ASTM B584
.4	Bronze subject to stress	ASTM B21, Alloy 464, Semi Hard (such as bolts and nuts)
.5	Castings	ASTM A27
.6	Forgings	ASTM A668
.7	Guide Rollers	CSA G40.20/G40.21 700 QT
.8	Guide Roller Axles	ANSI 430 or ASTM A276, type 304
.9	Helical Springs	SAE 5160
.10	Stainless Steel Shafts	ASTM A473, ASTM A564, AISI 431, A276
.11	Steel Shafts/Gears	AISI 3140, 4140, 4340
.12	Structural Steel	ASTM A36, ASTM A992, CSA G40.20-04/G40.21-04 Type W or WT
.13	Structural Steel for Hoist Towers and Bridges	CSA G40.20-04/G40.21-04 Type WT
.14	Steel for Wheels	ASTM A504, Class C
.15	Stainless Steel Fasteners	ASTM F593
.16	Stainless Steel Tubing	ASTM A269
.17	Stainless Steel	ASTM A176, ASTM A240, ASTM A276, (sheet & strip)

2.2 ALLOWABLE STRESSES AND DEFLECTIONS

2.2.1 General

.1 Contractor shall be responsible for design of all components to the relevant standards, and prudent utility practice, for spillways and hydro-electric facilities but the following design criteria shall be used as a minimum guideline.

.2 All design criteria is this document is based on Allowable Stress Design (ASD) methodology.

.3 If Contractor would like to use Limit States Design (LSD) methodology as an alternative to ASD for some or all the design work then Contractor shall submit a proposal to Engineer for Acceptance explaining methodology and all design criteria, with justification demonstrating that the proposed methodology and criteria meets all this specifications intended requirements.

.4 The LSD shall be based on CSA S16, CSA W59 and NBCC.

.5 Allowable stresses shall be based on the von Mises-Hencky criteria.

2.2.2 Normal Operating Condition

.1 General Mechanical and Structural Design

.1 For all the normal loading conditions specified in this document, the allowable stresses on equipment and their support structures shall not exceed 90% of the allowable stresses given in CSA S16-1969, CSA B167, CMAA-70, and CSA W59.

.2 Wire Rope

.1 The design load in wire rope shall not exceed 20% of the nominal breaking strength of the wire rope.

.3 Welded Joints

.1 Shop Welds

.1 The strength of a full penetration butt welded joint shall be such that the stresses in the weld do not exceed the following percentage of the permissible stresses in the weakest of the materials to be welded:

.1 100% of the allowable stresses in the lower strength material when the joint is subjected to thermal heat treatment and 100% radiography;

.2 95% of the allowable stresses in the lower strength material when the joint is subjected only to 100% radiography;

.3 90% of the allowable stresses in the lower strength material when the joint is subjected only to the thermal heat treatment;

.4 85% of the allowable stresses in the lower strength material when the joint is neither radiographed nor thermally heat treated.

.2 Field Welds

.1 For all field welded joints the stresses in the welds shall not exceed 80% of those permitted in Clause 2.2.2.3.1 unless 100% NDT has been performed and Accepted by Engineer.

.3 Fasteners

.1 For all mechanical fasteners the allowable stresses/loads shall not exceed 90% of those permitted by CSA Standard S16 or 100% of CMAA 70 whichever is more conservative.

.4 Hooks

.1 AISE Standard No. 7 shall be used in the determination of allowable stresses for hooks and lift blocks, with no additional safety factors applied.

.5 Bushings

.1 The average stresses in self-lubricated bushings shall not exceed the lesser of 20 MPa or the manufacturer's recommended design stress.

.6 Other Mechanical Components

.1 For elements not covered by a specific standard the allowable stresses shall not exceed 33% of the yield strength, or 20% of the ultimate strength of the material, whichever is the most conservative.

.7 Concrete

.1 The allowable stresses shall not exceed 90% of those specified in standards CSA A-23.3.

2.2.3 Abnormal Operating Conditions

.1 General

.1 For abnormal loading conditions such as jamming, broken wire rope, seismic events, and test loads, the allowable stresses on the structural elements may be increased by up to 33% above those specified in Clause 2.2.2, but in no case exceeds 90% of the yield strength of the material, subject to the exceptions specifically identified below. In addition concrete bearing and shear stresses shall not exceed 90% of the allowable factored stress in any case.

.2 Hoist Structure and Lifting Beams

.1 For the cases of;

.1 Jamming of a gate, stoplog, trashrack section, or a lifting beam, where the load being applied to the hoist structure is asymmetric, or,

.2 One wire rope breaks,

.3 The allowable stresses maybe increased up to 90% of the elastic limit of the material used.

.3 Wire Rope

.1 The design load in wire rope shall not exceed 50% of the nominal breaking strength of the wire rope and the stress in any individual wire shall not exceed 90% of the ultimate strength of the rope including stresses induced by bending of the wire ropes, calculated in accordance with the following formula:

$$f = \frac{E\, d_w}{D}$$

Where: f = bending stress in MPa;

E = Elasticity modulus of wire rope (assume 200000 MPa);

d_w = largest wire diameter in mm;

D = pulley pitch diameter in mm.

D1 .2 The forces in the ropes due to a stalled motor shall not exceed 50% of the rope breaking strength.

.3 If one rope is broken, the safety factor of the remaining ropes shall not be less than 2.

2.2.4 Allowable Deflection

The deflection of the main girders under rated load shall not exceed 1/1000 of their span.

2.3 RATED AND DESIGN LOADS

2.3.1 Hoist Rated Load

.1 Definitions:

.1 Basic Load – Capacity required to actually lift the component considering all possible load contributions.

.2 Rated Load – Equal to the Basic Load multiplied by a factor to provide some additional hoisting capacity and to accommodate unbalanced head on specific hoists.

.2 The Basic Load shall be the sum of all the following and shall be based on conservative estimates of the parameters taking into account the uncertainty in the estimation of the parameter:

.1 Weight of the heaviest component to lifted;

.2 Weight of the associated lifting beam and any other required lifting apparatus;

.3 All sliding friction including the effects of hydrostatic loads where applicable;

.4 Static friction including the effects of hydrostatic loads where applicable;

.5 All rolling friction including the effects of hydrostatic loads where applicable;

.6 The effects of friction in all sheaves;

.7 Additional loading due to any guide misalignment or gate skewing;

.8 Downpull where applicable;

.9 All transient hydrodynamic forces where applicable;

.10 Ice loading on exposed unheated surfaces and in the gate slots where applicable.

.3 The Basic Load shall exclude any buoyancy effects.

.4 The hoist Rated Load shall be equal to the Basic Load x Kh where Kh is:

.1 Kh = 1.10 for the Spillway and Intake Gate hoists.

.2 Kh = 1.20 for the Draft Tube Crane and Trash Cleaner hoist.

.3 Kh = 1.25 for the Spillway Maintenance Hoist

D1

.5 Friction forces used to evaluate hoist rated load shall be calculated using the hydrostatic pressure corresponding to Reservoir Level of El. 41.5m.

2.3.2 Impact Factor

.1 An impact factor of 1.25 shall be applied to the Hoist Rated Load and used in the analysis of the design of all components.

2.3.3 Weight of components

.1 The design load for the supporting structure shall include 110% of the weight of all hoisting and structural components.

2.3.4 Sheave Friction

.1 The design of the hoists, including the wire ropes, shall include the effects of friction in the sheaves.

2.3.5 Seismic Loads

.1 All equipment, except for the spillway hoist building and towers, shall be designed to withstand seismic horizontal acceleration of 0.091 g.

.2 Spillway Hoist Building and Towers

The design of the spillway hoist building and towers, shall be based on a horizontal ground acceleration of 0.091 g at the tower base and applying the appropriate amplifications factors based on the NBCC assuming that there shall be no permanent deformation in any part of the structure after a seismic event.

2.3.6 Wind Snow and Ice Loads

.1 See Section 48 13 10, Clause 2.3.

2.3.7 Gate Jamming Loads

.1 Gate jamming loads shall be based on the hoist motor producing its maximum breakdown torque of 210% using a torque rated motor, operating at rated voltage, and assuming a 100% mechanical efficiency of the hoist and reeving.

2.3.8 Hoist and Lifting Beam Load Cases

.1 Normal Load Cases

.1 Case H1 Hoist rated load

.2 Abnormal Load Cases

.1 Case H2

.1 Gate jamming with symmetrical loading (all components intact).

.2 Case H3A

.1 Gate jamming with asymmetric loading (only one side of gate suspended) – one wire rope broken.

.3 Case H3B

D1 .1 Gate jamming with symmetrical loading (both sides of gate still suspended) – This case is applicable to the spillway gates with one of four wire ropes broken.

D1 .2 Note: Depending on the design it is anticipated that only one of Case 3A or 3B will apply.

.4 Case H4

.1 Raising a test load (125% of rated load).

.5 Case H5

.1 Seismic event with load (Case H1) hoisted, constrained from swinging, and stationary.

Note for the Spillway Maintenance Hoist(s) only Load Cases H1 and H4 apply.

2.3.9 Spillway Hoist Tower Load Cases

.1 Normal Load Cases

.1 Case T1

.1 All gates being raised simultaneously (H1 loading condition), plus

.2 Wind, Snow and Ice Loads applied to the towers.

.2 Case T2

.1 All gates raised to their normal full open position (El. 39.0 m) (H1 loading condition), plus

.2 Wind, Snow and Ice Loads applied to the towers, plus

.3 Wind Load on the Gates (lateral load shared between embedded parts and tower).

.3 Case T3

.1 One gate being raised to its maximum height (H1 loading condition with gate at highest elevation), plus

.2 A second adjacent gate raised to normal full open position (El.39.0 m) (H1 loading condition), plus

.3 Wind, Snow and Ice Loads applied to the towers, plus

.4 Wind load on all open gates.

.2 Abnormal Load Cases

.1 Case T4

.1 Seismic event with one gate raised (stationary) to its maximum position (for the worst case gate hoist location), plus

.2 Wind, Snow and ice loads applied to the towers, plus

.3 Wind Load on open gate.

.2 Case T5

.1 Case H2 hoisting loading with side guide roller jamming at mid tower height, plus

.2 A second adjacent gate raised to normal full open position (El.39.0 m), plus

.3 Wind, Snow and Ice Loads applied to the towers, plus

.4 Wind load on all open gates.

.3 Case T6

.1 Case H3A and/or H3B loading with side guide roller jamming at mid tower height, plus

.2 A second adjacent gate raised to normal full open position (El.39.0 m), plus

.3 Wind, Snow and Ice Loads applied to the towers, plus

.4 Wind load on all open gates.

.4 Case T7

.1 Case H4 loading on one hoist with no load on adjacent hoists (for the worst case gate hoist location).

.3 Floor Loading

.1 Spillway hoist building floor shall be designed to sustain a minimum uniformly distributed load of 7.5 kPa and the heaviest component in the hoist house for operation and for disassembly for service and maintenance.

.2 Walkways, stairs, platforms, and passageways shall be designed to sustain a uniformly distributed load of 5 kPa.

.3 Outdoor walkways shall be designed to sustain a uniformly distributed load of 5 kPa, plus ice and snow load.

PART 3 DESIGN CRITERIA

3.1 GENERAL

3.1.1 All hoists shall be of welded steel construction composed of open type structural shapes.

3.1.2 All structures shall be designed to equalise loading of main structural members and avoid asymmetric deflections and twisting.

3.1.3 The hoists shall be designed such that the wheel loading are equalized for each component and where wheels are in groups are articulated to equalize the load on each wheel in that group.

3.1.4 All structural and mechanical elements of the hoists shall be designed to withstand maximum stalling torque of the motors without damage.

3.1.5 All hoists shall remain fully operational immediately after a seismic event without any intervention.

3.1.6 All hoist mechanisms shall be capable of operating up to 300% of rated speed without damage.

3.2 ELECTRICAL REQUIREMENTS

3.2.1 Hoist motors shall be torque rated and certified at 200% +/- 10% over rated torque of the hoists.

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3.2.2 Hoist motors used on hoist with fan brakes shall be designed for 300% over the rated speed.

3.2.3 Design to be completed in accordance with requirements of;

.1 Electrical Divisions, supplemented by this section;

.2 CSA C22.1 and CSA C22.2.

3.3 FASTENERS AND DOWELLING

3.3.1 Bolted connections shall be design according to CSA S16.

3.3.2 Bolted connections maybe either friction or shear type except as detailed below.

3.3.3 Where fastener torque is critical, the design of the fastener or joint shall take into consideration the uncertainty in the selected torque or tensioning method.

3.3.4 Where components are to be removed, and are part of routine or reasonably expected maintenance, the fastener design shall be of the shear type and designed such that precise torque or tensioning of the fastener is not required.

3.3.5 All other connections shall be friction type.

3.3.6 All joints where alignment is critical shall incorporate locating dowels or fitted fasteners.

3.3.7 Use of ASTM A490 bolts are not allowed where moisture is present.

3.4 WIRE ROPES

3.4.1 The wire ropes shall be manufactured of galvanized improved plow steel with synthetic fibre core. They shall meet CSA G4 requirements of the 6 x 19 classification.

3.4.2 The wire ropes shall be impregnated with lubricant during fabrication.

3.4.3 The wire rope system shall be equalized and arranged to prevent reverse bending.

3.4.4 Wire ropes shall be rotation resistant if used with a swivel on the dead end fitting, or shall be of a proven wire rope classification if rope rotation or a swivel is used.

3.5 WIRE ROPE DRUMS

3.5.1 Wire rope drums shall be designed for a single layer of wire rope with machined grooves.

3.5.2 Drums with two wire ropes shall have left and right hand rope lays for symmetrical tension on the gates through the full range of travel.

3.5.3 Drums shall have a minimum of three (3) wraps of wire rope when the hoist is at its lowest point and shall have a minimum of two (2) free grooves when the hoist is at its high point.

3.5.4 The wire rope dead ends on the hoist drums shall have a minimum of two (2) clamps.

3.5.5 The pitch diameters of the drums shall not be less than the values indicated for Class A in CSA Standard B167 but in no case shall be less than 30 times the wire rope diameter.

3.5.6 The drums shall have inspection ports on each end large enough to easily view all parts of the drum, and the inspection port shall be equipped with bolt on covers.

3.6 DRUM DOGGING DEVICE

3.6.1 The Intake Gate and Spillway Gate hoists shall be provided with drum dogging devices to allow disengagement of any hoist component when the gates are supported on the mechanical gate dogging devices.

3.6.2 The drum dogging devices shall shear if the gate weight or motor power is applied to the hoist with no damage to any other component.

3.6.3 Application of the drum dogging devices shall not involve the removal of any part of the safety guards.

3.6.4 The drum dogging devices shall have limit switches to disengage power to the motor when the drum dogging device not fully disengaged.

3.6.5 The drum dogging devices shall have pins to secure the dogging device in the disengaged position, and have provision to be lockable in both the engaged and disengaged position.

3.7 SHEAVES AND SHEAVE BLOCKS

3.7.1 The sheaves shall be fitted with grease-lubricated sealed roller bearings on stainless steel axles.

3.7.2 Each sheave shall be equipped with an independent greasing point.

3.7.3 The bearing seals shall prevent both the leakage of the lubricant and the ingress of water and contaminants.

3.7.4 The sheave axles shall be locked in position with stainless steel keeper plates and stainless steel bolts.

3.7.5 Sheave pitch diameter shall be according to CSA Standard B167, but shall be a minimum of 30 times the wire rope diameter but could be reduced to a minimum of 24 times the wire rope diameter, if the classification for the hoists allows the use of sheaves to this diameter, and a signed certification is provided from the wire rope manufacturers that the wire ropes provided can be operated for the life of the facility at the minimum design operating temperatures, and shall be machined in the groove.

3.7.6 To prevent corrosion, the pulley groove shall be covered with grease compatible with the grease used for the rope.

3.7.7 The fleeting angles for the rope sheaves shall not exceed 2½ degrees during normal working hoist travel and shall not exceed 3½ degrees over the full range of operation.

3.7.8 Sheave blocks shall be provided with a means for preventing the ropes from leaving the groove when the load is released.

3.7.9 Hoist usage for Intake Gates is estimated at ten (10) open/close cycles per year, and hoist usage for the Spillway Gates is estimated at eighty (80) open/close cycles per year.

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3.8 TENSION EQUALISING SYSTEM

3.8.1 For hoists with multiple drums, or 2 falls off one drum, and where the wire ropes are not required to be independent, a means of equalising the tension in the wire ropes shall be provided. Either equalising sheaves or equalising beams are acceptable. In the case of equalising beams the dead ends of the wire rope shall be spelter socketed.

3.8.2 For hoists that have multiple independent wire ropes some means of adjusting the wire ropes to balance the tension shall be provided. A means shall be provided to verify that the tension is balanced as part of normal maintenance. Limit switches shall be provided to provide an alarm indication that the ropes are out of balance by a preset limit. If equalizing sheaves are used on two independent ropes, load cells shall be provided on each rope to indicate and alarm if the load is unbalanced.

3.9 HOIST BASES

3.9.1 The hoist bases shall have machined pads for the mounting of all major components requiring precision alignment such as motors, gearboxes, brakes,

bearings supports etc., and the hoist bases shall be machined after all welding has been completed.

3.9.2 The design of the bases shall incorporate shims so as to permit both up and down adjustments.

3.9.3 Jacking screws shall be incorporated for facilitating alignment adjustments both vertically and horizontally.

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3.9.4 Components shall be doweled after all alignment has been completed. Use of stop-blocks is acceptable for large components requiring final assembly and alignment in the field. Factory aligned equipment shall be dowelled.

3.10 HOOKS

3.10.1 For hoists that have hooks, the hooks shall be equipped with safety latches to prevent disengagement of the slings and shall have a swivelling thrust bearing.

3.10.2 Hooks shall be easily removable by means of a steel pin.

3.11 TRAVEL WHEEL ASSEMBLIES

3.11.1 All travel wheels shall be double flanged tapered and shall be designed to prevent derailment.

3.11.2 The rolling surface of the wheel shall have a slightly higher hardness than that of the rails.

3.11.3 The wheels shall have grease lubricated roller bearings complete with seals and shall be designed for easy removal.

3.11.4 Provision shall be made for lifting or jacking trucks or trolleys to change a wheel.

3.12 BUMPERS, END STOPS AND RAIL SWEEPS

3.12.1 Bridge trucks and trolleys shall be provided with suitable removable rail sweeps at each end so as to be effective in both directions of travel.

3.12.2 Each end of the bridge trucks and trolleys shall be provided with an elastomeric type bumper, or an alternative Accepted by Engineer, and end stops, designed to absorb the kinetic energy of the bridge or trolley at 40% rated speed without damage.

3.12.3 The bridge and runways shall be fitted with end stops capable of withstanding the impact of the trolley or bridge at rated speed assuming the energy damping bumper has failed and does not absorb any energy.

3.12.4 Where the runway and end stops are supplied by Company's Other Contractor, Contractor shall provide to Engineer the design loads and bumper details on the related trolley or bridge for the use with solid end stops.

3.13 DROP STOPS

3.13.1 The hoists shall incorporate drop stops that prevent the hoist from dropping more than 10 mm in the event of a failure of any combination of wheel assemblies.

3.13.2 Drop stops shall be removable on under-hung hoists.

3.14 SPEED REDUCERS/GEAR BOXES, BEARINGS AND SHAFTS

3.14.1 All speed reductions shall be performed by fully enclosed geared speed reducers.

3.14.2 All speed reducers shall be designed to perform under all conditions of loading without undue noise, overheating or vibration.

3.14.3 Speed reducer/gear box drain holes shall be equipped with a stop valve and a threaded plug linked to the pipe with a chain, and the drain holes shall allow easy drainage of the gear boxes.

3.14.4 Oil levels shall be clearly readable from outside the speed reducer/gear box with graduated sight glasses or dip sticks.

3.14.5 Shafts shall be supported by anti-friction bearings. Where helical gears are used, bearings are to be suitably designed for all thrust loads. Ball and roller bearings shall be selected in accordance with the bearing manufacturer's recommendations and shall provide a minimum life expectancy, in accordance with CSA Standard B167.

3.14.6 All speed reducer bearings shall be lubricated (self lubricated bearing shall not be used without acceptance by Engineer).

3.14.7 If any drive train includes long shafts, the dimensions of the shafts shall be such as to minimize vibration.

3.14.8 Drive couplings shall be of the sealed grease lubricated flexible type and be capable of accommodating the worst case misalignment of the components.

3.14.9 All speed reducers/gear boxes shall be equipped with heaters.

3.15 DRIVING SYSTEMS

3.15.1 The driving mechanisms for the bridge and the trolley shall be provided with fluid couplings or electronic progressive starting devices to allow a progressive acceleration and a precise positioning of the bridge and trolley.

3.15.2 Drive systems shall be configured for ease of access and ease of maintenance.

3.16 HOIST HOLDING BRAKE

3.16.1 All hoists shall be equipped with an electromagnetic drum holding brake that is mechanically actuated and electrically released.

3.16.2 The brake shall be operated by a quick action direct current 125 Vdc solenoid.

3.16.3 The brake shall be mounted directly on the gear reducer inlet shaft in such a way that the motor can be removed with the hoist holding the load.

3.16.4 The drum brake shall be of the ‘Elevanja’ type or an equivalent Accepted by Engineer.

3.16.5 Braking torque shall be capable of holding 150% of the full load torque of the motor.

3.16.6 The brake on its own shall be capable of holding the load at any position during raising or lowering operations, and stop the load during emergency lowering.

3.16.7 The brake shall be self adjusting to compensate for wear.

3.16.8 The brake shall not lose its effectiveness due to heating if operated frequently over a short period of time.

3.16.9 Brake mechanism sliding contact surfaces shall be made of corrosion resistant and galling resistant materials.

3.17 HOIST HOLDING SECONDARY BRAKE

3.17.1 Where specified, the hoist shall be equipped with second brake in addition to the Hoist Holding Brake that will act as a backup to the Hoist Holding Brake. This brake shall have at least the same capability and operating characteristics as the Hoist Holding Brake and additionally shall activate by an over-speed detector. This brake shall operate simultaneously with the Hoist Holding Brake.

3.17.2 This brake design may be identical to the Hoist Holding Brake mounted on the opposite end of the motor input shaft on the gear reducer, or alternatively may also be a disk type brake(s) located on the main hoist drum(s).

3.17.3 This secondary brake shall allow the Hoist Holding Brake to be removed with the hoist holding the load.

3.18 HOIST FAN BRAKES

3.18.1 Where specified fan brakes shall be provided to limit the lowering speed to a maximum of 200% of the normal motor operated lowering speed but no less than 175% of the normal motor operated speed.

3.18.2 The fan brake shall be installed directly on an extension of an input shaft on the gear reducer.

3.18.3 The fan brake speed shall be controlled by an adjustable damper on the air inlet with the damper nominally at its mid-adjustment to get the specified speed, and once adjusted, the damper position shall be semi-permanently fixed by some means (such as tack welding) to avoid accidental adjustment.

3.18.4 The fan brake air inlet shall be covered by a non-flat (box like rectangular, cylindrical etc.) Protective screen that shall be at least 2.5 times the area of the fan inlet.

3.18.5 The fan brake air outlet shall be directed away from personnel walkways or equipment, and provided with a protective screen.

3.19 BRIDGE TRAVEL BRAKES

3.19.1 The bridge drive system shall be equipped with a proportional braking system, mechanically applied and electrically released.

3.19.2 When powered down these brakes shall act as the parking brake and be capable of holding the bridge position against lateral loads appropriate to the specific hoist (wind, seismic, within rail out of level tolerance while loaded, etc.).

3.19.3 Brake mechanism sliding contact surfaces shall be made of corrosion resistant and galling resistant materials.

3.20 TROLLEY TRAVEL BRAKES

3.20.1 The trolley drive system shall be equipped with mechanically applied and electrically released braking system.

3.20.2 When powered down these brakes shall act as the parking brake and be capable of holding the trolley position against lateral loads appropriate to the specific hoist (wind, seismic, within rail out of level tolerance while loaded, etc.).

3.20.3 Brake mechanism sliding contact surfaces shall be made of corrosion resistant and galling resistant materials.

3.21 BRAKE LININGS

3.21.1 Brake linings shall be of the REDCO RBW or RNAW type, or an equivalent Accepted by Engineer.

3.22 LUBRICATION

3.22.1 Bearings shall be grease lubricated. All mechanisms shall be periodically lubricated and fitted with grease nipples.

3.22.2 All the nipples which are hard to reach shall be extended with independent tubes grouped together at easily accessible points, and tubes shall be supported and protected on their whole length.

3.22.3 All grease nipple fittings shall be of Alemite type No. 1186 with 6 mm (1/4 in) NPT pipe threads.

3.22.4 The grease nipples for the electrical brakes shall be of the Alemite type No. 1627B.

3.22.5 Peep holes shall enable checking the greasing efficiency for each lubricated component.

3.22.6 In general, gears shall be splash lubricated.

3.22.7 Oil reservoirs shall be fitted with easily accessible dip rods or sight glasses, drain plugs and oil breathers.

3.22.8 All lubricated items not enclosed in sealed gear boxes shall be grease lubricated.

3.22.9 Drip pans shall be provided wherever necessary so as to contain leaked oil and grease.

3.22.10 All lubricants shall be of the winter-summer type, and they shall not lose their properties under the specified temperature ranges.

3.22.11 In addition to the information provided in the Operating and Maintenance Manual, Contractor shall supply and install a lubrication chart printed or engraved on an anodized aluminum plate and installed in a visible place on the hoist Accepted by Engineer.

3.22.12 This chart shall specify:

.1 The list of lubrication points;

.2 The type and make of lubricant to be used for each point;

.3 The names of at least three (3) manufacturers capable of supplying each lubricant;

.4 The lubrication cycle for each point.

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3.22.13 Not used.

3.23 LIFTING LUGS

3.23.1 All major components of the hoists (trolleys, trucks, gear boxes, motors, frames etc.) shall have lifting lugs for installation and removal.

3.23.2 The lifting lugs shall be designed such that sub-components do not necessarily have to be removed to perform the lift.

3.23.3 The lifting lugs shall be designed considering such things as available lifting height, access, sling angles, centre of gravity etc. and shall be sized for a minimum of 200% of the expected load.

3.24 HAND RAILS/PLATFORMS/WALKWAYS/STAIRS/LADDERS/GATES/FALL PROTECTION

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3.24.1 Handrails/platforms/walkways/ladders/gates/fall protection shall conform to the requirements in Section 05 50 10.

3.24.2 Hand rails, platforms, walkways, stairs, ladders, gates, and safety equipment such as attachment points for fall arrest/protection etc., shall be provided as necessary to give safe access to all components that will or could need inspection, maintenance and repair.

3.24.3 Stairways are preferred. Ladders may be used only where it is impossible to provide a stairway.

3.24.4 Unless otherwise stipulated, all platforms and their supports shall be designed for distributed loads of 5 kPa.

3.24.5 Fixed steel ladders or stairways shall be provided in accordance with Newfoundland and Labrador Occupational Health and Safety Regulations where necessary to afford access for operation and maintenance of the equipment. Ladders shall not exceed 7.5 m in length and suitable platforms with handrails shall be provided between each length. Where a ladder does not extend above a floor or platform level, hand grips or other suitable means of support shall be provided.

3.24.6 Protective cages shall be provided for ladders longer than 4.5 m, starting at 2.44 m from base of ladder.

3.24.7 Ladder rungs shall be of the anti-skid type and stringers not less than 300 mm apart.

3.24.8 Stairways shall be provided with handrails and shall have a slope not greater than 45º.

3.24.9 Walkways and platforms at any height shall be equipped with handrails and toe-boards in accordance with Newfoundland and Labrador Occupational Health and Safety Regulations.

3.24.10 Handrails shall be provided where ever necessary for the safety of personnel; shall consist of at least two horizontal tubular members; shall be approximately 1100 mm above floor level.

3.24.11 The handrails and supports shall be designed to withstand vertical and horizontal uniformly distributed loads of 750 N/m applied simultaneously on the top of the railing.

3.24.12 Openings in the handrails shall be closed by spring closure gates with latches; chains shall not be used.

3.24.13 All fall arrest/protection anchors, and mountings for other equipment such as Davit arms, shall be permanently installed.

3.24.14 All hand rails, platforms, walkways, stairs, and ladders shall be removable at any location where access to the equipment for maintenance would be restricted.

3.24.15 Spring loaded gates with latches shall be provided anywhere there is a fall hazard.

3.24.16 All walkways and access points shall have a minimum width of 0.9 m.

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3.24.17 Not Used

3.25 PROTECTIVE GUARDS

3.25.1 All rotating parts with the exception of the hoist drums shall be equipped with removable protective guards with handles for easy removal.

3.25.2 Where necessary, the guards shall be equipped with windows for inspection and maintenance.

3.25.3 Attachment screws and nuts shall be stainless steel.

3.25.4 A protective guard shall protect all the friction brakes from contamination from dripping and condensation from the hoists covers, lubricants from other components etc. but still allow adequate ventilation for cooling.

3.25.5 Removable protective guard rails, with wire mesh, shall be provided at the hoist drums, designed to stop anyone from being able to reach the drum or wire rope by reaching over, through, or around the guard.

3.25.6 The guard rails shall have lockable gates if quick access is required to hoist components.

3.26 LIFTING BEAMS

3.26.1 The lifting beams shall be provided with an efficient guiding system which shall utilize the gate and stoplog guides.

3.26.2 Lifting beams shall conveniently and easily be connected to the respective hoist or crane, if not direct connected to the hoist.

3.26.3 In the case where a lifting beam must be used with a mobile crane, the lifting beam shall be supplied with all rigging required to perform the various lifts and be designed to not overly restrict the type of crane or means of connection to the crane.

3.26.4 Lifting beams shall have one or two (2) hooks, with corresponding lifting point, or points, on the component, and if two hooks are used shall be linked by connecting rods to a release lever. Alternates shall be subject to Acceptance by Engineer.

3.26.5 Lift beam hooks shall automatically engage lifting point, or points, on the component sections, under the lift beam self weight.

3.26.6 Lift beams shall be fitted with guide rollers and other such guiding devices as required to ensure the beam is properly guided in the embedded parts, eliminating any risk of the beam or component jamming while raising or lowering.

3.26.7 All rotating parts shall be fitted with specified self-lubricating bushings with seals running on stainless steel or corrosion resistant steel pins, and pins shall be locked in position by means of keeper plates and fixing bolts;

3.26.8 Where applicable the lifting beam shall be equipped with a mechanism that operates the filler valve, and the weight of the lifting beam shall be sufficient to open the valve;

3.26.9 The automatic disengagement mechanism of the lifting beam hooks shall consist of a cable wound around a drum that is driven by an electric powered torque motor.

3.26.10 At the lower torque, the mechanism shall take up the cable slack while the lifting beam is going up or down. At the upper torque, the mechanism shall apply sufficient tension in the cable so as to disengage the hook, or hooks, from the lifting lugs of the gate sections. The lifting beam hooks shall slide under the lifting lugs under their own weight.

3.26.11 The release mechanism shall be designed such that the hook, or hooks, cannot be released by the torque motor cable, or manually, when the weight of the lifted load is being carried by the hooks.

3.26.12 The motor and the disengagement of the hook, or hooks, shall be controlled manually from the control panel with the help of push-buttons.

3.27 TRACK MARKERS AND ALIGNMENT SYSTEM

3.27.1 The Draft Tube Crane and trash cleaner shall have alignment systems to facilitate the operator locating the hoists over the centre of all the gates and stoplogs. The alignment systems shall consist of markers and pointers that:

.1 provide both longitudinal and upstream/downstream positioning,

.2 are clearly visible by the operator from their normal operating position,

.3 are protected from damage and not be a trip hazard to personnel,

.4 are adjustable over a 50 mm range,

.5 are clearly indentified,

.6 are fabricated from stainless steel plates and fasteners and of the reflecting type used for signs.

3.27.2 The pattern and colours shall be submitted to Engineer for Acceptance.

3.27.3 Contractor shall supply and install an electronic alignment system that will be complementary to the manual positioning system and that will enable the operator of the crane to position definitely the lifting beam above the gates guides and within ± 3 mm of its true position.

3.28 CONCRETE/GROUT/ANCHORS

3.28.1 Grouting shall be carried out according to this Section and 03 60 40.

3.29 HOIST LIMIT SWITCHES

3.29.1 See Section 26 29 03.03 for a description of the limit switches.

3.29.2 Once adjusted, the upper extreme limit switches shall be semi-permanently fixed by track welding an equivalent after the completion of all testing.

3.30 MISCELLANEOUS LIMIT SWITCHES

3.30.1 Each brake shall have one (1) limit switch to indicate brake application.

3.30.2 As per Clause 4.6.2.4 the Intake Gate hoist shall have a limit switch that performs an interlock function for the manually operated brake lever.

3.31 LOAD SENSING DEVICES

3.31.1 All hoists shall be equipped with a slack rope detection device except for the Spillway Maintenance hoist in the Spillway Hoist Tower.

3.31.2 For the Intake Gate hoist and the Spillway Gate hoist the slack rope detection device shall stop the hoist motor in the event of a sudden reduction in rope tension, and trigger point for the slack rope detection device shall be no more than 5% of the rated load.

3.31.3 For the Draft Tube Crane and Trash Cleaner hoist the slack rope detection device shall provide indication only, and the trigger point for the slack rope detection device shall be no more than 1.5 x the lifting beam weight.

3.31.4 All hoists shall be equipped with load cells with local displays indicating the hoist load in metric tonnes.

3.31.5 For the Spillway Gate and Intake Gate hoists, and the Draft Tube Crane, the load cells shall have programmable outputs to disconnect the electrical power to the motor nominally set to 120% of the design load when lifting, or to 90% of the design load during lowering.

3.32 POSITION INDICATOR

3.32.1 All hoists shall be equipped with a digital position indicator that will indicate the height of the load above the lowest position.

3.32.2 The intake hoist shall have mechanical indication of gate height above the sill, and indicate normal open position and upper maintenance position.

3.32.3 The position indicator's display shall be clearly visible from the operator's position.

3.32.4 The indicators shall be graduated in metres and decimetres.

3.32.5 For the Trash Cleaner crane and Draft Tube Crane, the position indicator shall display when the lifting beam is at each bulkhead gate or permanent stoplog position.

3.32.6 Rulers, a minimum of 175 mm wide, shall be provided on the Spillway Gate guides to indicate Spillway Gate opening, shall be visible from the upstream walkways with black on white increments and numbering, and shall be graduated in metres and decimetres.

3.33 SPARE PARTS

3.33.1 Required spare parts shall include the following:

.1 One (1) set of brake pads for each type of brake;

.1 One (1) set of each type of sheave;

.2 Two (2) sets of each type of bearings;

.3 Two (2) sets of each type of coupling;

.4 20 Litres of each type of gear box oil;

.5 One (1) brake solenoid of each type;

.6 One (1) torque rated motor for the Intake Gates;

.7 One (1) torque rated motor for the Spillway Gates.

3.33.2 Contractor shall provide a list of Recommended Spare Parts that the Contractor would recommend the Company purchase as an option.

3.34 TOOLING

3.34.1 Contractor shall design and supply maintenance tooling, jigs and special rigging necessary to safely remove components from the hoists and cranes.

PART 4 TECHNICAL REQUIREMENTS

4.1 SPILLWAY GATE HOISTS

4.1.1 General

.1 The hoists shall be capable of raising, lowering and sustaining the Spillway Gates in any position at the maximum reservoir water level.

.2 Each of the Spillway Gates shall be operated by a wire rope hoist with two drums, with two independent wire ropes on each drum, with each wire rope having its own independent dead end designed if any one of the four wire ropes failed the hoist would still be able to raise or lower the gate to the dogging devices or the sill.

.3 The normal raising and lowering speed of the gates shall be between 0.9 and 1.2 m/min.

4.1.2 Hoist Brakes

.1 The Spillway Gate hoists shall each have primary and secondary holding brakes and a fan brake.

4.2 SPILLWAY GATE HOIST TOWERS AND APPURTENANT STRUCTURES

4.2.1 General

.1 The hoist house, stair towers and associated structures shall be designed and constructed to the requirements specified herein, or to the requirements of the attached Civil and Architectural Sections, whichever is more stringent and the design shall be submitted and Approved by the Engineer.

4.2.2 Hoist Bridge Structures

.1 The hoist machinery for each surface gate shall be mounted on a steel bridge structure spanning each spillway opening.

.2 The hoist bridge structures shall be structural steel members, and designed to support the hoist house, the gate hoists, the electrical equipment and the bridge structure can be integral with hoist frames.

.3 One end of each hoist bridge structure shall be provided with free thermal expansion capability at the mounting points on the towers, as required for temperature changes for the outdoor ambient conditions, but shall prevent upstream or downstream movement and if sliding pads are required they shall be self-lubricating.

.4 One end of each hoist bridge structure shall be pinned to the tower to prevent movement relative to the tower when subjected to lateral or longitudinal forces.

.5 Design of the free expansion ends and the pinned ends shall permit free rotation of the hoist bridge structure ends resulting from bending loads.

.6 The hoist bridge structure deck shall be covered with a raised pattern steel plate of not less than 8 mm thick, suitably stiffened.

.7 Sufficient openings shall be provided in the floor of the hoist structure to allow safe access to equipment below for maintenance.

.8 The bridge deck shall be completely closed and weatherproof with only the openings necessary for the hoist ropes and maintenance hatches if so required.

.9 Conveyor belt strips, 12 mm thick, shall be bolted around the wire rope openings to restrict outside air from entering the hoist house.

.10 The hoist bridge deck shall be cantilevered out from the tower as shown on the Drawings, and a covered hatchway shall be provided with an opening of suitable size for hoisting and lowering items in the hoist house, by means of the overhead maintenance crane, to the level of the spillway road deck.

.11 The hatchway in the hoist bridge deck shall have adequately size covers to move different size equipment, except the hoist drums, and shall have handrails with kick plates around the hatchway, and shall have fall protection tie-off points at convenient locations if the handrails have to be removed.

4.2.3 Hoist House

.1 The hoist house shall be provided over the entire length of hoist bridge structure for full protection from the weather.

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.2 The hoist house shall consist of structural steel framework and coated sheet metal cladding. The Spillway hoist house shall not be insulated.

.3 Provision shall be made to accommodate thermal expansion and contraction of the structure.

.4 The hoist house shall be installed in sections so an individual roof section can be removed to service a hoist, and all equipment and cable trays in the hoist house shall be independently supported from the removable roof sections to ease hoist removal.

.5 The hoist house shall be large enough for the hoists, electrical and control panels, the maintenance crane, lighting and cable trays, and walkways.

.6 The hoist house shall extend over the cantilevered end of the hoist bridge structure as shown on the Drawings, and an overhead bridge crane shall be provided of suitable size for hoisting and lowering any items in the hoist house, except the hoist drums, to the level of the spillway road deck.

.7 A walkway, a minimum of one (1) m wide or wider as necessary, shall be provided along one of the side of the hoist bridge structures, and clear access shall be

provided to all parts of the hoist machinery in the hoist house for maintenance and repairs.

.8 Metal cladding shall be pre-painted on exposed side, and shall meet the following requirements, or an equivalent Accepted by Engineer:

.1 Galvanized steel sheet commercial grade, conform to ASTM A525, class 90, with Z275 zinc coating, CL 6025R profile by VICWEST, or an equivalent Accepted by Engineer; thickness 0.76 mm (gauge 22); Steelcolour prefinished '10,000' series from STELCO inc.; color slate blue QC 184;

.2 Metal flashings, counter flashings, closure, parapet copings and other exposed metal pieces shall be pre-painted sheet metal of same quality as metal cladding; thickness 0. 76 mm (gauge 22).

.3 Pre-painted stainless steel screws conforming to CSA 935.3 with and without washers shall be used.

.4 Screws shall have same colour as exterior siding.

.5 The sealant for exterior liner sheet shall be conform to CGSB 19-GP-24 such as Dymeric from "TREMCO" or an equivalent Accepted by Engineer.

.6 The spacing on the supporting girts and purlins shall be such that the deflection under load will not exceed 1/180 of the span.

.9 Contractor shall confirm with Engineer the final specifications of the cladding before purchasing.

.10 One window, 0.75 m x 1.2 m shall be provided on both sides of the hoist house in each spillway bay.

.11 The windows shall be of a type that may be opened a safe distance, and shall be of transparent tempered and safety wired glass with galvanized steel frame painted similar to the cladding.

.12 Ventilators shall be provided to prevent humidity and accumulation of frost inside the hoist house.

.13 Electric radiant heaters shall be provided in front of each hoist/motor location, and control panel for winter access to the equipment.

.14 Power cables to and instrumentation cables from the Spillway gates shall be provided with a single heavy duty sheathed weather proof cable hung from the hoist bridge on the downstream side of the gates. The cable shall have at least three (3) spare pairs of conductors capable of the highest load. The anchoring on

each end of the cable shall be non-abrasive and accommodate movement and flexing of the cable. Potential abrasive contact points on the structure or gates shall be eliminated.

4.2.4 Hoist Towers

D1

.1 Hoist Towers shall conform to the requirements in Section 05 50 10.

.2 Each tower shall be made of structural steel and shall consist of columns stiffened with bracing designed for static and dynamic loads from the hoist structure and from the gates.

.3 Structural connections shall be shop welded or bolted with high strength bolts.

.4 Bolted structural connections shall be friction type connections.

.5 The spillway hoist tower anchoring system shall be designed to apply a pre-stress sufficient to avoid surface separation under the worst overturning condition. The system shall permit the levelling of the towers followed by the tensioning of the anchor studs and subsequent grouting.

4.3 GATE GUIDES

4.3.1 The Spillway hoist towers shall have upper guides for the gates as described in Section 48 13 20.

D1

4.3.2 The gate guides shall be designed for lateral loads from gate jamming or a broken wire rope, and the guides can be designed to yield or transfer loads to the towers.

4.4 ANCHORS AND GROUTING

4.4.1 The towers and lateral guides shall be securely anchored to first stage concrete on the piers with adjustable, galvanized rod-anchors, designed and supplied by Contractor.

D2

4.4.2 The embedded anchors shall be provided to Engineer for installation and embedment of the anchors in first stage concrete by Company's Other Contractor, according to Contractor's layout drawing and installation procedures with technical assistance by Contractor during installation.

4.4.3 Contractor shall mount the anchors on templates to facilitate the attachment of these anchors to the forms and reinforcing steel for embedment.

D2

4.4.4 Contractor shall be responsible for technical assistance during the installation of the anchors in first stage concrete and accepting the Work of Company's other contractor to proceed with placement of first stage concrete.

4.4.5 Contractor shall supply and grout the anchor bolts for towers and column base plates of the structure.

4.4.6 During grouting operation of the anchor bolts for towers, the holes shall be completely filled with grout, of a type and mixture Accepted by Engineer.

4.4.7 Before grouting operation, all accumulation of water shall be removed from the holes by means of a compressed air jet.

4.4.8 Grouting operation shall not be carried out before mixing of sufficient quantity of grout necessary to completely fill the grout holes.

4.4.9 Grout under the base plates of the towers shall be pre-mixed grout, 'Sikagrout 212', or an equivalent Accepted by Engineer.

4.4.10 During cold weather, the foundation of the towers shall be heated to at least 20°C for five (5) days or to 10°C for seven (7) days before grouting, with cold weather protection methods that are accepted by Engineer.

4.5 STAIRWAY, LADDERS, WALKWAYS, AND HANDRAILS

4.5.1 Access to the hoist house shall be by means of stairways located in the two enclosed end towers.

4.5.2 The stair towers shall be completely enclosed by a weatherproof metal cladding of the same type as used for the hoist house walls. The Spillway stair towers shall not be insulated.

D1

4.5.3 Single pane windows, 900 mm by 900 mm, with tempered and safety wired glass, shall be provided at each stair landing on the upstream or downstream face of the covered stair towers over their full height.

4.5.4 The stairs and landings for the stairway shall be made with raised pattern floor plates.

4.5.5 The stairs and landings shall have complete hand railings and kick plates.

4.5.6 The access doors to the enclosed towers shall be of the hollow metal type, mounted on a steel frame having an opening size no less than 0.9 m x 2.15 m.

4.5.7 Covered hatchways shall be provided through the hoist bridge deck, with caged ladders to suspended walkways under the hoist bridge structures for access to the upper sheave blocks and the top of the fully raised gates.

4.5.8 These covered hatchways and suspended walkways shall have full handrails, kick plates, gates and fall protection tie off points.

4.5.9 These covered hatchways shall be located near the control panels so the hatchway covers can be opened to be able to observe gate operation from the hoist house.

4.5.10 Handrails and latched access gates shall be provided on the Spillway deck level, downstream of the road guardrails supplied by Company's Other Contractor, along the tops of the piers for safe access to the stoplogs, gates, walkways between the piers, and gate access openings in the piers downstream of the towers, up to an interface point at the guardrails around the Spillway Electrical Building that are supplied by Company's Other Contractor;

D1 **4.5.11** Handrails and latched access gates will be provided by Company's other contractor around the top of the concrete access ways in the piers that provide access to the tops of each of the Spillway gates;

4.5.12 Lockable gates shall be provided in the concrete access ways where they exit the piers to access the tops of the gates.

4.5.13 The ladders and hatch covers for concrete access ways in the piers will be provided and installed by Company's other contractor.

4.5.14 Walkways shall be provided, with handrails, kickplates and latchable gates, upstream and downstream of the Spillway gates between the piers to provide access to the piers, towers and guide heaters, to service the gate bottom seal, and to access the lower gate hatches when the gates are in the raised position.

D2 **4.5.15** Any anchors and inserts for the handrails that are required to be installed in first stage concrete shall be provided to Engineer for installation by Company's Other Contractor with Contractor's technical assistance during installation. As an alternative, Contractor may core and grout handrails and sleeves.

D2 **4.5.16** The stairwells shall have three (3) convenient panel doors, 600 wide by 900 high, 2 on the south tower upstream and downstream and one on the north tower upstream, accessible from the stairway landings, for accessing equipment (video cameras and horns by Company's Other Contractor) mounted on the outside of the towers at the locations shown on the Drawings.

4.6 INTAKE GATE HOISTS

4.6.1 General

.1 At the maximum differential head the hoists shall be capable of raising the Intake Gate from the fully closed position to approximately 150 mm open, to fill the water passages, and to lower the Intake Gate from fully open to fully closed at maximum discharge as part of an emergency turbine/generator shutdown sequence.

D2

.2 Each of the Intake Gates shall be operated by a wire rope hoist with two drums, with two independent wire ropes on each drum, with each wire rope having its own independent dead end designed if any one of the four wire ropes failed the hoist would still be able to raise or lower the gate to the dogging devices or the sill.

.3 The hoists shall have two drums, each with an independent wire rope, and wire rope dead end designed if one of the wire ropes failed it would still be possible to lower the gate to the dogging devices or the sill.

.4 The normal parking position for the hoists will be with the bottom of the gate about 300 mm above the lintel.

.5 The fully raised position will be with the bottom of the gate raised to above the inspection gallery floor at EL. 23.00 m, or the top of the gate raised for access from the ventilation shaft floor at El. 42.50 m.

.6 The normal raising and lowering speed shall be between 0.9 and 1.2 m/min.

4.6.2 Hoist Brakes

.1 The Intake Gate hoists shall each have primary and secondary holding brakes and a fan brake.

.2 Release of the hoist holding brake shall be possible by a manual lever to initiate closing of the gate with the fan brake in the absence of control power.

.3 The manual lever shall be designed to be capable of being latched in the released position.

.4 There shall be a limit switch on the brake assembly that indicates that the brake manual lever is in the release position, and shall block the gate from being raised.

4.6.3 Mechanical Safety Isolation

.1 The hoist shall be designed such that the coupling between the motor and gearbox can be routinely and easily removed as part of normal isolation and lock out of the Intake Gates when the gates are in the down position.

.2 The arrangement shall include a lockable cover or panel or barrier that prevents the re-installation of the coupling.

4.6.4 Gate Slot Heaters

.1 Heaters shall be provided to keep the water surface in the Intake Gate slots clear of ice for winter design conditions.

.2 Heaters shall be mounted to blow heated air from below the Intake Gate hoists, and can be mounted on the hoist frames or attached to the guides or concrete.

.3 Mechanical and electrical components shall be located above PMF water level.

.4 Ducting shall be provided to distribute the heated air at the water surface at FSL.

.5 Ducting and heaters shall be designed to withstand high air flows in the ventilation passages during an Intake Gate emergency closure with the generating unit still operating.

4.6.5 Gate slot cover plates (El.45.50)

D1

.1 Cover plates shall be designed to withstand negative pressures up to 500 Pa during Intake Gate emergency closure.

.2 Cover plates shall be provided with sealed openings around upper sheave blocks and wire ropes.

4.7 TRASH CLEANER HOIST

4.7.1 General

.1 The Trash Cleaner support structure will be equipped with an under-hung hoist, designed to connect to the Spillway Stoplog Lifting Beam or the Intake Bulkhead Gate Lifting Beam, and used to install, remove and store all the Spillway upstream temporary and permanent Stoplogs, and the Intake Bulkhead Gates.

.2 The Trash Cleaner hoist block, or blocks, shall be connected directly to the lifting beams via pins.

.3 The hoist lift points shall securely connect to the Trash Cleaner's downstream gantry structure when the hoist is not being used.

4.7.2 Hoist Brakes

.1 The Trash Cleaner hoist shall have two holding brakes; a hoist holding brake and a hoist holding secondary brake.

4.7.3 Speeds

.1 The trolley travel speed shall be not less than 5 m/min; and the hoisting speed shall not be less than 3 m/min.

.2 The hoist shall have variable frequency drives for the hoist and trolley travel drives.

4.7.4 Movements

.1 Minimum movements at rated capacity:

.1 Vertical movement: 3 mm

.2 Trolley travel: 6 mm

4.7.5 Lifting Beams for Bulkhead Gate and Spillway Stoplogs

.1 Two lifting beams shall be provided for use with the Trash Cleaner hoist.

.2 Bulkhead Gates Lifting Beam

.1 The first lifting beam shall be for the Intake Bulkhead Gates and shall be supplied with a dogging device for storage in the Bulkhead Gate guides.

.2 For the purpose of lock out, the Bulkhead Gates lifting beam shall be capable of being locked in the gate slot.

.3 The Bulkhead Gate lifting beam shall be designed to operate the fill valve in the top section of the Bulkhead gates.

.3 Spillway Stoplogs Lifting Beam

.1 The second lifting beam shall be for the Spillway stoplogs located upstream of the Spillway gates.

.2 The Spillway stoplogs lifting beam shall be capable of being used for all the permanent and temporary upstream stoplogs and as such shall also work with a mobile crane for use during construction.

.3 However, Contractor may at their choosing provide two (2) separate stoplog lifting beams; one permanent to be used with the Trash Cleaner and the permanent stoplogs only, and a second temporary stoplog lifting beam for the temporary stoplogs.

.4 The Spillway stoplogs lifting beam(s) shall be provided with a storage stand mounted on the piers at the location shown on the Drawings.

4.8 DRAFT TUBE CRANE

4.8.1 General

.1 The Draft Tube overhead crane shall consist of a wire rope hoist mounted on a motorized trolley, and a bridge structure travelling on one level runway.

.2 Engineer will supply and install the rails (Beth 104), clips, anchors, runway end stops, and all other parts required for the runway (Beth 104), with a runway gauge (centre to centre distance) of 7500 mm.

.3 The crane shall be compact and with very low headroom in order to fit the space available, and shall provide easy and direct access to the components requiring maintenance, as shown in the drawings.

.4 The crane shall be accessible for maintenance from the maintenance platform or maintenance gallery provided by Company's Other Contractor and as shown on the drawings, with adequate provisions provided for worker safety.

.5 The cranes shall be provided with maintenance platforms on the bridge and trolley for safe access to all components if the crane is in the maintenance area, of if the crane requires emergency maintenance anywhere in the Draft Tube Gallery.

.6 The Draft Tube Crane shall be connected directly to the lifting beam and be equipped with a torque motor driven cable release mechanism for releasing the lift beam from the stoplogs.

D1

.7 Permanent lighting shall be provided below the trolley providing adequate illumination of the stoplog slots and the top of the stoplogs, and on the bridge crane providing illumination of the walkway.

4.8.2 Hoist Brakes

.1 The Draft Tube Crane shall have two holding brakes on its hoist; a hoist holding brake, and a hoist holding secondary brake.

4.8.3 Speeds

.1 The bridge travel speed shall be not less than 30 m/min; the main trolley travel speed shall be not less than 5 m/min; and the hoisting speed shall not be less than 3 m/min.

.2 The crane shall have variable frequency drives for the hoist and the trolley and bridge travel drives.

4.8.4 Movements

.1 Minimum movements at rated capacity:

.1 Vertical movement: 3 mm

.2 Trolley travel: 6 mm

.3 Bridge travel: 6 mm

4.8.5 Equipment Elevations

.1 Top of rail level: El. 12.19 m

.2 Maximum water level in gallery (PMF): El. 12.28 m

.3 Maximum surge water level in gallery: El. 9.3 m

4.8.6 Lifting Beam

.1 The Draft Tube Crane shall be provided with a direct connected lifting beam for use with the Draft Tube stoplogs.

4.8.7 Runway Bus Conductor

.1 The electrical supply shall be through bus bars installed along the hoist upstream rail. The supply bus shall be heated, 600 V 3-phase, three copper conductors plus one for grounding (coloured green). Two additional conductor bars shall be supplied for signalling to supervise heating of the motors, brakes and gear boxes.

.2 The main conductor bars shall include the expansion joints and the anchor points taking into account the powerhouse joints and the maximum ambient temperature differential in the powerhouse.

.3 The contacts and bus conductor bars shall be capable of carrying the rated current continuously, without overheating, and withstand short circuit currents. The voltage drop over the entire length of the bus conductor and through to the connection to the hoist motor shall not be more than 1.5%.

4.9 SPILLWAY MAINTENANCE CRANE

D1 **4.9.1** A three (3)MT electric overhead crane shall be supplied in the Spillway Gate hoist house for maintenance purposes.

D1 **4.9.2** The maintenance crane shall run the full length of the hoist house, capable of moving any single operating component (except the hoist drums and gearboxes) in the hoist house to the level of the spillway deck level at the south end of the spillway hoist house.

4.9.3 The crane shall have two holding brakes; a hoist holding brake and a hoist holding secondary brake.

4.9.4 The crane shall be pendant controlled with power provided from a conductor bars mounted independent of the hoist house removable roof sections.

4.9.5 A limit switches shall be provided on both ends of the runway beam, to slow down and stop trolley travel at both ends of the hoist house runway rails.

4.9.6 The hoist beams shall be capable of being removed with the hoist house removable roof sections, with end stops and travel limit switch contacts provided for when the rail sections are removed.

4.10 ADDITIONAL LIFTING BEAMS

4.10.1 In addition to the lifting beams already specified, the two following additional lifting beams shall be provided:

.1 For handling the Downstream Spillway Stoplogs;

.2 For handling the Intake Trashrack panels.

4.10.2 These beams require nylon rope retraction lines, or an alternative design, to allow the hooks to be disengaged when the components are lowered into position. This design shall be safe and convenient for one person to operate and if required may use a manual winch to operate.

4.10.3 Both these lifting beams shall be designed for use with a mobile crane.

PART 5 COATINGS SCHEDULE

5.1.1 Coating and galvanizing shall be according to Section 48 13 10.

5.1.2 Coatings shall be as follows:

.1 Spillway and Intake Hoisting Equipment All surfaces Epoxy paint colour XXX

.2	Trash Cleaner Hoist	All surfaces Epoxy paint colour XXX
.3	Draft Tube Hoist	All surfaces Epoxy paint colour XXX
.4	Spillway Maintenance Hoist(s)	All surfaces Epoxy paint colour XXX
.5	Spillway Maintenance Hoist(s) Runway(s)	All surfaces Epoxy paint colour XXX
.6	Spillway Hoist House and stairwell – Interior Walls	colour XXX
.7	Spillway Hoist House and stair well – Exterior	colour XXX
.8	Spillway Hoist House – Interior Floors	colour XXX
.9	Spillway Hoist Tower Superstructure and all Accessories and Attachments	Hot dip galvanized
.10	Spillway Hoist House Bridge	Hot dip galvanized
.11	All Safety Equipment or Protective Components such as; Fan Guards/Grills, Rotating Equipment Guards, Lockout Devices etc.	colour XXX
.12	All accessories, such as ladders, walkways, platforms, handrails/guard rails and all hardware, not forming integral part of the main structure and liable of being dismantled, such as connection bolts, supports, heating equipment, pipes, etc.	Hot dip galvanized

PART 6 ERECTION AND FIELD TESTS

6.1 GENERAL

D2 .1 All equipment supplied and installed by Contractor, shall be installed, pre-commissioned and subjected to the required contractual tests by Contractor.

D2 .2 Contractor shall carry out full pre-commissioning and commissioning as required in MFA-SN-CD-2000-ME-SP-0002-01.

.3 Contractor shall be fully responsible for providing all the equipment necessary, such as portable cranes and tooling, instrumentation, test weights, spares etc., to complete all the installation and required field tests.

.4 All measurements taken as part of the installation of Contractor's work shall be submitted to Engineer for Acceptance.

.5 All modifications, re-work, repairs etc. required by Contractor to complete the work shall be subject to the Engineer's Acceptance prior to the start of the work.

.6 Contractor shall supply and place all the grout required to complete the installation.

.7 When selecting the erection methods, Contractor shall be responsible to take into account the load limitations imposed by the roads, decks, and bridges.

6.2 GROUTING

6.2.1 Grouting shall be carried out according to Section 03 60 40.

6.3 INSTALLATION MEASUREMENTS

6.3.1 General

.1 Contractor shall measure and record relevantly installation measurements as each component is installed, and shall provide a record of each set of installation measurements for inclusion in the records for Mechanical Completion, see Section 48 13 10, Clause 7.

.2 The following measurements shall, as a minimum, be recorded and provided to the Engineer for Acceptance.

6.3.2 Common

.1 Gearbox backlash.

.2 Holding brake clearance or reference measurement.

.3 Fan brake minimum clearances and thrust clearance.

.4 Fastener torque for all components.

.5 Coupling alignment.

.6 Sheave thrust clearances.

.7 Alignment of bumpers relative to stops (where applicable).

6.3.3 Fixed Hoists

.1 Drum, gearbox, brake and motor shaft alignments (XYZ offsets).

.1 Drum level

.2 Sheave block position relative to gate slot and gate connection points.

6.3.4 Bridge Cranes

.1 Bridge wheel base and track including diagonals.

.2 Trolley wheel base and track including diagonals.

.3 Bridge level.

.4 Minimum clearance to fixed objects over entire travel path.

6.3.5 Monorail

.1 Beam level.

.2 Minimum clearance to fixed objects over entire travel path.

6.4 DRIVE SYSTEMS ALIGNMENT CHECKS

6.4.1 All drives systems, including hoists, trolley drives and bridge drives, shall have their alignments verified and witnessed after each component is installed, prior to the start of all testing and one of each type of coupling shall have the alignment checked again after all testing has been completed.

6.5 PRESERVATION, MECHANICAL COMPLETION & AND COMMISSIONING REQUIREMENTS

D1

6.5.1 Preservation, mechanical completion and commissioning requirements noted herein are defined in MFA-SN-CD-2000-ME-0002-01 – Preservation, Mechanical Completion and Commissioning Requirements.

D1

END OF SECTION

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: 48 13 22
CH0032	**TRASH CLEANING SYSTEM**	Rev: D2
POWEHOUSE & SPILLWAY HYDRO-MECHANICAL EQUIPMENT		
MFA-SN-CD-2000-ME-TS-0001-01		505573-3321-45EG-0001

TABLE OF CONTENTS
SECTION 48 13 22
TRASH CLEANING SYSTEM

REGISTERED PROFESSIONAL ENGINEER
PEG Newfoundland and Labrador
RANDOLPH D. KOOB
6 Dec 2013
NEWFOUNDLAND & LABRADOR

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEG Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL 04458
which is valid for the year 2013

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 This section includes all Work necessary for design, fabrication, delivery, installation, testing and commissioning of the Trash Cleaning System at the Muskrat Falls Project. Work shall include the design, fabrication, installation and commissioning of a custom trash cleaning system for the Muskrat Falls Powerhouse used to clean the Intake Trashracks, remove floating debris from in front of the Intakes and remove debris from the Debris and Sediment Trap in front of the Intake structures. The Trash Cleaning System shall also have an under-hung hoist for handling the powerhouse Bulkhead Gates and the Spillway stoplogs, as shown on the Drawings

1.1.2 This document shall be read in conjunction with “Lower Churchill Project Muskrat Falls Hydroelectric Development – CH0032 - Supply and Install Powerhouse and Spillway Hydro-Mechanical Equipment - Scope of Work - 505573-3321-45EW-0001/ MFA-SN-CD-2000-ME-SP-0001-01, Part 2, Exhibit 1.

1.2 RELATED SECTIONS

.1 Section 48 13 10; General Mechanical Requirements

.2 Section 48 13 21; Hoist and Cranes

.3 Sections 11 08 00: Preservation, Mechanical Completion and Commissioning Requirements

D1

.4 Design to be completed in accordance with requirements of:

1. Electrical Divisions, supplemented by this section
2. CSA C22.1 and CSA C22.2

PART 2 DESIGN REQUIREMENTS

2.1 STANDARDS, CODES AND LEGISLATION

2.1.1 Unless otherwise stated in the Specification, the equipment shall be designed, manufactured, tested and supplied in accordance with the latest edition of all applicable Standards listed below. In case of any conflict between Standards, such conflict shall be brought to the attention of Engineer for clarification and determination.

.1	AGMA 260.02	Design of Components – Enclosed Gear Drives – Bearings, Bolting, Keys and Shafting
.2	AGMA 420.04	American Gear Manufacturers Association Standard
.3	AGMA 6001-E08	Design and Selection of Components for Enclosed Gear Drives
.4	AISC	American Institute of Steel Construction
.5	ANSI Standard B4a	Tolerances, Allowances and Gauges for Metal Fits
.6	ANSI B4.1	Positional Fits and Tolerance for Cylindrical Parts
.7	ANSI C42.30	Definitions of Electrical Terms
.8	ANSI/AGMA 2001 C95	Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
.9	ANSI/ABMA STD 9	Load Ratings and Fatigue Life for Ball Bearings
.10	ANSI/ABMA STD 11	Load Ratings and Fatigue Life for Roller Bearings
.11	ASME B15.1	Safety Standard for Mechanical Power Transmission
.12	ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
.13	ASTM A143	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
.14	ASTM A153/153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
.15	ASTM A384	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
.16	ASTM A385	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
.17	ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.18	AWS D1.1	Structural Welding Code
.19	CGSB 1-GP-12C	Standard Paint Colors
.20	CMAA 70	Specifications for Top Running Bridge and Gantry Type Multiple Girder Electrical Overhead Travelling Cranes
.21	CSA B167	Overhead Travelling Cranes – Design, Inspection, Testing, Maintenance and Safe Operation
.22	CSA C22.1	Canadian Electrical Code
.23	CSA C22.2	Safety Standards for Electrical Equipment
.24	CSA G4	Steel Wire Rope for General Purpose and for Mine Hoisting and Mine Haulage
.25	CSA G164	Hot Dip Galvanizing of Irregularly Shaped Articles Metals and Metal Products
.26	CSA G189 (R2003)	Sprayed Metal Coatings for Atmospheric Corrosion Protection
.27	CSA S16	Design of Steel Structures
.28	CSA W59	Welded Steel Construction - Metal Arc Welding
.29	CSA Z85	Abbreviations for Scientific and Engineering Terms
.30	IEEE SP1122	The Authoritative Dictionary of IEEE Standards Terms
.31	NBCC	National Building Code of Canada (Walkways, Platforms,Handrails and Ladders)
.32	NEMA AB1	Moulded Case Circuit Breaker
.33	NEMA MG-1	Motors and Generators
.34	NLOHS	Occupational Health and Safety Regulation of Newfoundland & Labrador
.35	SSPC PA2	Procedure for Determining Conformance to Dry Coating Thickness Requirements
.36	SSPC SP3	Power Tool Cleaning

.37	SSPC SP10	Near-White Metal Blast Cleaning
.38	SSPC VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

2.1.2 All materials used in manufacturing and finishing processes shall be approved for use in Canada.

2.1.3 All materials used in the different elements of the supply shall conform to the standards of the Canadian Standards Association, the Society of Automotive Engineers, the American Society for Testing and Materials, the American Iron and Steel Institute and any other standard enumerated below.

2.1.4 Any substitution for the materials described by these standards shall be proven, by a series of tests to the satisfaction of Company, to be equal or superior to the standardized materials.

2.1.5 The following standards shall be used for materials, fabrication and inspection:

.1	Bronze Bushings	ASTM B584
.2	Bronze subject to stress	ASTM B21, Alloy 464, Semi Hard (such as bolts and nuts)
.3	Bolts, studs and nuts	ASTM A307, ASTM A325, ASTM A193, A194
.4	Castings	ASTM A27
.5	Forgings	ASTM A668
.6	Fixed Axles for the Guide Rollers	ANSI 430 or ASTM A276, type 304
.7	Helical Springs	SAE 5160
.8	Piping	ASTM A53
.9	Stainless Steel Shafts	ASTM A473, ASTM A564, AISI 431
.10	Steel Shafts	AISI 3140, 4140, 4340
.11	Structural Steel	ASTM A36, ASTM A992 CSA G40.20-04/G40.21-04
.12	Steel for Wheels	ASTM A504, Class C
.13	Stainless Steel Tubing	ASTM A269

.14	Stainless Steel	ASTM A176; ASTM A240; ASTM A276, Type 304L

2.2 SEISMIC LOADS

.1 The equipment shall be designed to withstand seismic horizontal acceleration of 0.091 g.

2.3 MINIMUM MATERIAL THICKNESSES

.1 The minimum material thickness for structural and exterior components shall be 10 mm.

PART 3 TECHNICAL REQUIREMENTS

3.1 COMPONENT DESIGN CRITERIA

3.1.1 General

.1 For the Muskrat Falls Project, the powerhouse intake structures must be clear of obstructions that may impede the operation of the plant, particularly during commissioning and the first five years of operation when larger quantities of debris is expected to be generated by impoundment of the reservoir. A log boom will be provided in the reservoir upstream of the facility to capture the majority of the surface debris.

.2 The specific design and fabrication details for the trash cleaning system, including all operating components, hardware, controls and accessories required for the system shall be the responsibility of Contractor as specified herein. The Drawings are provided to clarify the performance requirements contained in this Section. Shop Drawings, in sufficient detail to describe the design, operating characteristics, materials, fabrication dimensions, assembly procedures, and testing procedures shall be provided to Engineer for review and Acceptance before fabrication begins.

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.3 The gantry supporting the trash cleaning system shall be designed to support the stop log lifting crane specified in Section 48 13 21 Hoists and Cranes.

.4 This Section, along with the Drawings, describes the basic operating performance criteria, design requirements, material requirements, dimensional limits, and features required for the system. Additional features, as required for a completely functional and operational system, based on Contractor's experience in designing and manufacturing similar systems of this type, shall be provided to ensure that the equipment furnished is a high-quality, fully functional system.

3.1.2 Manufacturer's Qualifications

.1 The manufacturer of this equipment shall demonstrate the following minimum qualifications:

.1 Ten (10) years experience in design and fabrication of custom trash cleaning equipment for hydroelectric and water supply intake structures;

.2 Design and manufacture of at least one (1) operating trash cleaning system that shall have all of the following operating characteristics:

.1 Operation to water depth of thirty-five (35) meter or greater;

.2 Hydraulic cylinder driven articulated trash cleaner rake;

.3 Pivoting machine deck with enclosed control car and operating enclosure;

.4 Electric motor driven gantry substructure;

.5 Experience with under-hung hoists.

3.2 DESIGN

3.2.1 The materials used in the construction of the equipment shall be new, of high quality and selected particularly to meet the duties required. The material specification shall be indicated in Contractor's detailed drawings. All workmanship shall be of highest quality throughout in order to ensure smooth operation under all possible operating conditions, and the design, dimensions and materials selection of all parts shall be such that the stresses to which they may be subjected shall not render them liable to distortion or damage under the most severe conditions encountered in service.

3.2.2 The Trash Cleaning System shall be designed to be stable for the worst case combined operating conditions including but not limited to; mass of structure, all load/radius/height lifting combinations, hoist loads, wind, seismic, and snow load with a factor of safety against overturning of at least 1.5.

3.2.3 The system shall operate without restriction or limits under the following conditions:

.1 The trash cleaning system should be capable of operating with a water velocity of 1.1 meter per second (m/s) normal to the trashrack, based on the gross area of the intake, combined with water sweeping velocity across the face of the racks of 0.5 m/s;

.2 High ambient electrical noise and electromagnetic interference conditions caused by adjacent power transmission lines (315 kV) and cable runs (25 kV).

3.3 EXPECTED VOLUMES OF TRASH AND DEBRIS

3.3.1 The majority of the trash and debris that is expected to enter the reservoir will occur during the first months after impoundment. Another significant influx of trash and debris into the reservoirs during the first five years of operation will occur during spring thaw due to ice clearing.

3.3.2 Studies indicate the net potential volume of trash and debris that may have to be managed in the Muskrat Falls reservoir during the first years of operation ranges from approximately 40,000 m^3 to 95,000 m^3.

3.4 PERFORMANCE REQUIREMENTS

3.4.1 Operating Requirements

.1 The trash cleaner is expected to be used 3 to 5 times a week when the reservoir is free of ice for approximately 3 years, and 3 to 5 times a month thereafter;

.2 The under-hung hoist located on the trash cleaning system is expected to be used daily during construction and commissioning and approximately 10 to 20 times a year during the long-term operation of the facility.

3.4.2 Trash Cleaning System Requirements

.1 The Trash Cleaner shall be designed to effectively clean the entire Trashrack area covering the full height of the racks between the sill and lintel elevations shown on the Drawings, while traversing the full length of the Intake in either direction;

.2 The Trash Cleaner shall be designed to remove floating debris that collects in front of the Intake;

.3 The Trash Cleaner shall be designed to visually inspect the Sediment and Debris Trap that covers the area 9.9 m wide in front of the Intake Trashracks, and be designed to remove submerged debris from the Debris and Sediment Trap;

.4 The Trash Cleaner shall be able to move the debris into four (4) meter high mobile or stationary trash receptacles on the Intake road deck or into a barge moored in front of the Intake;

.5 The trash Cleaner shall be designed to withstand loads from the hoist for handling the Spillway stoplogs and Intake Bulkhead Gates (see Section 48 13 21 for description of hoists).

3.4.3 Trash Materials

.1 Three types of trash and debris that can impact the operation of the plant were identified:

.1 Floating debris that can accumulate on the water surface;

.2 Submerged debris that can accumulate on the Trashracks;

.3 Debris that can accumulate in the Debris and Sediment Trap in front of the intakes;

.2 The Trash Cleaner shall effectively rake debris from the Trashracks and remove debris as sticks, branches and tree sections up to 600 mm in diameter from the reservoir surface or the Debris and Sediment Trap, and logs and tree roots, as well as removing boulders, gravel and sediment from the Debris and Sediment Trap;

.3 The Trash Cleaner shall also handle man-made trash including tires, plastics, log boom float, drums, boats, and other floating debris, without damage to the rake system.

3.4.4 Cleaning Head Capacity and Reach

.1 The Trash Cleaner heads and buckets shall be able to grab, hold and lift a 2500 kg wet load of trash materials or debris in the Sediment Trap, anywhere in the cleaning area upstream of the Intake at a sixteen (16) meter radius from the centre of the gantry rails, at the water depths indicated on the Drawings, and move the debris onto the Intake Deck;

.2 The Trash Cleaner heads and buckets shall be able to grab, hold and lift a 5000 kg object or wet load of trash materials or debris from the Sediment Trap, anywhere in the cleaning area upstream of the Intake at a ten (10) meter radius from the centre of the gantry rails, at the water depths indicated on the Drawings, and move the debris onto the Intake Deck;

.3 Cleaning heads and buckets shall have ability to move upstream of the trashracks and powerhouse concrete face a minimum of ten (10) meters meter at any elevation;

.4 For floating debris, the cleaning heads and buckets shall be able to grasp and remove floating debris in the forebay through a one hundred twenty degree (120°) arc and move debris into the Intake Deck;

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.5 When operating with the Trash Cleaner cleaning head to move trash up the face of the trashrack, the Trash Cleaner shall develop an upward cleaning force, parallel to the face of the trashrack, of 50 kN minimum.

3.4.5 Operating Speeds

.1 The trash cleaning system shall have the following operating speeds:

.1 Primary cycle time of twenty (20) minutes or less for one (1) complete down-up raking cycle over the full Trashrack height, beginning with the cleaner head over the trash receptacle on the roadway, raking the Trashrack face three (3) times, with the cleaner head having dumped the raked material into the trash receptacle each time it travels up the Trashracks;

.2 Ability to operate in cleaning mode continuously within the environmental conditions specified herein;

.3 Surface debris grab and dump cycle time of five (5) minutes or less beginning with the cleaner head over the trash receptacle on the roadway, through the pivot of the Trash Cleaner perpendicular to the powerhouse face, grappling of floating debris, and ending with the cleaner head having dumped the collected material into the trash receptacle;

.4 Telescopic arm extend and retract speeds not less than twenty (20) metre per minute (m/min);

.5 Gantry travel speed not less than twenty (20) m/min.

.2 Change-over time not more than two (2) hours for removing and installing different cleaning heads and buckets, assuming the Trash Cleaner operator and a crew of two mechanics.

3.4.6 Control Functions

.1 The Trash Cleaner shall have manual and semi-automatic control functions:

.1 Manual operation shall be used for surface debris removal, large debris removal in front of the Trashrack or in the Debris and Sediment Trap, and moving debris from the water surface into debris receptacles, operated from the operator's cab;

.2 Semi-automatic operation shall be used for one vertical sweep of the trashrack cleaning head or buckets, starting with the cleaner head just above the water surface, travelling in either direction one cleaner head width, and the cleaning head travelling to the base of the trashracks, up the trashrack face or across the Debris and Sediment Trap, and back to the water surface, with each cycle initiated from the operator in the operator's cab;

.2 For hoist control refer to Specification Section 26 29 03.03.

.3 A three position selector switches (CLEAN-OFF-HOIST) shall be provided in the operator cab, and at the hoist as described in Section 26 29 03.03, to prevent hoisting and cleaning operations to occur at the same time;

.4 There shall be interlocks to prevent the under-hung hoist from operating if the hydraulic arm is not fully retracted and the rotating deck is not in the normal parking position, or to prevent cleaning cycles if the hoist is not in a safe parked position.

3.4.7 Underwater Surveillance Camera

.1 An underwater video camera and sufficient underwater lighting shall be installed on the telescopic boom to observe the area around the base of the cleaning heads or buckets down to the bottom of the Debris and Sediment Trap, and view the trashracks.

3.5 GENERAL SYSTEM CONFIGURATION REQUIREMENTS

3.5.1 The basic machinery configuration shall include a traveling gantry system that supports a rotating machine deck that includes an operator cab, machinery enclosure, articulated operating arm and cleaner head.

3.5.2 The Intake deck, Centre Transition Dam deck, and Spillway deck will be an operating area, the use of which shall not be compromised by the addition of the trash cleaning system.

3.5.3 The Trash Cleaner gantry structure shall allow vehicle/load clearances of 3.75 m wide x 5 m height and 7 m wide x 4 m height and shall allow clearance for handling of stoplogs and Bulkhead Gates.

3.5.4 The overall system shall operate on electric power supplied from the Spillway Electrical Building during the Diversion Phase, and then moved to the power termination points at the north end of the Intake building, at the locations shown on the Drawings.

3.5.5 All other power requirements needed for operation of the Trash Cleaner, or the under-hung hoist, shall be developed at the Trash Cleaner via transformers to lower voltages, direct current power supplies, batteries, hydraulic systems, etc.

3.5.6 The Trash Cleaner shall include a PLC (Programmable Logic Controller) for control and monitoring system.

3.5.7 The Trash Cleaner shall be configured to stand idle for long periods of time, with internal heaters, control standby functions and internal environmental controls that will allow a rapid re-start operation and after prolonged periods of inactivity.

3.5.8 Long term storage of the Trash Cleaner in the storage area shown on the Contract Drawings shall be possible without any moisture, thermal or weather damage to the system components.

3.5.9 The Trash Cleaner shall provide all of the operating functions described in this specification and on the Drawings, without the need for special tools, handling devices, or procedures to be used.

3.5.10 All special tools for maintenance of the system shall be provided as part of the equipment supplied.

3.5.11 The system shall include, wherever feasible, devices necessary to eliminate the possibility of pinch points between moving and stationary components on the Trash Cleaner.

3.5.12 Where elimination of pinch points is not feasible, guard rails, warning lights, audible warning and signage shall be used.

3.6 GANTRY CONFIGURATION REQUIREMENTS

3.6.1 The gantry shall be constructed of welded and bolted steel shapes and plates using box sections to provide a neat appearance, minimize painting, and prevent areas for bird and insect nesting or roosting.

3.6.2 The gantry construction shall allow field assembly by bolting, with no field welding required.

3.6.3 The gantry shall incorporate ladders and walkways that allow safe personnel access to the operator's cab, to the equipment enclosures and to all points where maintenance or inspection is required.

3.6.4 All walkways and ladders shall comply with applicable safety codes.

3.6.5 The gantry system shall travel along the Intake deck, Centre Transition Dam Deck, and Spillway deck, as shown on the Drawings, with ability to travel through the curve, and with clearances for vehicles passing by and under the gantry, and past adjacent walls and concrete structures, as shown on the Drawings.

3.6.6 The gantry and gantry rail arrangement will allow full cleaning coverage of the face of all twelve (12) generating unit Trashracks, and coverage of floating and submerged debris.

3.6.7 Gantry structure shall be provided with shock absorbing end-of-travel bumpers, designed to contact end stops provided by Company's Other Contractor, at 40% of rated travel speed to reduce impact loads at the end of travel at each ends of both rails.

3.6.8 Radar sensors, or equivalent, shall be provided at the four corners the Trash Cleaner gantry structure to slow the Trash Cleaner to crawl speed and stop the Trash Cleaner before impact when the Trash Cleaner nears the end-of-travel bumpers or any other object that could cause impact with the Trash Cleaner.

3.6.9 Parking locks shall be provided on the Trash Cleaner, to manually clamp to the rails, capable of preventing motion under worst case weather conditions.

3.6.10 Gantry shall travel on double flanged steel wheels of a size matched to the intake deck rails, 175 lbs/yd crane rail, as shown on the Drawings.

3.6.11 A load equalizing system shall be provided if any support leg of the gantry structure has more than one (1) wheel.

3.6.12 Wheels shall be independently driven by heavy duty synchronized electrical motors, powered by Variable Frequency Drives (VFDs).

3.7 MACHINE DECK CONFIGURATION REQUIREMENTS

3.7.1 The machine deck shall be a fabricated steel platform supporting the machinery enclosure, operator cab, articulated boom, walkways, and shall resist all operating forces developed by the trash cleaning system during all operating modes and conditions.

3.7.2 The machine deck shall ride on steel rollers around a hardened steel circular raceway at the top of the gantry structure, and shall be provided with counter-rollers or over-turning bearings to resist any overturning loads on the machine deck.

3.7.3 The turning motion of the machine deck shall be provided by a hydraulic oil-driven motor that engage a rim gear on the raceway, all configured in such a way that the drive mechanism and gearing are protected from debris, loose materials and any items that might be dropped or misplaced during maintenance or operation, with safe design to eliminate danger point for operation and maintenance personnel.

3.8 OPERATOR CAB CONFIGURATION REQUIREMENTS

3.8.1 The cab shall be mounted on, and rotate with, the machine deck.

3.8.2 The cab shall be generously sized to allow the operator to sit or stand while operating the trash cleaning system.

3.8.3 A rain-proof door shall be provided.

3.8.4 The cab shall have windows, at least two of which can be opened for air circulation, shall be tinted, and shall be fitted with roll-down polarized film protective shades extending to the top of the seat back.

3.8.5 The operator cab windows shall be designed to allow an untestricted view of trash cleaning operations, and shall be sloped back to restrict rain build up on the windows.

3.8.6 The operator’s seat shall swivel to allow easy access and orientation of the operator during use.

3.8.7 There shall always be safe access/egress to/from the cab to the ground level regardless of the position of the machine deck.

3.8.8 A heater, multi-speed ventilation fan, and a thermostatically controlled refrigerated air conditioning system shall be provided in the cab.

3.8.9 The heater shall be configured to allow use of the heater at low outputs during storage and inactivity of the system.

3.8.10 The heating system shall include adjustable defrost vents for clearing of moisture from the windows.

3.8.11 The HVAC system shall be capable of maintaining a cab interior temperature of twenty (20) degrees Celsius, with the range of environmental conditions specified herein.

3.8.12 Operating controls in the cab shall be positioned to allow easy access and manipulation by the operator.

3.8.13 Human Machine Interface (HMI) and underwater camera display shall be easily viewed and accessible from the operator's seat and on an adjustable base to be pivoted and moved for ease of viewing by the operator.

3.8.14 Three (3) duplex electrical outlets 120 Vac, 20A, shall be provided in the cab, at locations Accepted by Engineer.

3.9 MACHINERY ENCLOSURE CONFIGURATION REQUIREMENTS

3.9.1 The machinery enclosure shall be a fabricated metal housing, attached to the machine deck, and shall house the hydraulic pressure system, drive motors and other machinery in a weather-protected enclosure.

3.9.2 The enclosure shall be generously sized to allow maintenance work inside the enclosure.

3.9.3 All openings in the enclosure shall be screened and louvered to prevent the entry of rain, insects, and birds.

3.9.4 All enclosed spaces shall be heated and cooled as necessary to protect equipment during operative and idle periods.

3.9.5 Maximum sound levels in the cab shall be 50dB.

3.9.6 The machine enclosure shall include sumps, drain pans or similar features that will serve as a secondary containment structure for all leakage from any hydraulic oil system component, including tubing, pipe, and hose that is contained in the enclosure.

3.9.7 The active volume of the secondary containment shall be at least one hundred-ten percent (110%) of the total oil volume in the hydraulic system.

3.10 ARTICULATED ARM CONFIGURATION REQUIREMENTS

3.10.1 The articulated arm shall consist of a main boom, and multiple telescopic arm segments.

3.10.2 All parts shall be fabricated steel weldments.

3.10.3 The arm shall be designed to provide the full range of cleaning coverage, as specified herein and as shown on the Drawings.

3.10.4 All telescope/retract functions of the arm shall be provided by hydraulic cylinders (not wire rope).

3.10.5 Hydraulic cylinders and their associated hose and tubing shall be housed within the arm and boom segments.

3.10.6 Guide rollers between the telescopic sections shall be stainless steel cam-follower or similar rollers, with permanently sealed anti-friction bearings or shall be self-lubricated sliding pad bearings, Orkot, Kamatics, or an alternative Accepted by Engineer.

3.10.7 Access panels shall be provided to allow maintenance of mechanical and hydraulic assemblies.

3.11 CLEANER HEAD AND CLAM BUCKET CONFIGURATION REQUIREMENTS

3.11.1 The system shall be provided with:

.1 A trashrack cleaning head, 2.4 m wide, with an opposing gripper/cover covering at least ninety percent (90%) of the head width, for cleaning of trash and debris from the face of the Trashracks with a replaceable plastic wearing face surface of sufficient thickness, width, and material properties to provide a design life of the plastic not less than five (5) years, based on the specified cleaning cycles of the Powerhouse trashracks;

.2 A 2.4 m wide articulated bucket with an opposing gripper/cover covering at least ninety percent (90%) of the bucket width for cleaning the Debris and Sediment trap and collecting floating debris;

.3 An articulated clam bucket for gripping large floating and submerged debris.

3.11.2 The cleaning devices shall be articulated sufficiently to permit aligning the device with the trash being removed, and with the trash receptacle.

3.11.3 The closed articulated bucket shall be designed to drag across the Debris and Sediment Trap to pick up small boulders, gravel and sediment, and close securely so sediment and gravel is retained and not washed out of the bucket by the water flow in front of the Trashracks.

3.11.4 The trashrack cleaning head and articulated clam bucket shall be a steel fabrication with an open framework to contain trash while draining away water from the trash when the head is above the water surface.

3.11.5 Lifting capacities and limits shall be clearly marked on the boom at the hook points and in the operator's cab at the controls;

3.11.6 Control of the cleaning devices, both opening/closing and rotation shall be by hydraulic cylinders located at the end of the lowest telescopic arm section.

3.11.7 All cleaning devices, except the trashrack cleaning head, shall have a freely suspended intermediate section between the connection to the telescopic boom and the device that will minimize shock or damage in the case of contact with the structure or the floor of the Debris and Sediment Trap.

3.11.8 The structural and oil-hydraulic connections between the telescopic boom and the cleaning devices shall be configured to allow easy removal and replacement of the heads without the need for special tools, hoists, cranes or other handling equipment. Oil line connections shall be by quick disconnect, zero (0) leakage fittings.

3.11.9 Structural connections shall be by pin and clevis, latch/lock mechanisms or similar, that does not require a large number of threaded or precision fasteners to attach and remove the heads.

3.11.10 If oil hoses and oil tubing must be exposed, hose shall have braided stainless steel jackets or similar protection from damage or disconnection.

3.11.11 Trash cleaning heads shall be as follows:

Area	Debris	Bucket Type
Intake Trashracks Intake Debris Trap	Logs, Branches Branches, Debris	Trashrack cleaning head; 2.4 m wide with 3 closure blades
Intake Surface Intake Debris Trap	Floating Debris Logs, Roots, Sand, Gravel, Branches Sand, Gravel	Clam bucket; 2.0 m wide by 1.2 m deep Closed bucket; 2.4 m wide with closure plate

Notes:

.1 Clam bucket customized for the lifting capacity of Trash Cleaner, with added top closure plates.

.2 Closed bucket customized with solid plate to drag debris near the Intake concrete face to raise debris to the surface, or for later debris removal with the clamshell bucket.

3.12 HYDRAULIC SYSTEM CONFIGURATION REQUIREMENTS

3.12.1 The hydraulic system shall be a self-contained hydraulic oil pressure system of sufficient size to allow continuous trash cleaning operation. The system shall provide pressurized oil for operation of the articulated arm, telescopic arm, cleaner head, and other components of the cleaning system.

3.12.2 The nominal operating pressure of the system shall not exceed 27,500 kPa. Hydraulic pressure shall be supplied by two primary motor-pump-filter sets, such that the system can continue operation (at reduced speeds) if one motor-pump set is out of service.

3.12.3 The system shall operate with biodegradable hydraulic oil Accepted by Company. Contactor shall include biodegradable oil data sheet, a list of reference projects where this product was used as well as specific maintenance requirements associated with the proposed oil.

3.12.4 The oil system shall have heaters and chillers as needed to allow continuous cleaning operation in the ambient temperature ranges specified herein.

3.12.5 All motions of the boom, telescopic arms, grippers, and the machine deck pivot shall be controlled by proportional control valves to ensure smooth starts and stops of all movement functions.

3.13 ELECTRIC POWER CONFIGURATION REQUIREMENTS

3.13.1 Power will be furnished at 600 Vac, 3 phase, 60 Hz for operation of the cleaning system at two (2) locations as shown on the Drawings. For electrical requirements see electrical section of this specification.

3.13.2 These two (2) power feeds shall be the only source of electric power for the trash cleaning system.

3.14 POWER QUALITY

3.14.1 All equipment connected to AC circuits shall be protected from power surges.

3.14.2 Equipment shall meet the requirements of IEEE C62.41 or other Engineer Accepted standard.

3.14.3 Furnish properly sized filter reactors on each VFD drive input and output if recommended by the drive manufacturer.

3.14.4 Performance of the reactors shall be as required by the drive manufacturer.

3.15 POWER CABLES

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3.15.1 Power shall be delivered from fixed electrical disconnect provided in the Spillway Electrical Buildings adjacent to the gantry rails for operation of the hoist during the Diversion phase.

D1 **3.15.2** Power cables from the trash cleaning system shall extend to the electrical disconnects provided by Company's Other Contractor in the Intake building adjacent to the gantry rails for long term operation. The power cable from the trash cleaning system shall be suitable for pulling through embedded conduit provided by Company's Other Contractor under the concrete decks as shown on the Drawings. A suitable device to hold the power cable shall be provided where the power cable exits the conduit to allow movement of the trash cleaning system.

3.15.3 A motor-powered electrical cable take-up and pay-out spool shall be provided on the upstream side of the gantry as shown on the Drawings.

D1 **3.15.4** Cable take-up and pay-out guides shall be provided on the gantry to ensure that the cable lies straight within the cable guideway to be mounted on the upstream guardrails that are supplied by Company's Other Contractor.

3.15.5 The normal operation of cable take-up and pay-out functions shall be automated as part of the gantry movement control.

3.15.6 Manual control of the motorized cable take-up and pay-out shall be provided to allow extension or retraction of the power cable if needed.

3.15.7 Power feeds to the machine deck and machinery enclosure shall be via cable designed for repetitive bending and rotation, with extra-fine conductor wires, strain restraints and cable grips as required.

3.15.8 Cable lengths shall be adequate for the furthest system position from the normal operation feed point on the Intake deck, plus the distance through the buried conduit to the permanent disconnect switch in the Intake Hoist House, plus an additional ten (10) m.

3.15.9 Cable shall be sized to carry the maximum demand load of the system, plus twenty percent (20%) over capacity, and shall be adequately oversized so the voltage drop along the cable at maximum demand does not exceed two percent (2%).

3.15.10 "Kellm" style vertical supports shall be provided as required for type "W" cord to relieve stress on cable terminals.

3.15.11 The cable reel shall provide automatic take-up and release of cable while traveling, and shall be equipped with full capacity collector rings and brushes for each conductor (three (3) phases plus ground).

3.15.12 The cable reel shall be weatherproof NEMA Type.

3.15.13 The take-up and release features shall function with both of the feed points, as indicated on the Contract Drawings.

3.15.14 To facilitate maintenance and repairs, and ensure safety, the cable reel system shall be designed so it is capable of being maintained by crews working on the dam deck, and in no circumstances shall crews be required to work over the water.

3.15.15 Cable Reel Manufacturer: Insul-8 motor drive reel, or an alternative Accepted by Engineer.

3.16 POWER CABLE TAKE-UP AND PAY-OUT SYSTEM

3.16.1 The power cable take-up and pay-out system shall be a motor driven cable reel system with a spiral motor cable reel, as manufactured by Stemmann-Technik, GMBH, CONDUCTIX/Insul8, or alternate accepted by Engineer. This system shall have the following features and components:

.1 Spiral cable reel with capacity for full range of travel on powerhouse intake deck and spillway;

.2 Diverting unit without tension control;

.3 Roller bow;

.4 Type “W” power supply cord for use with the cable reel.

3.17 INSTRUMENTATION CONFIGURATION REQUIREMENTS

3.17.1 Instrumentation and control devices shall be manufactured and installed to allow easy adjustment, troubleshooting, and replacement of devices. Surge protection, optical isolators, or equivalent signal conditioning equipment shall be used wherever needed to ensure reliable instrument signals and control functions in the ambient electrical noise and interference condition environment specified herein.

3.17.2 Where position monitoring devices are required for operator safety, avoidance of structures and avoidance of motions that could damage the trash cleaning system, a redundant set of instruments and control functions shall be provided. This redundant set of instruments and control functions shall be completely independent from the PLC control system and shall remain functional in case of PLC failure.

3.17.3 Gantry Travel

.1 The movement and position of the gantry shall be monitored via a PLC based gantry position monitoring system, with location markers on the concrete deck or cableway for precise cleaning of all trashracks and for installing / removing bulkhead gates and spillway upstream stoplogs.

.2 This system shall allow the gantry to be positioned within 2.5 cm of the correct location for cleaning of the trashracks.

.3 The position monitoring system shall also monitor the areas where the Trash Cleaner is near the buildings or areas with light standards, to maintain a safe clearance.

.4 Limit switches and end-of-travel position contacts shall be provided.

.5 The following main motions of the cleaning system shall be monitored by position transducers:

.1 Position of gantry along deck rails;

.2 Position of the main boom arm;

.3 Position of the telescopic arm;

.4 Stroke of the telescoping arm;

.5 Rotation of the machine deck.

.6 Position of cleaner head on the trashracks or in the Debris and Sediment Trap, with this position developed in software and displayed on the operator interface in the operators cab.

3.17.4 Emergency System Stop

.1 Red mushroom cap push buttons shall be provided to stop related motion of the pieces of machinery that could cause injury to workers, including but not limited to the gantry drives, the rotation of the trash cleaning system machinery deck, and movement of the articulating arm.

.2 The mushroom cap push buttons shall be provided at the four corners of the Trash Cleaner gantry structure, at the hoist control platform, at access points onto and off of the machinery deck, at pinch points, and in the operators cab.

.3 The operation of the red mushroom cap push buttons shall be independent of the PLC and functional in case of PLC failure.

3.17.5 Cleaner Head Pressure on Trashrack

.1 A system of pressure transducers shall be used to provide cleaner head pressure against the trashrack face.

.2 The system shall be designed to limit the pressure of the trashrack cleaning head on the Trashrack to no more than 50kN.

3.18 OPERATOR INTERFACE CONFIGURATION REQUIREMENTS

3.18.1 Manual Control Devices (Outside PLC)

.1 A manual control system, independent of the touchscreen control and PLC, shall be provided at the HPU to allow manual operation of the system in case of touchscreen or PLC failure.

.2 This manual system shall allow a shutdown of the cleaning operation and movement of the system to the storage area for repair of the PLC, without the cleaner head graphical position feedback or semi-automatic cleaning system functions.

3.18.2 Touchscreen Control

.1 Normal operation of the system shall be provided by a touchscreen control interface in the operator cab that allows manual and semi-automatic system operation.

.2 The touchscreen shall be visible while looking at the trash boom, within plus or minus fifteen degrees (±15°). The touchscreen shall be reasonably sized for ease of operation and the screen size shall be Accepted by Engineer.

.3 This screen shall report the following functions:

.1 Selected operating mode;

.2 Cleaner head position relative to trashrack (graphical and numerical display);

.3 Cleaner head elevation;

.4 Cleaner head gripper or clam head finger position (open/closed);

.5 Time counter for remaining cycle time;

.6 Cleaner head pressure on trashrack face;

.7 Top-of-boom elevation;

.8 Condition monitoring of cleaning system (hydraulic pressure, system temperatures, run-time hours, alarm status, etc);

.9 Location of trash cleaning system on intake deck (which cleaning position of which generating unit).

3.18.3 Underwater Camera Display

.1 A monitor shall be provided in the operator cab for viewing the underwater surveillance camera.

3.19 CONTROL REQUIREMENTS

3.19.1 Manual Cleaning System Operation

.1 Manual control of all boom, telescopic arm, cleaning head operation, machine deck pivot and other functions shall be possible in manual mode from the operator cab.

3.19.2 Semi-Automatic Trashrack Cleaning System Operation

.1 Semi-automatic control shall include a single-command initiation of one trash cleaning system operating cycle, beginning with the gantry at any cleaning position. The sequence shall include:

.1 Rotation of the machine deck to the cleaning position;

.2 Opening of the cleaner head gripper and tilt of the cleaner head to the cleaning angle;

.3 Extension of the boom and telescopic arm to the full-down position;

.4 Movement of the cleaner head against the rack, developing the setpoint cleaner head pressure against the rack;

.5 Vertical cleaning of the face of the trashrack to a point at the top of the rack face (this point shall be user-adjustable);

.6 Closing of the cleaner head gripper;

.7 Retraction of the telescopic arm and boom rotation to lift the cleaner head free of the water surface (this point shall be user-adjustable);

.8 Pause and wait for one of the following actions:

.1 Operator terminates semi-automatic cleaning control;

.2 Operator manually operates boom and gantry to place collected trash into a receptacle;

.3 Operator moves the control lever in the direction of the next cleaning position and the Trash Cleaner gantry automatically travels to and stops at the next cleaning position, which includes rotating the machine deck to a safe travel position and moving to the next water passage if that is the next position to be cleaned.

.9 The trash cleaner is ready for another semi-automatic cleaning cycle initiated by the operator.

3.19.3 Operation with Other Cleaning Device Attachment

.1 With any of the other cleaning devices (buck, clamshell, gripper) connected to the telescopic arm, the cleaning system shall allow manual operation of the cleaning device, to the depths and area extents shown on the Drawings. When in this mode, the position of the device (elevation and position relative to the trashrack face) shall be graphically and numerically displayed on the controller touchscreen.

3.19.4 Hoist Operation for Bulkhead Gates and Spillway Stoplogs

.1 Hoist operation shall be possible at any point on the spillway and powerhouse intake deck rails, with the trash cleaning machine deck locked in the parked position.

.2 The hoist shall be designed as specified in Section 48 13 21 and 26 29 03.03.

3.19.5 Alarm and Warning Functions

.1 The Trash Cleaning System control system shall include a complete group of alarm and warning functions that shall:

.1 Prevent damage to any system component due to overload or overextension;

.2 Notify operator of any operating problem or undesirable condition within the trash cleaning system (high temperature, low fluid level, etc); and,

.3 Warn operators when the machinery is near its limits of travel.

.4 Warn operators when the machinery is near structures.

.2 Alarms shall be both audible and visual alarms, with a record of alarm indications logged as part of the PLC control system operation.

3.20 LIGHTING AND ALARM REQUIREMENTS

3.20.1 Trash Cleaner Lighting Systems

.1 Where flood lights or area lighting is specified, the light fixtures shall be sized and located to furnish the following light levels:

.1 Floodlights with: 550 lux at the working surface below the cleaning system (0.75 m above the intake deck; and 550 lux minimum on the hoist to provide lighting on the stoplogs and gate slots

.2 Lighting with 300 lux at the floor area of enclosures and access areas.

.3 Operator cab interior lights providing a minimum of 400 lux at floor area, sufficient for reading, with switch near door, minimum two (2) florescent fixtures;

.4 Low level illumination of controls, for night operation of system.

.2 Access Lighting: Walkway and ladder illumination, three (3) way switched at cab and at concrete deck access entry point to the system.

.3 Under Gantry and Hoist Lighting: Illumination of area under gantry for safe vehicle passage after dark, minimum (4) four floodlights, with a three (3)-position switch (off-on-photocell). Floodlights: 550 lux minimum at the working surface below the hoist (0.75 m above the deck);

.4 Motion Alarm Lighting: Flashing yellow area lights on each side of gantry for warning during gantry travel or machine deck rotation;

.5 Work Area Lighting: Illumination of area near boom, the telescopic arm, and hoist for night operation of system. Minimum four (4) four-hundred (400) watt halogen fixtures, switched from cab.

.6 Machinery Enclosure Lighting: Florescent interior lights for proper illumination of all equipment, switched from a point near the primary access door.

.7 Intake Deck Lighting: Illumination of the left and right side deck areas, from light fixtures on the gantry, two fixtures on each side. Each side lighting circuit shall be independently switched using a three-way circuit, with switches on the gantry leg accessible from the intake deck, and switches in the operator cab.

.8 Equipment Enclosure Lighting: Fluorescent interior lights for all equipment cabinet interiors, switched from a point near the access door of each enclosure.

.9 Emergency Exit Lighting: Battery operated emergency exit lighting that illuminates the exit pathway extending from the operator cab, across the machine deck and down the access ladder or stair on the gantry. This lighting system shall illuminate upon loss of electric power in the trash cleaning system.

.10 Red lights visible on the deck from all sides to indicate that the system is powered up.

.11 Audible Alarm: The trash cleaning system shall have a siren for gantry movement and for rotation of the machine deck.

3.21 DESIGN LIFE AND MAINTENANCE INTERVALS

3.21.1 Design Life:

.1 Hydraulic System Fixed Components (tubing, fittings, cylinders, valves and all accessories): Thirty (30) years or 20,000 operating hours;

.2 Hydraulic System Renewable Components (cylinder seals, pump seals, motor seals, and similar items): Ten (10) years or 10,000 operating hours;

.3 Rollers, Bearings, Gear Systems, Telescopic Arm Guide Rollers and Similar Items: Thirty (30) years or 20,000 operating hours, except that all bearings shall have a B10 operating life of not less than 100,000 hours;

.4 Hydraulic oil minimum life of 4 years or 1000 operating hours.

3.21.2 Maintenance Intervals

.1 The trash cleaning system shall be designed for the following maintenance intervals:

.1 Weekly inspection of system during operating season;

.2 Monthly minor maintenance (check of fluid levels, temperatures, lubrication, etc) during operating season;

.3 Annual maintenance for renewing fluids, transducer calibration, filter replacement, control function checks, etc.

3.22 SUBMITTALS

3.22.1 General

.1 Before proceeding with manufacture of trash cleaning systems, submit to Engineer/Company for review and approval: design brief, Contractor's Shop Drawings, and catalog cut sheets to demonstrate fully that all parts will conform to the provisions and intent of this Section and related Sections, and to the requirements related to installation, operation, and maintenance.

3.22.2 Procedures

.1 Work Plan

.1 Submit detailed Work Plans for the Muskrat Falls's erection of the trash cleaning system, including a description of work activities, illustrative diagrams, and suggested schedule. Submit detailed Work Plans for installation and testing of the trash cleaning system along with Contractor's Shop Drawings to demonstrate that the proposed design is consistent with the intended approach regarding installation and testing. Submit revised, detailed Work Plans for erection and installation of trash cleaning system prior to delivery.

.2 Field Assembly Instructions

.1 Submit detailed step-by-step instructions for un-crating, fit-up, assembly and installation of the trash cleaning system. Include diagrams of all crane picks above 1000 kg in weight, with specific pick points for the components. Provide interconnection diagrams for all required wiring connections. Provide all torque, alignment tolerances, and recommended adjustments for connections and moving components.

.3 Construction Quality Control Plan (CQC Plan)

.1 Submit for review and approval a CQC Plan in accordance with the Submittal Schedule, Administrative Requirements, before proceeding with manufacture of the trash cleaning system.

.4 Inspection and Test Plan

.1 Submit for review and approval a Shop and Field Inspection and Test Plan in accordance with the Submittal Schedule, Administrative Requirements, before proceeding with manufacture and installation of trash cleaning system.

3.22.3 Drawings

.1 Drawings showing all necessary dimensions and fabrication details, complete Bill of Materials (including the type and grade of materials), details of welded and bolted joint connections, tolerances, surface finishes, non-destructive examinations, and other pertinent details, shall be submitted to Engineer for review and Acceptance.

.2 Detail Drawings (including but not limited to):

.1 General arrangement drawings for trash cleaning system assembly showing clearances, capacities, speeds, pertinent dimensions, weights, wheel loads, etc. Drawings showing clearances shall clearly detail the relationship of the trash cleaning system with respect to existing and proposed powerhouse features;

.2 Trash cleaning system clearance diagrams;

.3 Installation and erection (field assembly) drawings for trash cleaning system and accessories;

.4 Load diagrams for operation of the hoist;

.5 Subassembly drawings of gantry, machine deck, machinery enclosure, operator cab, boom, telescopic arm, cleaner head, clam head and other subassemblies;

.6 Details of trash cleaning system structures, translation devices, cab, walkways, ladders, and enclosures;

.7 Details of gantry traversing motion machinery, motors, brakes, speed reducers, bearings, shafts, wheels, couplings, etc;

.8 Details of bumpers, parking devices, and trash cleaning system accessories;

.9 Details of end of travel bumpers and wheel stops;

.10 Details and equipment arrangement in operator's cabs;

.11 Details of lubrication systems;

.12 Details of hydraulic system including hydraulic schematic, all operating set point pressures and calculated pressures required for system operation;

.13 Details of power conductors and cable take-up and pay-out system;

.14 Details of trash cleaning system lighting;

.15 Detailed list of limit switches, anti-collision devices, control devices and other instrumentation with all settings delineated;

.16 Locations and layout of all electrical equipment, including cabinets, motors, brakes, controls, and interconnection conduits;

.17 Weights of items shall be included;

.18 Each cabinet or equipment housing, with locations and sizes of external equipment, conduit drilling, cabinet mounting means, hinges, latches, and locks;

.19 Conduit type and size; locations of the conduits, fittings, splice and junction boxes; and the number and the sizes of conductors in each conduit;

.20 Controls arrangements and components;

.21 Electrical schematics and wiring diagrams for the power and control system, showing all components interconnects for power, control, monitoring, and protective circuits. The wiring diagrams shall indicate the wiring for individual items of equipment within all panels and equipment items, terminal board connections, wire designations, and sizes and types of wire. The wiring diagrams shall also show all connections between individual panels, and between panels and separately located items;

.22 Wiring interconnection diagrams showing interconnecting cable between each piece of equipment and termination details for each of the cables. Interconnection drawings shall be furnished for all control and power cable to be installed by Contractor;

.23 Controller program details shall be submitted for review and approval. The programming shall be fully annotated with sufficient information for determining operation of the system. Flow type logic diagrams of the control system showing all logic flow from the controlling devices to the controlled devices;

.24 Match marking drawings;

.25 Nameplates;

.26 Foundation Loadings: Diagrams shall be provided for loads transferred from trash cleaning system to the supporting runway structure at the Intake, Centre Transition Dam and Spillway for all load cases.

3.22.4 Catalogue Data

.1 Product specifications, descriptive literature, and performance data for items of standard manufacture.

3.22.5 Spare Parts Lists

.1 Required Capital Spare Parts shall be provided as follows:

.1 One (1) HPU motor and pump;

.2 Two (2) sets replaceable plastic scrapers on the cleaning head, along with fasteners;

.3 Four (4) hydraulic quick connects of each size and type;

.4 One (1) gantry drive motor;

.5 Two (2) complete sets of each type of brake shoes;

.6 Two (2) sets of wheel bearings;

.7 One (1) set of bearings for the rotating platform;

.2 A Recommended Spare Parts list shall be provided by Contractor, and shall list and price components individually for possible purchase at Engineer's option as a part of the Contract.

.3 All Spare Parts shall be interchangeable with, and of the same materials and workmanship as the corresponding parts of the equipment furnished.

.4 Capital Spare Parts and Spare Parts ordered by Engineer shall be individually packaged for indefinite storage indoors at the powerhouse, and each part shall be marked with its description and purpose on the outside of the packaging.

.5 Capital Spare Parts and Recommended Spare Parts ordered by Engineer shall be delivered into stores as directed by Engineer. Delivery shall be deemed to be complete when the packages have been opened by Contractor, their contents checked by a representative of Engineer and the parts re-protected and repacked by Contractor to the satisfaction of Engineer.

.6 Where Spare Parts have been used by Contractor during the construction, Commissioning or guarantee periods, such Spare Parts shall be replaced by Contractor at its own cost at the earliest possible date.

.7 Contractor shall maintain at Worksite an adequate supply of spare parts for commissioning to avoid any schedule delay.

3.22.6 Tools

.1 Contractor shall provide any specialty tools used for the initial installation of the equipment and necessary for dismantling, adjustment and maintenance of the equipment. The cost of these tools shall be included in the Contract Price and shall be handed over to Engineer after Commissioning.

.2 Each tool shall be in good working condition and marked with its size and/or purpose. If, in the opinion of Engineer, any tool is excessively worn or damaged when handed over, Contractor shall provide an adequate replacement. Tools shall be stored in a suitable container.

3.22.7 Reports and Documentation

.1 Work Plans

.1 Submit detailed Work Plans for erection of the trash cleaning system, including a description of work activities, illustrative diagrams, and schedule.

.2 Submit detailed Work Plans for installation and testing of the trash cleaning system along with Contractor's Shop Drawings to demonstrate that the proposed design is consistent with the intended approach regarding installation and testing.

.2 Material test certificates (mechanical and chemical properties)

.3 Shop and Field Inspection Plan: Submit Contractor's plan of inspection to be performed at key stages of assembly and testing of equipment, with applicable illustrations, diagrams, check sheets, and procedures, for fit-up, dimensional correctness, alignment, and sequential checkout, startup, testing, and operation of equipment.

.4 Shop test report: Shop test record, including shop assembly and inspection check sheets for fit-up, dimensional correctness, alignment, functional tests, and other checks.

.5 Certification Records: Submit copies of all shop and field inspection records and reports.

.6 Packing and shipping procedures

.7 Installation instructions

.8 Operation and Maintenance Manuals: Submit complete sets of O&M manuals containing the manufacturer's operating and maintenance instructions for each piece of equipment and the integrated trash cleaning system.

D2

.9 Not used.

.10 Certificate of Compliance

.11 Certificate of Proper Installation

.12 Closeout submittals

.13 Schedules

.14 Field test report

PART 4 PRODUCTS

4.1 MACHINE GUARDS

4.1.1 All exposed moving parts shall be provided with guards in accordance with the applicable safety requirements. Such safety devices shall meet or exceed federal, state and municipal requirements.

4.1.2 The Contractor shall furnish equipment with suitable guards and safety devices designed to protect persons against contact with moving parts and hazardous surfaces.

4.1.3 Fabricate guards of 2 mm (minimum) steel, 13 mm opening in expanded metal screen to provide visual inspection of moving parts without removal of the guard.

4.1.4 Guards shall be painted after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts.

4.1.5 Openings shall be provided in the guard for access to the lubricating fittings and may require provisions to extend lube fittings through guards.

4.1.6 Cut-outs and holes through guard screen shall be reinforced.

4.2 HYDRAULIC PRESSURE SYSTEM

4.2.1 Hydraulic Pressure Unit, (HPU)

.1 The HPU reservoir shall be sized for a minimum active volume of two hundred percent (200%) of rod return volume. The HPU reservoir shall be Joint Industry Conference (JIC) type and shall be designed to prevent the intrusion of foreign matter and precipitation water.

.2 Fluid level shall be visible in a sight gage over the normal operating range with high and low levels marked.

.3 A filler-breather assembly, filling strainer, drain valve, and air filter shall be provided. Intake and return lines shall be routed to near the bottom of the reservoir.

.4 Means for accessing the tank interior shall be provided such that the entire interior can be inspected and cleaned.

.5 The reservoir interior shall be painted with a multiple coat oil-resistant paint system, per the manufacturer's standard practice.

.6 A low level alarm float switch and an extreme low oil level pump shutoff switch shall be provided, in addition to all pressure switches required for pump control.

.7 A reservoir temperature switch shall be furnished and installed.

.8 The system shall allow gravity drainage of ninety-eight percent (98%) of the oil volume.

.9 A low watt density electric heater shall be provided to maintain temperature in the HPU above 15°C with the minimum ambient air temperature specified herein.

.10 An oil cooler shall be provided to limit the maximum oil operating temperature to 65°C with the maximum ambient air temperature specified herein.

4.2.2 Hydraulic Cylinders

.1 Hydraulic cylinders shall be of welded marine grade (suitable for wet locations) construction.

.2 The rod shall be 17-4 pH stainless steel, grade H-1100 with a hard chrome plate 0.025 mm minimum thickness after grinding and polishing to a 0.2032 µm (micron) finish.

.3 Cylinder working pressure shall not to be less than one hundred fifty percent (150%) of the rated system operating pressure.

4.2.3 Hydraulic Tubing and Fittings

.1 Hydraulic tubing shall be seamless Type 304 stainless steel tubing aircraft quality per MIL-T or AMS specifications.

.2 Fittings shall be bite-type compression fitting, SWAGELOK or equal. Tubing sizes shall be sufficient to meet pump manufacturer's suction pressure requirements and to prevent starvation, undue temperature rise or pressure losses.

.3 Fluid velocities shall be 1.2 m/s maximum in suction lines and 3 m/s maximum in other lines. Tubing clamps shall be Parker Parklamp Standard and Twin series clamps or equal.

.4 Attach clamps shall be attached to steel structures by welding with clamp weld plates or by threaded fasteners and clamp mounting rails.

.5 Tubing clamps shall be provided within 0.3 m of all tube terminations and every 2.4 m, along each tubing run.

4.2.4 Hydraulic Hose and Fittings

.1 Hose shall have a minimum burst pressure of four (4) times the operating pressure.

.2 Hose shall be provided at connections to each hydraulic cylinder or as needed to limit excessive loading on tube sections.

.3 Fittings shall be quick disconnect, non-spill stainless steel, Parker FS Series 316 Non-Spill, or equal, fitting size to match hose size.

4.2.5 Hydraulic Pumps and Motors

.1 Pumps shall be variable volume piston pumps (Parker Series PV or an alternative Accepted by Engineer) with a minimum capacity of one hundred ten percent (110%) percent of the maximum calculated system oil requirement at the rated operating pressure.

.2 For motor requirements, see Section 26 05 81 – Motors 1 to 250 hp.

4.2.6 Accessories

.1 A pressure relief valve shall be provided on the discharge side of the pump.

.2 A 10 micron filter shall be provided on the pump outlet, and a fine mesh filter shall be provided on the pump inlet.

.3 Dirty filter alarms shall be provided.

.4 A minimum 76.2 mm diameter liquid filled pressure gage with shutoff valve and snubber, visible from the front of the enclosure, shall be provided for monitoring system pressure.

4.2.7 Hydraulic Equipment Enclosure

.1 The hydraulic equipment shall be contained within the overall machinery enclosure in a manner that prevents oil mist and vapours from contaminating electrical devices, walkway areas and other non-hydraulic equipment in the overall machinery enclosure.

.2 The hydraulic equipment enclosure shall be a steel enclosure (or partition within the overall machinery enclosure) that contains the pumps, motors, control valves, and other devices.

4.2.8 HPU Power and Controls

.1 Motor power feeds, control power, and instrumentation cabling should be adequately separated from each other. Remote device connections shall be terminated at a terminal strip in the control enclosure, labelled to correspond to the electrical connection diagram.

.2 Local controls and indication shall be provided for the following:

.1 Indicating lights to show pump operation (ON/OFF);

.2 Indicating lights to show low system pressure alarm;

.3 Indicating light to show low reservoir level alarm;

.4 Indicating light to show high reservoir temperature;

.5 Hand-Off-Auto control switch(es) for manual operation of pump(s).

4.3 GANTRY DRIVE

4.3.1 Brake Control

.1 Type: Electrically released, spring set brakes, released by means of an electro-mechanical contactor that supplies full voltage to the brake coil when a directional command is issued.

.2 Brake Operation: Upon release of a directional command, one (1) of the following sequences shall occur:

.1 Brake sets immediately due to de-energizing of the brake contactor and the controller immediately goes to zero (0) output;

.2 Controller decelerates the motor to zero (0) speed using dynamic braking over a programmable time ramp and then sets the holding brake by de energizing the brake contactor;

.3 Selection of either of the above brake operating methods is programmable.

4.4 COATINGS SCHEDULE

4.4.1 Coating and galvanizing shall conform to Section 48 13 10, Clause 5.2.8.

4.4.2 Coatings shall be as follows:

Main Structure	All surfaces Epoxy paint colour XXX
Hydraulic arm and any submerged parts	Hot dip galvanized
All accessories, such as ladders, walkways, platforms, handrails/guard rails and all hardware, not forming integral part of the main structure and liable of being dismantled, such as connection bolts, supports, heating equipment, pipes, etc.	Hot dip galvanized
Hydraulic equipment	Different colour than the main structure
Safety equipment	Epoxy paint colour XXX

4.4.3 Surface preparation and application shall be as specified in Section 48 13 10, Clause 5.2.8.

4.4.4 Colour schedule to be provided by Company.

PART 5 EXECUTION

5.1 TOLERANCE

5.1.1 Tolerances shall be selected by Contractor to meet the precision required for the proper operation of the equipment, considering the nature and function of the part. All tolerances shall be indicated on Contractor's Shop Drawings and submitted for review.

5.1.2 Contractor shall establish finer shop tolerances, if necessary, to meet the specified performance or operational requirements or for interchangeability of spare parts. All tolerances shall be selected with due considerations to the nature and function of the parts and to the corresponding accuracy required to secure proper operation, but shall not exceed the tolerances specified.

5.2 PRESERVATION, MECHANICAL COMPLETION AND COMMISSIONING REQUIREMENTS

D1

5.2.1 Preservation, mechanical completion and commissioning requirements noted herein are defined in MFA-SN-CD-2000-ME-SP-0002-01 – Preservation, Mechanical Completion, Commissioning Requirements.

5.3 FIELD TRAINING

5.3.1 Field training for Company's operating staff shall be carried out on site by qualified individuals familiar with the installation, operation, and maintenance of the trash cleaning system furnished under this Contract.

5.3.2 An individual from the trash cleaning system manufacturer shall conduct the training.

5.3.3 Training shall be required for twelve (12) Company employees during two (2) sessions of approximately eight (8) hours before the trash cleaning system is ready for the Diversion Phase.

5.3.4 Training shall be required for twelve (12) Company employees during two (2) sessions of approximately eight (8) hours when the trash cleaning system if ready for turnover for Substantial Completion of the project.

5.3.5 Field Training Operations and Maintenance (O&M) Manuals shall be provided for each employee participating in the training.

5.3.6 Company reserves the right to record such training for future internal use.

5.3.7 Training shall include:

.1 Classroom activities and hands-on type training with the actual equipment;

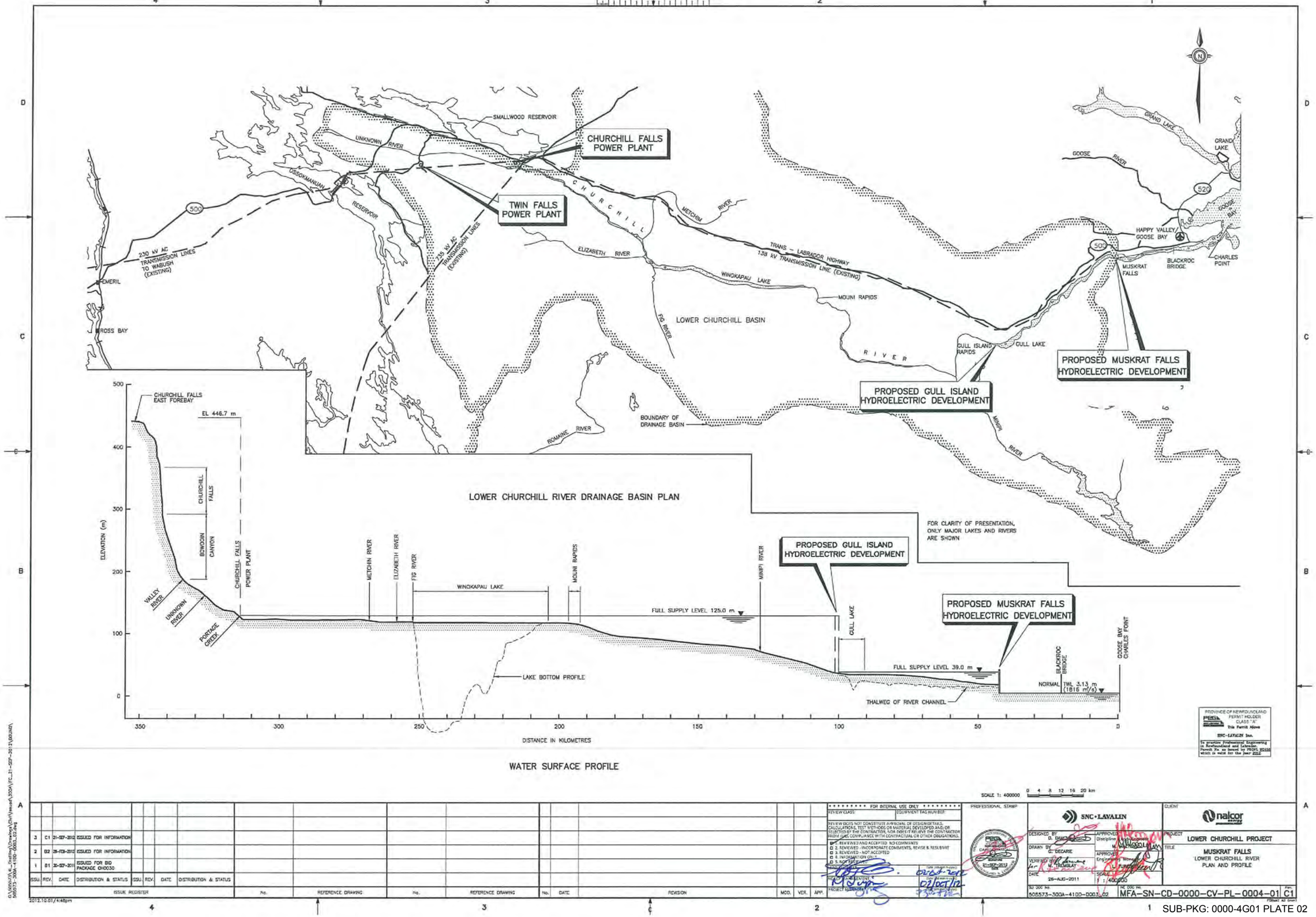
.2 Operating and troubleshooting the equipment to return it to service;

.3 All required maintenance activities; including preventative maintenance as well as corrective procedures.

D2

5.4 NOT USED

END OF SECTION



3	C1	21-SEP-2012	ISSUED FOR INFORMATION											
2	B2	28-FEB-2012	ISSUED FOR INFORMATION											
1	B1	30-SEP-2011	ISSUED FOR BID PACKAGE CH0030											
ISSU.	REV.	DATE	DISTRIBUTION & STATUS	SSU.	REV.	DATE	DISTRIBUTION & STATUS							

ISSUE REGISTER

No.	REFERENCE DRAWING	No.	REFERENCE DRAWING	No.	DATE	REVISION	MOD.	VER.	APP.

FOR INTERNAL USE ONLY

REVIEW CLASS: EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

1. REVIEWED AND ACCEPTED, NO COMMENTS
2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
3. REVIEWED - NOT ACCEPTED
4. INFORMATION ONLY
5. NOT REVIEWED

PROJECT MANAGER'S INITIALS:

PROFESSIONAL STAMP

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A" This Permit Allows SNC-LAVALIN Inc. To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL 02160 which is valid for the year 2012

SNC·LAVALIN

DESIGNED BY: D. DIAMOND
DRAWN BY: C. DECARIE
VERIFIED BY: M. TREMBLAY
APPROVED: M. TREMBLAY
DATE: 28-AUG-2011
SCALE: 1 : 400000

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
LOWER CHURCHILL RIVER
PLAN AND PROFILE

SLI DOC No. 505573-300A-4100-0003_02

ENL DOC No. MFA-SN-CD-0000-CV-PL-0004-01 Rev. C1

SUB-PKG: 0000-4G01 PLATE 02

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2012.10.01/4:48pm

NOTES:

1. ALL COORDINATES ARE REFERENCED TO UTM NAD83, ZONE 20.
2. THE GROUND TOPOGRAPHY CONTOURS HAVE BEEN OBTAINED FROM A 1:50000 MAP.

TO CHURCHILL FALLS

LOWER CHURCHILL PROJECT MUSKRAT FALLS SITE

NORTH SPUR

TRANS-LABRADOR HIGHWAY ROUTE 500

TRANSMISSION LINE

TRANS-LABRADOR HIGHWAY ROUTE 500

HAPPY VALLEY/ GOOSE BAY

EXISTING CAUSEWAY AND BRIDGE. MAXIMUM ALLOWABLE GROSS WEIGHT FOR A SPECIAL OVERWEIGHT PERMIT IS 100 TONNES PLUS CARRIER TO A MAXIMUM OF 48 TONNES

FLOW

CHURCHILL RIVER

Muskrat Island

FLOW

CONTRACTOR'S LAYDOWN AREA

COMPANY'S LAYDOWN AREA

McKenzie River

STA. 030E014

ACCOMMODATIONS COMPLEX

Caroline Brook

PERMANENT SOUTH SIDE ACCESS ROAD

TRANS-LABRADOR HIGHWAY ROUTE 510

EXISTING FOREST ACCESS ROAD

TO CARTWRIGHT

Caroline Brook

N 5 910 000 | N 5 900 000 | E 650 000 | E 660 000 | E 670 000

PLAN

0 500 1000 1500 2000 m
SCALE 1:25000

PROVINCE OF NEWFOUNDLAND PEGL PERMIT HOLDER CLASS "A" This Permit Allows SNC-LAVALIN Inc. To practice Professional Engineering in Newfoundland and Labrador. Permit to be issued by PEGNL Stamp which is valid for the year 2013

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
5	C1	21-SEP-2012	ISSUED FOR INFORMATION
4	B4	8-JUN-2012	ISSUED FOR INFORMATION
3	B3	22-MAY-2012	ISSUED FOR INFORMATION
2	B2	29-FEB-2012	ISSUED FOR INFORMATION
1	B1	30-SEP-2011	ISSUED FOR BID PACKAGE CH0030
6	C2	08-MAR-2013	ISSUED FOR INFORMATION

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
C2	08-MAR-2013	LAYDOWN AREAS MODIFIED	A.C.	A.E.P.	R.C.
C1	21-SEP-2012	GENERAL REVISION			
B4	8-JUN-2012	GENERAL REVISION			
B3	22-MAY-2012	GENERAL REVISION			

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REVIEW CLASS: | EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- ☐ 1. REVIEWED AND ACCEPTED NO COMMENTS
- ☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy)

NE-LCP MANAGEMENT: Date (dd-mmm-yyyy)

PROJECT MANAGER: Date (dd-mmm-yyyy)

PROFESSIONAL STAMP

ALVARO CORDEIRO 08-MAR-2013

SNC·LAVALIN

DESIGNED BY T. McGRATH | APPROVED Discipline Lead Engineer M. MARTIN

DRAWN BY R. MERRI | APPROVED Engineering Manager G. Simpson

VERIFIED BY A. [illegible] | SCALE 1 : 25000

DATE 26-AUG-2011

SU DOC No. 505573-300A-41DD-0012_05

NE DOC No. MFA-SN-CD-2000-CV-GA-0001-01 | Rev. C2

FORMAT A0 (mm)

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS ACCESS ROAD, ACCOMMODATIONS AND LAYDOWN AREAS

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2013.03.18/5:15pm

SUB-PKG: 0000-4G01 PLATE 03

NOTES:

1. ALL COORDINATES ARE REFERENCED TO UTM NAD83, ZONE 20.
2. THE GROUND TOPOGRAPHY CONTOURS ARE BASED ON A SITE-SPECIFIC LIDAR SURVEY COMPLETED IN 2006.
3. THE RIVER BATHYMETRY CONTOURS ARE BASED ON AN AIRBORNE BATHYMETRIC SURVEY COMPLETED IN 1998.
4. THE CONTOUR INTERVAL OF THE GROUND TOPOGRAPHY AND THE RIVER BATHYMETRY IS 2 METRES.
5. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

LEGEND

- DITCH
- DIVERSION CHANNEL
- CULVERT
- NIC. NOT IN CONTRACT
- ROCK STOCKPILE AREA A, C2, G
- LAYDOWN AREA B, C1, D, E, F, H
- 25 kV LINE
- STOCKPILE AND LAYDOWN AREAS BOUNDARIES

NORTH RCC OVERFLOW DAM (NIC)
NORTH TRANSITION DAM (NIC)
GATED SPILLWAY STRUCTURE (NIC)
DISCHARGE CHANNEL (NIC)
CENTRE TRANSITION DAM (NIC)
DOWNSTREAM ACCESS TO THE SPILLWAY (NIC)
TAILRACE CHANNEL
SHORELINE
POWERHOUSE
END OF PERMANENT ACCESS ROAD BY OTHERS
FULL SUPPLY LEVEL (FSL) EL 39.0
ORIGINAL SHORELINE
UPSTREAM COFFERDAM (NIC)
SPILLWAY APPROACH CHANNEL
CHURCHILL RIVER
ORIGINAL SHORELINE
RCC RIVER SIDE COFFERDAM
SEPARATION WALL (NIC)
CONSTRUCTION ROAD
TO LAYDOWN AND STOCKPILE AREAS
C1
C2
G
F
E
D
B
APPROACH CHANNEL AND INTAKE
FULL SUPPLY LEVEL (FSL) EL 39.0
A
SOUTH ROCKFILL DAM (NIC)
H
SOUTH TRANSITION DAM (NIC)
SWITCHYARD
TRANSMISSION LINES
315 kV (NIC)
138 kV (NIC)
315 kV (NIC)
138 kV (NIC)
CONSTRUCTION ROAD
DIVERSION CHANNEL
CONVERTER STATION

PROVINCE OF NEWFOUNDLAND PEGL PERMIT HOLDER CLASS "A" This Permit Allows
SNC-LAVALIN Inc.
No persons Professional Engineering as Professional and Individual Permit No. as issued by PEGNL 2013 which is valid for the year 2013

0 50 100 150 200 250 m
SCALE 1:3000

SITE PLAN

No.	REV.	DATE	DISTRIBUTION & STATUS
5	C1	21-SEP-2012	ISSUED FOR INFORMATION
4	B4	8-JUN-2012	ISSUED FOR INFORMATION
3	B3	22-MAY-2012	ISSUED FOR INFORMATION
2	B2	28-FEB-2012	ISSUED FOR INFORMATION
1	B1	30-SEP-2011	ISSUED FOR BID PACKAGE CH0030
6	C2	08-MAR-2013	ISSUED FOR INFORMATION

ISSUE REGISTER

No.	DATE	REVISION	MOD.	VER.	APP.
C2	08-MAR-2013	GENERAL REVISION			
C1	21-SEP-2012	GENERAL REVISION			
B4	8-JUN-2012	GENERAL REVISION			
B3	22-MAY-2012	GENERAL REVISION			
B2	28-FEB-2012	GENERAL REVISION			

REFERENCE DRAWING

FOR INTERNAL USE ONLY
REVIEW CLASS: EQUIPMENT TAG NUMBER:
REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.
1. REVIEWED AND ACCEPTED. NO COMMENTS
2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
3. REVIEWED - NOT ACCEPTED
4. INFORMATION ONLY
5. NOT REVIEWED
LEAD REVIEWER:
NE-LCP MANAGEMENT:
PROJECT MANAGER:

PROFESSIONAL STAMP: PEGNL DANIEL CARTER 2012 21-SEP-2012

SNC·LAVALIN

DESIGNED BY	O. SAMOILOV	APPROVED Discipline Lead Engineer M. MACKEAN
DRAWN BY	R. MERRI	APPROVED Engineering Manager G. STRONG
VERIFIED BY	for M. TRUMLEY	
DATE	26-AUG-2011	SCALE 1 : 3000
SLI DOC. No.	505573-3004-4100-0004_05	NE DOC. No. MFA-SN-CD-2000-CV-PL-0003-01 Rev. C2

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
GENERAL ARRANGEMENT OF WORKS PLAN

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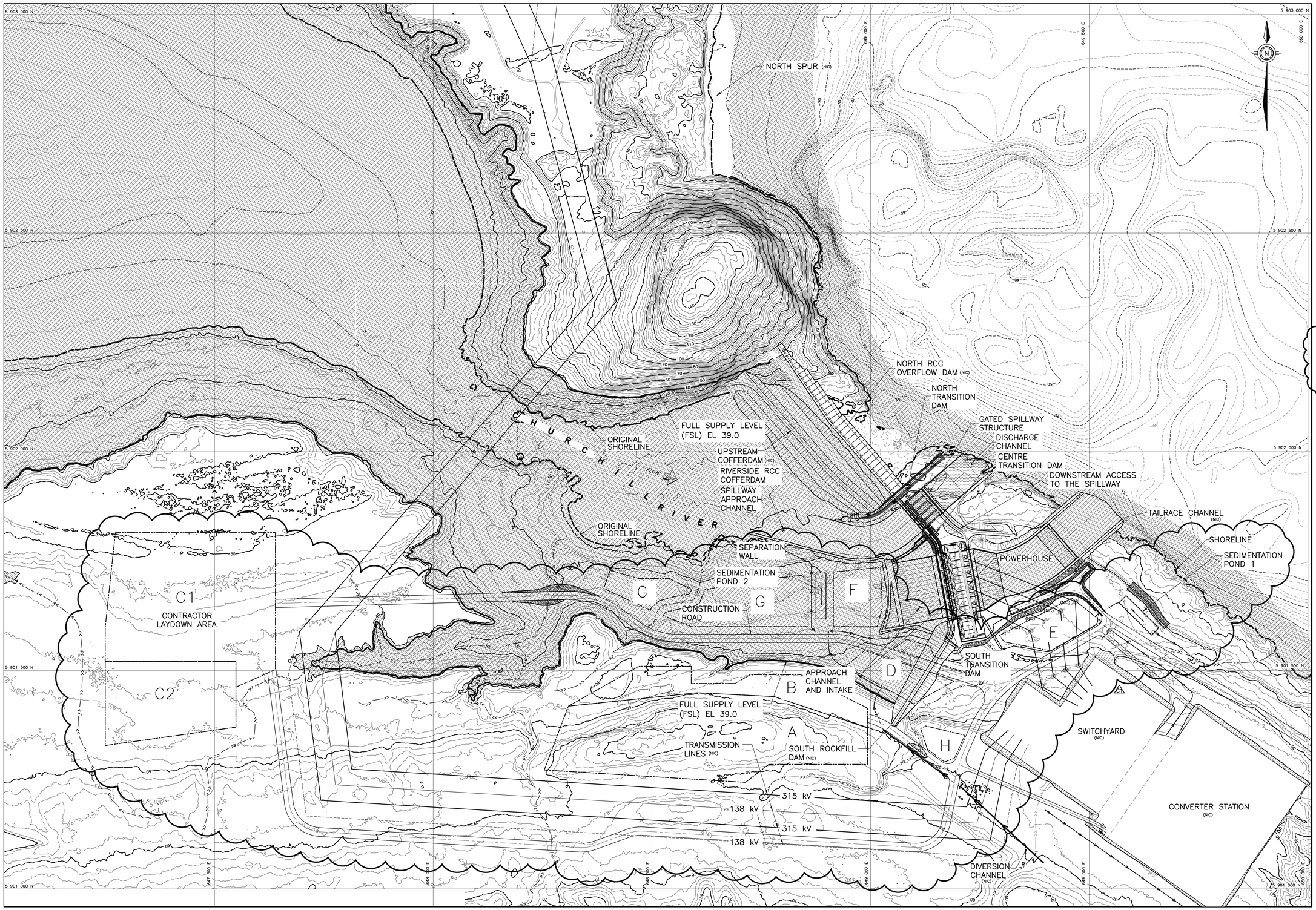

NOTES:

1. ALL COORDINATES ARE REFERENCED TO UTM NAD83, ZONE 20.
2. THE GROUND TOPOGRAPHY CONTOURS ARE BASED ON A SITE–SPECIFIC LIDAR SURVEY COMPLETED IN 2006.
3. THE RIVER BATHYMETRY CONTOURS ARE BASED ON AN AIRBORNE BATHYMETRIC SURVEY COMPLETED IN 1998.
4. THE CONTOUR INTERVAL OF THE GROUND TOPOGRAPHY AND THE RIVER BATHYMETRY IS 2 METRES.
5. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

LEGEND

- TOPOGRAPHIC CONTOUR
- BATHYMETRIC CONTOUR
- DITCH
- DIVERSION CHANNEL
- CULVERT
- NIC — NOT IN CONTRACT
- 25 kV LINE
- STOCKPILE AND LAYDOWN AREAS BOUNDARIES
- TRANSMISSION LINE TOWERS (NIC)

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL N0458 which is valid for the year 2013.

0 50 100 150 200 250 m
SCALE 1:3000

SITE PLAN

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
3	C1	22-APR-2013	ISSUED FOR CONSTRUCTION
2	B2	15-OCT-2012	ISSUED FOR ADDENDUM 1
1	B1	31-JUL-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
C1	22-APR-2013	AS NOTED	A.C.	A.E.B.	R.B.
B2	15-OCT-2012	SOUTH TRANSITION DAM ADDED; CONVERTER STATION SHOWN	A.E.B.	D.D.	M.M.

* * * * * * * * FOR INTERNAL USE ONLY * * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- ☐ 1. REVIEWED AND ACCEPTED NO COMMENTS
- ☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP
PROFESSIONAL ENGINEER — PROVINCE OF NEWFOUNDLAND & LABRADOR — PEGNL — ALVARO CEBALLOS — 22-APR-2013 — SIGNATURE

SNC·LAVALIN

DESIGNED BY D. DAMOV	APPROVED Discipline Lead Engineer M. MAEYENS
DRAWN BY R. MERRI	APPROVED Engineering Manager G. SNYDER
VERIFIED BY M. TREMBLAY	SCALE 1 : 3000
DATE 26-AUG-2011	

CLIENT: nalcor energy — LOWER CHURCHILL PROJECT

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
INTAKE AND POWERHOUSE,
SPILLWAY AND TRANSITION DAMS
GENERAL LAYOUT
PLAN

SU DOC No. 505573-3331-41DD-0100_02 | NE DOC No. MFA-SN-CD-3000-GT-GA-0001-01 | Rev. C1

FORMAT A0 (mm)

SUB-PKG: 0007-4G01 PLATE 01

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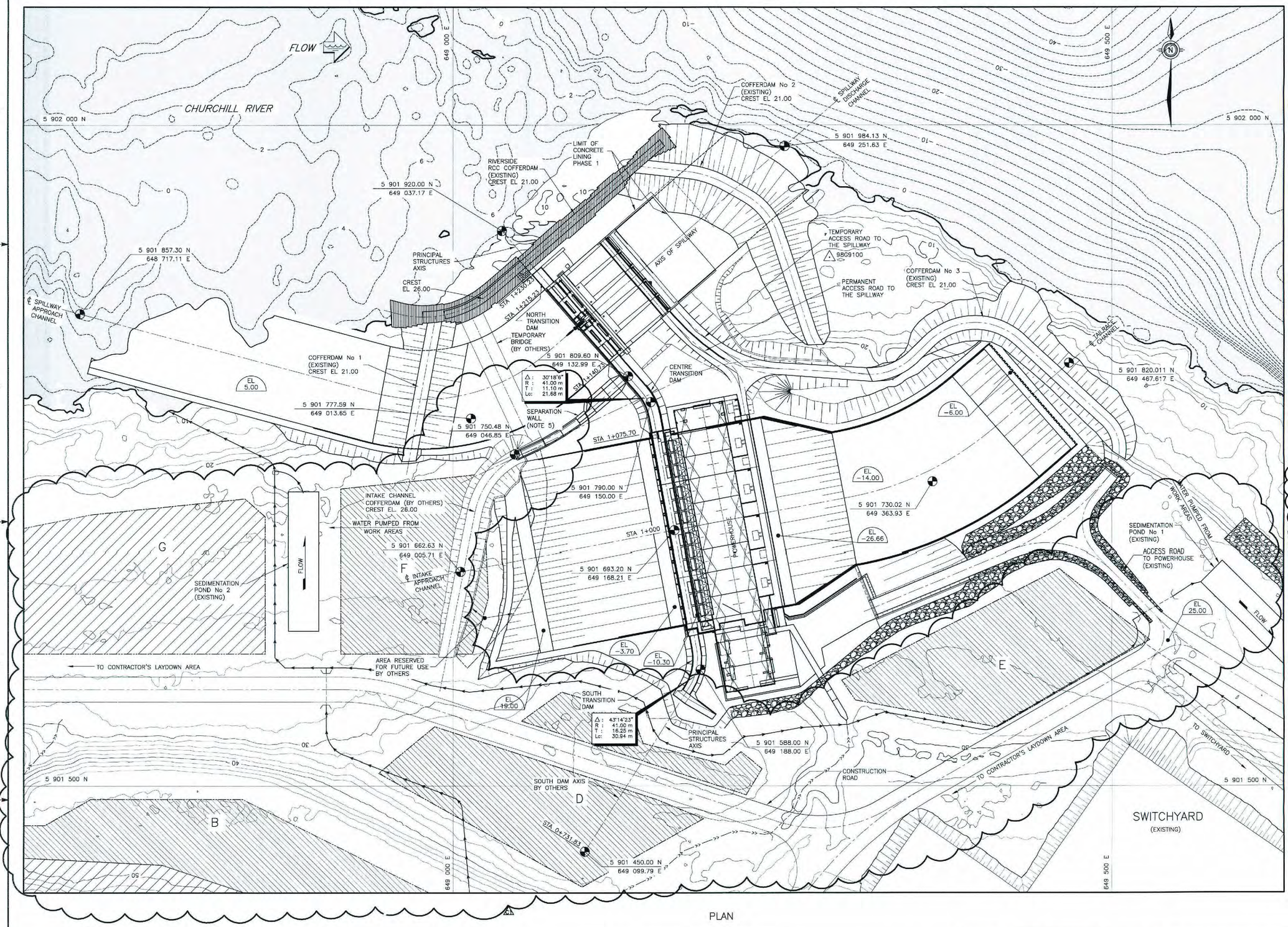

PLAN

NOTES:

1. THE UTM20 NAD83 CONTOURS OF THE GROUND TOPOGRAPHY SHOWN ON THE DRAWING WERE GENERATED FROM THE 2006 LIDAR SURVEY DATA.
2. THE UTM20 NAD83 CONTOURS OF THE RIVER BATHYMETRY SHOWN ON THE DRAWING WERE GENERATED FROM THE 1998 AIRBORNE BATHYMETRIC SURVEY DATA.
3. THE CONTOUR INTERVAL OF THE GROUND TOPOGRAPHY AND THE RIVER BATHYMETRY IS 2 METRES.
4. ELEVATIONS AND DIMENSIONS ARE IN METRES.
5. FOR SEPARATION WALL SEE DRAWING: MFA-SN-CD-2360-CV-PL-0003-01

LEGEND

- BENCHMARK
- LOCATION POINT
- RCC
- SHORELINE (JULY–OCTOBER FOR AVERAGE FLOW OF 1830 m^3/s)
- BATHYMETRIC CONTOUR
- TOPOGRAPHIC CONTOUR
- CULVERT
- DITCH
- ROCK STOCKPILE AREA
- LAYDOWN AREA
- STOCKPILE AND LAYDOWN AREAS BOUNDARIES
- B, D, E, F, G ROCK STOCKPILE AND LAYDOWN AREAS

SCALE 1:1000

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A" This Permit Allows SNC-LAVALIN Inc. To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL 02458 which is valid for the year 2013

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
4	C1	22-APR-2013	ISSUED FOR CONSTRUCTION
3	B3	19-NOV-2012	ISSUED FOR ADDENDUM 3
2	B2	15-OCT-2012	ISSUED FOR ADDENDUM 1
1	B1	31-JUL-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3000-GT-PL-xxxx-01 (505573-3231-4JDD-0009)	SOUTH TRANSITION DAM – DRILLING, GROUTING AND DRAINAGE – PLAN AND SECTIONS
MFA-SN-CD-3000-GT-PL-0006-01 (505573-3231-4JDD-0004)	NORTH TRANSITION DAM – DRILLING, GROUTING AND DRAINAGE – PLAN AND SECTIONS
MFA-SN-CD-3000-GT-PL-0005-01 (505573-3231-4JDD-0003)	CENTRE TRANSITION DAM – DRILLING, GROUTING AND DRAINAGE – PLAN AND SECTIONS
MFA-SN-CD-3000-GT-PL-0004-01 (505573-3231-4JDD-0001)	TRANSITION DAMS – FOUNDATION PREPARATION PLAN, PROFILE AND SECTIONS
MFA-SN-CD-2400-CV-PL-0001-01 (505573-3241-4ZDD-0072)	SPILLWAY DISCHARGE CHANNEL CONCRETE LINING – PLAN
MFA-SN-CD-2430-CV-SE-0001-01 (505573-3241-4ZDD-0073-SH1)	SPILLWAY DISCHARGE CHANNEL CONCRETE LINING – SECTIONS – SHEET 1 OF 2

No.	REFERENCE DRAWING
MFA-SN-CD-3000-GT-PL-0009-01 (505573-3231-4JDD-0007)	INTAKE AND SPILLWAY – PLAN SURVEY MONUMENTS
MFA-SN-CD-3000-GT-PL-0012-01 (505573-3231-4JDD-0005)	CENTRE TRANSITION DAM – GEOTECHNICAL INSTRUMENTATION AND SURVEY MONUMENTS

No.	DATE	REVISION	MOD.	VER.	APP.
C1	22-APR-2013	AS NOTED	A.C.	A.E.B.	R.B.
B3	19-NOV-2012	AREA RESERVED FOR FUTURE USE BY OTHERS REVISED	A.E.B.	R.B.	M.M.
B2	15-OCT-2012	SOUTH TRANSITION DAM ADDED TO CONTRACT AND CONCRETE LINING MODIFIED	A.E.B.	R.L.	M.M.

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

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- ☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 14-May-2013

RECORD MANAGEMENT: Date (dd-mmm-yyyy) 21-MAY-2013

PROJECT MANAGER: Date (dd-mmm-yyyy)

PROFESSIONAL STAMP

PROFESSIONAL ENGINEER ALVARO CEBALLOS 02458 NEWFOUNDLAND & LABRADOR 22-APR-2013

SNC·LAVALIN

DESIGNED BY A. CEBALLOS	APPROVED Discipline Lead Engineer H. BOUZAIENE
DRAWN BY R. MERRI	APPROVED Engineering Manager G. SNYDER
VERIFIED BY R. LEMIEUX	
DATE 23-SEP-2011	SCALE 1 : 1000

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS INTAKE AND POWERHOUSE, SPILLWAY AND TRANSITION DAMS LOCATION OF STRUCTURES PLAN

SNC DOC No. 505573-3331-4JDD-0001_03

NE DOC No. MFA-SN-CD-3000-GT-PL-0001-01 Rev. C1

FORMAT A0 (mm)

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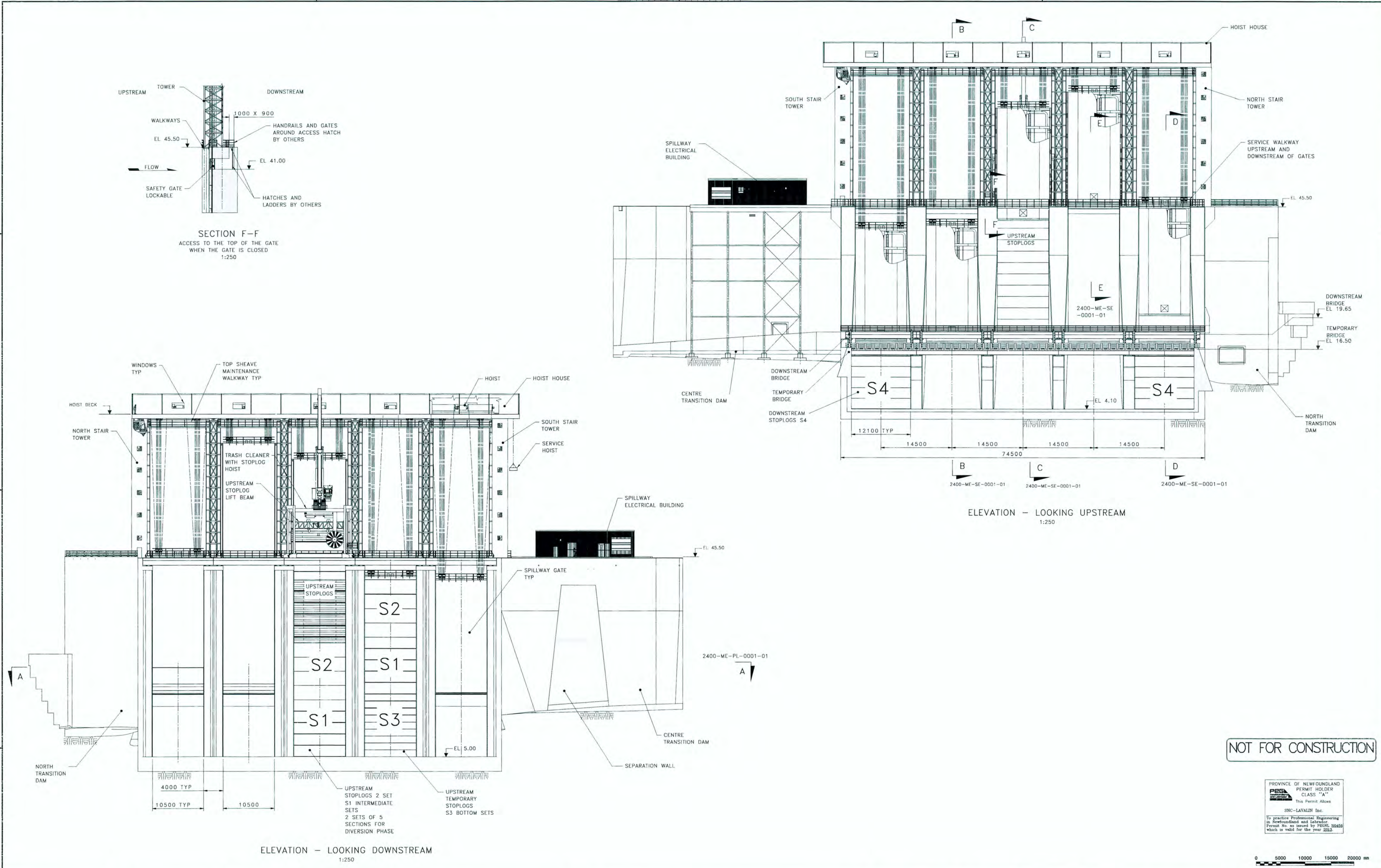
SUB-PKG: 0007-4G01 PLATE 02



NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL N0456 which is valid for the year 2013.

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SCALE 1:250

ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31-JUL-2013	APPROVED FOR DESIGN				
1	B1	17-OCT-2012	ISSUED FOR BID				

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2400-ME-PL-0001-01	GENERAL ARRANGEMENT PLAN AND SECTION
MFA-SN-CD-2400-ME-SE-0001-01	GENERAL ARRANGEMENT SECTIONS

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-13	NO CHANGES	FM	RT	GS

* * * * * * * * FOR INTERNAL USE ONLY * * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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- ☐ 2.REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3.REVIEWED - NOT ACCEPTED
- ☐ 4.INFORMATION ONLY
- ☐ 5.NOT REVIEWED

LEAD REVIEWER: — Date (dd-mmm-yyyy): 15-08-2013
NE-LCP MANAGEMENT: — Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER: — Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP
REGISTERED PROFESSIONAL ENGINEER — PEG Newfoundland and Labrador — RANDOLPH KOOB — SIGNATURE — 8 AUG 13 — DATE — NEWFOUNDLAND & LABRADOR

SNC·LAVALIN

DESIGNED BY	R. LETOURNEAU	APPROVED Discipline Lead Engineer	R. KOOB
DRAWN BY	F. MARTIN	APPROVED Engineering Manager	
VERIFIED BY	E. CIDREI		
DATE	14-SEP-2011	SCALE	1:250

CLIENT: nalcor energy — LOWER CHURCHILL PROJECT

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS SPILLWAY - HYDRO-MECHANICAL GENERAL ARRANGEMENT ELEVATIONS AND SECTION

SLI DOC No. 505573-324B-45DD-0001_01
NE DOC No. MFA-SN-CD-2400-ME-EL-0001-01
Rev. D1

FORMAT A0 (mm)
SUB-PKG: 0032-4501 PLATE 01

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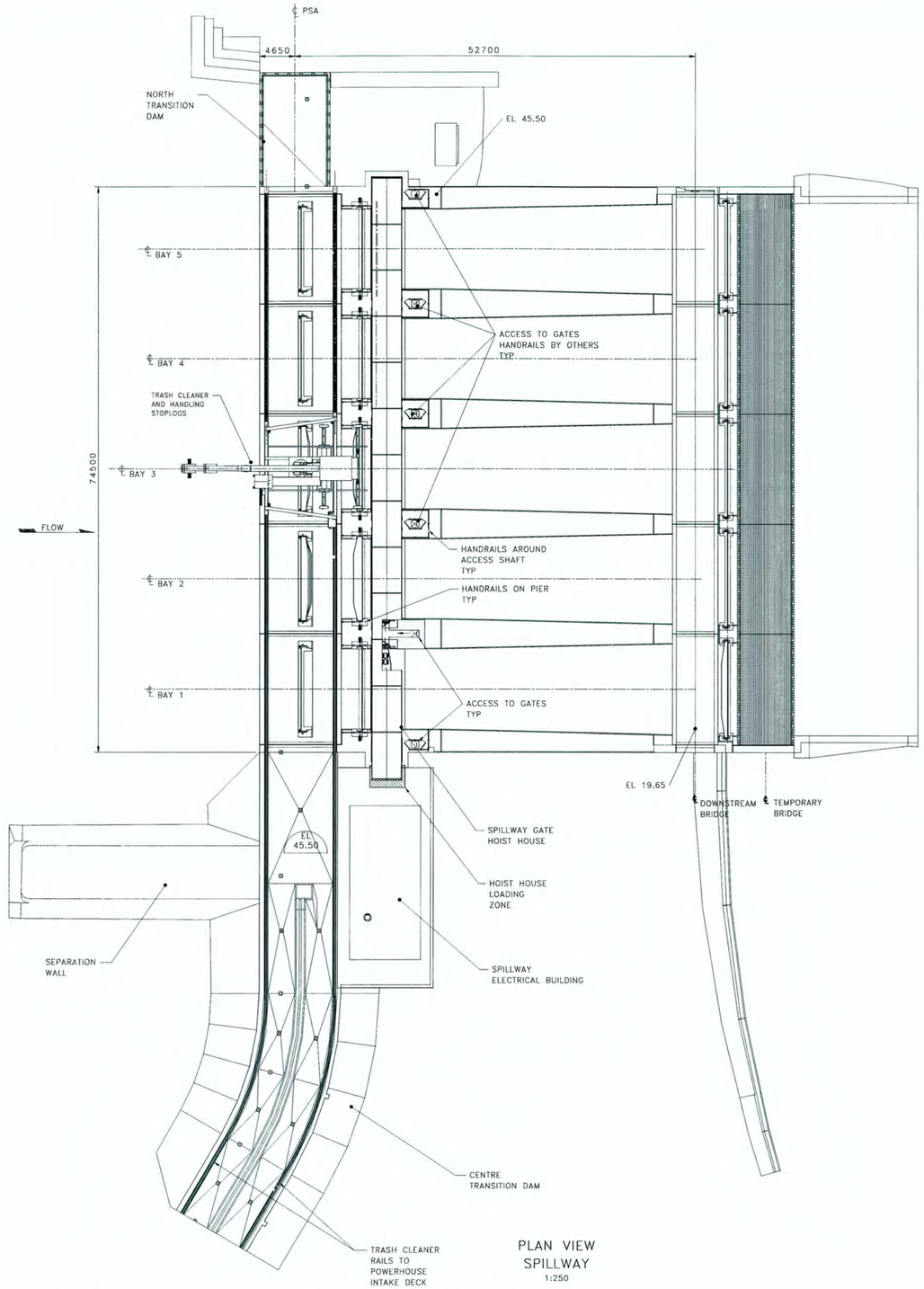
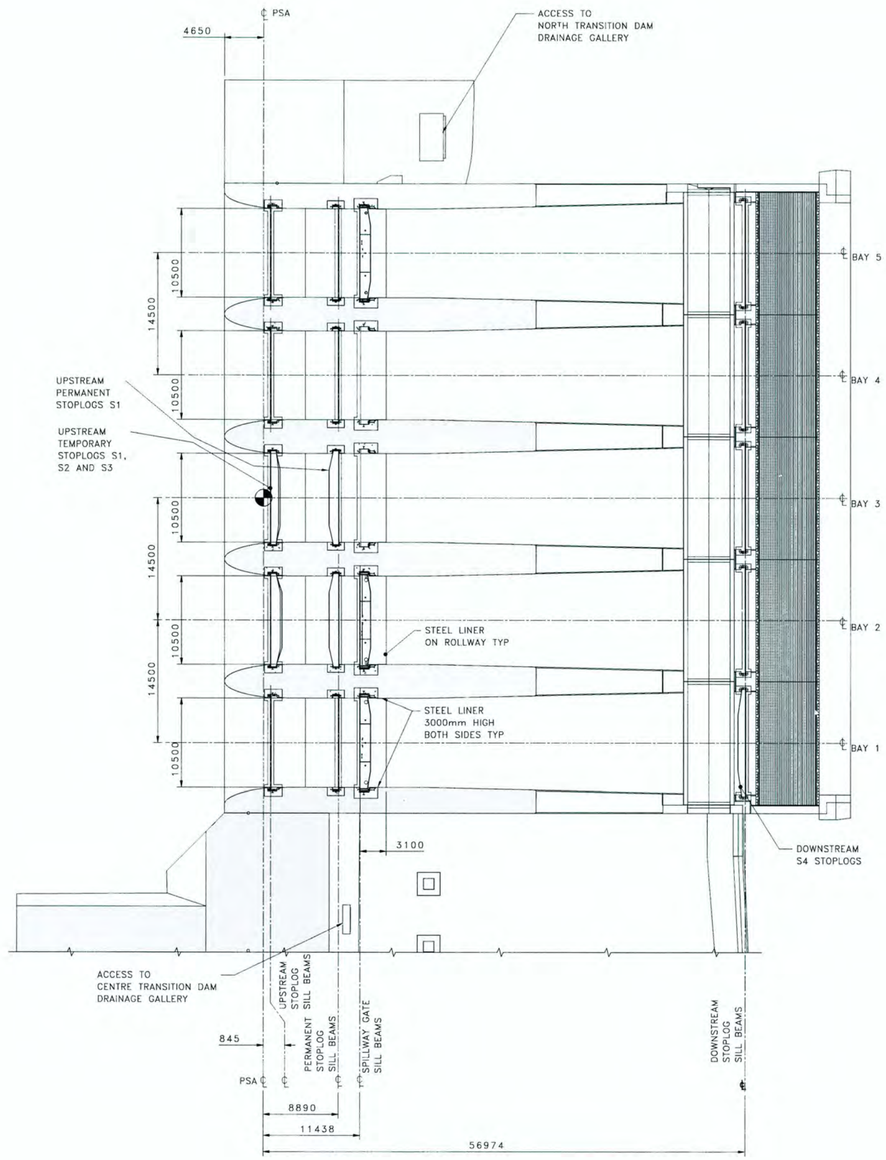


PLAN VIEW
SPILLWAY
1:250



SECTION A–A
2400–ME–EL–0001–01
1:250

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC–LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL NO450 which is valid for the year 2013

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SCALE 1:250

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31–JUL–2013	APPROVED FOR DESIGN
1	B1	17 OCT–2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA–SN–CD–2400–ME–EL–0001–01	GENERAL ARRANGEMENT ELEVATIONS AND SECTION

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31–JUL–13	NO CHANGES	AK	RK	RS

* * * * * * * FOR INTERNAL USE ONLY * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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☐ 2.REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd–mmm–yy) 15–DEC–2013
NE–LCP–MANAGER: Date (dd–mmm–yy) 12–Dec–2013
PROJECT MANAGER: Date (dd–mmm–yy) 16–AUG–2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEER PROVINCE OF NEWFOUNDLAND & LABRADOR PEGNL PERMIT HOLDER CLASS "A" AUTHORIZATION RANDOLPH KOOB DATE 9 AUG 13

SNC·LAVALIN

DESIGNED BY R. LETOURNEAU	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY F. MARTIN	APPROVED Engineering Manager
VERIFIED BY E. CIDREI	
DATE 27–OCT–2011	SCALE 1:250
SLI DOC No. 505573–324B–45DD–0002_01	NE DOC No. MFA–SN–CD–2400–ME–PL–0001–01 Rev. D1

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS SPILLWAY – HYDRO–MECHANICAL GENERAL ARRANGEMENT PLAN AND SECTION

FORMAT A0 (mm)
SUB–PKG: 0032–4501 PLATE 02

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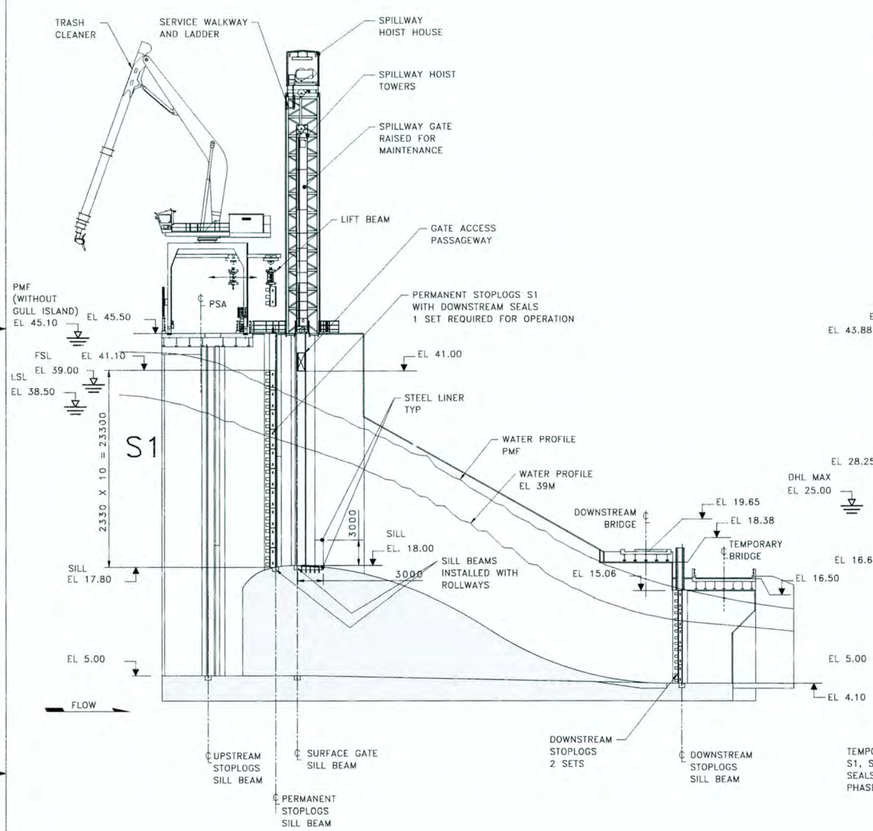
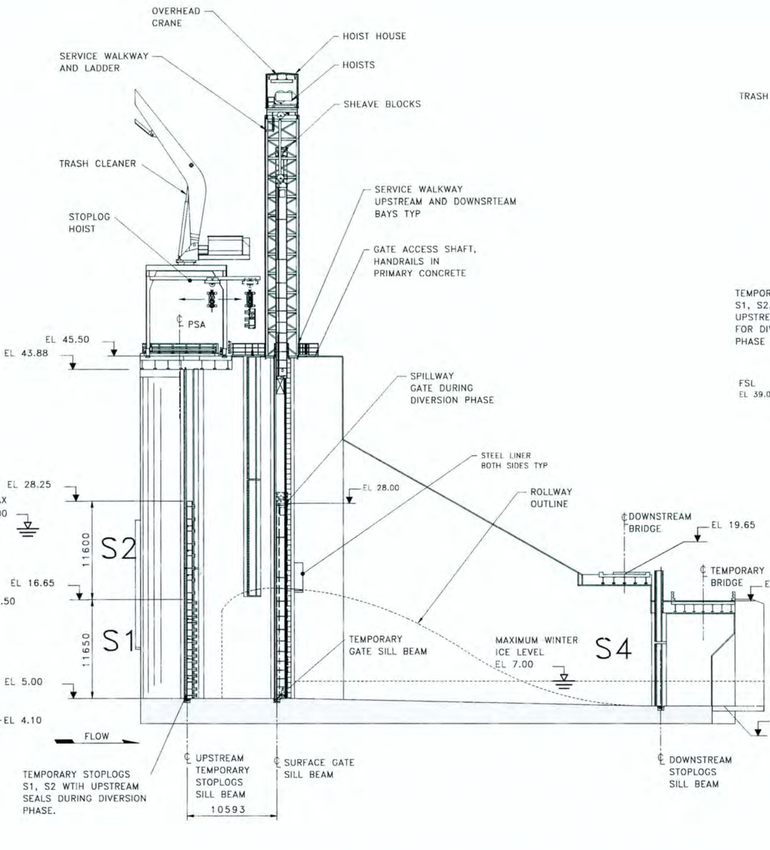


SECTION B–B – DURING OPERATION AT FSL EL 39.00
2400–ME–EL–0001–01
1:250



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2400–ME–EL–0001–01
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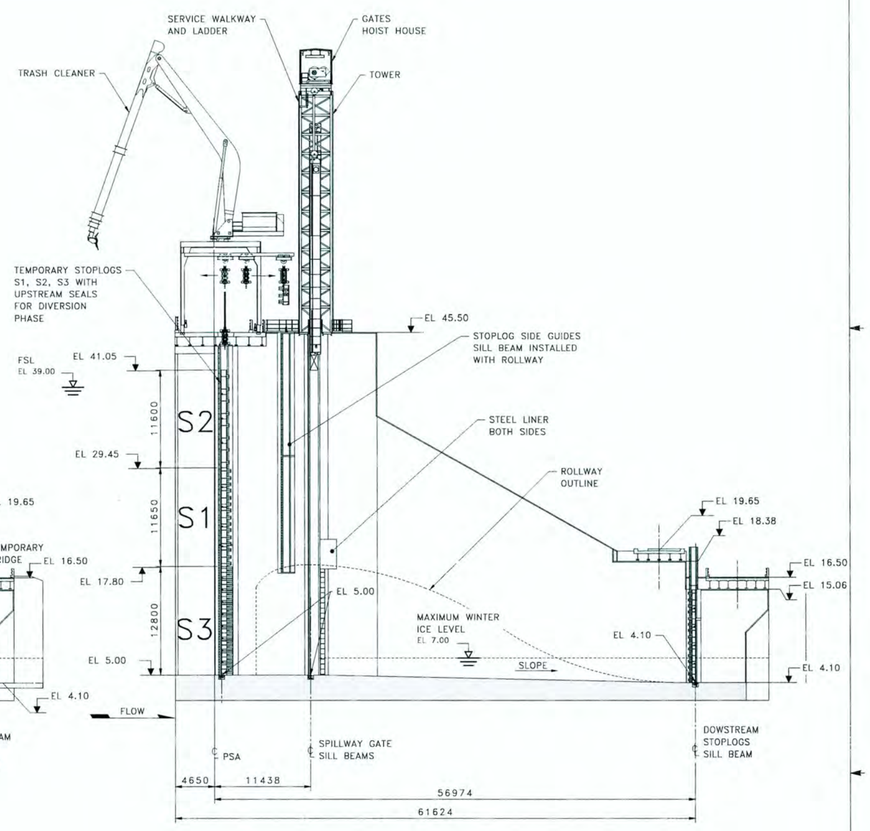

SECTION D–D – DURING DIVERSION AT FSL EL 39.00
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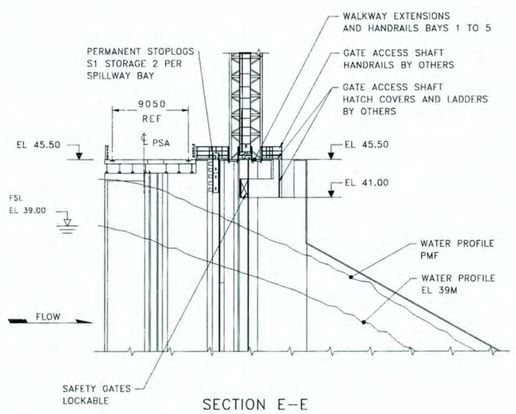

SECTION E–E
2400–ME–EL–0001–01
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NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A"
This Permit Allows
SNC–LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador Permit No. as issued by PEGNL NO4501 which is valid for the year 2013.

0 5000 10000 15000 20000 mm
SCALE 1:250

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31–JUL–2013	APPROVED FOR DESIGN
1	B1	17–OCT–2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA–SN–CD–2400–ME–EL–0001–01	GENERAL ARRANGEMENT ELEVATIONS AND SECTION

REFERENCE DRAWING

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31–JUL–13	NO CHANGES	AK	RK	

REVISION

* * * * * * * FOR INTERNAL USE ONLY * * * * * * *

REVIEW CLASS: EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

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☐ 2.REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd–mmm–yyyy) 15–08–2013
NE–LCH MANAGEMENT: Date (dd–mmm–yyyy) 16 Aug 2013
PROJECT MANAGER: Date (dd–mmm–yyyy) 16 AUG 2013

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY R. LETOURNEAU — APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY F. MARTIN — APPROVED Engineering Manager
VERIFIED BY E. CIOREI
DATE 14–SEP–2011 — SCALE 1:250

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS SPILLWAY – HYDRO–MECHANICAL GENERAL ARRANGEMENT SECTIONS

File No. 505573–324B–45DD–0003_01
MFA–SN–CD–2400–ME–SE–0001–01 Rev. D1
FORMAT A0 (mm)

SUB–PKG: 0032–4501 PLATE 03

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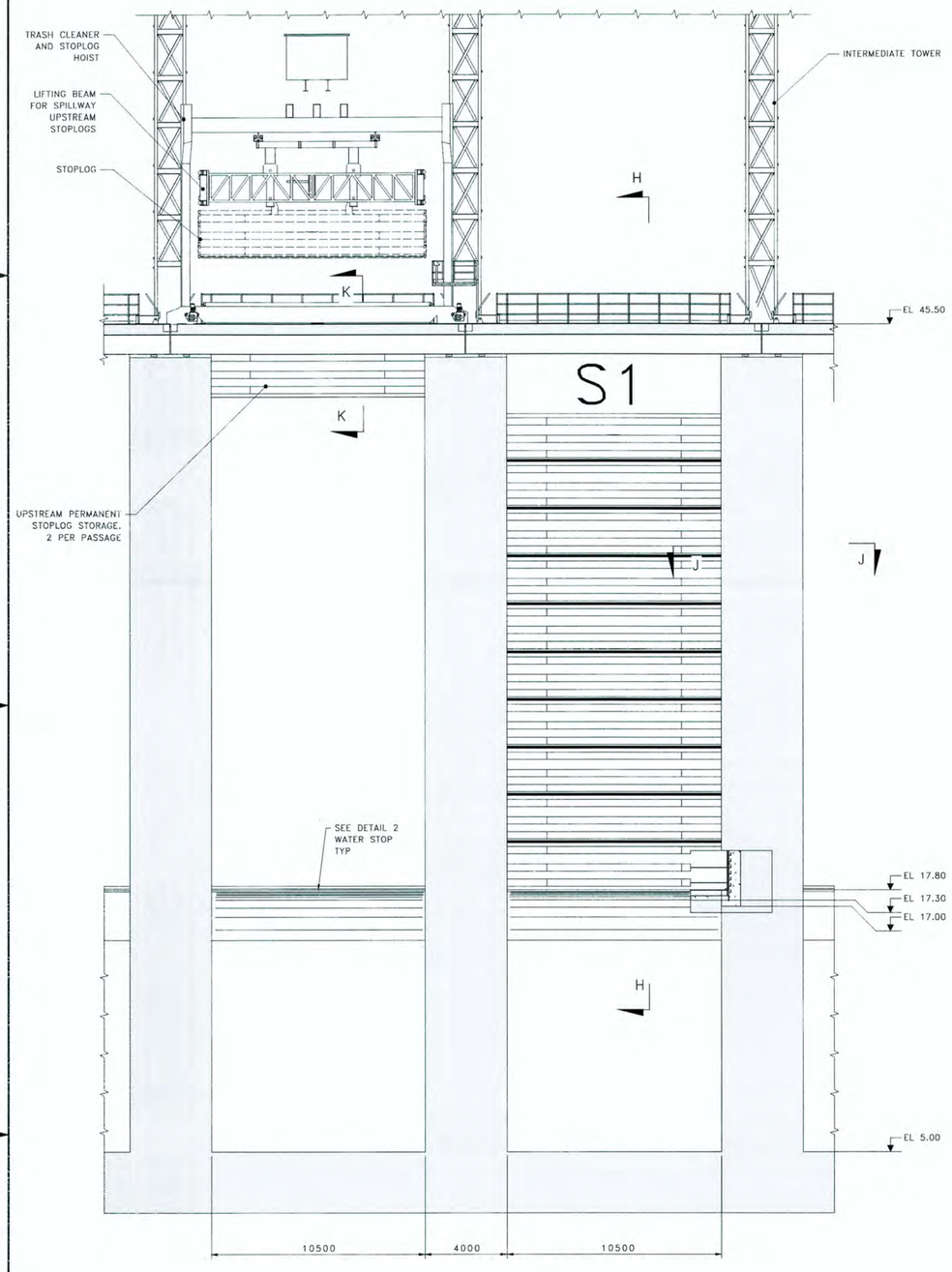
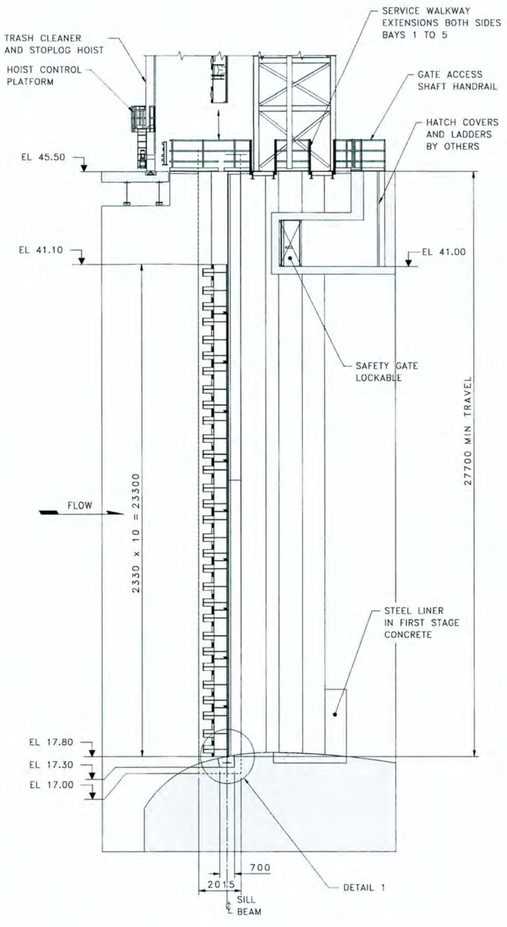


ELEVATION AT PERMANENT STOPLOGS
LOOKING DOWNSTREAM
1:100



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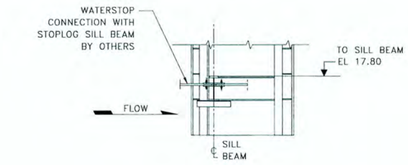
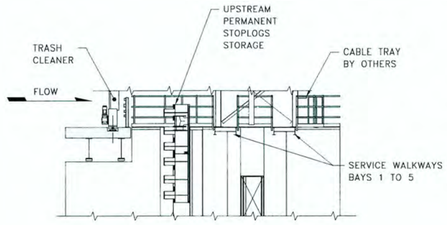


DETAIL 2
PERMANENT STOPLOG
SILL BEAM/WATERSTOP
1:25



SECTION K–K
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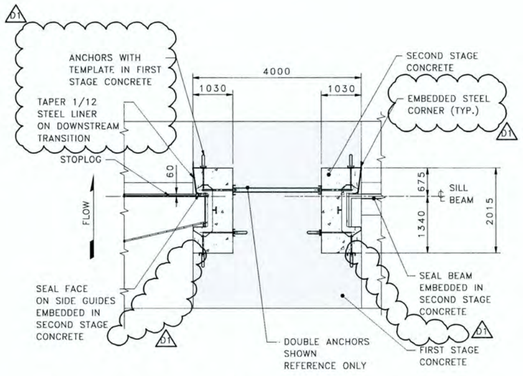

SECTION J–J
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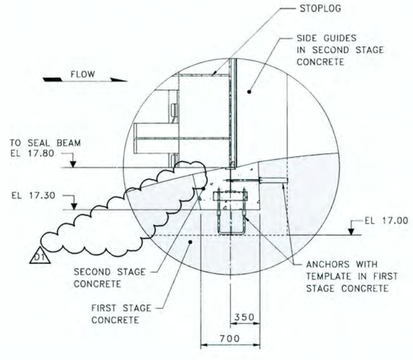

DETAIL 1
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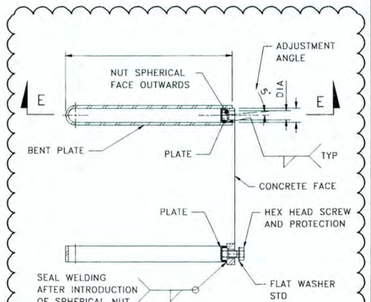


SECTION E–E

DETAIL 3
PRIMARY ANCHOR TYP
NTS

ISOMETRIC

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador
Permit No. as issued by PEGNL, 504SB
which is valid for the year 2013

NOT FOR CONSTRUCTION

0 1000 1500 2000 2500 mm
SCALE 1:25

0 1000 2000 3000 4000 5000 mm
SCALE 1:50

0 2000 4000 6000 8000 10000 mm
SCALE 1:100

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31-JUL-2013	APPROVED FOR DESIGN
1	B1	17-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-13	DETAIL PRIMARY ANCHOR ADDED, EMBEDDED STEEL CORNER AND STEEL LINER TRANSITION ADDED, WATER STOPS REMOVED	AF for ITM	RK	RT for LC

• • • • • • • • FOR INTERNAL USE ONLY • • • • • • • •

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

☑ 1.REVIEWED AND ACCEPTED NO COMMENTS
☐ 2.REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 16-08-13
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy) 16-Aug-2013
PROJECT MANAGER: Date (dd-mmm-yyyy) 16-Aug-2013

PROFESSIONAL STAMP

PROFESSIONAL ENGINEERS PROVINCE OF NEWFOUNDLAND AND LABRADOR PEGNL PERMIT HOLDER CLASS "A" RANDOLPH KOOB APPROVING DATE 16AUG13

SNC·LAVALIN

CLIENT: nalcor energy

DESIGNED BY: K. LETOURNEAU	APPROVED: Discipline Lead Engineer R. KOOB
DRAWN BY: F. MARTIN	APPROVED: Engineering Manager L. CIOREI
VERIFIED BY: L. CIOREI	
DATE: 29-05-2012	SCALE: AS NOTED

PROJECT: LOWER CHURCHILL PROJECT

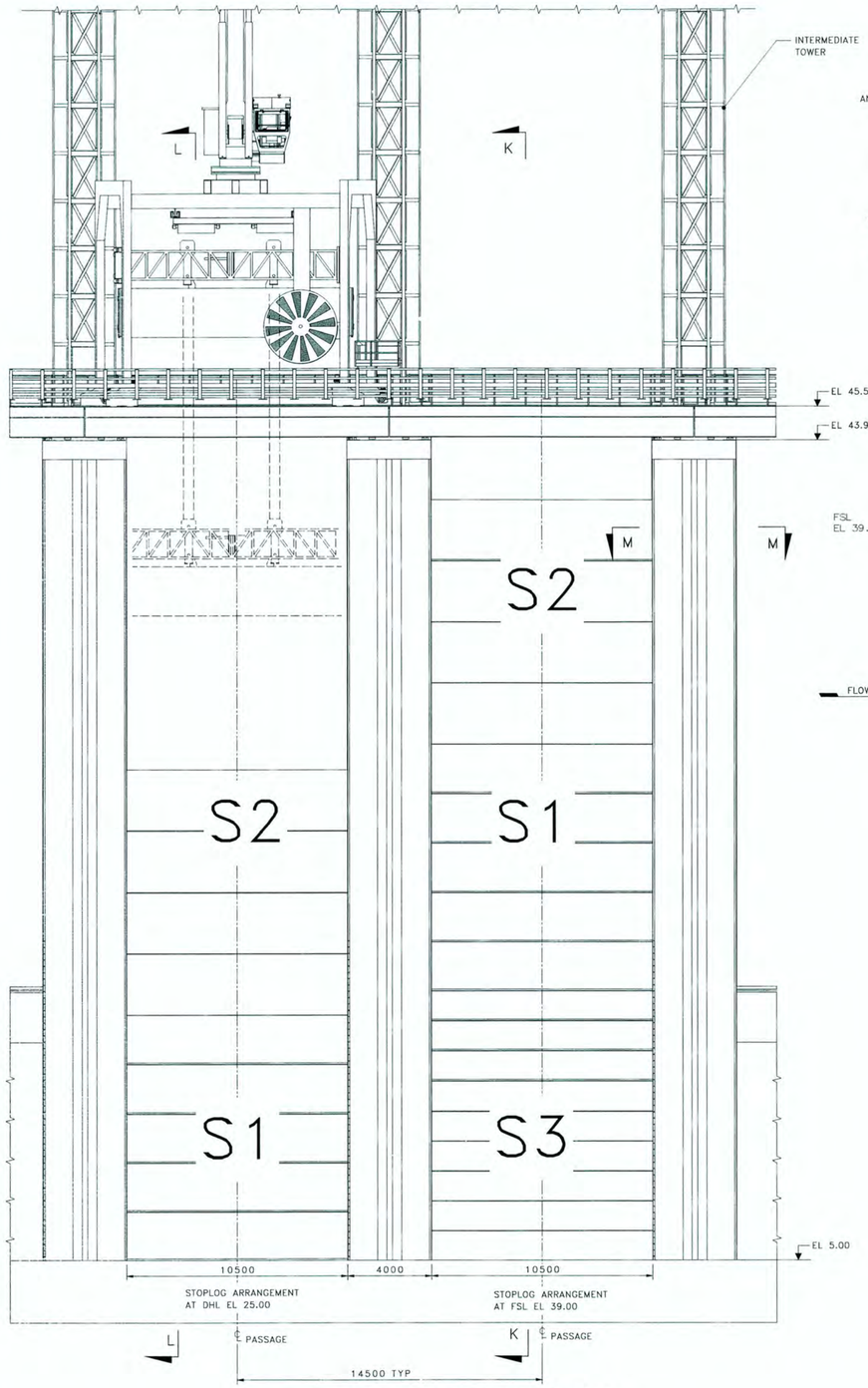
TITLE: MUSKRAT FALLS
SPILLWAY – HYDRO-MECHANICAL
UPSTREAM PERMANENT STOPLOGS
ELEVATION, SECTIONS AND DETAILS

SLI DOC No.: 505573-324B-45DD-0005_01
LNL DOC No.: MFA-SN-CD-2420-ME-EL-0001-01 Rev. D1

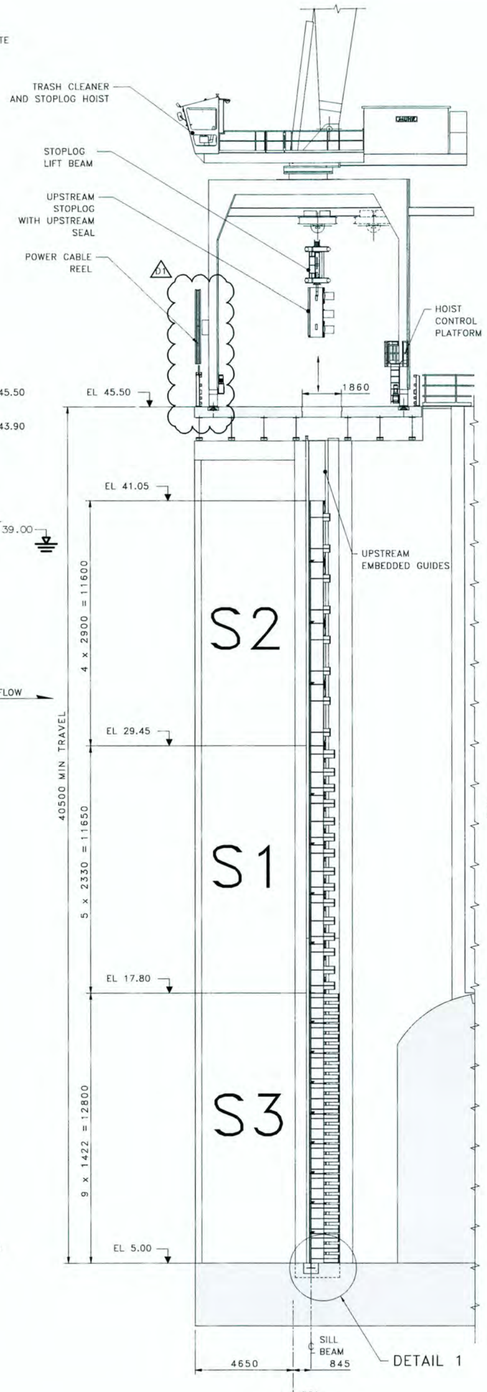
FORMAT A0 (mm)

SUB-PKG: 0032-4501 PLATE 05

W:\Travail\Temp\ppelit\MEC --- DWG No. 505573-324B-45DD-0005-01.CATDrawing



ELEVATION AT TEMPORARY STOPLOGS
LOOKING DOWNSTREAM
1:100



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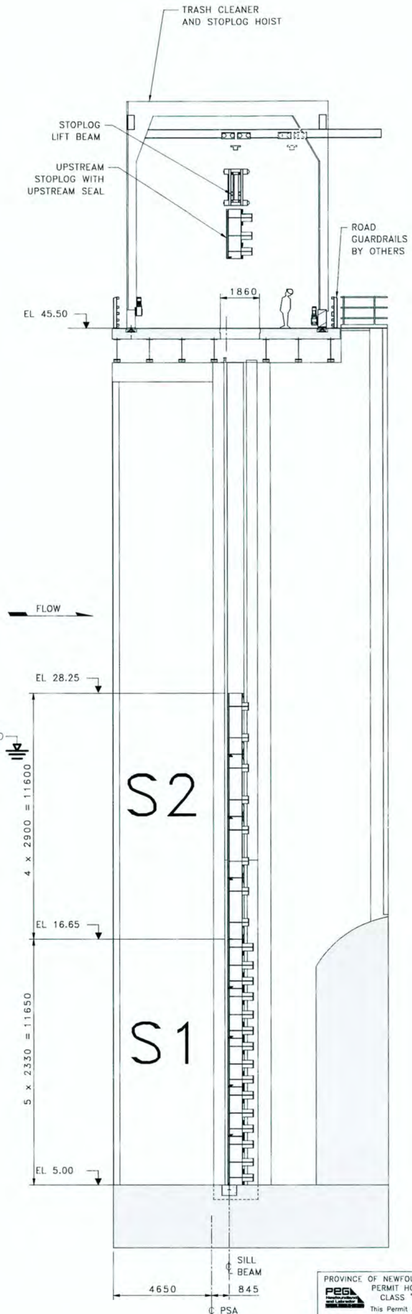

SECTION L-L
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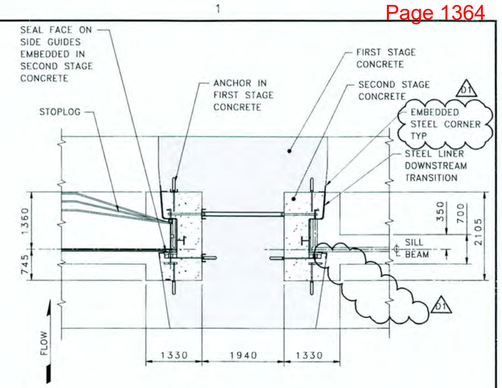

SECTION M-M
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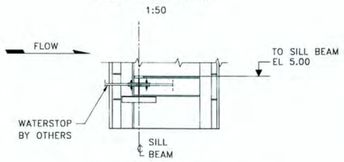
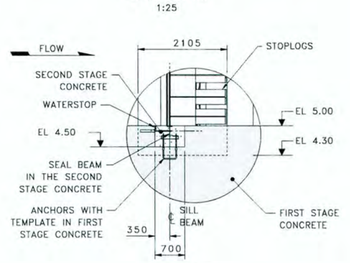
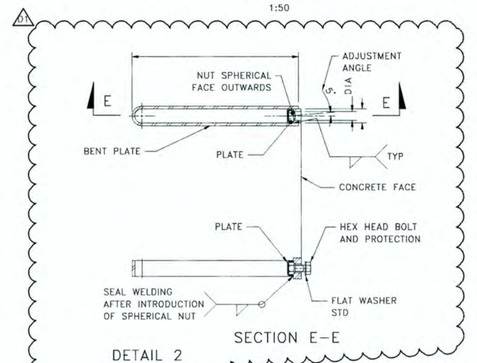


TYPICAL DETAIL
OF WATERSTOP CONNECTION WITH
SILL BEAM
1:25



DETAIL 1
SILL BEAM
1:50



SECTION E-E

DETAIL 2
PRIMARY ANCHOR TYP
NTS

ISOMETRIC

NOT FOR CONSTRUCTION

0 1000 1500 2000 2500 mm
SCALE 1:25

0 1000 2000 3000 4000 5000 mm
SCALE 1:50

0 2000 4000 6000 8000 10000 mm
SCALE 1:100

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL 00458 which is valid for the year 2013

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31-JUL-2013	APPROVED FOR DESIGN
1	B1	17-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-13	DETAIL PRIMARY ANCHOR ADDED, EMBEDDED STEEL CORNER ADDED AND WATER STOPS REMOVED	AK	RK	
			FM	RT	
			RK	AA	
				US	

FOR INTERNAL USE ONLY

REVIEW CLASS: EQUIPMENT TAG NUMBER:

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☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 16-OCT-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy) 16-Oct-2013
PROJECT MANAGER: Date (dd-mmm-yyyy) 16-Oct-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEER PEGL PROVINCE OF NEWFOUNDLAND AND LABRADOR PERMIT HOLDER 04413 DATE SIGNED IN NEWFOUNDLAND & LABRADOR

SNC·LAVALIN

DESIGNED BY R. LETOURNEAU	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY F. MARTIN	APPROVED Engineering Manager
VERIFIED BY L. CIOREI	
DATE 29-05-2012	SCALE AS NOTED

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

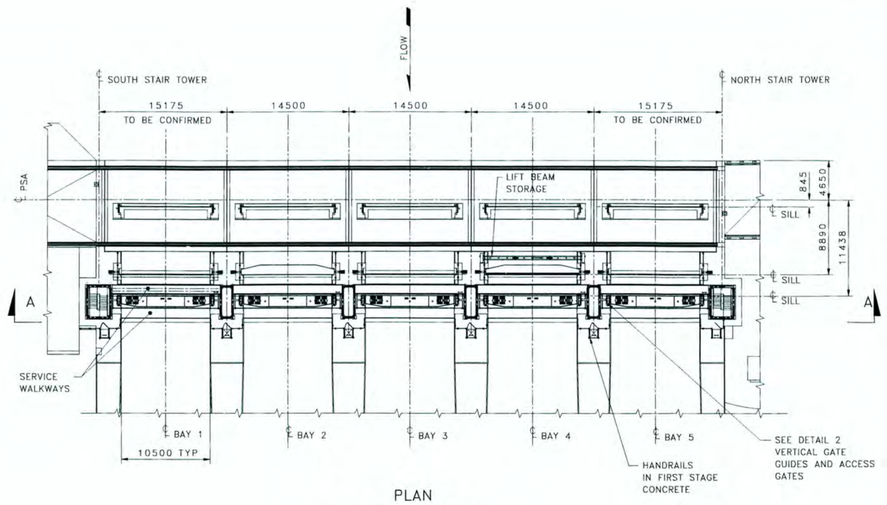
TITLE: MUSKRAT FALLS
SPILLWAY – HYDRO-MECHANICAL
UPSTREAM TEMPORARY STOPLOGS
ELEVATION, SECTIONS AND DETAILS

SLI DOC No.	NE DOC No.	Rev.
505573-324B-45DD-0006_01	MFA-SN-CD-2420-ME-EL-0002-01	D1

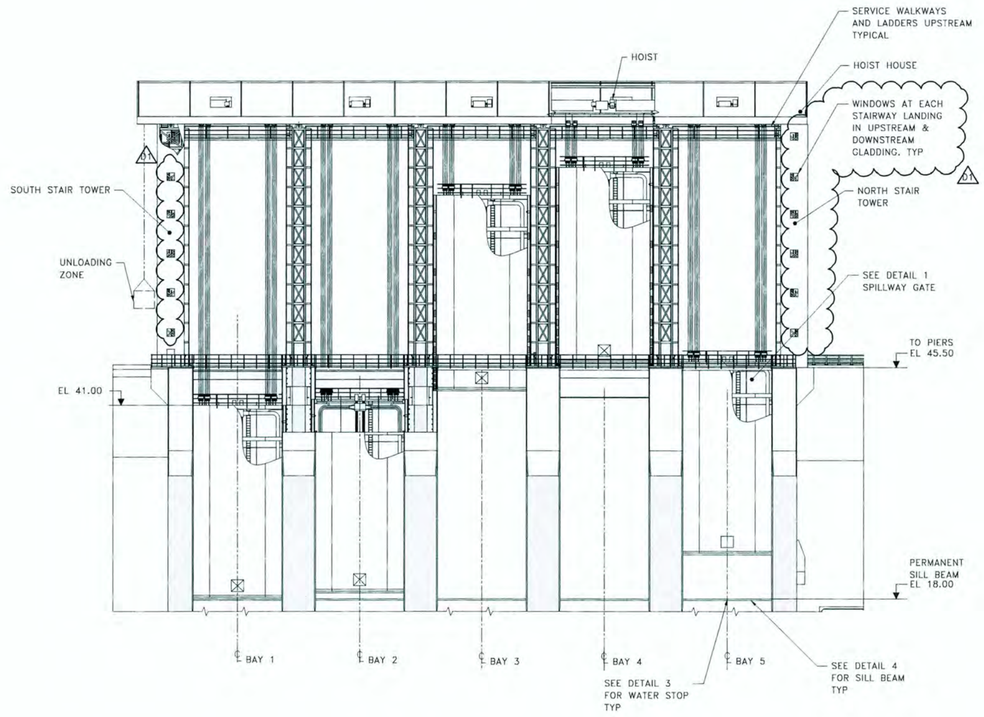
FORMAT A0 (mm)

SUB-PKG: 0032-4501 PLATE 06

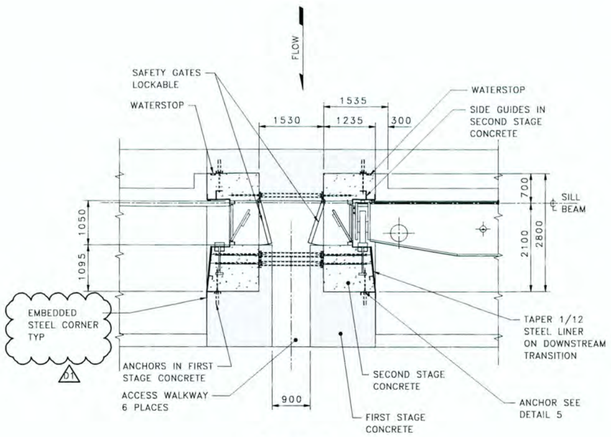
W:\Travail\Temp\ppetit\MEC --- DWG No. 505573-324B-45DD-0006-01.CATDrawing



PLAN
ABOVE EL 45.50
1:250



ELEVATION A–A
LOOKING UPSTREAM
1:250



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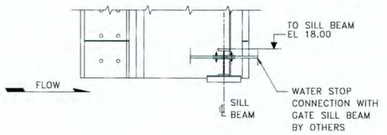
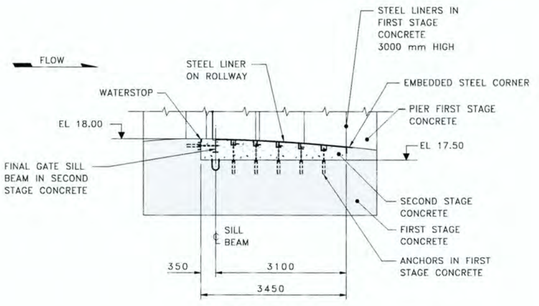
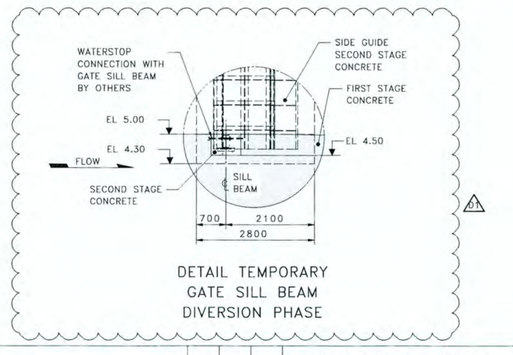


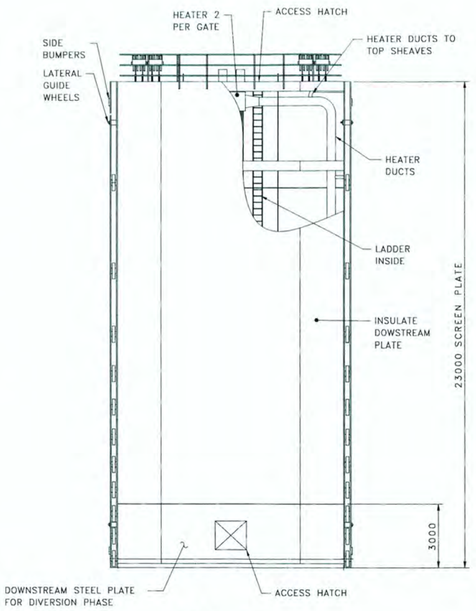
DETAIL 3
SILL BEAM/WATERSTOP
1:25



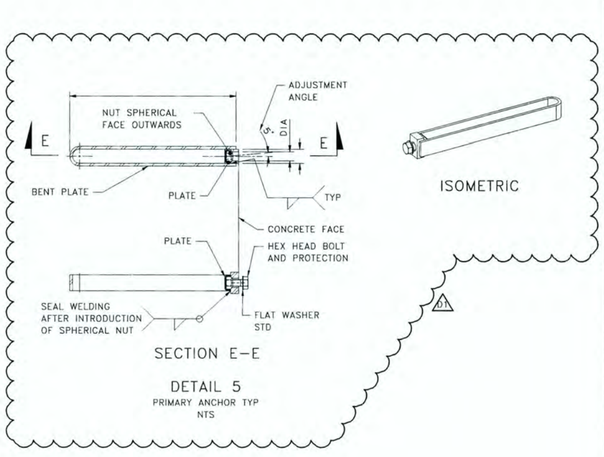
DETAIL 4
GATE SILL BEAM
1:50



DETAIL TEMPORARY
GATE SILL BEAM
DIVERSION PHASE



DETAIL 1
SPILLWAY GATE
1:100



SECTION E–E

DETAIL 5
PRIMARY ANCHOR TYP
NTS

NOT FOR CONSTRUCTION

SCALE 1:25 — 0 1000 1500 2000 2500 mm
SCALE 1:50 — 0 1000 2000 3000 4000 5000 mm
SCALE 1:100 — 0 2000 4000 6000 8000 10000 mm
SCALE 1:250 — 0 5000 10000 15000 20000 mm

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL NO450 which is valid for the year 2013

ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31-JUL-2013	APPROVED FOR DESIGN				
1	B1	17-OCT-2012	ISSUED FOR BID				

ISSUE REGISTER

No.	REFERENCE DRAWING	No.	REFERENCE DRAWING	No.	DATE	REVISION	MOD.	VER.	APP.
				D1	31-JUL-13	DETAIL PRIMARY ANCHOR ADDED, DETAIL TEMPORARY SILL BEAM ADDED AND EMBEDDED STEEL CORNER TYP. ADDED	AK TM GH	RK RT AS	AK GH

* * * * * * * FOR INTERNAL USE ONLY * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

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☐ 2.REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: | Date (dd-mmm-yyyy): 15-DEC-2013
NE-LCP MANAGEMENT: | Date (dd-mmm-yyyy): 16-DEC-2013
PROJECT MANAGER: | Date (dd-mmm-yyyy): 16-DEC-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEER PEGNL RANDOLPH KOOB 08AU413 DATE SIGNATURE NEWFOUNDLAND & LABRADOR

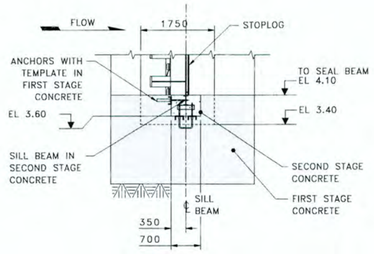
SNC·LAVALIN

DESIGNED BY R. LETOURNEAU	APPROVED Discipline Lead Engineer R. KOOB	CLIENT nalcor energy
DRAWN BY F. MARTIN	APPROVED Engineering Manager	PROJECT LOWER CHURCHILL PROJECT
VERIFIED BY L. CIOREI		TITLE MUSKRAT FALLS SPILLWAY – HYDRO-MECHANICAL SPILLWAY GATES AND HOIST HOUSE PLAN, ELEVATION AND DETAILS
DATE 26-OCT-2011	SCALE AS NOTED	
File No. 505573-324B-45DD-0004_01	MFA-SN-CD-2420-ME-PL-0001-01	Rev. D1

FORMAT A0 (mm)

SUB-PKG: 0032-4501 PLATE 04

W:\Travail\Temp\ppelit\MEC -- DWG No. 505573-324B-45DD-0004-01.CATDrawing



DETAIL 1
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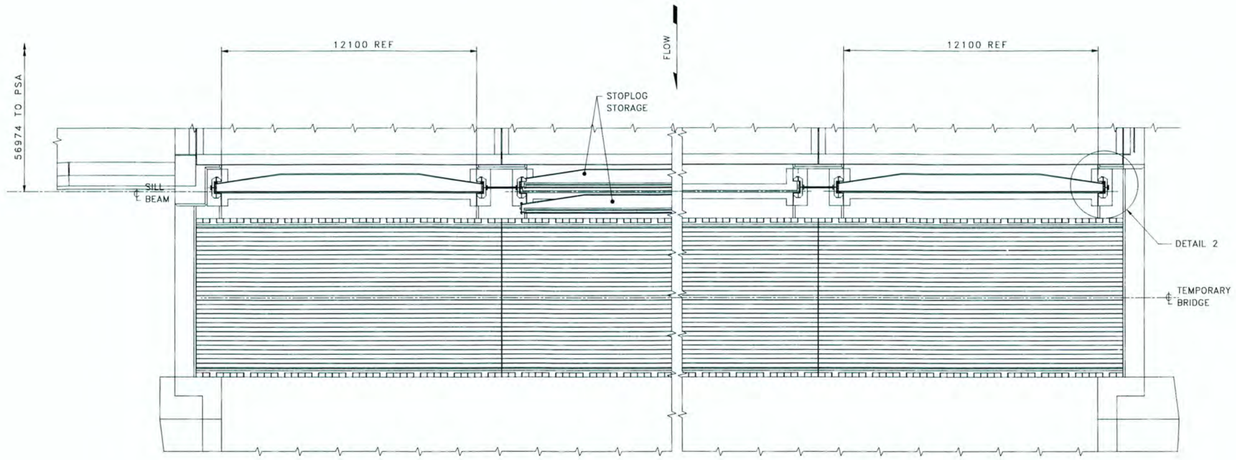
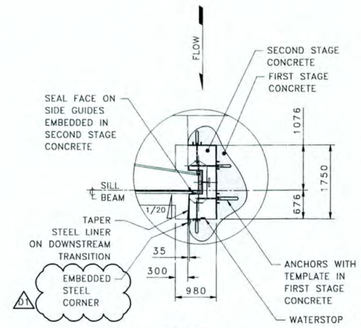
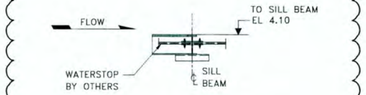


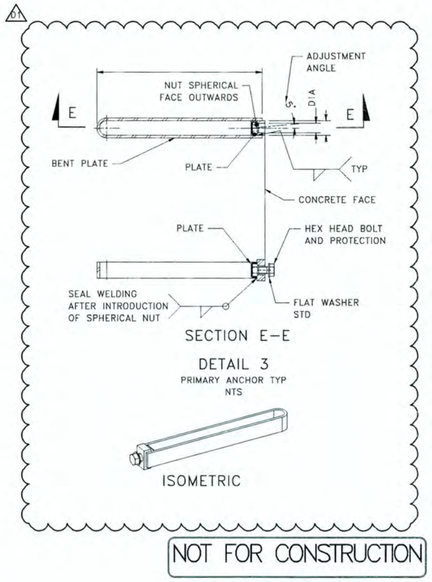
PLAN
1:100



DETAIL 2
1:50



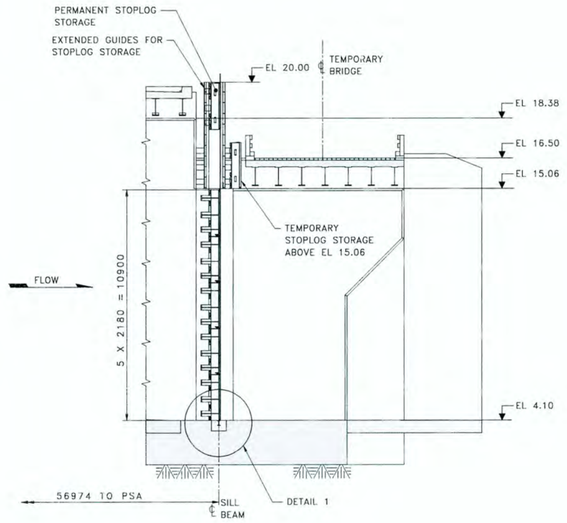
TYPICAL DETAIL
OF WATERSTOP CONNECTION WITH SILL BEAM
1:25



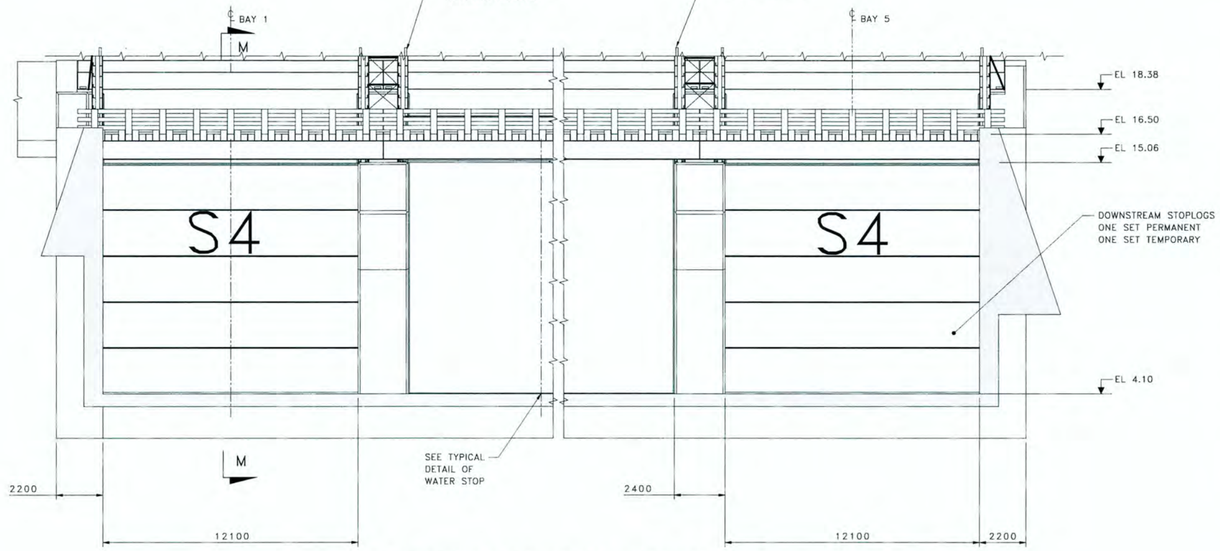
SECTION E–E

DETAIL 3
PRIMARY ANCHOR TYP
NTS

ISOMETRIC



SECTION M–M
1:100



ELEVATION AT DOWNSTREAM STOPLOGS
LOOKING UPSTREAM
1:100

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL 10458
which is valid for the year 2013

0 1000 1500 2000 2500 mm
SCALE 1:25

0 1000 2000 3000 4000 5000 mm
SCALE 1:50

0 2000 4000 6000 8000 10000 mm
SCALE 1:100

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31-JUL-2013	APPROVED FOR DESIGN
1	B1	17-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-13	DETAIL PRIMARY ANCHOR ADDED, EMBEDDED STEEL CORNER ADDED AND DETAIL WATER STOP CONNECTION ADDED	PF FM	RD FOR RT	

FOR INTERNAL USE ONLY

REVIEW CLASS: EQUIPMENT TAG NUMBER:

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☐ 2.REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 15-AUG-2013
NE–LCP MANAGEMENT
PROJECT MANAGER: Date (dd-mmm-yyyy) 16-AUG-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERING SOLUTIONS PEGNL PERMIT HOLDER RANDOLPH KOOB DATE SIGNATURE SIGNATURE AND SEAL

SNC·LAVALIN

DESIGNED BY R. LETOURNEAU	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY F. MARTIN	APPROVED Engineering Manager
VERIFIED BY L. CIDREI	
DATE 30-05-2012	SCALE AS NOTED

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY – HYDRO–MECHANICAL
DOWNSTREAM STOPLOGS
PLAN, ELEVATION, SECTION AND DETAILS

SLI DOC No. 505573-324B-45DD-0007_01

NE DOC No. MFA-SN-CD-2420-ME-PL-0002-01 | Rev. D1

FORMAT A0 (mm)

SUB-PKG: 0032-4501 PLATE 07

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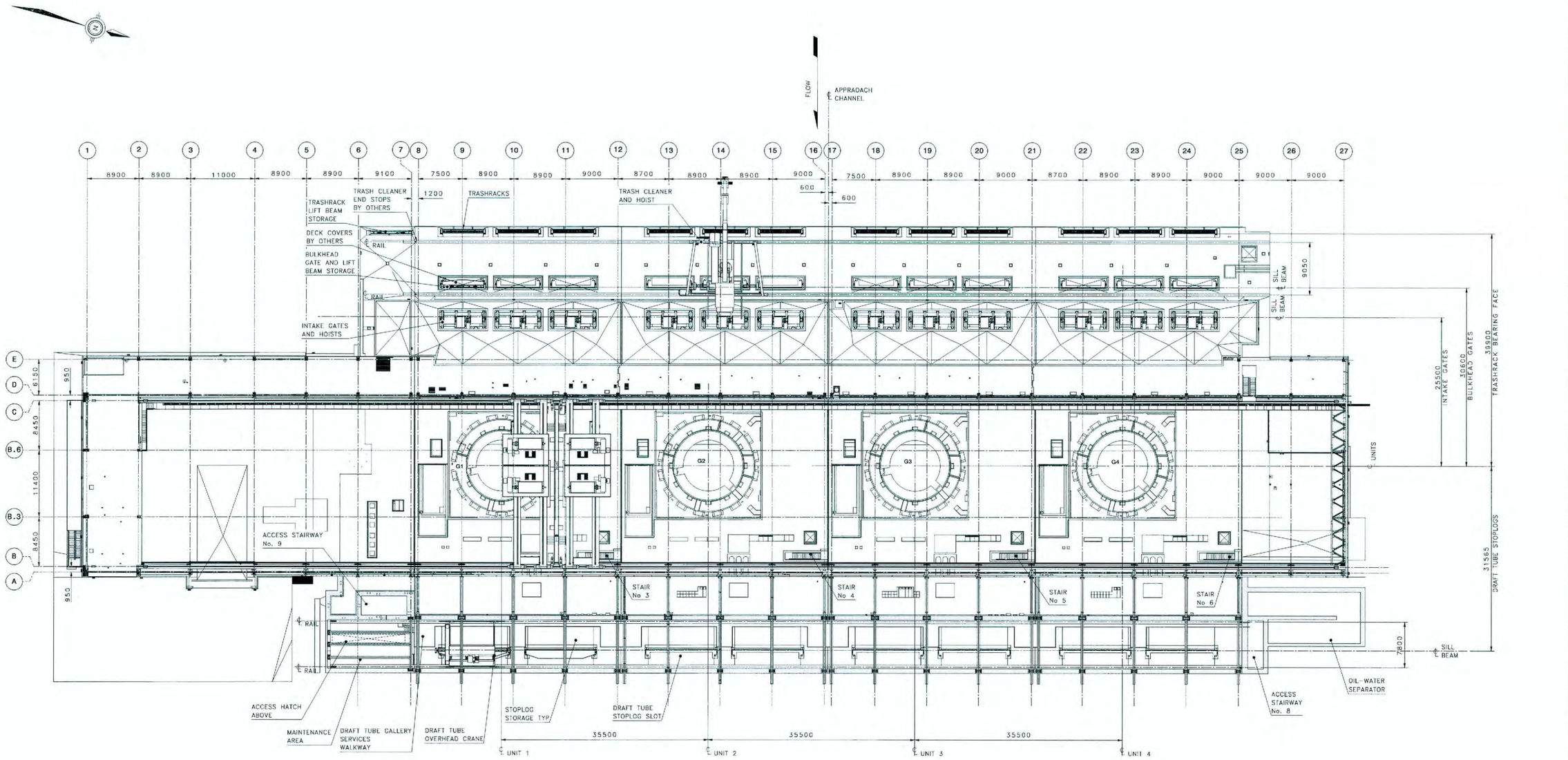

PLAN A–A

3200–ME–SE–0001–01

1:250

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A" This Permit Allows SNC-LAVALIN Inc To practice Professional Engineering in Newfoundland and Labrador Permit No. as issued by PEGNL 02402 which is valid for the year 2013

0 5000 10000 15000 20000 mm

SCALE 1:250

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	01	31-JUL-2013	APPROVED FOR DESIGN
1	01	17-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3200-ME-SE-0001-01	GENERAL ARRANGEMENT ELEVATON AND SECTION

No.	DATE	REVISION	MOD.	VER.	APP.
01	31-JUL-13	NO CHANGES	AE AM AR	EK BT	RS

* * * * * * * FOR INTERNAL USE ONLY * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 15-08-2013
NE–LCP MGMT REVIEW: Date (dd-mmm-yyyy)
PROJECT MANAGER: Date (dd-mmm-yyyy) 16-AUG-2013

PROFESSIONAL STAMP

PROVINCE OF NEWFOUNDLAND AND LABRADOR PROFESSIONAL ENGINEERS REGISTERED MANOJ KUMAR KOOB SIGNATURE DATE 16 Aug 13

SNC·LAVALIN

DESIGNED BY R. LETOURNEAU
DRAWN BY F. MARTIN
VERIFIED BY E. CLOUET
DATE 23-SEP-2011
APPROVED Discipline Lead Engineer R. KOOB
APPROVED Engineering Manager
SCALE 1:250

SNC DOC No. 505573-332A-45DD-0001_01

CLIENT nalcor energy

PROJECT LOWER CHURCHILL PROJECT

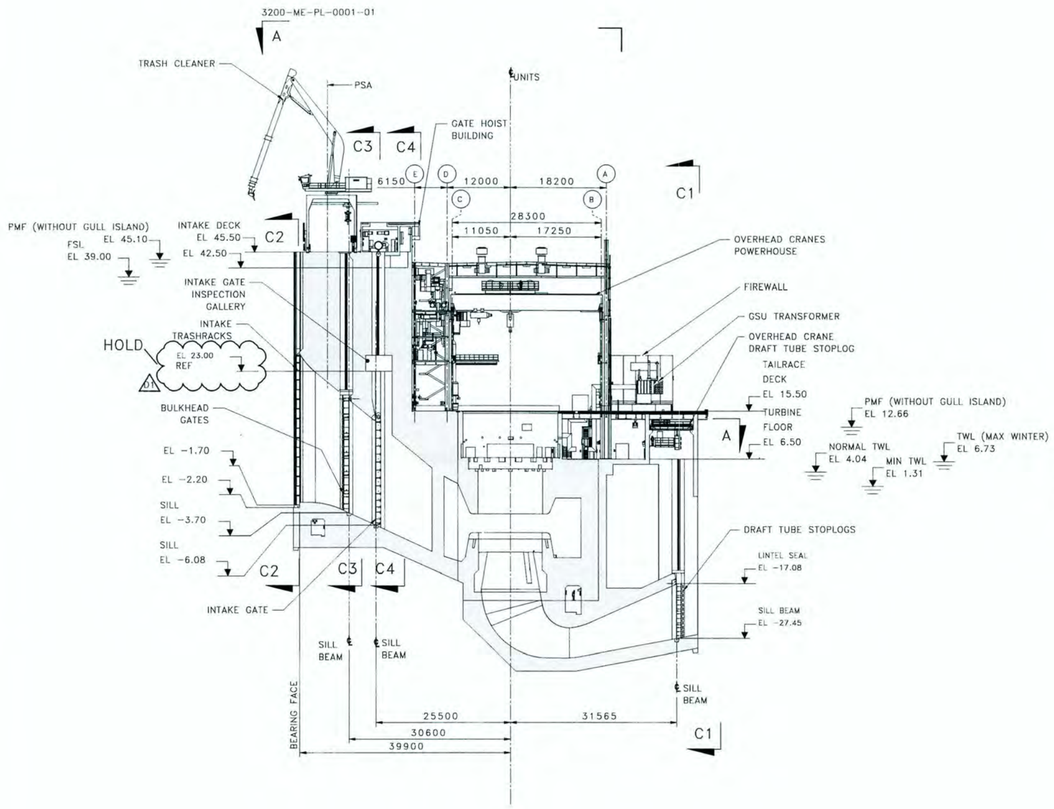
TITLE MUSKRAT FALLS POWERHOUSE – HYDRO-MECHANICAL GENERAL ARRANGEMENT PLAN

NL DOC No. MFA–SN–CD–3200–ME–PL–0001–01 Rev. D1

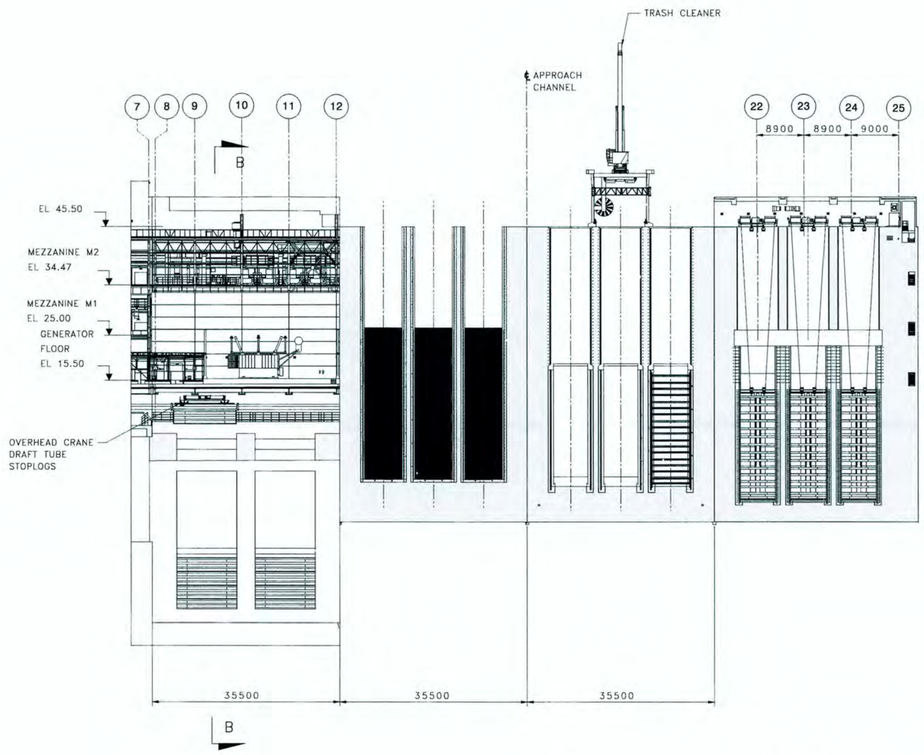
ISSUED FOR: Design

SUB-PKG: 0032–4502 PLATE 01

W:\Travail\Temp\pelt\MEC --- DWG No. 505573-332A-45DD-0001_01.CATDrawing



SECTION B–B
1:400



DRAFT TUBE STOPLOGS C1–C1

INTAKE TRASHRACKS C2–C2

BULKHEAD GATES C3–C3

INTAKE GATES C4–C4

ELEVATION C–C
LOOKING UPSTREAM
1:400

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND
PEGNL PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL 10458
which is valid for the year 2013

0 10000 20000 30000 mm
SCALE 1:400

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31-JUL-2013	APPROVED FOR DESIGN
1	B1	17-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3200-ME-PL-0001	GENERAL ARRANGEMENT PLAN

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-13	GATE INSPECTION GALLERY EL. HOLD	AE IM for RT	BD for RT	GS

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REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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☒ 1.REVIEWED AND ACCEPTED. NO COMMENTS
☐ 2.REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 15-08-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy) 16-May-2013
PROJECT MANAGER: Date (dd-mmm-yyyy) 16-AUG-2013

PROFESSIONAL STAMP
PEGNL PERMIT HOLDER CLASS "A"
RANDOLPH KOOB
DATE 16-AUG-2013
PROFESSIONAL ENGINEER NEWFOUNDLAND & LABRADOR

SNC·LAVALIN

DESIGNED BY R. LETOURNEAU	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY F. MARTIN	APPROVED Engineering Manager
VERIFIED BY E. CIOREI	
DATE 26-SEP-2011	SCALE 1:400
SLT DOC No. 505573-332A-45DD-0002_01	Nt. DOC No. MFA-SN-CD-3200-ME-SE-0001-01 Rev. D1

CLIENT: nalcor ENERGY
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS POWERHOUSE – HYDRO-MECHANICAL GENERAL ARRANGEMENT ELEVATION AND SECTION

FORMAT A0 (mm)
SUB-PKG: 0032-4502 PLATE 02

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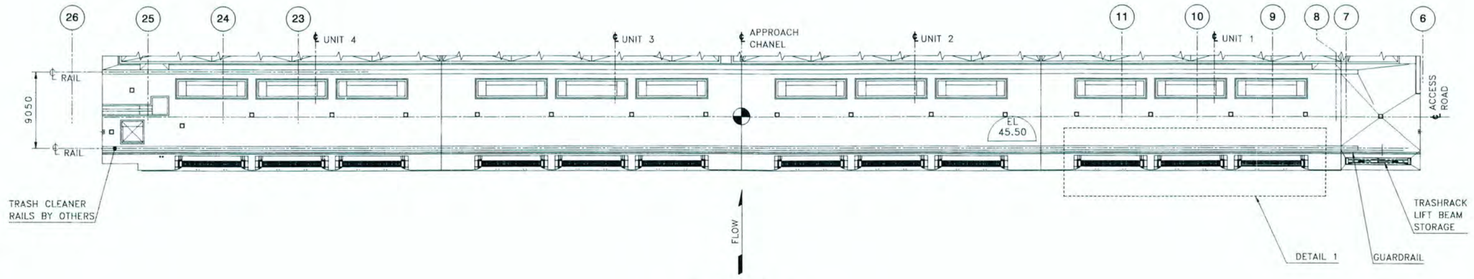

PLAN VIEW
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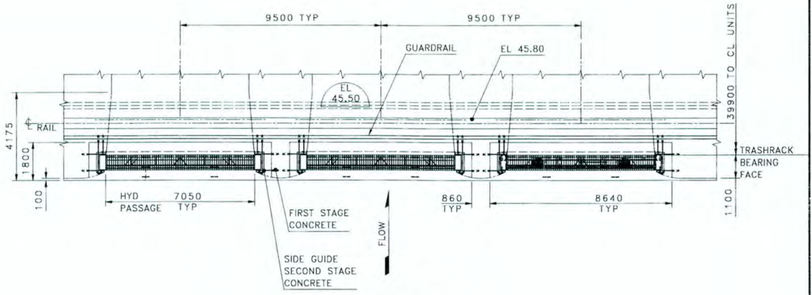

DETAIL 1
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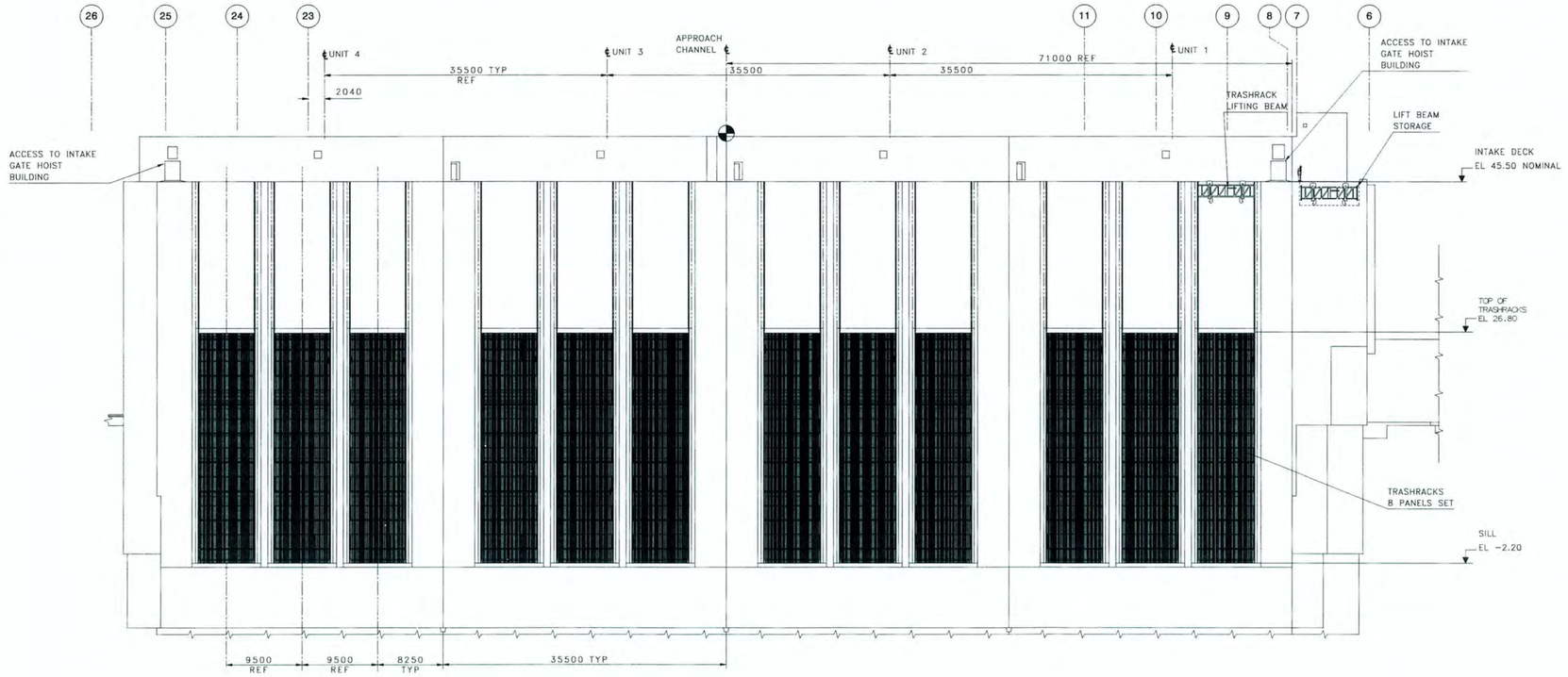
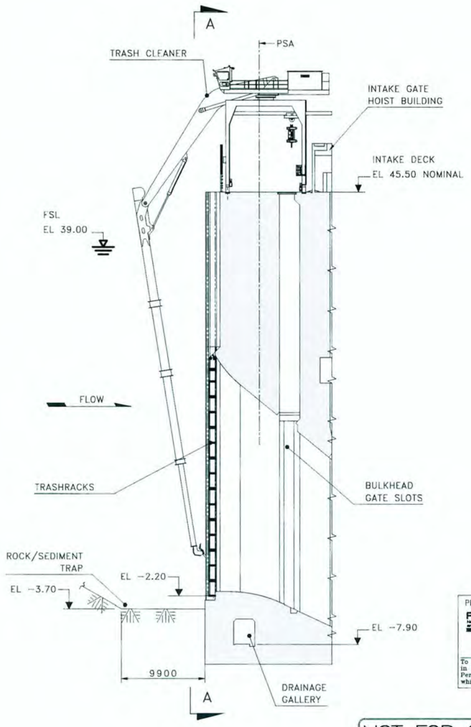


ELEVATION A–A
LOOKING DOWNSTREAM
1:250



TYPICAL SECTION
1:250

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL NL4458
which is valid for the year 2013.

NOT FOR CONSTRUCTION

0 5000 10000 15000 20000 mm
SCALE 1:250

0 2000 4000 6000 8000 10000 mm
SCALE 1:100

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31-JUL-2013	APPROVED FOR DESIGN
1	B1	17-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-13	NO CHANGES	AR JM GR	RK RT	GS

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- ☐ 3.REVIEWED – NOT ACCEPTED
- ☐ 4.INFORMATION ONLY
- ☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy): 15-08-2013
NE-LCP QUALITY MGR: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy): 16-AUG-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGL
RANDOLPH KOOB
Signature
DATE 13 AUG 13

SNC·LAVALIN

DESIGNED BY	R. LETOURNEAU	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY	F. MARTIN	APPROVED Engineering Manager
VERIFIED BY	C. CIOREI	
DATE	07-SEP-2011	SCALE AS NOTED

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

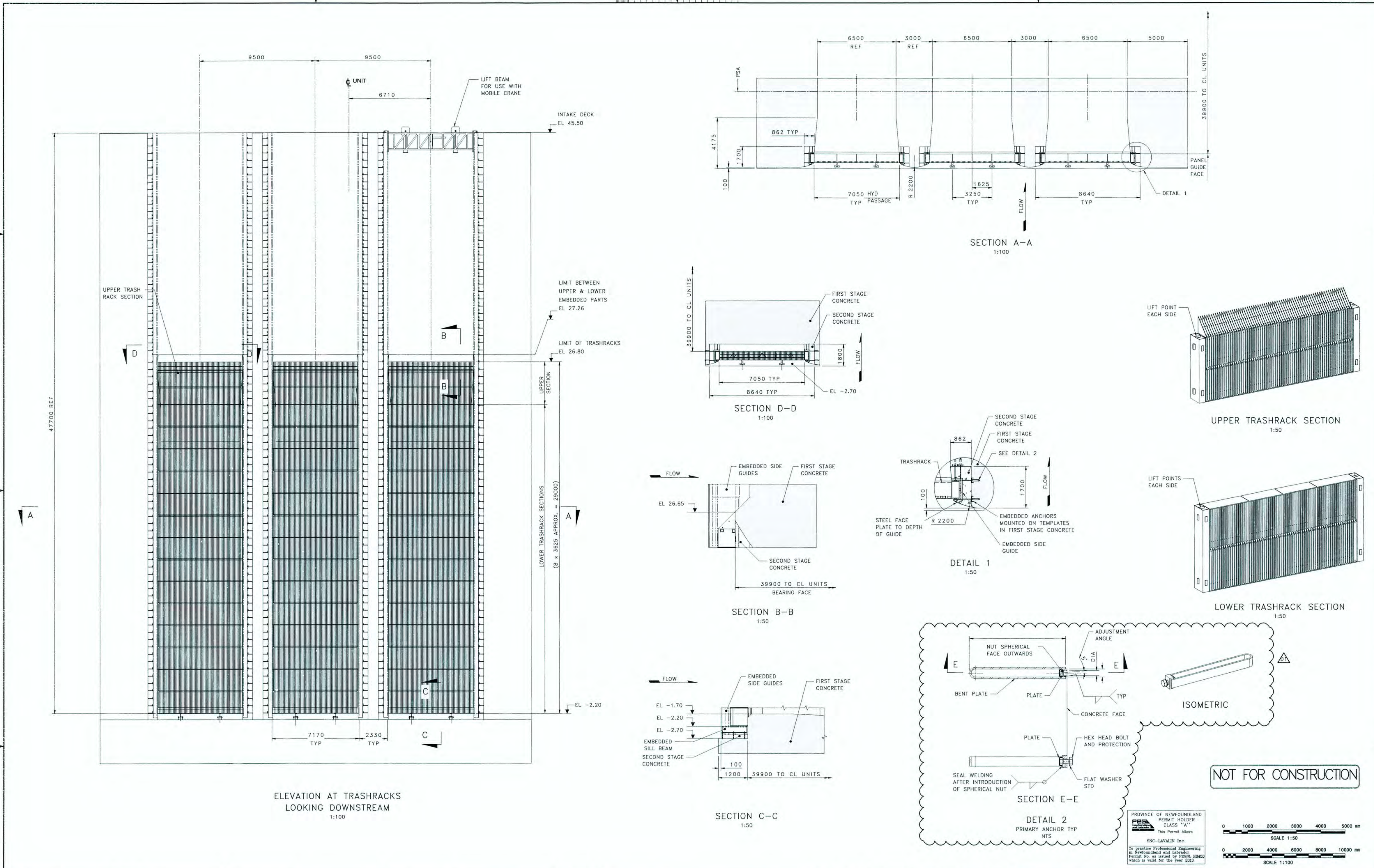
TITLE: MUSKRAT FALLS
POWERHOUSE – HYDRO-MECHANICAL
INTAKE – TRASHRACKS
PLAN, ELEVATION, SECTION AND DETAIL

SNC DOC No.	NE DOC No.	Rev.
505573-332A-45DD-0003_01	MFA-SN-CD-3240-ME-PL-0001-01	D1

FORMAT A0 (mm)

SUB-PKG: 0032-4502 PLATE 03

W:\Travail\Temp\ppetit\MEC — DWG No. 505573-332A-45DD-0003_01.CATDrawing



PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL N0458 which is valid for the year 2013.

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31-JUL-2013	APPROVED FOR DESIGN
1	B1	17-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No. | REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-13	PRIMARY ANCHOR DETAIL ADDED	FM	RT	GS

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REVIEW CLASS: | EQUIPMENT TAG NUMBER:
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☐ 3.REVIEWED -- NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED
LEAD REVIEWER: — Date (dd-mmm-yyyy): 15-08-2013
NE-LCP MANAGEMENT: — Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER: — Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP
REGISTERED PROFESSIONAL ENGINEER — RANDOLPH KOOB — NEWFOUNDLAND & LABRADOR — DATE 8 AUG 13

SNC·LAVALIN

DESIGNED BY R. LETOURNEAU	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY F. MARTIN	APPROVED Engineering Manager
VERIFIED BY E. CIOREI	
DATE 07-SEP-2011	SCALE AS NOTED

CLIENT: nalcor energy — LOWER CHURCHILL PROJECT
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
POWERHOUSE - HYDRO-MECHANICAL
INTAKE - TRASHRACKS
UNIT ARRANGEMENT
SECTIONS, ELEVATION AND DETAILS

SLI DOC No. 505573-332A-45DD-0004_01
NE DOC No. MFA-SN-CD-3240-ME-PL-0002-01 Rev. D1
FORMAT A0 (mm)

SUB-PKG: 0032-4502 PLATE 04

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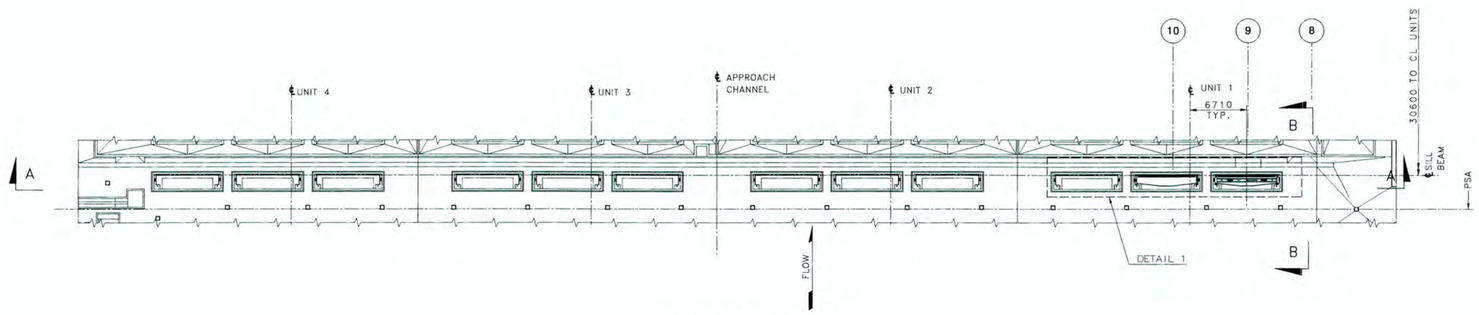

PLAN VIEW
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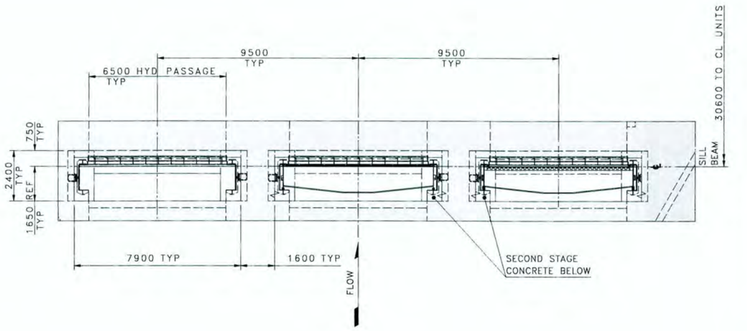

DETAIL 1
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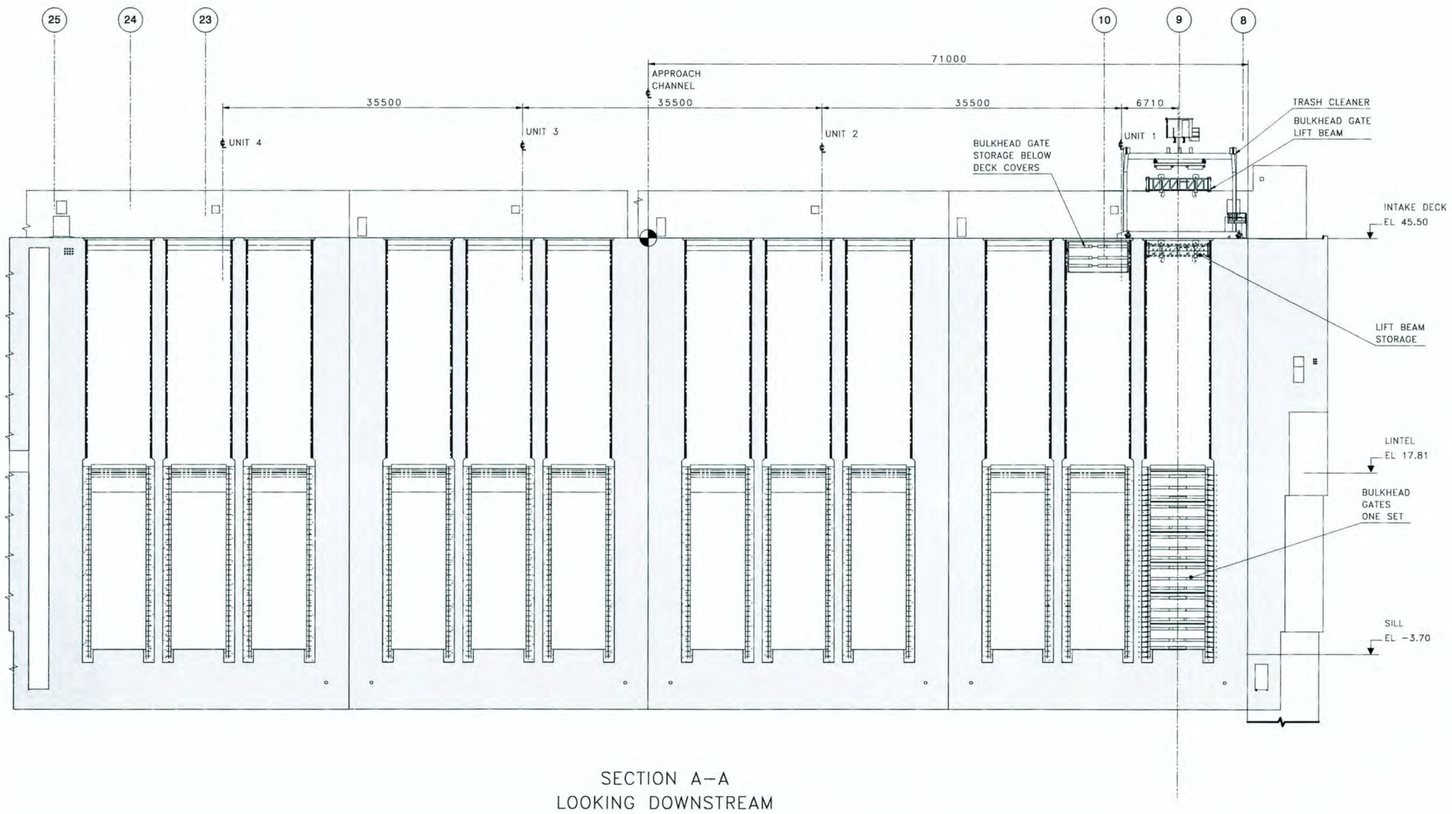
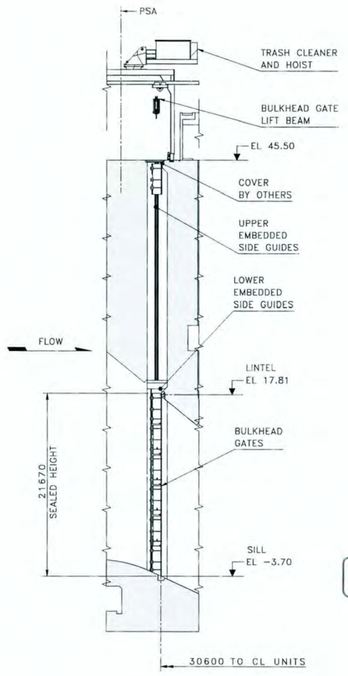


SECTION A–A
LOOKING DOWNSTREAM
1:250



SECTION B–B
1:250

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL 02450 which is valid for the year 2013

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SCALE 1:100

0 5000 10000 15000 20000 mm
SCALE 1:250

ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS
3	D1	31-JUL-2013	APPROVED FOR DESIGN				
2	B2	21-JAN-2013	ISSUED FOR ADDENDUM				
1	B1	17-OCT-2012	ISSUED FOR BID				

ISSUE REGISTER

No.	REFERENCE DRAWING	No.	REFERENCE DRAWING

No.	DATE	REVISION
D1	31-JUL-13	NO CHANGES
B2	21-JAN-2013	UPPER SIDE GUIDES MODIFIED/WATER STOPS REMOVED

MOD.	VER.	APP.
FM	RDK	GS

* * * * * * * * FOR INTERNAL USE ONLY * * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

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- ☐ 2.REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3.REVIEWED – NOT ACCEPTED
- ☐ 4.INFORMATION ONLY
- ☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 15-08-2013
NE-LCP MANAGEMENT:
PROJECT MANAGER: Date (dd-mmm-yyyy) 16 Aug 2013

PROFESSIONAL STAMP

PROFESSIONAL ENGINEERS PEGNL PROFESSIONAL ENGINEER RANDOLPH KOOB 10193 REGISTERED NEWFOUNDLAND & LABRADOR DATE 8 AUG 2013

SNC·LAVALIN

DESIGNED BY R. LETOURNEAU	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY F. MARTIN	APPROVED Engineering Manager G. SNYDER
VERIFIED BY E. CIOREI	
DATE 08-SEP-2011	SCALE AS NOTED

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE – HYDRO-MECHANICAL
INTAKE – BULKHEAD GATES
PLAN, SECTIONS AND DETAIL

SLI DOC No. 505573-332A-45DD-0007_02

NE DOC No. MFA-SN-CD-3240-ME-PL-0003-01 Rev. D1

FORMAT A0 (mm)

SUB-PKG: 0032-4502 PLATE 05

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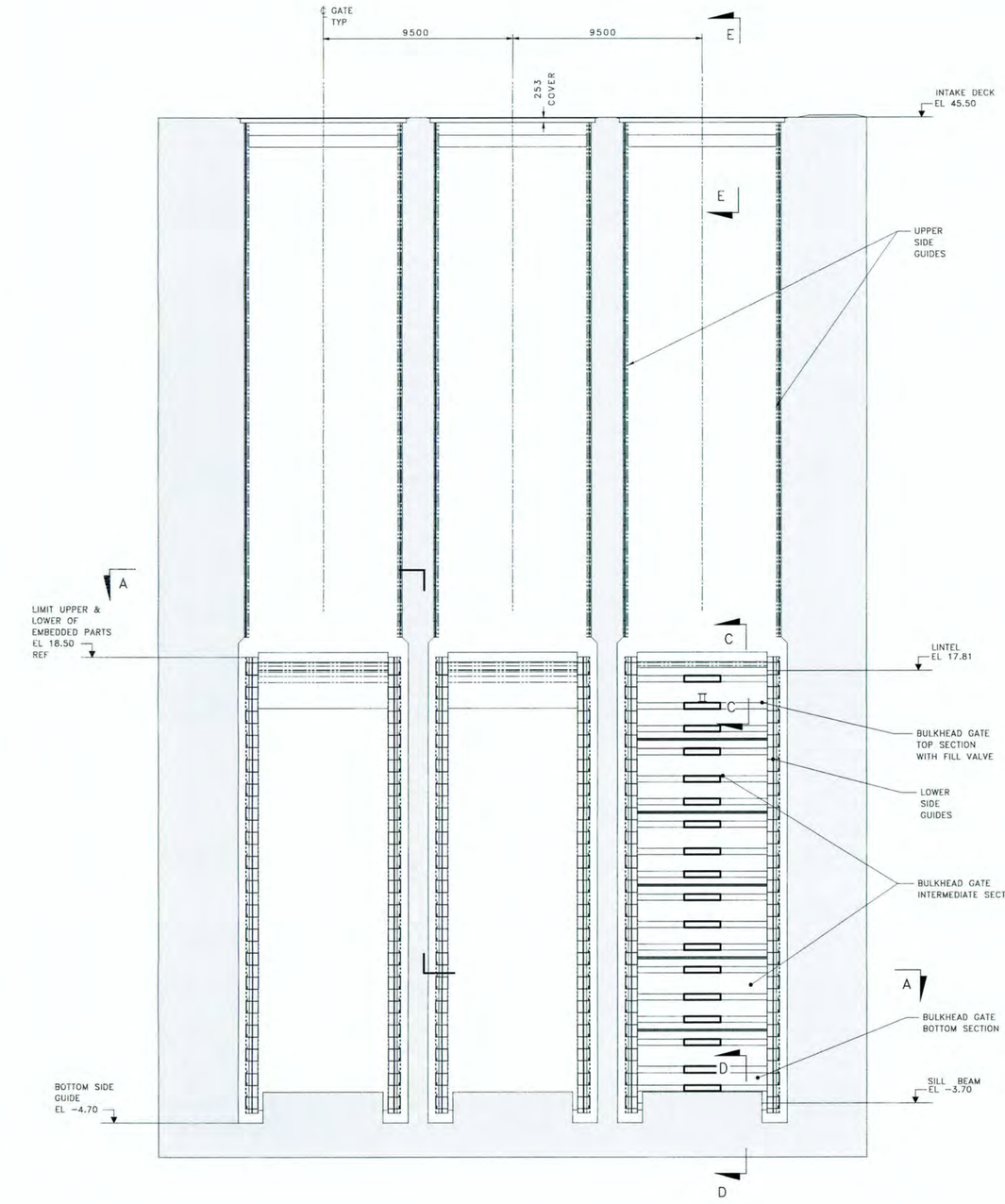

SECTION B–B
LOOKING DOWNSTREAM
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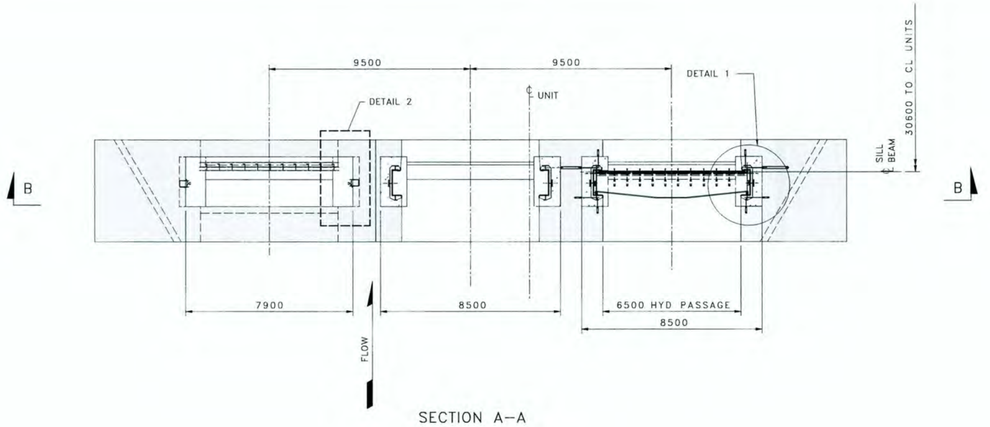

SECTION A–A
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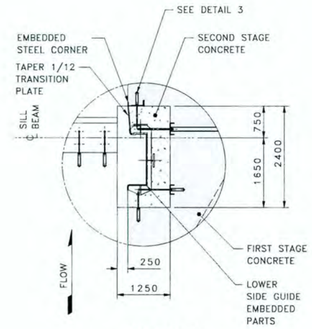

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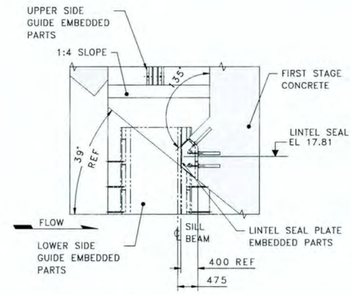

SECTION C–C
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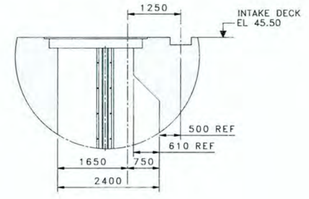

SECTION E–E
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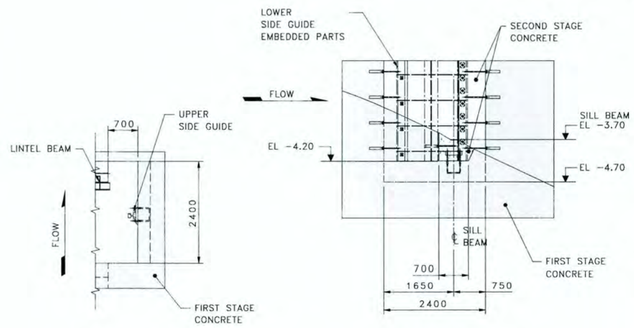
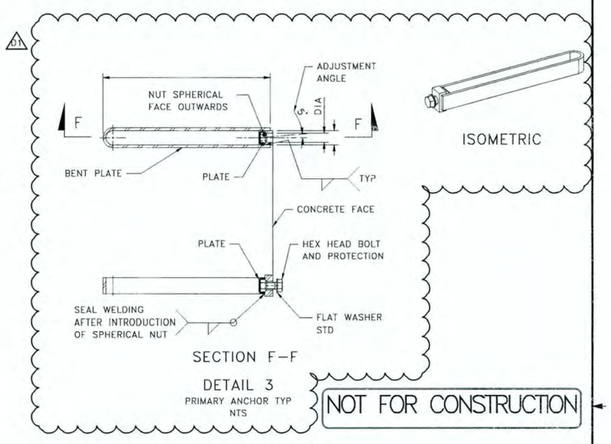


DETAIL 2
1:50

SECTION D–D
1:50



SECTION F–F

DETAIL 3
PRIMARY ANCHOR TYP
NTS

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc
To practice Professional Engineering in Newfoundland and Labrador. Permit No as issued by PEGNL 104650 which is valid for the year 2013

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SCALE 1:50

0 2000 4000 6000 8000 10000 mm
SCALE 1:100

ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS
3	D1	31-JJ-2013	APPROVED FOR DESIGN				
2	B2	21-JAN-2013	ISSUED FOR ADDENDUM				
1	B1	17-OCT-2012	ISSUED FOR BID				

ISSUE REGISTER

No.	REFERENCE DRAWING	No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JJ-13	PRIMARY ANCHOR DETAIL ADDED	AK	RK	
B2	21-JAN-2013	UPPER SIDE GUIDES MODIFIED/WATER STOP REMOVED	AM	RT	DS
			CM	MDK	GC

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

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☐ 3. REVIEWED – NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED

HEAD REVIEWER: Date (dd-mmm-yyyy) 19-AUG-2013
NE-LCP MANAGEMENT
PROJECT MANAGER: Date (dd-mmm-yyyy) 19-AUG-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS PEGNL RANDOLPH KOOB DATE 19 AUG 13 NEWFOUNDLAND & LABRADOR

SNC·LAVALIN

DESIGNED BY R. LETOURNEAU	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY F. MARTIN	APPROVED Engineering Manager G. SNYDER
VERIFIED BY E. CIOREI	
DATE 19-04-2012	SCALE AS NOTED

SLI DOC No. 505573-332A-45DD-0008_02
SNC DOC No. MFA-SN-CD-3240-ME-PL-0004-01 Rev. D1
FORMAT A0 (mm)

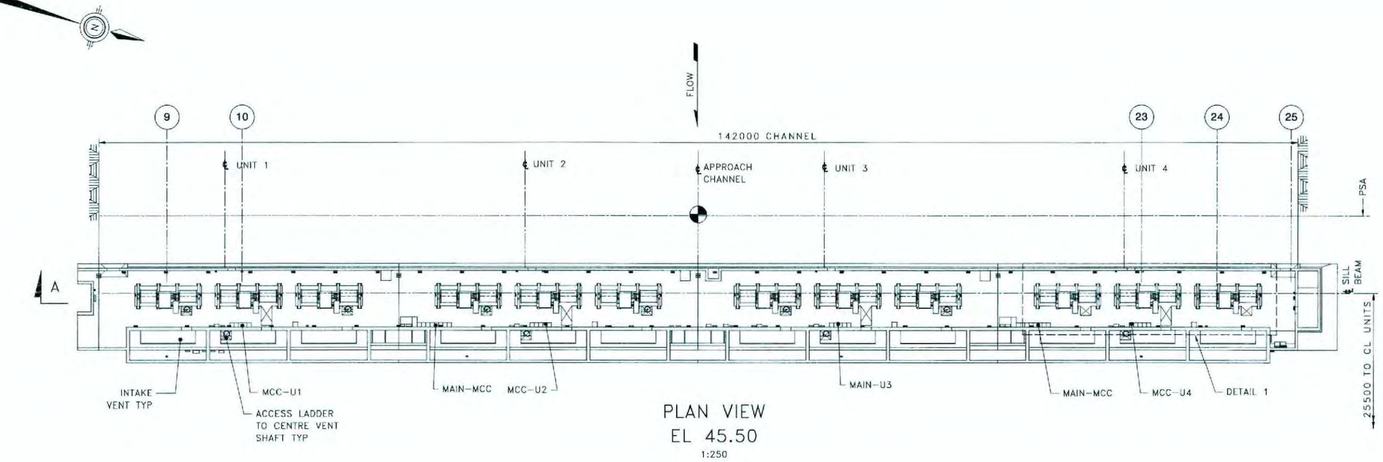
CLIENT: nalcor ENERGY

PROJECT: LOWER CHURCHILL PROJECT

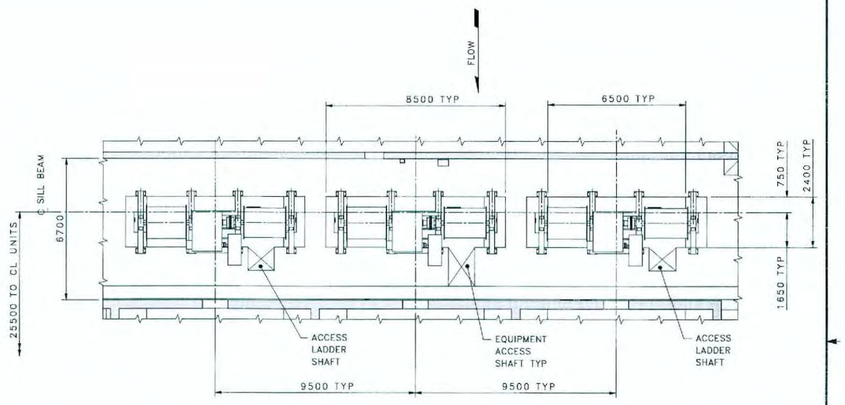
TITLE: MUSKRAT FALLS
POWERHOUSE – HYDRO-MECHANICAL
INTAKE – BULKHEAD GATES
UNIT ARRANGEMENT
SECTIONS AND DETAIL

SUB-PKG: 0032-4502 PLATE 06

W:\Travail\Temp\ppetit\MEC — DWG No. 505573-332A-45DD-0008_02.CATDrawing



PLAN VIEW
EL 45.50
1:250



DETAIL 1
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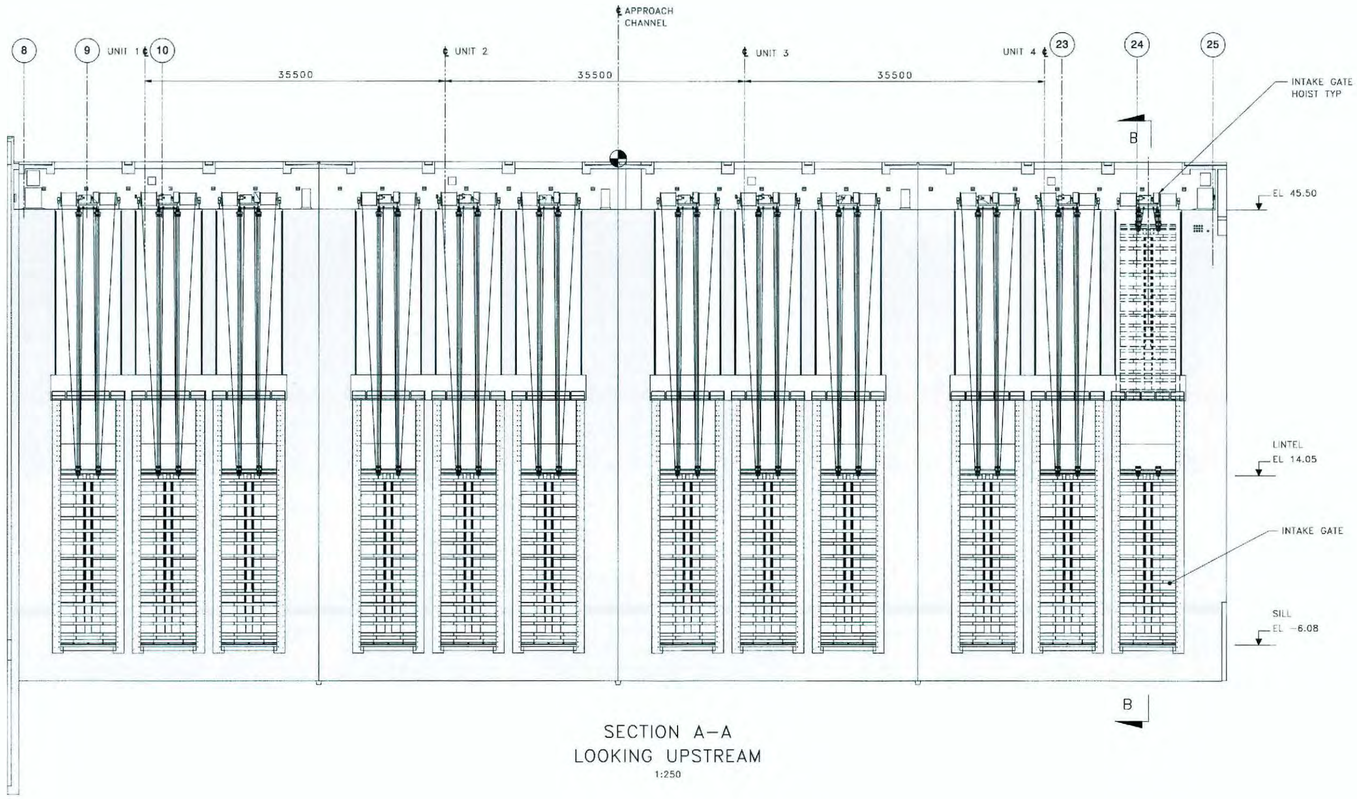
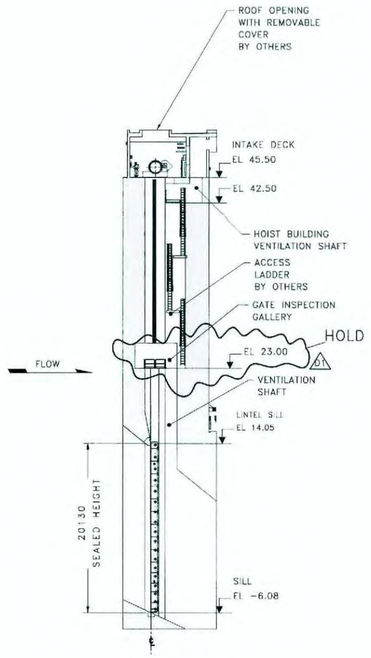


SECTION A–A
LOOKING UPSTREAM
1:250



SECTION B–B
1:250

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL 101450 which is valid for the year 2013

0 2000 4000 6000 8000 10000 mm
SCALE 1:100

0 5000 10000 15000 20000 mm
SCALE 1:250

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31-JUL-2013	APPROVED FOR DESIGN
1	B1	17-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-13	GATE INSPECTION GALLERY EL HOLD	AK	RK	GS

* * * * * * * FOR INTERNAL USE ONLY * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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☐ 2.REVIEWED – INCORPORATE COMMENTS, RESUBMIT & RESUBMIT
☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy): 15-AUG-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER: Date (dd-mmm-yyyy): 16-Aug-13

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS PEGNL RANDOLPH KOOB SIGNATURE RANDOLPH NEWFOUNDLAND & LABRADOR

SNC·LAVALIN

DESIGNED BY	APPROVED
R. LETOURNEAU	Discipline Lead Engineer
DRAWN BY	R. KOOB
F. MARTIN	APPROVED
VERIFIED BY	Engineering Manager
L. CIDREI	
DATE	SCALE
08-SEP-2011	AS NOTED

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

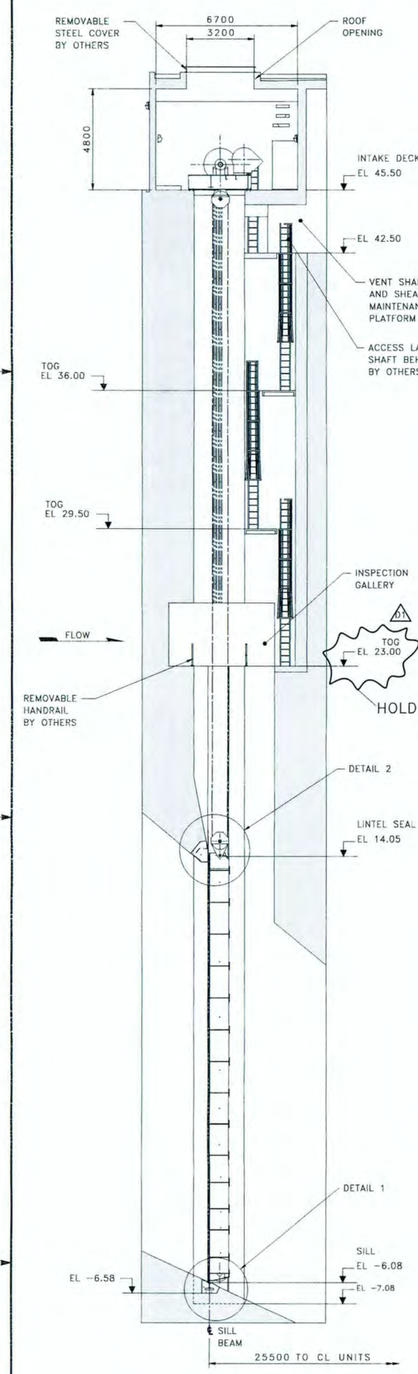
TITLE: MUSKRAT FALLS
POWERHOUSE – HYDRO-MECHANICAL
INTAKE GATES
PLAN, SECTIONS AND DETAIL

S. DOC No.	NE DOC No.	Rev.
505573-332A-45DD-0011_01	MFA-SN-CD-3240-ME-PL-0006-01	D1

FORMAT A0 (mm)

SUB-PKG: 0032-4502 PLATE 07

W:\Travail\Temp\opetit\MEC -- DWG No. 505573-332A-45DD-0011_01.CATDrawing



SECTION D–D
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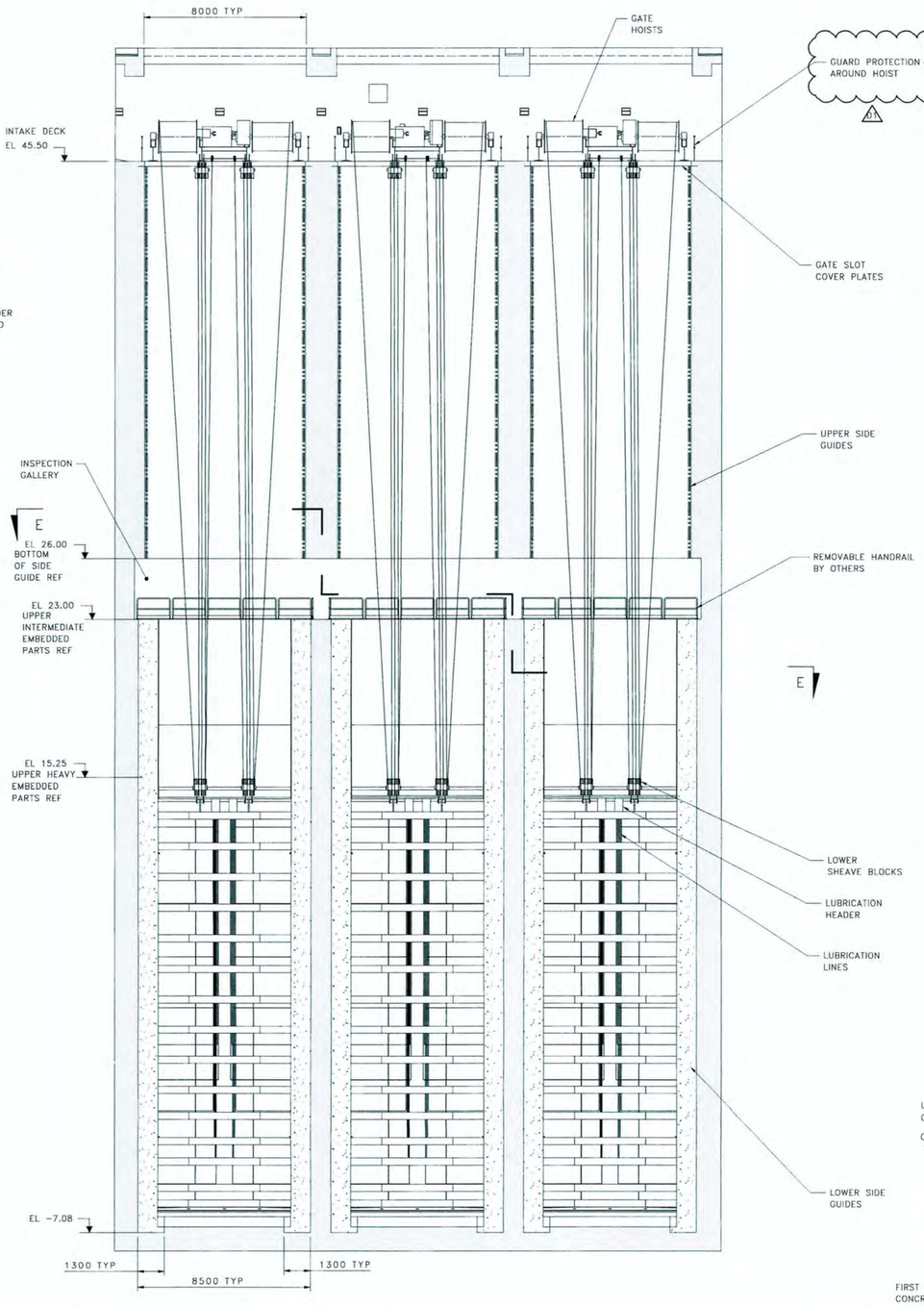
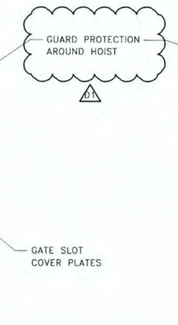
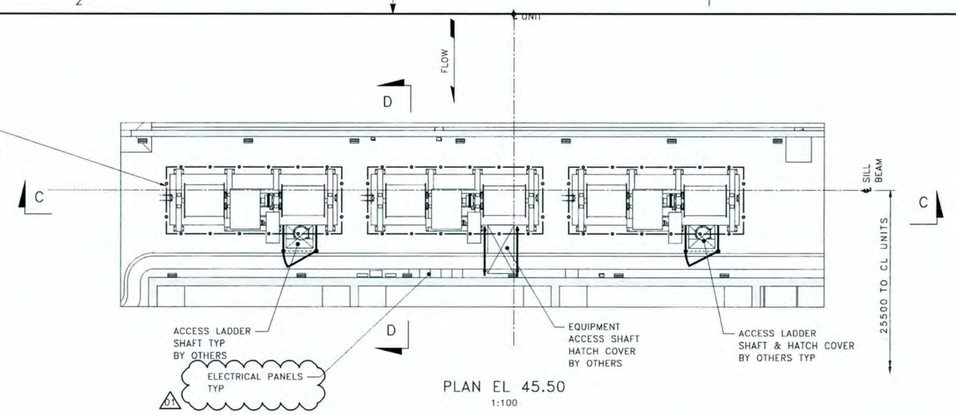


SECTION C–C
LOOKING UPSTREAM
1:100





PLAN EL 45.50
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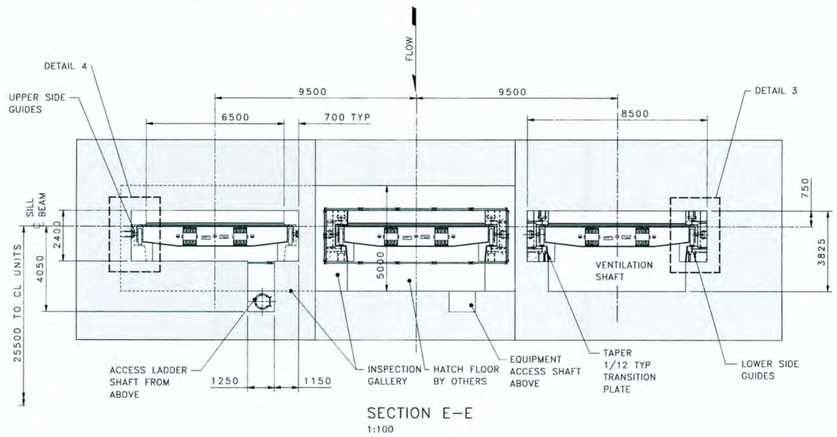

SECTION E–E
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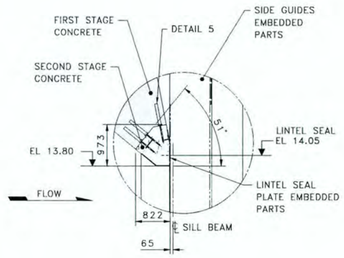

DETAIL 2
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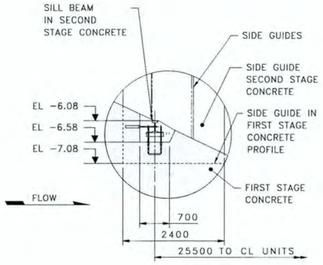
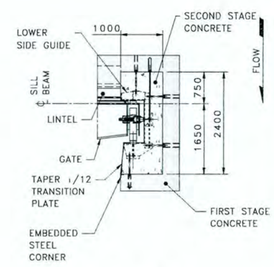
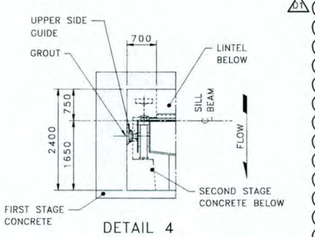


DETAIL 1
1:50



DETAIL 3
1:50



DETAIL 4
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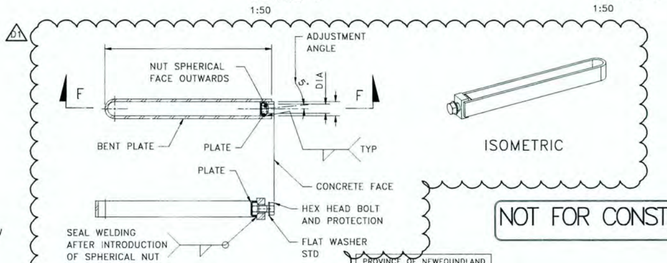

SECTION F–F

DETAIL 5
PRIMARY ANCHOR TYP
NTS

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador Permit No. as issued by PEGNL NO450 which is valid for the year 2013

SCALE 1:50
SCALE 1:100

3	D1	31-JUL-2013	APPROVED FOR DESIGN				
2	B2	21-JAN-2013	ISSUED FOR ADDENDUM				
1	B1	17-OCT-2012	ISSUED FOR BID				
ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	

ISSUE REGISTER

No.	REFERENCE DRAWING	No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-13	PRIMARY ANCHOR DETAIL ADDED AND GATE INSPECTION GALLERY EL. HOLD	AK	KF	
B2	21-JAN-2013	UPPER SIDE GUIDES MODIFIED/WATER STOPS REMOVED			

FOR INTERNAL USE ONLY

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- ☐ 1:REVIEWED AND ACCEPTED - NO COMMENTS
- ☐ 2:REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3:REVIEWED – NOT ACCEPTED
- ☐ 4:INFORMATION ONLY
- ☐ 5:NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 19-AUG-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy)
PROJECT MANAGER: Date (dd-mmm-yyyy) 19-AUG-2013

PROFESSIONAL STAMP

PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND & LABRADOR — PEGL — RANDOLPH KOOB — 8444 — DATE 31 JULY 13

SNC·LAVALIN

DESIGNED BY R. LETOURNEAU	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY F. MARTIN	APPROVED Engineering Manager G. SNYDER
VERIFIED BY E. CIOREI	
DATE 08-SEP-2011	SCALE AS NOTED

CLIENT: nalcor energy — LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE – HYDRO-MECHANICAL
INTAKE GATES
UNIT ARRANGEMENT
PLAN, SECTIONS AND DETAILS

SLI DOC No. 505573-332A-45DD-0012_02
NE DOC No. MFA-SN-CD-3240-ME-PL-0007-01 Rev. D1

FORMAT A0 (mm)

SUB-PKG: 0032-4502 PLATE 08

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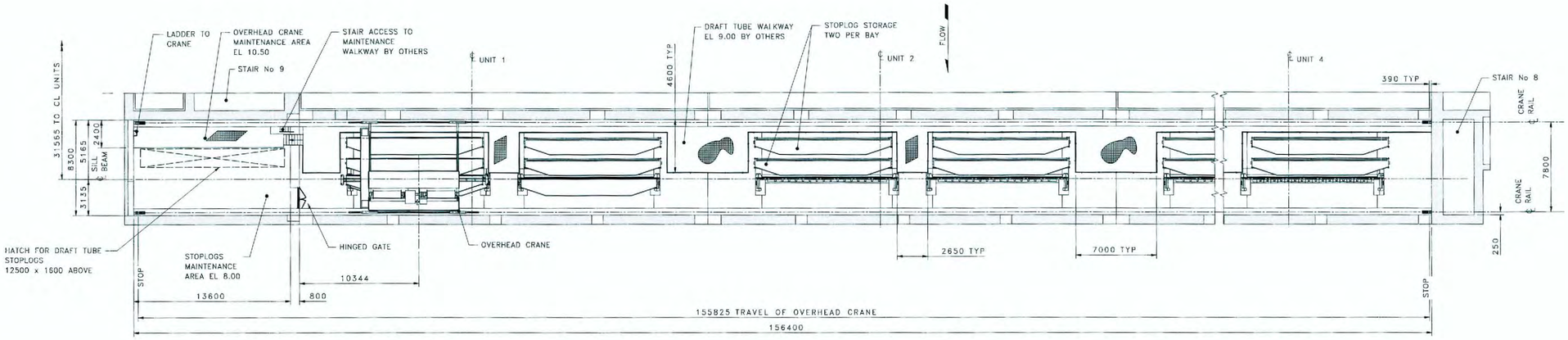
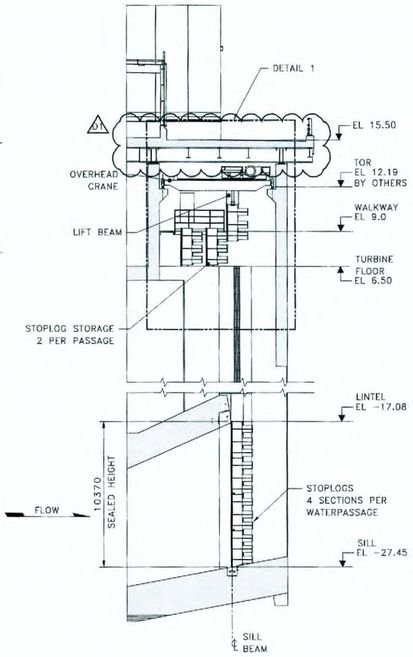


SECTION A–A
STORAGE AREA
1:150



SECTION B–B
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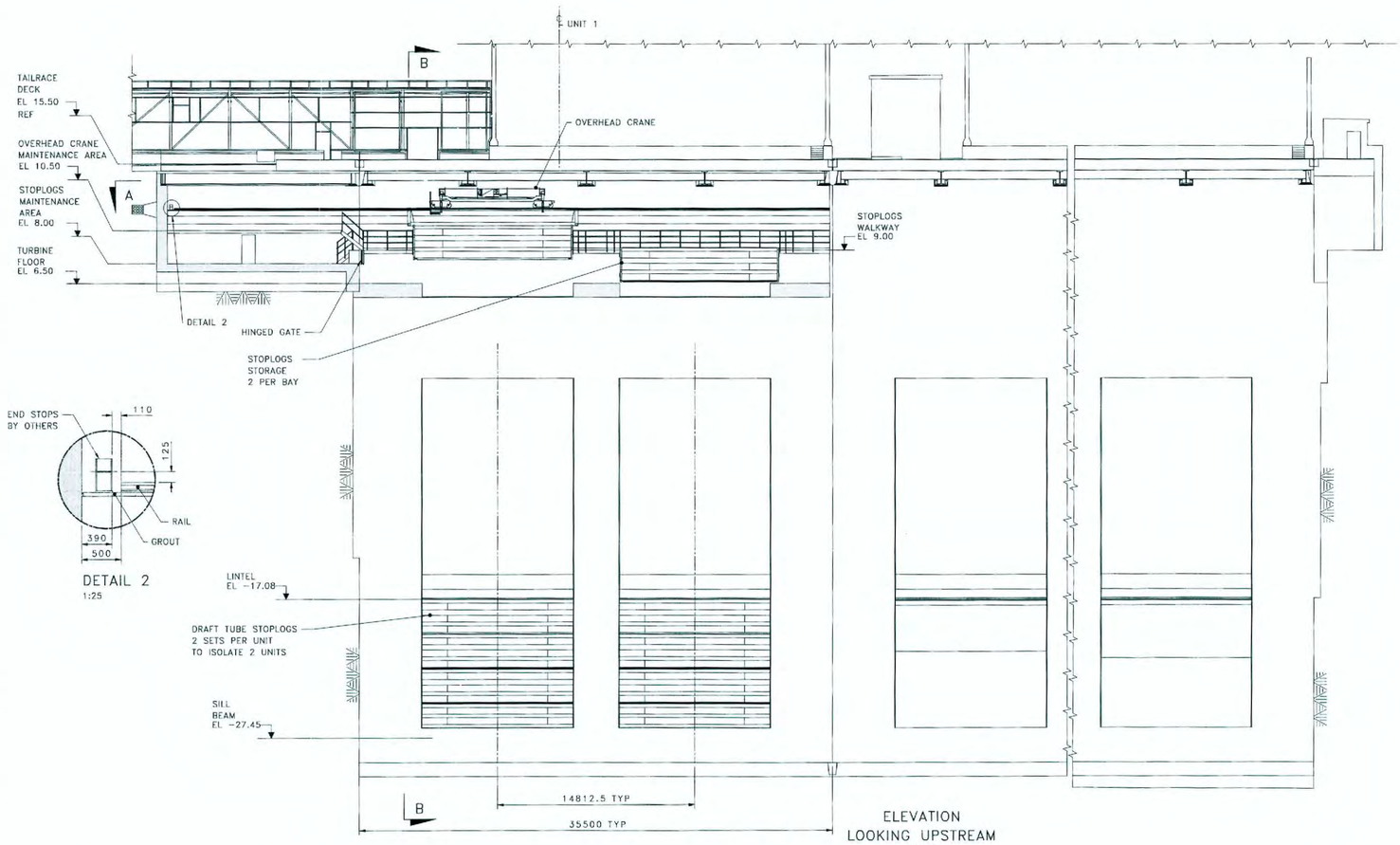
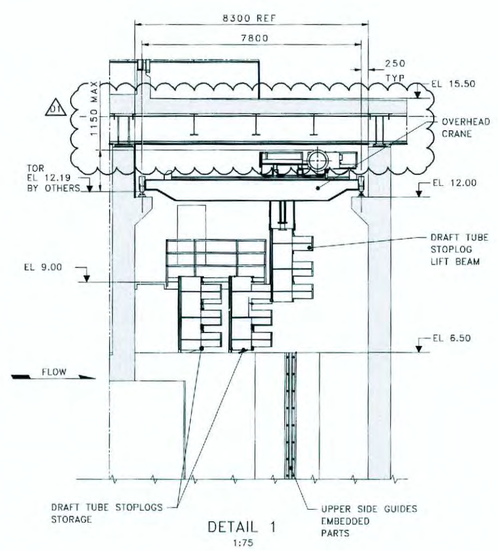


DETAIL 2
1:25

ELEVATION
LOOKING UPSTREAM
1:150



DETAIL 1
1:75

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL 102450
which is valid for the year 2013

NOT FOR CONSTRUCTION

0 5000 10000 mm
SCALE 1:150
0 1000 2000 3000 4000 5000 mm
SCALE 1:75
0 1000 1500 2000 2500 mm
SCALE 1:25

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
3	D1	31-JUL-2013	APPROVED FOR DESIGN
2	B2	21-JAN-2013	ISSUED FOR ADDENDUM
1	B1	17-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-13	GALLERY CEILING BEAMS ADDED	AK	RIC	
B2	21-JAN-2013	UPPER SIDE GUIDES MODIFIED/WATER STOPS REMOVED/CRANE HEIGHT MODIFIED	JM	RT	

* * * * * * * FOR INTERNAL USE ONLY * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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- ☐ 2.REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3.REVIEWED – NOT ACCEPTED
- ☐ 4.INFORMATION ONLY
- ☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy): 15-OCT-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy): 16-Oct-2013
PROJECT MANAGER: Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND & LABRADOR
PEGL PERMIT HOLDER
RANDOLPH KOOB
DATE 8 AUG 13

SNC·LAVALIN

DESIGNED BY R. LETOURNEAU	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY F. MARTIN	APPROVED Engineering Manager G. SNYDER
VERIFIED BY E. CIOREI	
DATE 15-SEP-2011	SCALE AS NOTED
SLI DOC No. 505573-332A-45DD-0015_02	NC DOC No. MFA-SN-CD-3330-ME-PL-0001-01

Rev. D1

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE – HYDRO-MECHANICAL
DRAFT TUBE STOPLOGS
ELEVATION, SECTIONS AND DETAILS

FORMAT A0 (mm)

SUB-PKG: 0032-4503 PLATE 01

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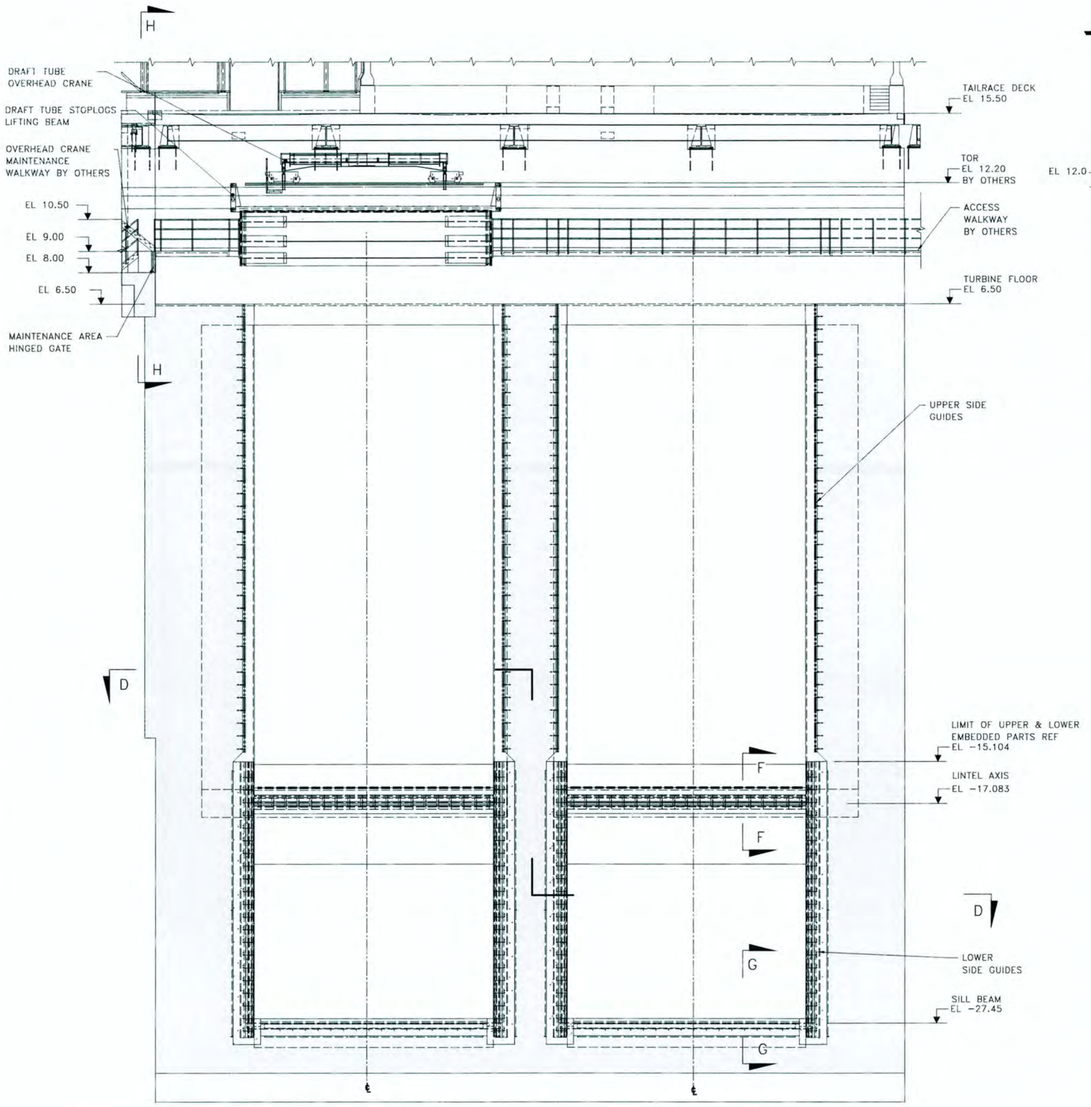
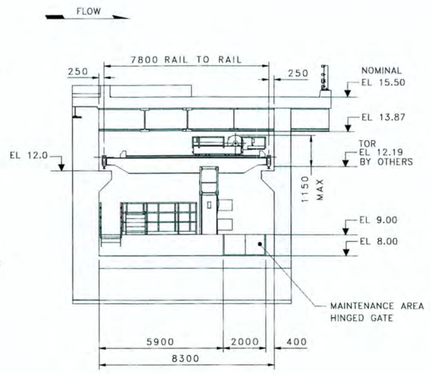


ELEVATION
LOOKING UPSTREAM
1:100



SECTION H–H
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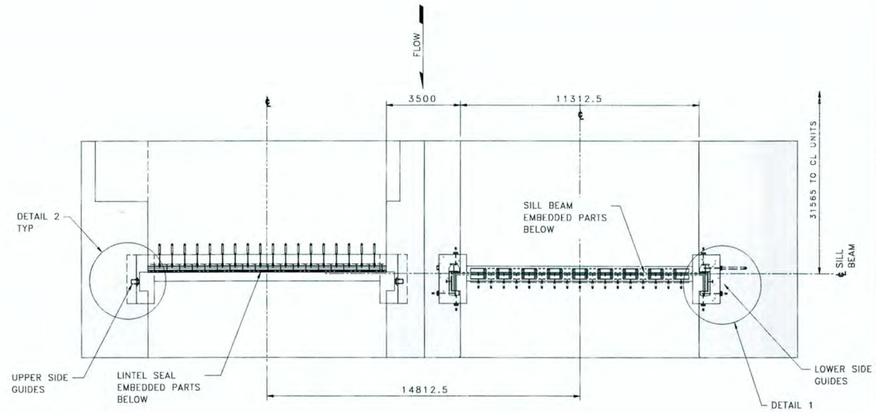
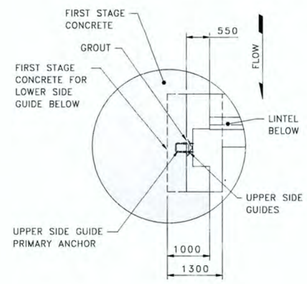
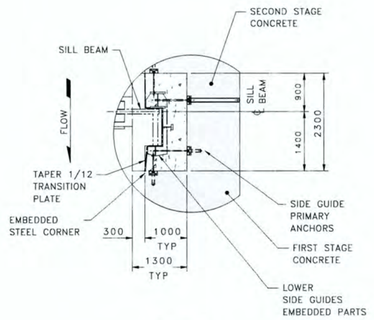


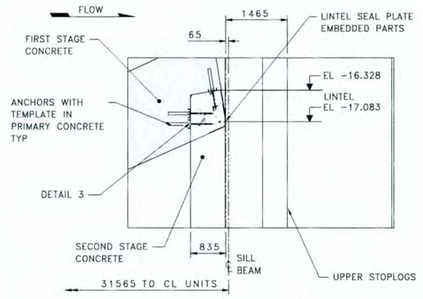
SECTION D–D
1:100



DETAIL 2
1:50



DETAIL 1
1:50



SECTION F–F
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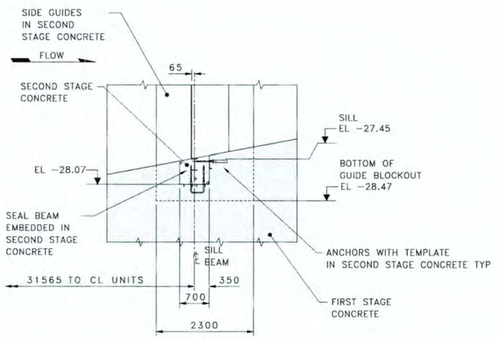
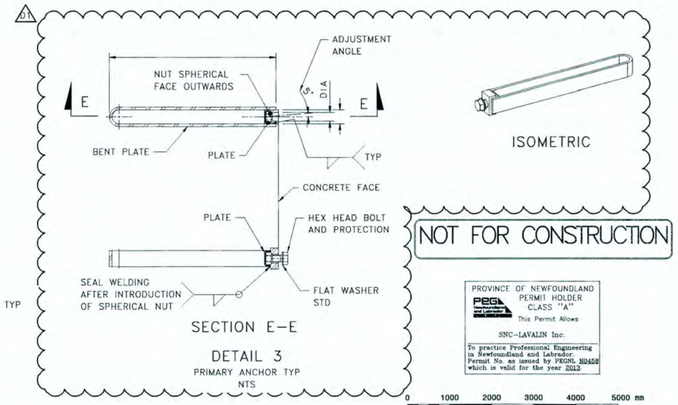


SECTION G–G
1:50



SECTION E–E
DETAIL 3
PRIMARY ANCHOR TYP
NTS

ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS
3	D1	31-JUL-2013	APPROVED FOR USE				
2	B2	21-JAN-2013	ISSUED FOR ADDENDUM				
1	B1	17-OCT-2012	ISSUED FOR BID				

ISSUE REGISTER

No.	REFERENCE DRAWING	No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-13	PRIMARY ANCHOR DETAIL ADDED	AK JM	RK RT	CSY MDK
B2	21-JAN-2013	UPPER SIDE GUIDES MODIFIED/WATER STOPS REMOVED/CRANE HEIGHT MODIFIED	RK JM	RT MDK	CSY

* * * * * * * * FOR INTERNAL USE ONLY * * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 15-OCT-2013
NE–LCP MANAGEMENT: Date (dd-mmm-yyyy) 16-OCT-2013
PROJECT MANAGER: Date (dd-mmm-yyyy) 16-OCT-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS PEGL
RANDOLPH KOOB
PROVINCE OF NEWFOUNDLAND AND LABRADOR

SNC·LAVALIN

DESIGNED BY	R. LETOURNEAU	APPROVED	Discipline Lead Engineer R. KOOB
DRAWN BY	F. MARTIN	APPROVED	Engineering Manager G. SNYDER
VERIFIED BY	E. CIOREI		
DATE	19-SEP-2011	SCALE	AS NOTED

SLT DOC No. 505573-332A-45DD-0016_02
NE DOC No. MFA-SN-CD-3330-ME-SE-0001-01 Rev. D1

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE – HYDRO-MECHANICAL
DRAFT TUBE STOPLOGS
UNIT ARRANGEMENT
ELEVATION, SECTIONS AND DETAILS

FORMAT A0 (mm)
SUB-PKG: 0032-4503 PLATE 02

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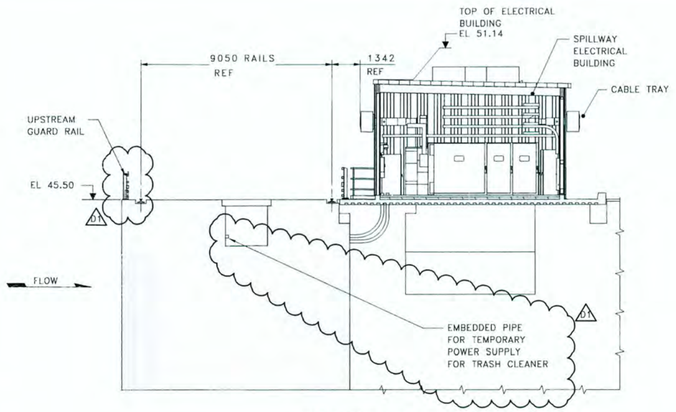

SECTION M–M
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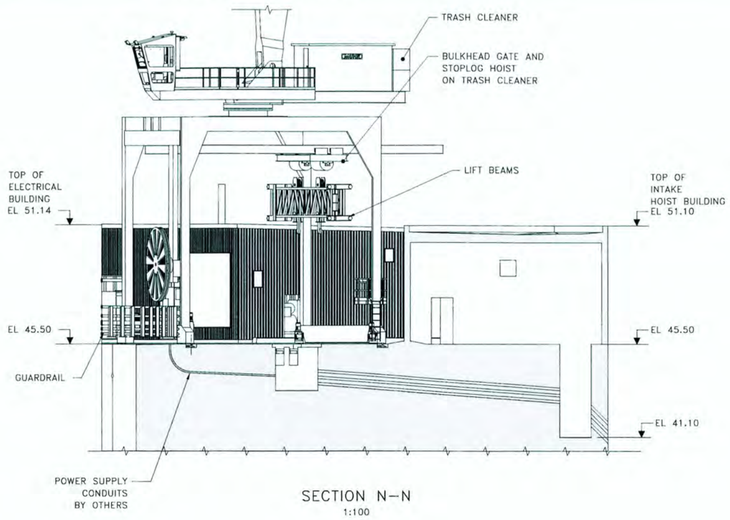
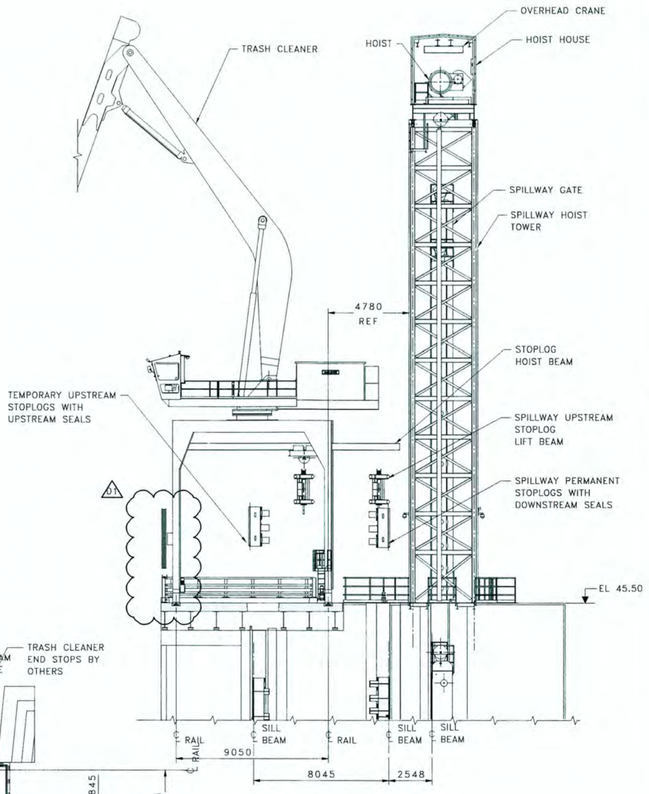


SECTION N–N
1:100



SECTION P–P
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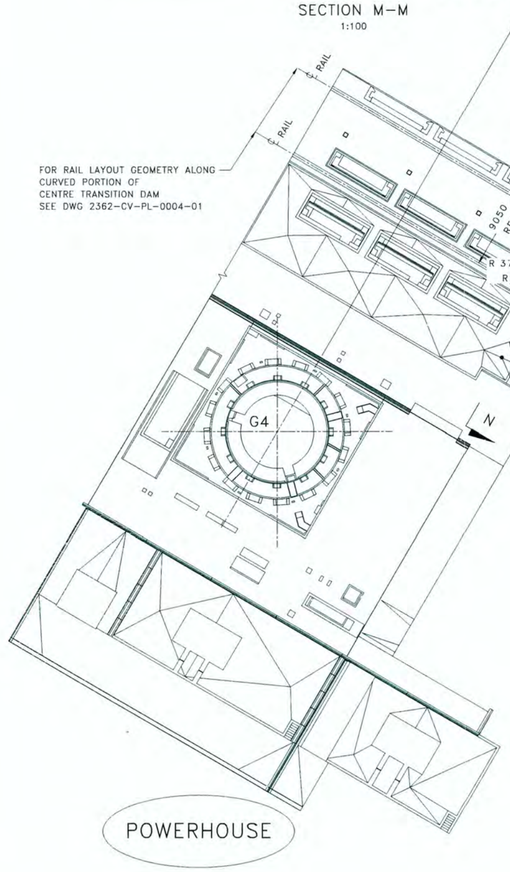
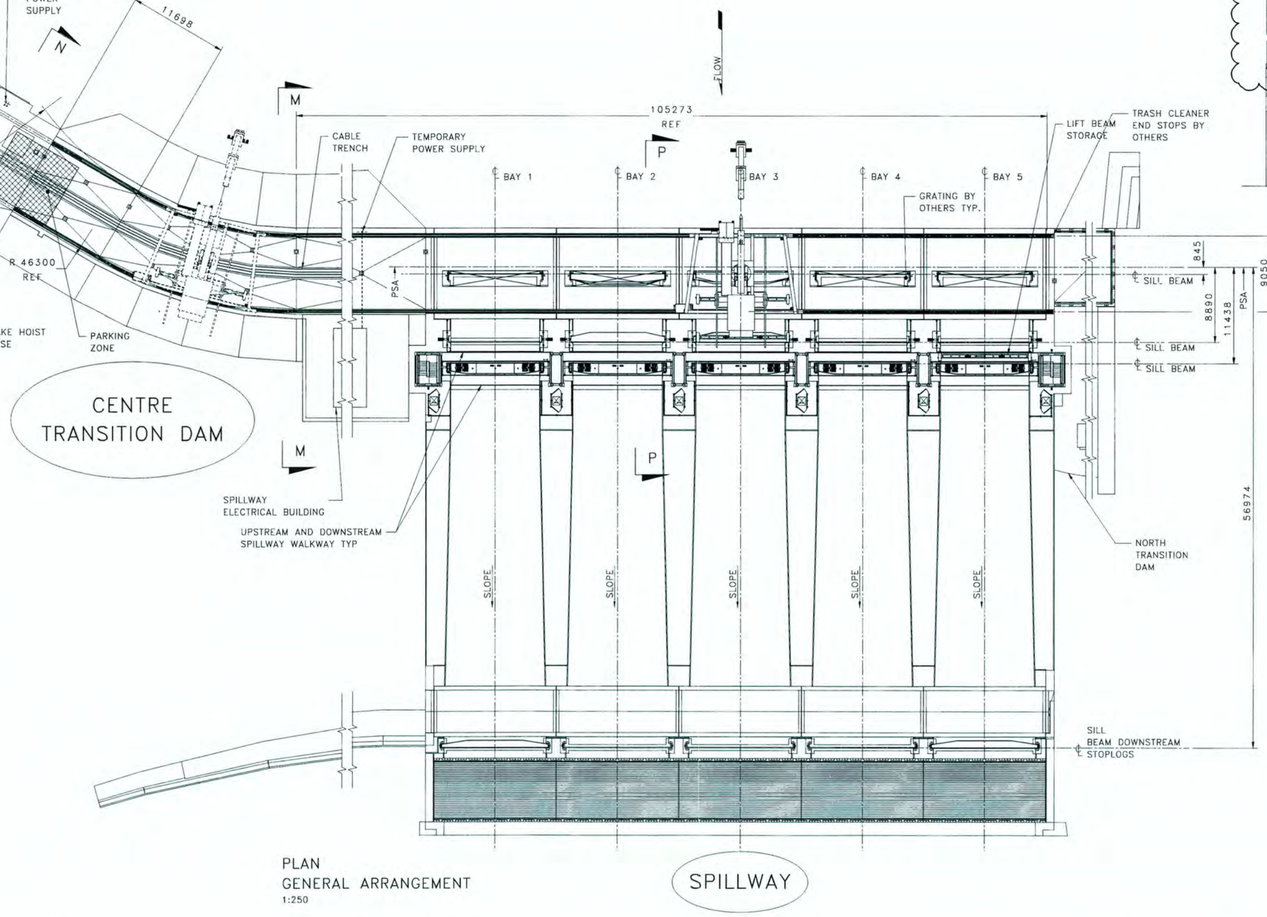
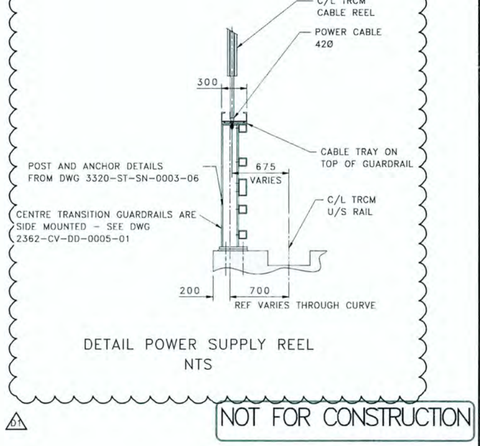




PLAN
GENERAL ARRANGEMENT
1:250



DETAIL POWER SUPPLY REEL
NTS

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL NO450
which is valid for the year 2013

0 2000 4000 6000 8000 10000 mm
SCALE 1:100
0 2000 4000 6000 8000 10000 mm
SCALE 1:125
0 5000 10000 15000 20000 mm
SCALE 1:250

ISSUE REGISTER								REFERENCE DRAWING		REFERENCE DRAWING					
ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS	No.		No.		No.	DATE	REVISION	MOD. VER. APP.
2	D1	31-JUL-2013	APPROVED FOR DESIGN					MFA-SN-CD-2362-CV-CD-0005-01	GUARDRAIL DETAILS MISCELLANEOUS STEEL						
1	B1	17-OCT-2012	ISSUED FOR BID					MFA-SN-CD-3320-ST-SN-0003-06	MISCELLANEOUS STEEL SHEET 6 OF 9						
								MFA-SN-CD-2362-CV-PL-0004-01	GANTRY CRANE RAILS AT EL 45.50 MISCELLANEOUS STEEL			D1	31-JUL-13	DETAIL POWER SUPPLY REEL CABLE GUIDE UPDATED AND EMBEDDED PIPE FOR TEMPORARY POWER SUPPLY FOR TRASH RACK CLEANER UPDATED	AK RT DS

FOR INTERNAL USE ONLY

REVIEW CLASS: EQUIPMENT TAG NUMBER:

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☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 15-08-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy)
PROJECT MANAGER: Date (dd-mmm-yyyy) 16-AUG-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND & LABRADOR
PEGNL PERMIT HOLDER
RANDOLPH KOOB
DATE 16/AUG/13

SNC·LAVALIN

DESIGNED BY R. LETOURNEAU	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY F. MARTIN	APPROVED Engineering Manager
VERIFIED BY L. CUREI	
DATE 25-05-2012	SCALE AS NOTED

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

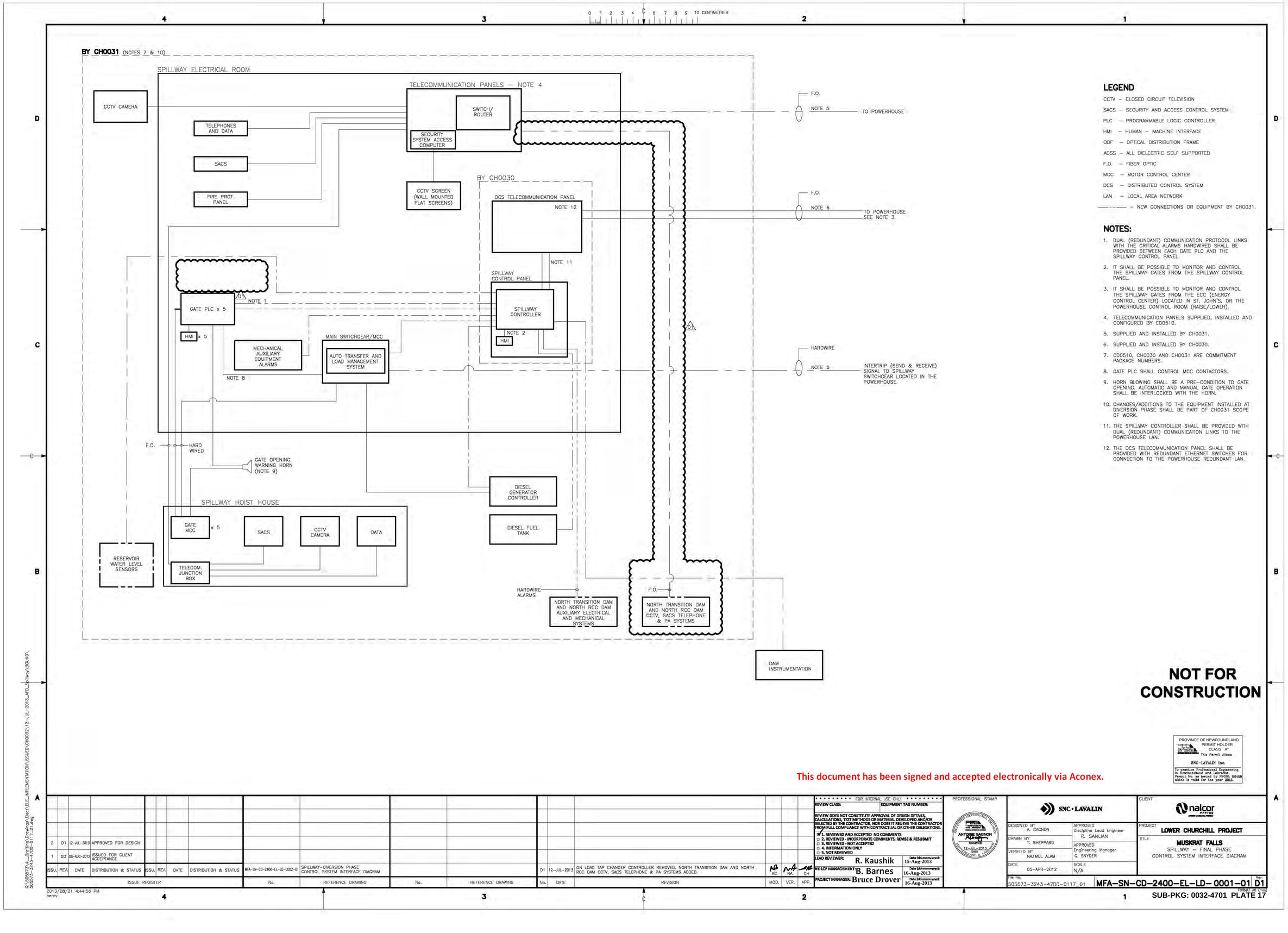
TITLE: MUSKRAT FALLS
SPILLWAY – HYDRO-MECHANICAL EQUIPMENT
TRASH CLEANER AND STOPLOG HANDLING
GENERAL ARRANGEMENT
PLAN, SECTIONS AND DETAIL

Sl DOC No. 505573-3322-45DD-0001_01
Nf DOC No. MFA-SN-CD-2130-ME-GA-0002-01 Rev. D1

FORMAT A0 (mm)

SUB-PKG: 0032-4504 PLATE 01

W:\Travail\Temp\ppetit\MEC — DWG No. 505573-3322-45DD-0001-01.CATDrawing



LEGEND

CCTV — CLOSED CIRCUIT TELEVISION
SACS — SECURITY AND ACCESS CONTROL SYSTEM
PLC — PROGRAMMABLE LOGIC CONTROLLER
HMI — HUMAN — MACHINE INTERFACE
ODF — OPTICAL DISTRIBUTION FRAME
ADSS — ALL DIELECTRIC SELF SUPPORTED
F.O. — FIBER OPTIC
MCC — MOTOR CONTROL CENTER
DCS — DISTRIBUTED CONTROL SYSTEM
LAN — LOCAL AREA NETWORK
———— — NEW CONNECTIONS OR EQUIPMENT BY CH0031.

NOTES:

1. DUAL (REDUNDANT) COMMUNICATION PROTOCOL LINKS WITH THE CRITICAL ALARMS HARDWIRED SHALL BE PROVIDED BETWEEN EACH GATE PLC AND THE SPILLWAY CONTROL PANEL.
2. IT SHALL BE POSSIBLE TO MONITOR AND CONTROL THE SPILLWAY GATES FROM THE SPILLWAY CONTROL PANEL.
3. IT SHALL BE POSSIBLE TO MONITOR AND CONTROL THE SPILLWAY GATES FROM THE ECC (ENERGY CONTROL CENTER) LOCATED IN ST. JOHN'S, OR THE POWERHOUSE CONTROL ROOM (RAISE/LOWER).
4. TELECOMMUNICATION PANELS SUPPLIED, INSTALLED AND CONFIGURED BY CD0510.
5. SUPPLIED AND INSTALLED BY CH0031.
6. SUPPLIED AND INSTALLED BY CH0030.
7. CD0510, CH0030 AND CH0031 ARE COMMITMENT PACKAGE NUMBERS.
8. GATE PLC SHALL CONTROL MCC CONTACTORS.
9. HORN BLOWING SHALL BE A PRE-CONDITION TO GATE OPENING. AUTOMATIC AND MANUAL GATE OPERATION SHALL BE INTERLOCKED WITH THE HORN.
10. CHANGES/ADDITIONS TO THE EQUIPMENT INSTALLED AT DIVERSION PHASE SHALL BE PART OF CH0031 SCOPE OF WORK.
11. THE SPILLWAY CONTROLLER SHALL BE PROVIDED WITH DUAL (REDUNDANT) COMMUNICATION LINKS TO THE POWERHOUSE LAN.
12. THE DCS TELECOMMUNICATION PANEL SHALL BE PROVIDED WITH REDUNDANT ETHERNET SWITCHES FOR CONNECTION TO THE POWERHOUSE REDUNDANT LAN.

NOT FOR CONSTRUCTION

This document has been signed and accepted electronically via Aconex.

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL 102456
which is valid for the year 2013.

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	00	05-AUG-2012	ISSUED FOR CLIENT ACCEPTANCE

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2400-EL-LD-0032-01	SPILLWAY- DIVERSION PHASE CONTROL SYSTEM INTERFACE DIAGRAM

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	ON LOAD TAP CHANGER CONTROLLER REMOVED. NORTH TRANSITION DAM AND NORTH RCC DAM CCTV, SACS TELEPHONE & PA SYSTEMS ADDED.	AC	NA	GH

* * * * * * * * FOR INTERNAL USE ONLY * * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- ☑ 1. REVIEWED AND ACCEPTED NO COMMENTS
- ☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: R. Kaushik — Date (dd-mmm-yyyy): 15-Aug-2013
RE-LCP MANAGEMENT: B. Barnes — Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER: Bruce Drover — Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND & LABRADOR
PEGL PERMIT HOLDER
ANTOINE GAGNON
12-JUL-2013
DATE
PROFESSIONAL ENGINEER

SNC·LAVALIN

CLIENT: nalcor ENERGY

DESIGNED BY: A. GAGNON	APPROVED: Discipline Lead Engineer R. SANLIAN
DRAWN BY: T. SHEPPARD	APPROVED: Engineering Manager G. SNYDER
VERIFIED BY: NAZMUL ALAM	
DATE: 05-APR-2012	SCALE: N/A

PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
SPILLWAY — FINAL PHASE
CONTROL SYSTEM INTERFACE DIAGRAM

File No.: 505573-3243-47DD-0117_01
MFA-SN-CD-2400-EL-LD-0001-01 | Rev. D1
FORMAT A0 (mm)
SUB-PKG: 0032-4701 PLATE 17

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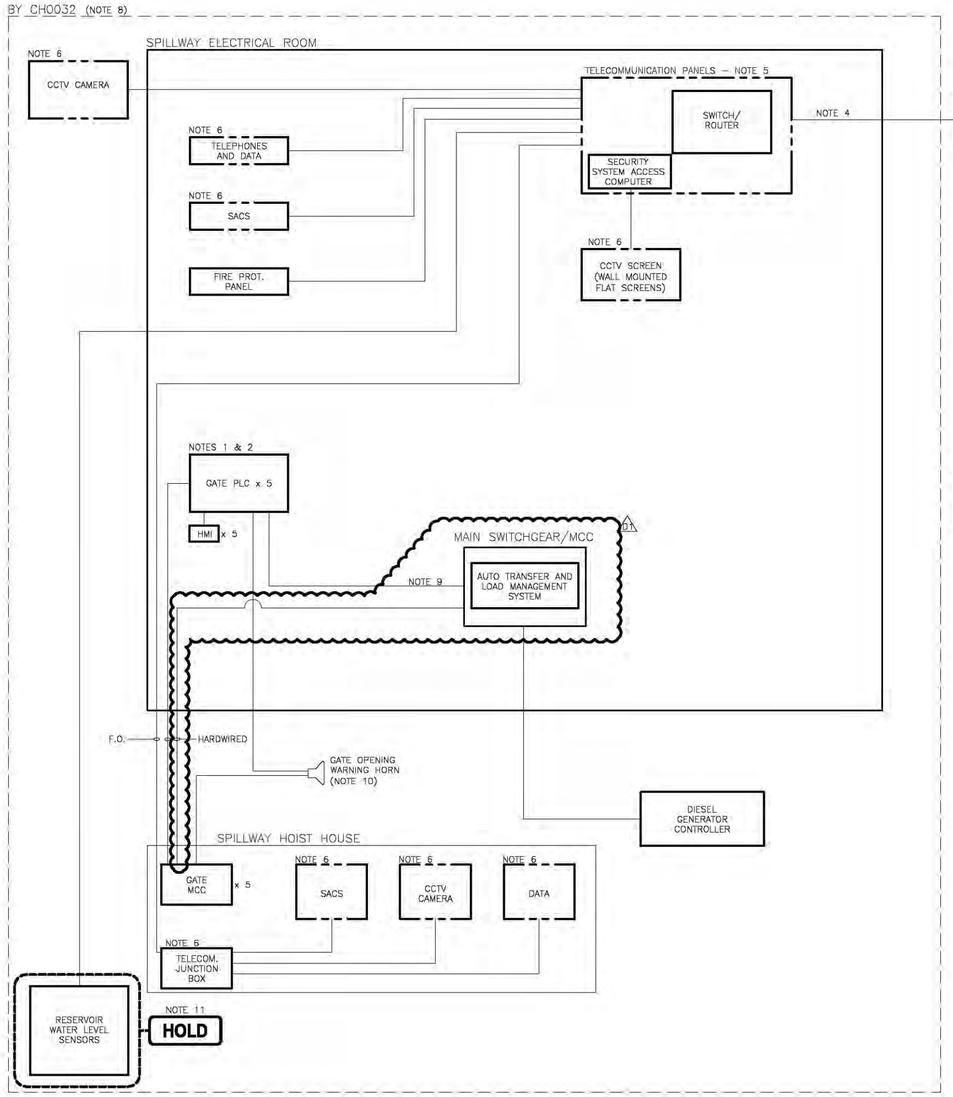

LEGEND

CCTV – CLOSED CIRCUIT TELEVISION
SACS – SECURITY AND ACCESS CONTROL SYSTEM
PLC – PROGRAMMABLE LOGIC CONTROLLER
HMI – HUMAN – MACHINE INTERFACE
ODF – OPTICAL DISTRIBUTION FRAME
ADSS – ALL DIELECTRIC SELF SUPPORTED
F.O. – FIBER OPTIC
MCC – MOTOR CONTROL CENTER
– – – – CD0510 SUPPLY

NOTES:

1. SPILLWAY GATES SHALL BE OPERATED ONLY LOCALLY AT THE SPILLWAY DURING DIVERSION PHASE.
2. PLC SHALL HAVE PROVISION FOR ADDITIONAL INPUTS.
3. ADSS F.O. CABLE BETWEEN ACCOMMODATION CAMP AND CONSTRUCTION SITE SUPPLIED AND INSTALLED BY CD0512.
4. F.O. CABLE BETWEEN OPTICAL JUNCTION BOX ON LAST 25 kV POLE AND THE TELECOMMUNICATION PANELS IN THE SPILLWAY ELECTRICAL ROOM SUPPLIED AND INSTALLED BY CH0032 AND CONNECTED AT BOTH ENDS AND TESTED BY CD0510.
5. TELECOMMUNICATION PANELS SUPPLIED, INSTALLED, CONNECTED AND CONFIGURED BY CD0510.
6. ACTIVE EQUIPMENT SUPPLIED, INSTALLED, CONNECTED AND CONFIGURED BY CD0510. CABLING AND JUNCTION BOXES SUPPLIED AND INSTALLED BY CH0032.
7. OPTICAL JUNCTION BOX SUPPLIED AND INSTALLED BY CD0512.
8. CD0509, CD0510, CD0512 AND CH0032 ARE COMMITMENT PACKAGE NUMBERS.
9. GATE PLC SHALL CONTROL MCC CONTACTORS.
10. HORN BLOWING SHALL BE A PRE-CONDITION TO GATE OPENING. AUTOMATIC AND MANUAL GATE OPERATION SHALL BE INTERLOCKED WITH THE HORN.
11. TYPE AND AMOUNT OF SENSORS TO BE DETERMINED LATER.

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL NL0A08 which is valid for the year 2013

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	B1	08-AUG-2012	ISSUED FOR CLIENT ACCEPTANCE

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2400-EL-LD-0001-01	SPILLWAY-FINAL PHASE CONTROL SYSTEM INTERFACE DIAGRAM

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	MAIN SWITCHGEAR UPDATED.	QH	AC	QH

* * * * * * * * * FOR INTERNAL USE ONLY * * * * * * * * *
REVIEW CLASS: EQUIPMENT TAG NUMBER:
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✓ 1. REVIEWED AND ACCEPTED NO COMMENTS
☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED
LEAD REVIEWER: R. Kaushik — Date [dd-mmm-yyyy]: 15-Aug-2013
NE-LCP MANAGEMENT: B. Barnes — Date [dd-mmm-yyyy]: 16-Aug-2013
PROJECT MANAGER: Bruce Drover — Date [dd-mmm-yyyy]: 16-Aug-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND AND LABRADOR
ANTOINE GAGNON NL08
ISSUED 12-JUL-2013
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND AND LABRADOR

SNC·LAVALIN

CLIENT: nalcor energy

DESIGNED BY: A. GAGNON	APPROVED: Discipline Lead Engineer R. SANJUAN
DRAWN BY: T. SHEPPARD	APPROVED: Engineering Manager G. SNYDER
VERIFIED BY: NAZMUL ALAM	
DATE: 05-APR-2012	SCALE: N/A

PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
SPILLWAY – DIVERSION PHASE
CONTROL SYSTEM INTERFACE DIAGRAM

File No. 505573-3243-47DD-0131_01
MFA-SN-CD-2400-EL-LD-0002-01 Rev. D1
SUB-PKG: 0032-4701 PLATE 03
FORMAT A0 (mm)

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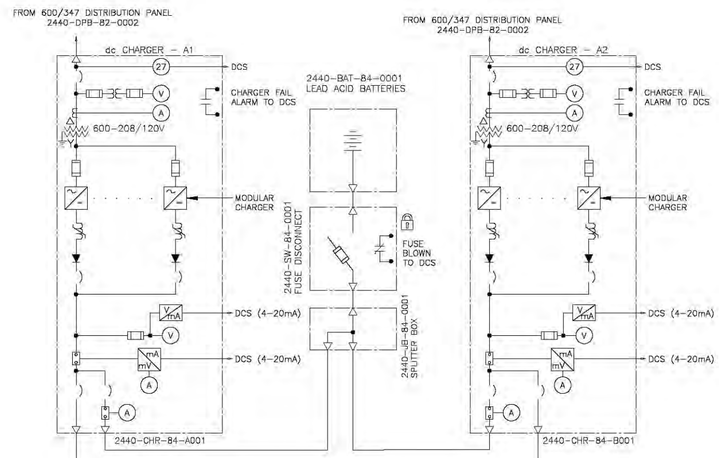
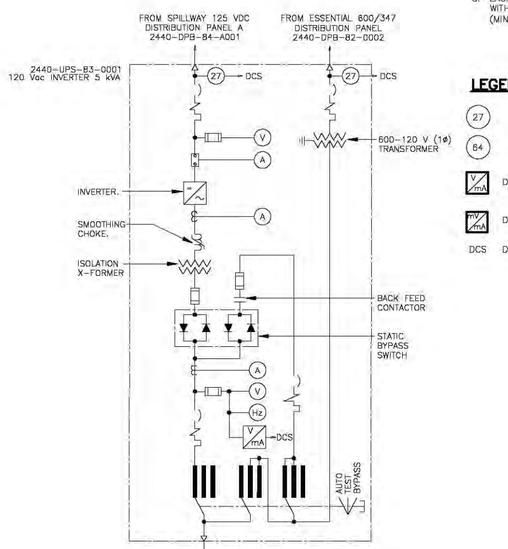
NOTE

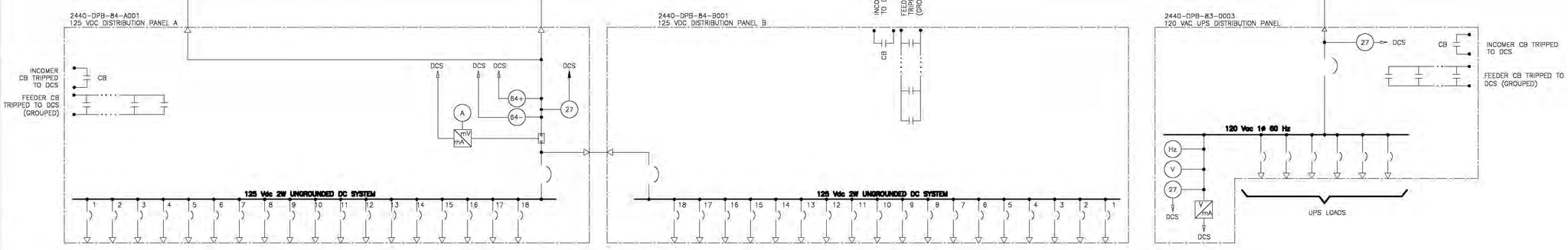
1. ALL LOAD RATINGS ARE PRELIMINARY. LOAD RATINGS WILL BE FINALIZED BASED ON SUPPLIERS DATA SHEETS.
2. ALL CB AND BUS RATINGS, CABLE SIZES AND TRANSFORMER RATINGS ARE PRELIMINARY. DEVICE RATINGS AND CABLE SIZES WILL BE REVISED ACCORDING TO SUPPLIER LOAD LISTS.
3. EACH DC OR AC PANEL SHALL BE PROVIDED WITH AT LEAST 20% OF SPARE FEEDERS (MINIMUM 2, NOT SHOWN).

LEGEND

- 27 – dc UNDER VOLTAGE RELAY.
- 64 – GROUND FAULT RELAY.
- V/mA DC VOLTAGE TRANSDUCER
- mV/mA DC AMPERE TRANSDUCER
- DCS DISTRIBUTED CONTROL SYSTEM.







120 VAC INVERTER FOR UPS LOADS
ROLLWAY GATE –1 CONTROLLER DC–A
ROLLWAY GATE –2 CONTROLLER DC–A
ROLLWAY GATE –3 CONTROLLER DC–A
ROLLWAY GATE –4 CONTROLLER DC–A
ROLLWAY GATE –5 CONTROLLER DC–A
MAIN CONTROLLER DC–A
600 V MAIN MCC/SWGR DC–A
D.C CONTROLLER DC–A
ROLLWAY GATE–1 MCC DC–A
ROLLWAY GATE–2 MCC DC–A
ROLLWAY GATE–3 MCC DC–A
ROLLWAY GATE–4 MCC DC–A
ROLLWAY GATE–5 MCC DC–A
TELECOM–1 125/48 V INVERTER DC–A
TELECOM–2 125/48 V INVERTER DC–A 1.5 kW
TELECOM–3 125/48 V INVERTER DC–A 1.5 kW
CCTV/INTRUSION/ALARM SYSTEMS DC–A 1.5 kW

CCTV/INTRUSION/ALARM SYSTEMS DC–B
TELECOM–3 125/48 V INVERTER DC–B 1.5 kW
TELECOM–2 125/48 V INVERTER DC–B 1.5 kW
TELECOM–1 125/48 V INVERTER DC–B 1.5 kW
ROLLWAY GATE–5 MCC DC–A
ROLLWAY GATE–4 MCC DC–A
ROLLWAY GATE–3 MCC DC–B
ROLLWAY GATE–2 MCC DC–B
ROLLWAY GATE–1 MCC DC–B
D.C CONTROLLER DC–B
600 V MAIN MCC/SWGR DC–B
MAIN CONTROLLER DC–B
ROLLWAY GATE –5 CONTROLLER DC–B
ROLLWAY GATE –4 CONTROLLER DC–B
ROLLWAY GATE –3 CONTROLLER DC–B
ROLLWAY GATE –2 CONTROLLER DC–B
ROLLWAY GATE –1 CONTROLLER DC–B
SPARE

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A" This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL NO456 which is valid for the year 2013.

This document has been signed and accepted electronically via Aconex.

ISSU	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	B1	31-OCT-2012	ISSUED FOR BID

No.	REFERENCE DRAWING
MFA-SN-CD-2440-EL-DR-0002-01	SPILLWAY 600/347 V DISTRIBUTION PANELS PANELBOARD SCHEDULES
MFA-SN-CD-2440-EL-SL-0001-01	SPILLWAY 600 VAC AUXILLARY SINGLE LINE DIAGRAM
MFA-SN-CD-3430-EL-LS-0005-01	ELECTRICAL SERVICES DIAGRAM LEGEND

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	GENERAL REVISION.	NA	WC	GH

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

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☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED

		Date (dd-mmm-yyyy)
LEAD REVIEWER:	R. Kaushik	15-Aug-2013
W-LCP MANAGEMENT:	B. Barnes	16-Aug-2013
PROJECT MANAGER	Bruce Drover	16-Aug-2013

PROFESSIONAL STAMP: PEGNL PERMIT HOLDER G. W. HAINES 20-AUG-2013 SIGNED & SEALED

SNC·LAVALIN

DESIGNED BY: NAZMUL ALAM	APPROVED: Discipline Lead Engineer R. SANJAN
DRAWN BY: T. SHEPPARD	APPROVED: Engineering Manager C. SNYDER
VERIFIED BY: W. CALDWELL / A. GAGNON	
DATE: 02-APR-2012	SCALE: NTS

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
DIVERSION PHASE
UPS AND 125 VDC DISTRIBUTION
SINGLE LINE DIAGRAM

File No. 505573-3243-47DD-0140_01 | MFA-SN-CD-2400-EL-SL-0001-01 | Rev. D1

FORMAT A0 (mm)

SUB-PKG: 0032-4701 PLATE 11

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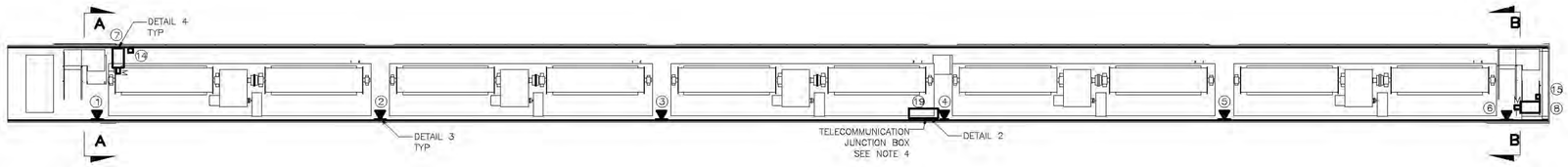
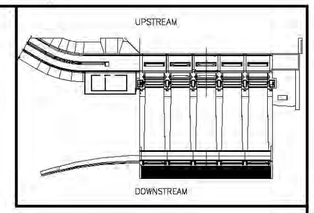


HOIST HOUSE PLAN



NOTES:

1. SWING DOOR SHALL ALLOW CAMERA & WARNING HORN MAINTENANCE FROM INSIDE THE TOWER. DOOR SHALL SWING INSIDE AND BE LOCKABLE IN CLOSED POSITION.
2. ALL CABLES TO CAMERAS & WARNING HORNS SHALL BE INSTALLED IN CABLE TRAYS UP TO THE JUNCTION BOX.
3. FOR SPILLWAY ELECTRICAL ROOM CAMERAS, TELEPHONES AND ACCESS CONTROL EQUIPMENT, SEE DWG: MFA-SN-CD-3340-EL-DD-0045-01 (505573-3243-47DD-0107)
4. JUNCTION BOX, INSULATED ON ALL FACES AND COMPLETE WITH FIBRE OPTIC PATCH PANEL, DIGITAL DISTRIBUTION FRAME, HEATER & COMMUNICATION SWITCH.
5. DATA OUTLETS & CAMERAS IN HOIST HOUSE SHALL BE CONNECTED TO TELECOM JUNCTION BOX.
6. ALL CABLE ARMOUR TO BE CONNECTED TO GROUND BAR LOCATED IN THE JUNCTION BOXES AT BOTH ENDS OF ALL CABLE RUNS.
7. CAMERA MODEL TO BE DEFINED LATER.

EQUIPMENT TAG NUMBER

1. 2440-LANJ-89-0003
2. 2440-LANJ-89-0004
3. 2440-LANJ-89-0005
4. 2440-LANJ-89-0006
5. 2440-LANJ-89-0007
6. 2440-LANJ-89-0008
7. 2440-CCTV-94-0003
8. 2440-CCTV-94-0004
9. 2440-CCTV-94-0005
10. 2440-CCTV-94-0006
11. 2440-CCTV-94-0007
12. 2440-ACCC-93-0004
13. 2440-ACCC-93-0005
14. 2440-JB-94-0003
15. 2440-JB-94-0004
16. 2440-JB-94-0005
17. 2440-JB-94-0006
18. 2440-JB-94-0007
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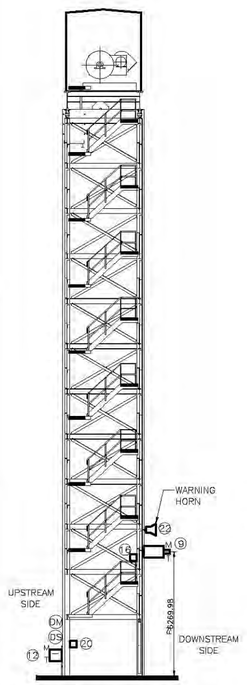
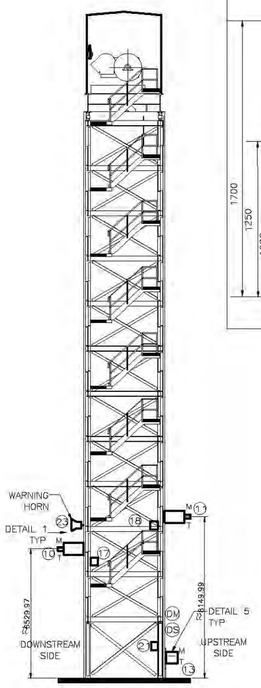
20. 2440-JB-93-0003
21. 2440-JB-93-0004
22. 2440-HN-00-0001
23. 2440-HN-00-0002



SECTION A–A



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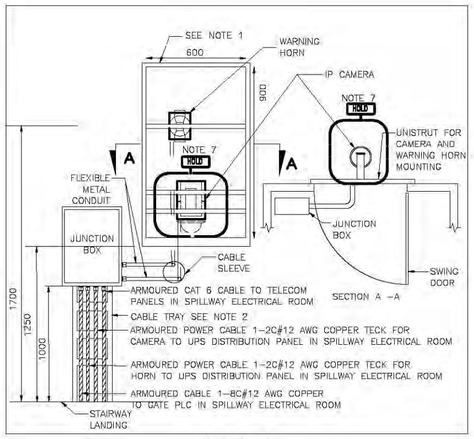
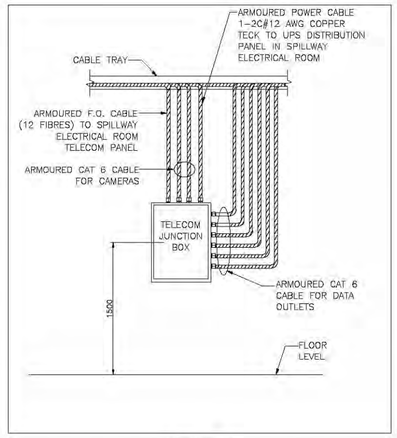
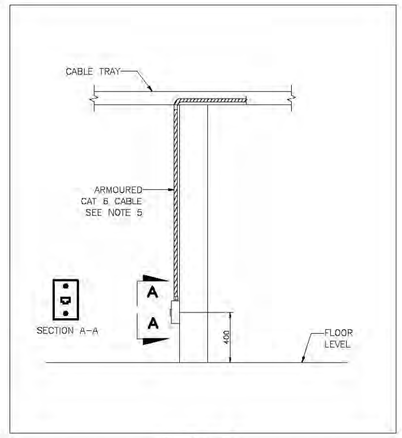


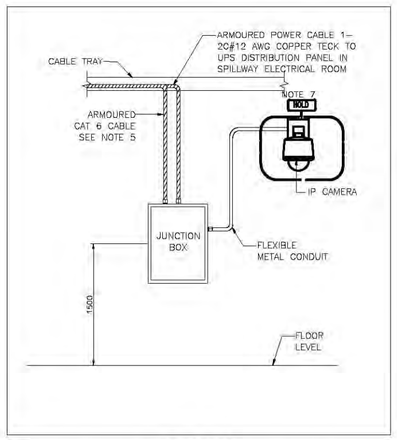
DETAIL 1
TYPICAL OUTDOOR CAMERA INSTALLATION
N.T.S



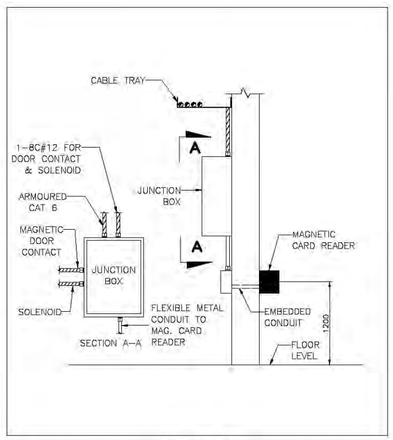
DETAIL 2
TYPICAL TELECOM JUNCTION BOX INSTALLATION
N.T.S



DETAIL 3
TYPICAL DATA OUTLET INSTALLATION
N.T.S



DETAIL 4
TYPICAL INDOOR CAMERA INSTALLATION
N.T.S



DETAIL 5
TYPICAL DOOR ACCESS CONTROL INSTALLATION
N.T.S

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A"
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To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL NO466 which is valid for the year 2013.

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0 2000 4000 6000 8000 10000 mm
SCALE 1:100

ISSU	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	B1	09-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3340-EL-DD-0045-01	SPILLWAY ELECTRICAL BUILDING CCTV,TELEPHONE, COMMUNICATION, FIRE ALARM AND SECURITY SYSTEMS EQUIPMENT LAYOUT AND DETAILS
MFA-SN-CD-2440-EL-RT-0001-01	SPILLWAY ELECTRICAL BUILDING CABLE TRAY AND CONDUIT LAYOUT
MFA-SN-CD-2440-EL-LI-0002-01	SPILLWAY DIVERSION PHASE ELECTRICAL ROOM EQUIPMENT LAYOUT
MFA-SN-CD-3430-EL-LS-0007	ELECTRICAL SERVICES LAYOUT LEGEND

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	NO CHANGES.	AC	NA	WC

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

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☐ 1.REVIEWED AND ACCEPTED. NO COMMENTS
☐ 2.REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: R. Kaushik Date (dd-mmm-yyyy): 15-Aug-2013
WE-LCP MANAGEMENT: B. Barnes Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER: Bruce Drover Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND AND LABRADOR
PEGNL
ANTOINE DAGNON
12-JUL-2013
DATE

SNC·LAVALIN

DESIGNED BY: A. GAGNON	APPROVED: Discipline Lead Engineer: R. SANLIAN
DRAWN BY: T. SHEPPARD	APPROVED: Engineering Manager: G. SNYDER
VERIFIED BY: N. ALAM	SCALE: 1:100 UNO
DATE: 09-JUL-2012	

CLIENT: nalcor ENERGY

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
CCTV SYSTEM, TELEPHONE, COMMUNICATION AND SECURITY SYSTEM EQUIPMENT LAYOUT AND INSTALLATION DETAILS

SNC DOC No.: 505573-3243-47DD-0116_01
Nalcor Doc No.: MFA-SN-CD-2440-EL-DD-0004-01 REV: D1

SUB-PKG: 0032-4701 PLATE 20

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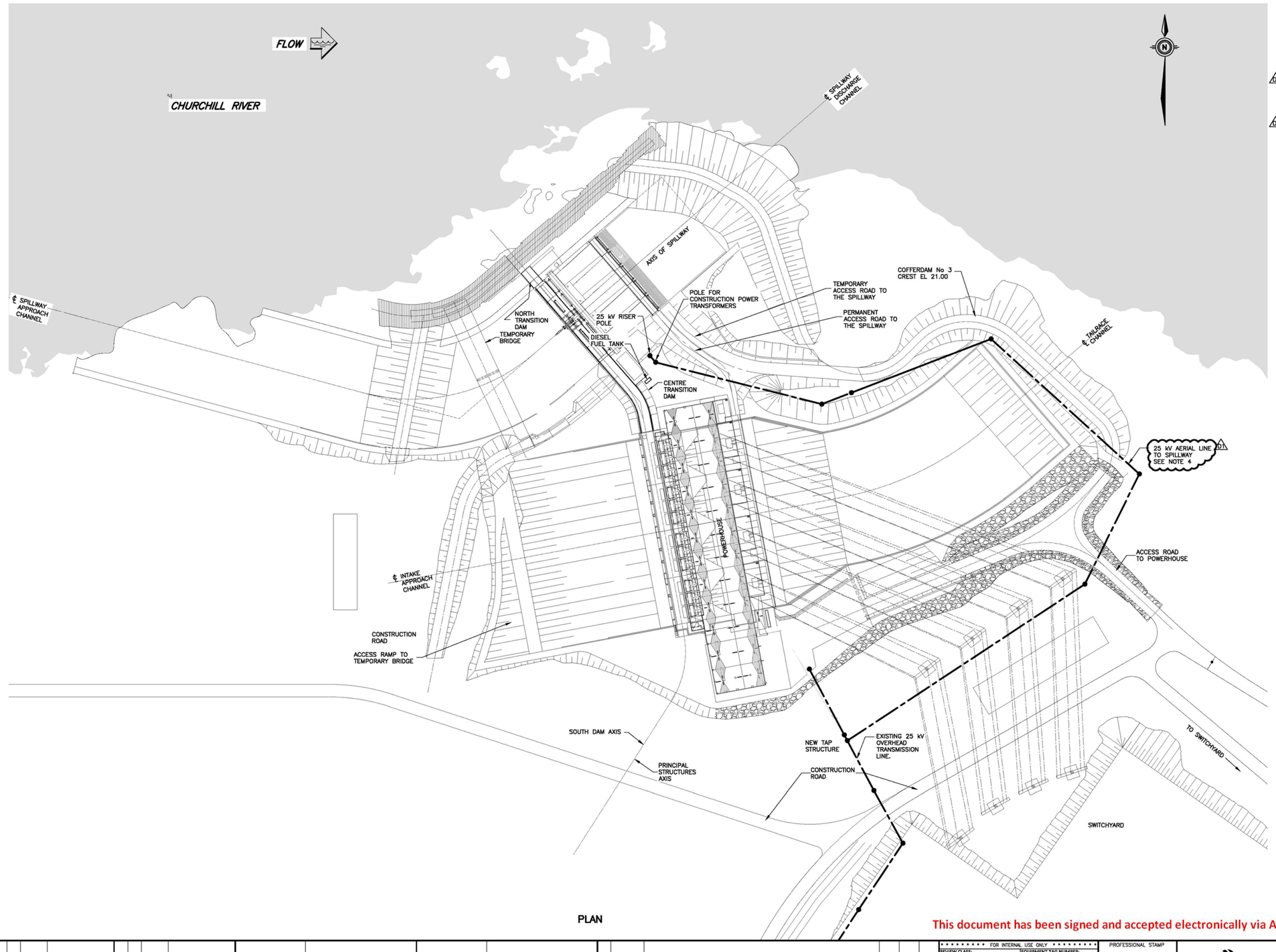

PLAN

NOTES:

1. ELEVATIONS AND DIMENSIONS ARE IN METRES.
2. 25 kV LINE ROUTING TO SPILLWAY IS APPROXIMATE, CONSTRUCTED UNDER CONTRACT CD0512.
3. FOR CABLE CONNECTION DETAILS BETWEEN 25 kV RISER POLE AND SPILLWAY ELECTRICAL BUILDING, SEE REFERENCE DRAWINGS.
4. INCOMING 25 kV LINE TO RISER POLE SUPPLIED BY OTHERS. D1

D1

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL, NO488 which is valid for the year 2013.

0 10 20 30 40 50 100 m
SCALE 1:1000

This document has been signed and accepted electronically via Aconex.

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	B1	05-NOV-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2440-EL-LT-0008-01	SPILLWAY DIESEL FUEL TANK AREA ELECTRICAL LAYOUT
MFA-SN-CD-1320-EL-SL-0003-01	ACCOMMODATION AND CONTRUCTION SITE MAIN DISTRIBUTION SINGLE LINE DIAGRAM
MFA-SN-CD-2440-EL-SL-0002-01	SPILLWAY DIVERSION PHASE TEMPORARY POWER DETAILS

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	REMOVED LEGEND, ADDED NOTE 4.	VJ	NC	GH

* * * * * * * * FOR INTERNAL USE ONLY * * * * * * * *
REVIEW CLASS: EQUIPMENT TAG NUMBER:
REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.
☑ 1. REVIEWED AND ACCEPTED NO COMMENTS
☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED
LEAD REVIEWER: R. Kaushik — Date (dd-mmm-yyyy): 15-Aug-2013
NE-LCP MANAGEMENT: B. Barnes — Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER: Bruce Drover — Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP
VICTOR JAREMKO — 12-JUL-2013

SNC·LAVALIN

DESIGNED BY: V. JAREMKO	APPROVED: Discipline Lead Engineer R. SANJAN
DRAWN BY: T. SHEPPARD	APPROVED: Engineering Manager G. SNYDER
VERIFIED BY: W. CALDWELL	
DATE: 07-SEP-2012	SCALE: 1 : 1000

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS SPILLWAY DIVERSION PHASE 25 kV INCOMING LINE GENERAL LAYOUT

SU DOC No. 505573-3243-47DD-0119_01
NE DOC No. MFA-SN-CD-2440-EL-DD-0005-01 Rev. D1
SUB-PKG: 0032-4701 PLATE 04
FORMAT A0 (mm)

G:\505573\4_Drafting\Drawings\Elect\E.E._IMPLEMENTATION\ISSUED\CH0032\12-JUL-2013_AFC_Spillway\SKD\UND\505573-3243-47DD-0119_01.dwg
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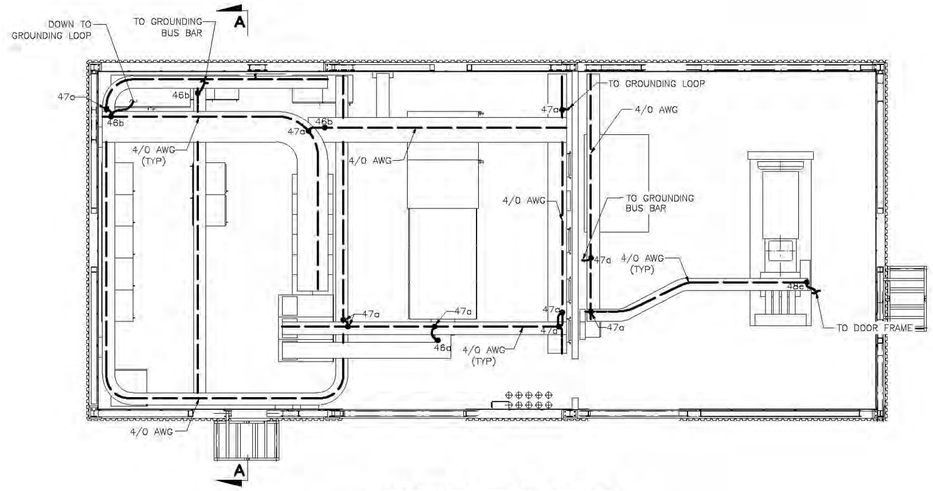
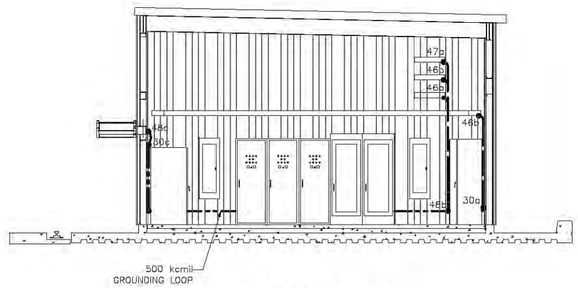
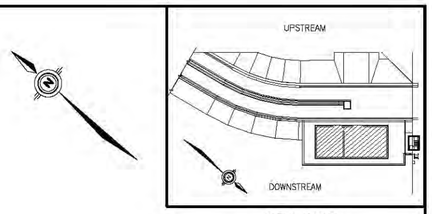


SPILLWAY ELECTRICAL BUILDING
CABLE TRAY GROUNDING PLAN AT EL 45.50



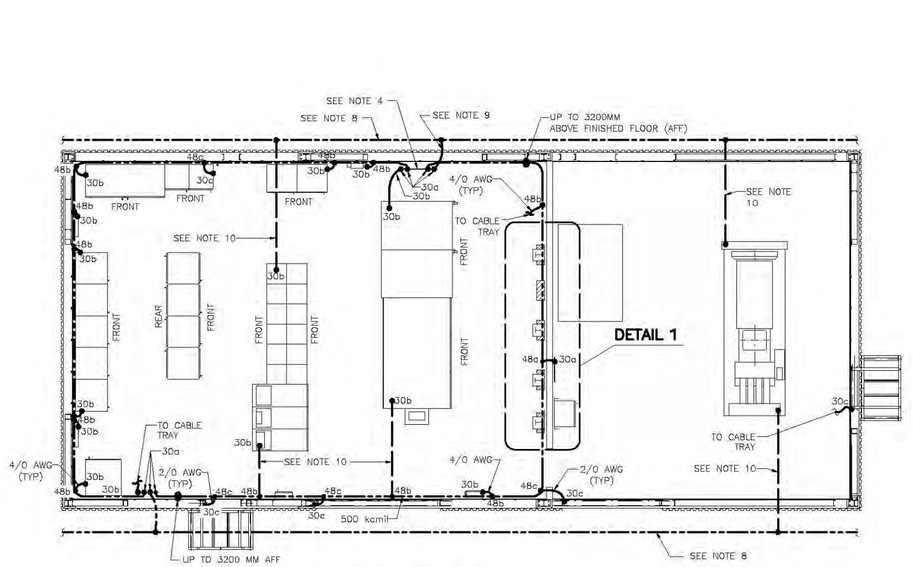
SECTION A –A



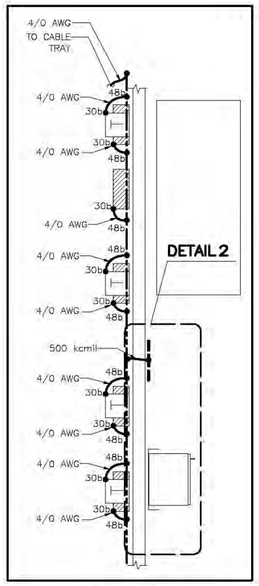
KEY PLAN

NOTES:

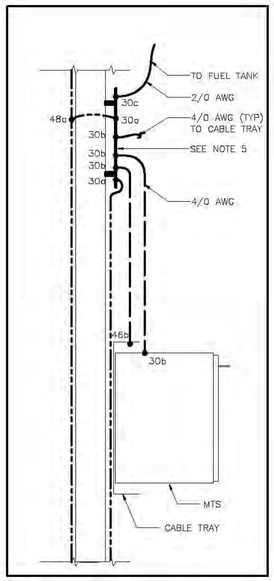
1. CONNECTION TYPE (ie 47a) REFERS TO DETAIL NUMBER AS REFERRED TO ON DRAWING: MFA-SN-CD-3340-EL-DD-0003-01 FOR GROUNDING LEGEND AND DETAILS.
2. SEE DETAIL 51 FOR CABLE TRAY EXPANSION JOINT GROUNDING.
3. SEE DETAIL 50 FOR CABLE TRAY BONDING.
4. GROUND BUS BAR (DETAIL 48) 1000 (L) X 50 (H) X 6 (DP) mm.
5. GROUND BUS BAR (DETAIL 48) 500 (L) X 50 (H) X 6 (DP) mm.
6. REFER TO DRAWING MFA-SN-CD-2440-EL-LT-0002-01 FOR EQUIPMENT IDENTIFICATION.
7. ISOLATED GROUND BUS BAR (TELECOM) (DETAIL 49) 300(L) X 50 X 6 (DP) mm.
8. EXISTING EMBEDDED GROUND CONDUCTOR (500 kcmil).
9. EXISTING 500 kcmil PIGTAIL CONNECT PIGTAIL TO GROUND BUS BAR.
10. EXISTING 500 kcmil PIGTAIL CONNECT TO ELECTRICAL EQUIPMENT.
11. ATTACH 500 kcmil BAR GROUND LOOP CONDUCTOR TO WALL USING SINGLE HOLE CABLE CLAMPS AT 400 MM SPACING. MOUNT GROUND CONDUCTOR 300 MM ABOVE FINISHED FLOOR EXCEP WHERE INDICATED OTHERWISE.



SPILLWAY ELECTRICAL
EQUIPMENT GROUNDING PLAN AT EL 45.50



DETAIL 1
1 : 25



DETAIL 2
1 : 10

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A" This Permit Allows SNC-LAVALIN Inc. To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL 2013 which is valid for the year 2013

0 500 750 1000 mm SCALE 1:10
0 1000 1500 2000 2500 mm SCALE 1:25
0 1000 2000 3000 4000 5000 mm SCALE 1:50

This document has been signed and accepted electronically via Aconex.

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	B1	06-NOV-2012	ISSUED FOR BID/PURCHASE

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2440-EL-RT-0001-01	SPILLWAY ELECTRICAL BUILDING CABLE TRAY AND CONDUIT LAYOUT
MFA-SN-CD-2440-EL-LT-0004-01	SPILLWAY DIVERSION PHASE LIGHTING LAYOUT AND DETAILS
MFA-SN-CD-2440-EL-LT-0002-01	SPILLWAY DIVERSION PHASE ELECTRICAL ROOM EQUIPMENT LAYOUT
MFA-SN-CD-2440-EL-LT-0006-01	SPILLWAY ELECTRICAL AUXILIARIES INSTALLATION LAYOUT
MFA-SN-CD-3340-EL-DD-0045-01	SPILLWAY ELECTRICAL BUILDING CCTV, TEL; FIRE ALARM AND SECURITY SYSTEMS EQUIP. LAYOUT AND DETAILS
MFA-SN-CD-3430-EL-SD-0002-01	ELECTRICAL SERVICES IDENTIFICATION STANDARD

No.	REFERENCE DRAWING
MFA-SN-CD-2382-EL-PL-0001-01	RCC AND TRANSITION DAMS CENTRE TRANSITION DAM PLAN AT EL 18.50 AND 45.50 EMBEDDED GROUNDING AND CONDUITS
MFA-SN-CD-3340-EL-DD-0003-01	POWERHOUSE INSTALLATION DETAILS SHEET 1 SURFACE GROUNDING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	GENERAL REVISION.	VJ	WC	GH

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

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LEAD REVIEWER: R. Kaushik — Date (dd-mmm-yyyy) 15-Aug-2013
NE-LCP MANAGEMENT: B. Barnes — Date (dd-mmm-yyyy) 16-Aug-2013
PROJECT MANAGER: Bruce Drover — Date (dd-mmm-yyyy) 16-Aug-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND AND LABRADOR
VICTOR JAREMKO
ENGINEER
12-JUL-2013
DATE
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND AND LABRADOR

SNC·LAVALIN

DESIGNED BY V. JAREMKO	APPROVED Discipline Lead Engineer R. SANJAN
DRAWN BY V. HERNANDEZ	APPROVED Engineering Manager G. SNYDER
VERIFIED BY W. CALDWELL	
DATE 07-SEP-2012	SCALE 1 : 50 U.N.O.

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS — SPILLWAY DIVERSION PHASE SURFACE GROUNDING

SLI DOC No. 505573-3243-47DD-0128_01
Nalcor DOC No. MFA-SN-CD-2440-EL-DD-0006-01 REV. D1
FORMAT A0 (mm)
SUB-PKG: 0032-4701 PLATE 08

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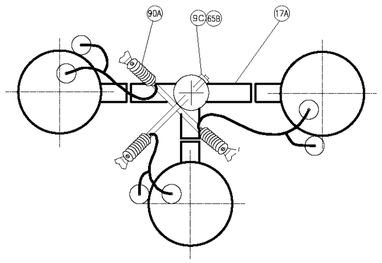
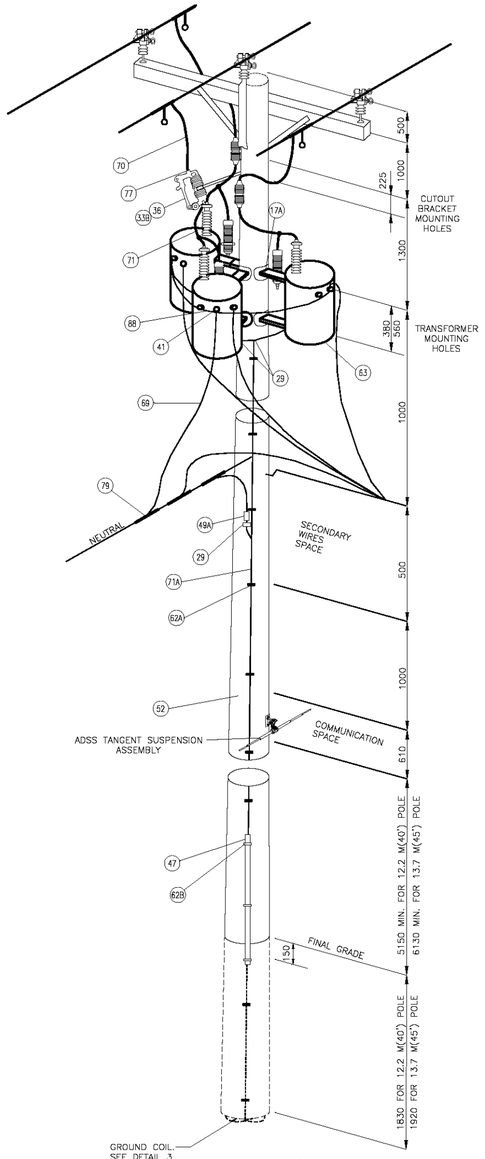


CUTOUT CLUSTER MOUNTING DETAILS TANGENT TYPE STRUCTURE

DETAIL 2 NOTES:

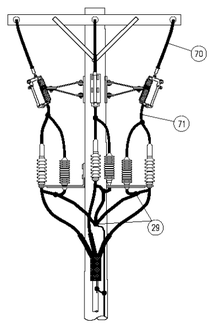
1. REFER TO DETAIL 3 FOR STANDARD GROUND COIL INSTALLATION DETAILS.
2. GROUND ROD TO BE USED WHERE IT IS IMPRACTICAL TO INSTALL GROUND COIL.
3. TANK STRAP OR EQUIVALENT JUMPER MOST BE SECURED, CONNECTING TANK TO SECONDARY NEUTRAL TERMINAL.
4. THE TRANSFORMER PRIMARY WINDING NEUTRAL (H2) IS ELECTRICALLY CONNECTED TO TRF. TANK INTERNALLY, THEREFORE, THE PRIMARY NEUTRAL TERMINALS (H2) SHALL BE JUMPERED TOGETHER AND CONNECTED DIRECTLY TO SYSTEM NEUTRAL CONDUCTOR. EACH TRANSFORMER TANK GROUND WIRE SHALL BE SEPARATELY CONNECTED TO THE POLE GROUND AND A JUMPER ADDED BETWEEN THE POLE GROUND AND THE SYSTEM NEUTRAL CONDUCTOR.
5. "PENETROX" TO BE ADDED TO CONTACT SURFACES AND SCRATCH INTO SURFACES USING WIRE BRUSH BEFORE MAKING CONNECTIONS.
6. INSTALLATION OF THE 25 kV POLE STRUCTURE INCLUDING FUSE CUTOUTS, FUSELINK, TRANSFORMERS AND WIRING TO PRIMARY OF TRANSFORMERS ARE BY OTHERS.

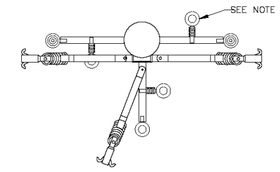


INSTALLATION ON TANGENT TYPE STRUCTURE

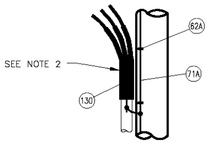
DETAIL 2 – TYPICAL 25 kV CLUSTER MOUNTED THREE PHASE TRANSFORMER INSTALLATION

N.T.S.





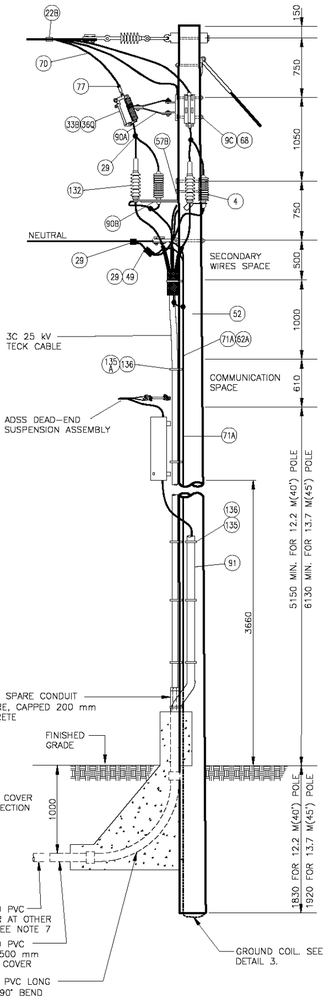
CUTOUT, TERMINATOR & ARRESTOR ARRANGEMENT

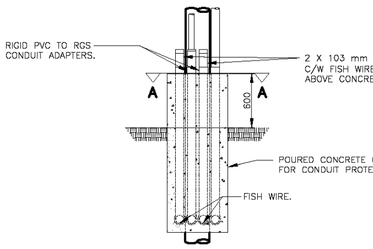


CABLE BREAKOUT DETAILS

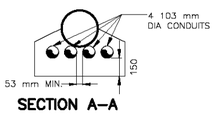
DETAIL 1 NOTES:

1. BENDING RADIUS OF CABLE SHALL NOT BE LESS THAN 8 TIMES OUTSIDE DIAMETER OF CABLE. NO BENDS PERMITTED WITHIN 150 mm OF BOTTOM OF TERMINATOR.
2. REFER TO MANUFACTURER'S INSTRUCTIONS FOR DETAILS OF CABLE TERMINATION KIT.
3. SUPPORT CONDUIT AND ARMOURED CABLE AT 1.2 M INTERVALS.
4. INSTALL RISER POLE ARRESTER ON THE TERMINATOR BRACKET AS SHOWN.
5. GROUND ROD TO BE USED WHERE IT IS IMPRACTICAL TO INSTALL GROUND COIL.
6. THE CONDUIT CONTAINING THE CABLES SHALL BE SEALED WITH AIRSEAL.
7. FOR CONTINUATION OF CABLE AND CONDUIT IN TRENCH, SEE REFERENCE DWG. MFA-SN-CD-2440-EL-LT-0008-01.
8. INSTALLATION OF 25 kV TERMINATION POLE INCLUDING THE FUSE CUTOUTS, FUSELINK AND WIRING TO THE LINE SIDE OF THE FUSE CUTOUTS IS BY OTHERS.
9. INSTALLATION AND TERMINATION OF THE ADSS IN THE SPILLWAY ELECTRICAL ROOM IS BY OTHERS.





DUCT INSTALLATION DETAILS AT RISER POLE

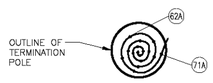


SECTION A–A

N.T.S

ITEM NO.	QTY.	DESCRIPTION
4	6	ARRESTER, LIGHTNING 15.3 kV MCOV
9B	A.R.	BOLT, MACHINE 5/8" X 10"
9C	A.R.	BOLT, MACHINE 5/8" X 12 "
10B	A.R.	BOLT, MACHINE 3/4" X 12 "
17A	1	BRACKET, TRANSFORMER CLUSTER MOUNT,3-UNIT
22B	A.R.	CLAMP, HOT LINE
29	A.R.	CONNECTOR, COMPRESSION
33B	6	CUTOUT, FUSE 27 kV, 100 A, 26" CREEPAGE
36	3	FUSELINK 10 K
36Q	3	FUSELINK 80 K
41	A.R.	CONNECTOR, TRANSFORMER TERMINAL LUG
47	A.R.	MOULDING GROUND WIRE.
49	A.R.	PIN, TERMINAL (1/0 AASC)
49A	A.R.	PIN, TERMINAL (#2)
52	A.R.	WOOD POLE, CLASS 3, PENTA-TREATED
57B	A.R.	SCREW, LAG, 1/2" X 4"
62A	A.R.	STAPLE 1-1/4" WITH 3/8" OPENING
62B	A.R.	STAPLE 2" WITH 11/16" OPENING
63	3	TRANSFORMER (TAG #1570-T-0041 TO 0043)
65B	A.R.	WASHERS, CURVED 2-1/4"X 3/16" WITH 11/16" HEAD
65C	A.R.	WASHER CURVED 3 1/8" X 3 1/4" X 1/4" WITH 13/16" HEAD
68	A.R.	WASHER, SQUARE, 2 1/2, 11/16" HOLE
69	A.R.	WIRE, AASC POLYETHYLENE WEATHER PROOF (PEWP)
70	A.R.	WIRE, #2 BARE ALUMINUM
71	A.R.	WIRE, BARE COPPER
71A	A.R.	WIRE, BARE COPPER #4 AWG SOLID CONDUCTOR.
77	A.R.	SLEEVE, PIGTAIL #2 ALUMINUM
78	A.R.	SEALING / DIELECTRIC COMPOUND
79	A.R.	CONNECTOR, PRESS-ON COMPRESSION
81	A.R.	TAPE – VINYL ELECTRIC
88	A.R.	BOLT, HEXHEAD 1/2" X 3" C/W WASHERS & HEX NUT
88B	A.R.	BOLT, HEXHEAD 1/2" X 2" C/W WASHERS & HEX NUT
90	A.R.	BRACKET, CROSSARM MOUNT
90A	A.R.	BRACKET – CUTOUT CLUSTER MOUNTING
90B	1	BRACKET – EQUIPMENT MOUNTING 24"
91	A.R.	CONDUIT, RIGID GALVANIZED STEEL 4"
130	1	OUTDOOR CABLE BREAKOUT BOOT ASSEMBLY FOR 3 CONDUCTOR (PLUS GROUND) COPPER TAPE SHIELD ARMOURED CABLE
132	3	OUTDOOR TERMINATOR, SLIP-ON, 25 kV, SIZED TO SUIT CABLE
135	A.R.	STRAP, CONDUIT , 2 HOLE 4"
135A	A.R.	STRAP, CONDUIT , 2 HOLE 3"
136	A.R.	SCREW, LAG, 1/4" X 2 1/2"
154A	A.R.	BRACKET, ANGLE C/W MOUNTING BOLT
154B	A.R.	PLATE, BACKING FOR ANGLE BRACKET
155	A.R.	BOLT, 3/8" X 3/4" STAINLESS STEEL HEX HEAD
156	A.R.	WASHER, LOCK 3/8" STAINLESS STEEL

A.R. – AS REQUIRED



DETAIL 3 – GROUND COIL DETAIL

N.T.S

DETAIL 1 – TYPICAL 25 kV THREE PHASE RISER POLE TERMINATION DETAIL

N.T.S.

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND
PEGA PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL 10458 which is valid for the year 2013.

REV.	DATE	DISTRIBUTION & STATUS
D1	21-JUL-2013	APPROVED FOR DESIGN
B1	19-NOV-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2440-EL-LT-0008-01	SPILLWAY DIESEL FUEL TANK AREA ELECTRICAL LAYOUT
MFA-SN-CD-2440-EL-DD-0005-01	SPILLWAY DIVERSION PHASE TEMPORARY POWER GENERAL LAYOUT
MFA-SN-CD-3430-EL-LS-0007-01	ELECTRICAL SERVICES LAYOUT LEGEND

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	GENERAL REVISION.	VJ	WC	GH

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		Date (dd-mmm-yyyy)
LEAD REVIEWER:	R. Kaushik	15-Aug-2013
NE-LCP MANAGEMENT:	B. Barnes	16-Aug-2013
PROJECT MANAGER:	Bruce Drover	16-Aug-2013

PROFESSIONAL STAMP
VICTOR JAREMKO
09-JUL-2013

SNC·LAVALIN

DESIGNED BY V. JAREMKO	APPROVED Discipline Lead Engineer R. SANLIAN
DRAWN BY B. ACREMAN	APPROVED Engineering Manager G. SNYDER
VERIFIED BY W. CALDWELL	
DATE 13-AUG-2012	SCALE NTS

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY-DIVERSION PHASE
TEMPORARY POWER
DETAILS

File No. 505573-3243-47DD-0120_01

MFA-SN-CD-2440-EL-DD-0012-01 Rev. D1

SUB-PKG: 0032-4701 PLATE 05

FORMAT A0 (mm)

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PANELBOARD 2440 – DPB – 90 – 0001

POWER SYSTEM: 600/347 Vac, 3 PHASE, 4 WIRE, 60 Hz.
BUS RATING: 225 AMPS
MAIN BREAKER: 60 AMPS
INTERRUPTING CAPACITY: 18 kA RMS (SYMMETRICAL)
NUMBER OF POLES: 42

SERVICE: GENERAL LIGHTING DISTRIBUTION
LOCATION: SPILLWAY ELECTRICAL BUILDING
FED FROM: 2440–T–90–0001
FEEDER CABLE No.: 2440–90C4–NNNN
MOUNTING TRIM: SURFACE

REV.	CABLE No.	LOAD DESCRIPTION	LOAD (VA)	BKR AMPS	CCT. No.	PHASE LOAD (VA) A	B	C	CCT. No.	BKR AMPS	LOAD (VA)	LOAD DESCRIPTION	CABLE No.	REV.
	–	SPARE	–	15	1	–			2	15	–	ELECTRICAL BUILDING INTERIOR LIGHTING – GENERATOR ROOM	2440–90C2–NNNN	
	–	SPARE	–	15	3		–		4	15	–	ELECTRICAL BUILDING EXTERIOR LIGHTING	2440–90C2–NNNN	
	–	SPARE	–	15	5			–	6	15	–	ELECTRICAL BUILDING INTERIOR LIGHTING – ELECTRICAL ROOM	–	
	2440–90C2–NNNN	LIGHTING – GATE HOIST ACCESS STAIR	–	15	7	–			8	15	–	SPARE	–	
	2440–90C2–NNNN	LIGHTING – GATE HOIST ACCESS STAIR	–	15	9		–		10	15	–	SPARE	–	
	2440–90C2–NNNN	LIGHTING – GATE HOIST FLOODLIGHTS	–	15	11			–	12	15	–	SPARE	–	
	–	SPARE	–	15	13	–			14	15	–	SPARE	–	
	–	SPARE	–	15	15		–		16	15	–	SPARE	–	
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	–	SPARE	–	15	23			–	24	15	–	SPARE	–	
	–	SPACE	–	–	25	–			26	–	–	SPACE	–	
	–	SPACE	–	–	27		–		28	–	–	SPACE	–	
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	–	SPACE	–	–	35			–	36	–	–	SPACE	–	
	–	SPACE	–	–	37	–			38	–	–	SPACE	–	
	–	SPACE	–	–	39		–		40	–	–	SPACE	–	
	–	SPACE	–	–	41			–	42	–	–	SPACE	–	
		TOTAL PHASE LOAD (VA)	–	–	–									
		TOTAL CONNECTED LOAD (VA)	–											
		DIVERSITY FACTOR (%)	–											
		MAXIMUM DEMAND (VA)	–											

AF: ARC FAULT BREAKER
ST: SHUNT TRIP BREAKER
GFI: GROUND FAULT INTERRUPTER
LOTF: LOCK–ON/TRIP–FREE DEVICE

PANELBOARD 2440 – DPB – 82 – 0001

POWER SYSTEM: 600 Vac, 3 PHASE, 3 WIRE, 60 Hz.
BUS RATING: 225 AMPS
MAIN BREAKER: 200 AMPS
INTERRUPTING CAPACITY: 18 kA RMS (SYMMETRICAL)
NUMBER OF POLES: 42

SERVICE: NON–ESSENTIAL 600 Vac LOADS
LOCATION: SPILLWAY ELECTRICAL BUILDING
FED FROM: 2440–MCC–82–0001
FEEDER CABLE No.: 2440–82C3–NNNN
MOUNTING TRIM: SURFACE

REV.	CABLE No.	LOAD DESCRIPTION	LOAD (VA)	BKR AMPS	CCT. No.	PHASE LOAD (VA) A	B	C	CCT. No.	BKR AMPS	LOAD (VA)	LOAD DESCRIPTION	CABLE No.	REV.
	2440–82C3–NNNN	TRANSFORMER: 2440–T–82–0002 PANELBOARD: 2440–DPB–83–0001 NON–ESSENTIAL 208/120 V LOADS	10,000	40 3P	1	20000			2	40 3P	10,000	TRANSFORMER: 2440–T–90–0001 PANELBOARD: 2440–DPB–90–0001 GENERAL LIGHTING DISTRIBUTION PANEL	2440–82C3–NNNN	
			10,000		3		20000		4		10,000			
			10,000		5			20000	6		10,000			
	2440–82C3–NNNN	POWER OUTLET 2440–PO–82–0004 AT GRADE LEVEL BELOW ELECTRICAL BUILDING	20000	60 3P	7	20000			8	40 3P	–	SPARE	–	
			20000		9		20000		10		–			
			20000		11			20000	12		–			
	–	SPARE	–	40 3P	13	–			14	40 3P	–	SPARE	–	
			–		15		–		16		–			
			–		17			–	18		–			
	–	SPACE	–	– –	19	–			20	– –	–	SPACE	–	
			–		21		–		22		–			
			–		23			–	24		–			
	–	SPACE	–	– –	25	–			26	– –	–	SPACE	–	
			–		27		–		28		–			
			–		29			–	30		–			
	–	SPACE	–	– –	31	–			32	– –	–	SPACE	–	
			–		33		–		34		–			
			–		35			–	36		–			
	–	SPACE	–	– –	37	–			38	– –	–	SPACE	–	
			–		39		–		40		–			
			–		41			–	42		–			
		TOTAL PHASE LOAD (VA)	–	–	–									
		TOTAL CONNECTED LOAD (VA)	–											
		DIVERSITY FACTOR (%)	–											
		MAXIMUM DEMAND (VA)	–											

AF: ARC FAULT BREAKER
ST: SHUNT TRIP BREAKER
GFI: GROUND FAULT INTERRUPTER
LOTF: LOCK–ON/TRIP–FREE DEVICE

PANELBOARD 2440 – DPB – 90 – 0002

POWER SYSTEM: 600/347 Vac, 3 PHASE, 4 WIRE, 60 Hz.
BUS RATING: 225 AMPS
MAIN BREAKER: 100 AMPS
INTERRUPTING CAPACITY: 18 kA RMS (SYMMETRICAL)
NUMBER OF POLES: 42

SERVICE: EMERGENCY LIGHTING DISTRIBUTION
LOCATION: SPILLWAY ELECTRICAL BUILDING
FED FROM: 2440–UPS–90–0001
FEEDER CABLE No.: 2440–90C4–NNNN
MOUNTING TRIM: SURFACE

REV.	CABLE No.	LOAD DESCRIPTION	LOAD (VA)	BKR AMPS	CCT. No.	PHASE LOAD (VA) A	B	C	CCT. No.	BKR AMPS	LOAD (VA)	LOAD DESCRIPTION	CABLE No.	REV.
	2440–90C2–NNNN	LIGHTING – GATE HOIST BUILDING	–	15	1	–			2	15	–	EXIT LIGHTING	2440–90C2–NNNN	
	2440–90C2–NNNN	LIGHTING – GATE HOIST BUILDING	–	15	3		–		4	15	–	ELECTRICAL BUILDING EXTERIOR LIGHTING	2440–90C2–NNNN	
	2440–90C2–NNNN	LIGHTING – GATE HOIST BUILDING	–	15	5			–	6	15	–	ELECTRICAL BUILDING EXTERIOR LIGHTING	2440–90C2–NNNN	
	2440–90C2–NNNN	LIGHTING – GATE HOIST ACCESS STAIR	–	15	7	–			8	15	–	ELECTRICAL BUILDING INTERIOR LIGHTING ELECTRICAL RM	2440–90C2–NNNN	
	2440–90C2–NNNN	LIGHTING – GATE HOIST ACCESS STAIR	–	15	9		–		10	15	–	ELECTRICAL BUILDING INTERIOR LIGHTING GEN. RM	2440–90C2–NNNN	
	2440–90C2–NNNN	LIGHTING – GATE HOIST FLOODLIGHTS	–	15	11			–	12	15	–	SPARE	–	
	–	SPARE	–	15	13	–			14	15	–	LIGHTING – FUTURE NORTH DAM INSPECTION GALLERY (BY OTHERS)	–	
	–	SPARE	–	15	15		–		16	15	–	LIGHTING – FUTURE NORTH DAM INSPECTION GALLERY (BY OTHERS)	–	
	–	SPARE	–	15	17			–	18	15	–	LIGHTING – FUTURE NORTH DAM INSPECTION GALLERY (BY OTHERS)	–	
	–	SPARE	–	15	19	–			20	15	–	SPARE	–	
	–	SPARE	–	15	21		–		22	15	–	SPARE	–	
	–	SPARE	–	15	23			–	24	15	–	SPARE	–	
	–	SPACE	–	–	25	–			26	–	–	SPACE	–	
	–	SPACE	–	–	27		–		28	–	–	SPACE	–	
	–	SPACE	–	–	29			–	30	–	–	SPACE	–	
	–	SPACE	–	–	31	–			32	–	–	SPACE	–	
	–	SPACE	–	–	33		–		34	–	–	SPACE	–	
	–	SPACE	–	–	35			–	36	–	–	SPACE	–	
	–	SPACE	–	–	37	–			38	–	–	SPACE	–	
	–	SPACE	–	–	39		–		40	–	–	SPACE	–	
	–	SPACE	–	–	41			–	42	–	–	SPACE	–	
		TOTAL PHASE LOAD (VA)	–	–	–									
		TOTAL CONNECTED LOAD (VA)	–											
		DIVERSITY FACTOR (%)	–											
		MAXIMUM DEMAND (VA)	–											

AF: ARC FAULT BREAKER
ST: SHUNT TRIP BREAKER
GFI: GROUND FAULT INTERRUPTER
LOTF: LOCK–ON/TRIP–FREE DEVICE

PANELBOARD 2440 – DPB – 82 – 0002

POWER SYSTEM: 600/347 Vac, 3 PHASE, 4 WIRE, 60 Hz.
BUS RATING: 225 AMPS
MAIN BREAKER: 100 AMPS
INTERRUPTING CAPACITY: 18 kA RMS (SYMMETRICAL)
NUMBER OF POLES: 42

SERVICE: ESSENTIAL 600/347 Vac LOADS
LOCATION: SPILLWAY ELECTRICAL BUILDING
FED FROM: 2440–T–82–0001
FEEDER CABLE No.: 2440–82C4–NNNN
MOUNTING TRIM: SURFACE

REV.	CABLE No.	LOAD DESCRIPTION	LOAD (VA)	BKR AMPS	CCT. No.	PHASE LOAD (VA) A	B	C	CCT. No.	BKR AMPS	LOAD (VA)	LOAD DESCRIPTION	CABLE No.	REV.
	2440–82C3–NNNN	EMERGENCY LIGHTING SYSTEM 2440–UPS–90–0001	4,000	15 3P	1	14000			2	40 3P	10,000	TRANSFORMER: 2440–T–82–0004 PANELBOARD: 2440–DPB–83–0002 ESSENTIAL 208/120 V LOADS	2440–82C3–NNNN	
			4,000		3		14000		4		10,000			
			4,000		5			14000	6		10,000			
	2440–82C3–NNNN	BATTERY CHARGER A1	–	15 3P	7	–			8	15 3P	–	BATTERY CHARGER A2	2440–82C3–NNNN	
			–		9		–		10		–			
			–		11			–	12		–			
	2440–82C3–NNNN	ELECTRICAL ROOM UNIT HEATER (5 kW)	1667	15 3P	13	3333			14	15 3P	1667	ELECTRICAL ROOM UNIT HEATER (5 kW)	2440–82C3–NNNN	
			1667		15		3333		16		1667			
			1667		17			3333	18		1667			
	2440–82C2–NNNN	120 VAC INVERTER FOR UPS LOADS (3 kVA)	2500	15 2P	19	2500			20	– –	–	SPACE	–	
			2500		21		2500		22		–			
	–	SPACE	–	–	23			–	24		–			
	–	SPARE	–	15 3P	25	–			26	– –	–	SPACE	–	
			–		27		–		28		–			
			–		29			–	30		–			
	–	SPACE	–	– –	31	–			32	– –	–	SPACE	–	
			–		33		–		34		–			
			–		35			–	36		–			
	–	SPACE	–	– –	37	–			38	– –	–	SPACE	–	
			–		39		–		40		–			
			–		41			–	42		–			
		TOTAL PHASE LOAD (VA)	–	–	–									
		TOTAL CONNECTED LOAD (VA)	–											
		DIVERSITY FACTOR (%)	–											
		MAXIMUM DEMAND (VA)	–											

AF: ARC FAULT BREAKER
ST: SHUNT TRIP BREAKER
GFI: GROUND FAULT INTERRUPTER
LOTF: LOCK–ON/TRIP–FREE DEVICE

NOTE

1. ALL LOAD RATINGS ARE PRELIMINARY. LOAD RATINGS WILL BE FINALIZED BASED ON SUPPLIER DATA SHEETS.
2. ALL CB AND BUS RATINGS, CABLE SIZES AND TRANSFORMER RATINGS ARE PRELIMINARY. DEVICE RATINGS AND CABLE SIZES WILL BE REVISED ACCORDING TO SUPPLIER LOAD LISTS.

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC–LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL: N0466
which is valid for the year 2013

This document has been signed and accepted electronically via Aconex.

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12–JUL–2013	APPROVED FOR DESIGN
1	B1	31–OCT–2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA–SN–CD–2440–EL–SL–0001–01	SPILLWAY 600 VAC AUXILLARY SINGLE LINE DIAGRAM

No.	REFERENCE DRAWING

No.	DATE	REVISION	NA/RN	WC	GH	MOD.	VER.	APP.
D1	12–JUL–2013	GENERAL REVISION.						

* * * * * * * * * FOR INTERNAL USE ONLY * * * * * * * * *
REVIEW CLASS: EQUIPMENT TAG NUMBER:
REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.
☑ 1. REVIEWED AND ACCEPTED NO COMMENTS
☐ 2. REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED – NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED
LEAD REVIEWER: R. Kaushik — Date (dd–mmm–yyyy): 15–Aug–2013
NE–LCP MANAGEMENT: B. Barnes — Date (dd–mmm–yyyy): 16–Aug–2013
PROJECT MANAGER: Bruce Drover — Date (dd–mmm–yyyy): 16–Aug–2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND & LABRADOR
PEGL PERMIT HOLDER
G. W. HAINES
NEWFOUNDLAND
12–JUL–2013
DATE
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND & LABRADOR

SNC•LAVALIN

CLIENT: nalcor energy

DESIGNED BY: R. NOSEWORTHY/NAZMUL ALAM	APPROVED: Discipline Lead Engineer R. SANJAN
DRAWN BY: T. SHEPPARD	APPROVED: Engineering Manager G. SNYDER
VERIFIED BY: W. CALDWELL	
DATE: 04–JUL–2012	SCALE: NTS

PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
SPILLWAY
600/347 V DISTRIBUTION
PANELBOARD SCHEDULES

The No.: 505573–3243–47DD–0122_01
MFA–SN–CD–2440–EL–DR–0002–01 Rev. D1
FORMAT A0 (mm)
SUB–PKG: 0032–4701 PLATE 15

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PANELBOARD 2440 – DPB – 83 – 0002

POWER SYSTEM: 208/120 Vac, 3 PHASE, 4 WIRE, 60 Hz.
BUS RATING: 225 AMPS
MAIN BREAKER: LUGS ONLY
INTERRUPTING CAPACITY: 14 kA RMS (SYMMETRICAL)
NUMBER OF POLES: 42

SERVICE: ESSENTIAL 208/120 Vac LOADS
LOCATION: SPILLWAY ELECTRICAL BUILDING
FED FROM: 2440–T–82–0004
FEEDER CABLE No.: 2440–83C4–NNNN
MOUNTING TRIM: SURFACE

REV.	CABLE No.	LOAD DESCRIPTION	LOAD (VA)	BKR AMPS	CCT. No.	PHASE LOAD (VA) A	B	C	CCT. No.	BKR AMPS	LOAD (VA)	LOAD DESCRIPTION	CABLE No.	REV.
	3340–83C3–0201	FUTURE MAIN GATE CONTROLLER	–	15	1	–			2	15		MAIN MCC/SWITCHGEAR	3340–83C3–0251	
	3340–83C3–0203	GATE 1 CONTROLLER	–	15	3		–		4	15		DIESEL GENERATOR CONTROLLER	3340–83C3–0253	
	3340–83C3–0205	GATE 2 CONTROLLER	–	15	5			–	6	15		DIESEL GENERATOR BATTERY CHARGER	3340–83C3–0255	
	3340–83C3–0207	GATE 3 CONTROLLER	–	15	7	–			8	15		DIESEL GENERATOR FUEL PUMP	3340–83C3–0257	
	3340–83C3–0209	GATE 4 CONTROLLER	–	15	9		–		10	15		DIESEL GENERATOR BLOCK HEATER	3340–83C3–0259	
	3340–83C3–0211	GATE 5 CONTROLLER	–	15	11			–	12	15		DIESEL GENERATOR COOLANT HEATER	3340–83C3–0261	
	3340–83C3–0213	TELECOM PANEL 1	–	15	13	–			14	15		DIESEL GENERATOR LUBE OIL HEATER	3340–83C3–0263	
	3340–83C3–0215	TELECOM PANEL 2	–	15	15		–		16	15		DIESEL GENERATOR BATTERY HEATER	3340–83C3–0265	
	3340–83C3–0217	TELECOM PANEL 3	–	15	17			–	18	15		DIESEL GENERATOR FUEL LIGHTING	3340–83C3–0267	
	3340–83C3–0219	CCTV MONITORS	–	15	19	–			20	15	–	SPARE	–	
	3340–83C3–0221	FIRE ALARM CONTROL PANEL	–	15	21		–		22	15	–	SPARE	–	
	3340–83C3–0223	INTRUSION ALARM CONTROL PANEL	–	15	23			–	24	15	–	SPARE	–	
	3340–83C3–0225	LIGHTING CONTROL PANEL	–	15	25	–			26	15	–	SPARE	–	
	–	SPACE	–	15	27		–		28	15	–	SPACE	–	
	–	SPACE	–	15	29			–	30	15	–	SPACE	–	
	–	SPACE	–	–	31	–			32	–	–	SPACE	–	
	–	SPACE	–	–	33		–		34	–	–	SPACE	–	
	–	SPACE	–	–	35			–	36	–	–	SPACE	–	
	–	SPACE	–	–	37	–			38	–	–	SPACE	–	
	–	SPACE	–	–	39		–		40	–	–	SPACE	–	
	–	SPACE	–	–	41			–	42	–	–	SPACE	–	
		TOTAL PHASE LOAD (VA)	–	–	–									
		TOTAL CONNECTED LOAD (VA)	–											
		DIVERSITY FACTOR (%)	–											
		MAXIMUM DEMAND (VA)	–											

AF: ARC FAULT BREAKER
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BUS RATING: 225 AMPS
MAIN BREAKER: LUGS ONLY
INTERRUPTING CAPACITY: 14 kA RMS (SYMMETRICAL)
NUMBER OF POLES: 42

SERVICE: NON–ESSENTIAL 208/120 Vac LOADS
LOCATION: SPILLWAY ELECTRICAL BUILDING
FED FROM: 2440–T–82–0002
FEEDER CABLE No.: 2440–83C4–NNNN
MOUNTING TRIM: SURFACE

REV.	CABLE No.	LOAD DESCRIPTION	LOAD (VA)	BKR AMPS	CCT. No.	PHASE LOAD (VA) A	B	C	CCT. No.	BKR AMPS	LOAD (VA)	LOAD DESCRIPTION	CABLE No.	REV.
	3340–83C3–0150	RECEPTACLES – ELECTRICAL ROOM	–	15	1	–			2	15	–	RECEPTACLES – DIESEL ROOM	3340–83C3–0200	
	3340–83C3–0152	RECEPTACLES – ELECTRICAL ROOM	–	15	3		–		4	15	–	RECEPTACLES – DIESEL ROOM	3340–83C3–0202	
	3340–83C3–0154	HVAC AC CTL PANEL–1	–	15	5			–	6	15	–	HVAC AC CTL PANEL–2	3340–83C3–0204	
	3340–83C3–0156	RECEPTACLES – EXTERIOR	–	15	7	–			8	15	–	SPARE	–	
	3340–83C3–0158	RECEPTACLES – EXTERIOR UNDER DECK	–	15	9		–		10	15	–	SPARE	–	
	3340–83C3–0160	SPARE	–	15	11			–	12	15	–	SPARE	–	
	3340–83C3–0162	SPARE	–	15	13	–			14	15	–	SPARE	–	
	3340–83C3–0164	SPARE	–	15	15		–		16	15	–	SPARE	–	
	3340–83C3–0166	SPARE	–	15	17			–	18	15	–	SPARE	–	
	3340–83C3–0168	SPARE	–	15	19	–			20	15	–	SPARE	–	
	3340–83C3–0221	SPARE	–	15	21		–		22	15	–	SPARE	–	
	3340–83C3–0223	SPARE	–	15	23			–	24	15	–	SPARE	–	
	3340–83C3–0225	SPARE	–	15	25	–			26	15	–	SPARE	–	
	–	SPACE	–	15	27		–		28	15	–	SPACE	–	
	–	SPACE	–	15	29			–	30	15	–	SPACE	–	
	–	SPACE	–	–	31	–			32	–	–	SPACE	–	
	–	SPACE	–	–	33		–		34	–	–	SPACE	–	
	–	SPACE	–	–	35			–	36	–	–	SPACE	–	
	–	SPACE	–	–	37	–			38	–	–	SPACE	–	
	–	SPACE	–	–	39		–		40	–	–	SPACE	–	
	–	SPACE	–	–	41			–	42	–	–	SPACE	–	
		TOTAL PHASE LOAD (VA)	–	–	–									
		TOTAL CONNECTED LOAD (VA)	–											
		DIVERSITY FACTOR (%)	–											
		MAXIMUM DEMAND (VA)	–											

AF: ARC FAULT BREAKER
ST: SHUNT TRIP BREAKER
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LOTF: LOCK–ON/TRIP–FREE DEVICE

NOTE

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NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC–LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL: 02466
which is valid for the year 2013.

This document has been signed and accepted electronically via Aconex.

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12–JUL–2013	APPROVED FOR DESIGN
1	B1	31–OCT–2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA–SN–CD–2440–EL–SL–0001–01	SPILLWAY 600 VAC AUXILLARY SINGLE LINE DIAGRAM

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12–JUL–2013	GENERAL REVISION.	NA/BN	WC	GH

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LEAD REVIEWER: R. Kaushik — Date (dd-mmm-yyyy): 15-Aug-2013
NS–LCP MANAGEMENT: B. Barnes — Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAG: Bruce Drover — Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS PEGNL PERMIT TO PRACTICE
Q. W. HAINES
NEWFOUNDLAND & LABRADOR
25–JUL–2013

SNC•LAVALIN

DESIGNED BY R. NOSEWORTHY/NAZMUL ALAM	APPROVED Discipline Lead Engineer R. SANJAN
DRAWN BY T. SHEPPARD	APPROVED Engineering Manager G. SNYDER
VERIFIED BY W. CALDWELL	
DATE 04–JUL–2012	SCALE NTS

CLIENT: nalcor energy — ARMB CHURCHILL PROJECT
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
SPILLWAY
208/120 V DISTRIBUTION
PANELBOARD SCHEDULES

File No. 505573–3243–47DD–0106_01
MFA–SN–CD–2440–EL–DR–0003–01 Rev. D1
FORMAT: ISO (mm)
SUB–PKG: 0032–4701 PLATE 16

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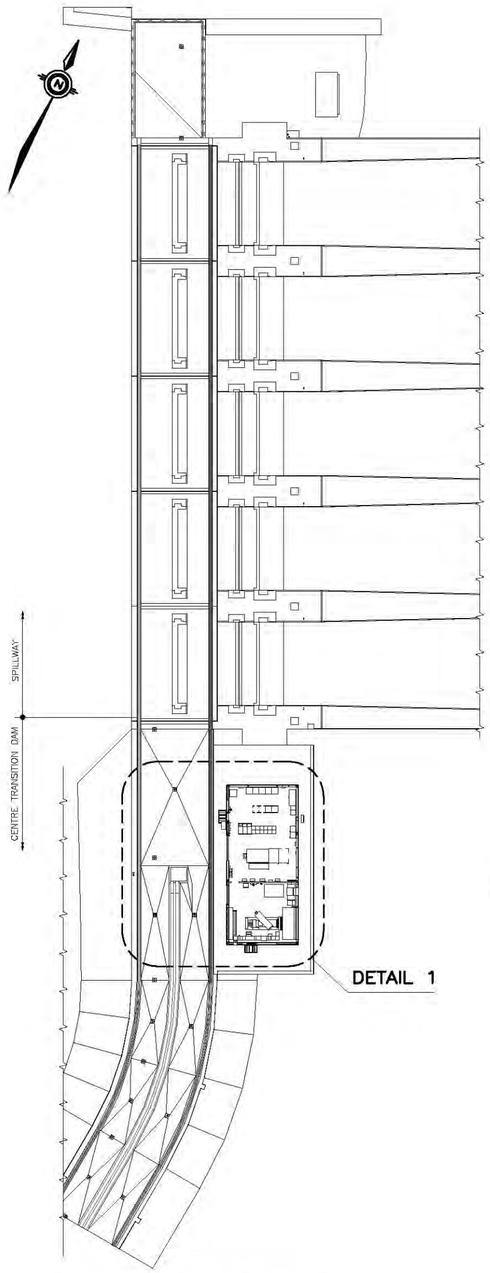
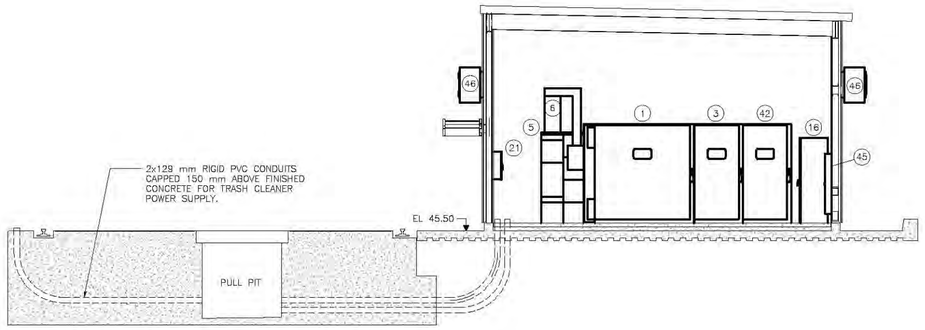
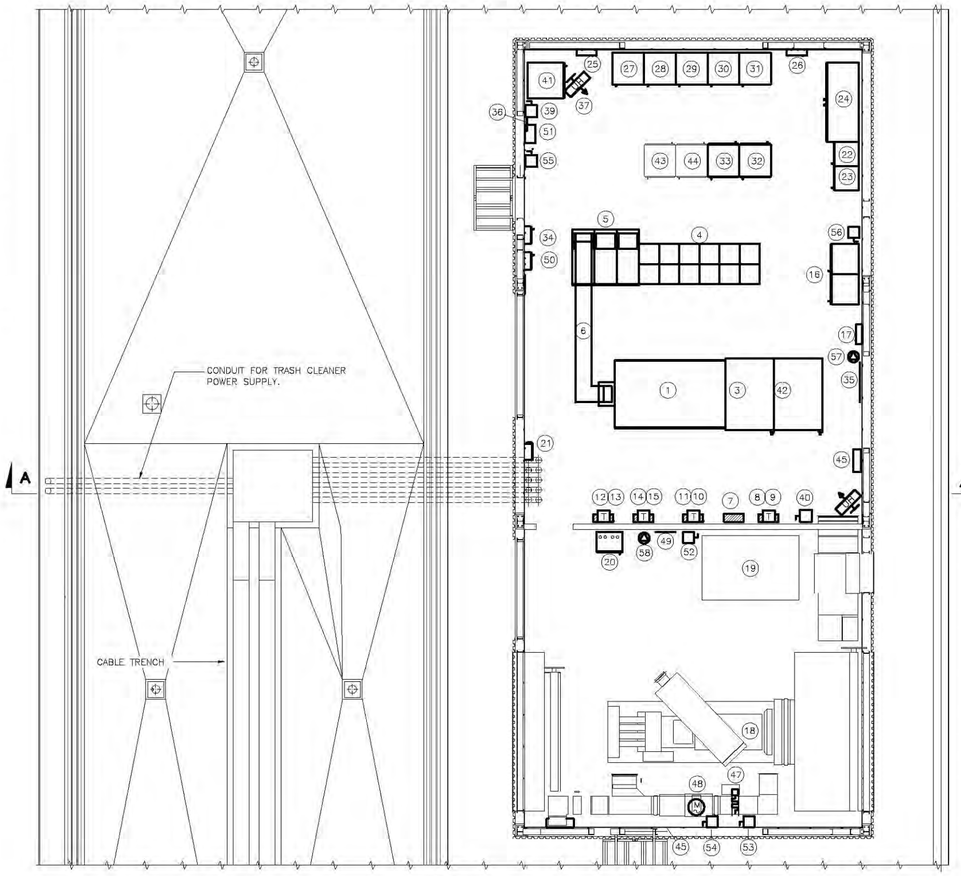


SPILLWAY PART SITE PLAN EL 45.50
1:250

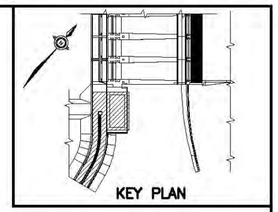


SECTION A–A
ELECTRICAL BUILDING AT SPILLWAY
1:50



DETAIL 1
ELECTRICAL BUILDING AT SPILLWAY EL 45.50
1:50

1	2440–T–81–0001	25–0.6 kV DRY TYPE TRANSFORMER
2	–	NOT USED
3	2440–LBS–81–0002	25 kV FUSED LOAD BREAK SWITCH
4	2440–MCC–82–0001	600 V MCC
5	2440–SWG–82–0001	600 V SWITCHGEAR WITH 2 INCOMERS AND BUS TRANSITION SECTION
6	2440–NPB–82–0001	600 V, 3W COPPER BUSWAY
7	2440–DPB–82–0001	600 V, 3W PANELBOARD FOR NORMAL LOADS
8	2440–T–90–0001	600–600/347 V NORMAL LIGHTING TRANSFORMER
9	2440–DPB–90–0001	600/347 V NORMAL LIGHTING PANELBOARD
10	2440–T–82–0002	600–208/120 V TRANSFORMER FOR NORMAL LOADS
11	2440–DPB–83–0001	208/120 V PANELBOARD FOR NORMAL LOADS
12	2440–T–82–0001	600–600/347 V TRANSFORMER FOR ESSENTIAL LOADS
13	2440–DPB–82–0002	600/347 V PANELBOARD FOR ESSENTIAL LOADS
14	2440–T–82–0004	600–208/120 V TRANSFORMER FOR ESSENTIAL LOADS
15	2440–DPB–83–0002	208/120 V PANELBOARD FOR ESSENTIAL LOADS
16	2440–UPS–90–0001	CENTRAL EMERGENCY LIGHTING SYSTEM
17	2440–DPB–90–0002	600/347 V EMERGENCY LIGHTING PANELBOARD
18	2440–DG–82–0001	600 V DIESEL GENERATOR
19	2440–TK–00–0001	DIESEL GENERATOR DAY TANK
20	2440–MTS–82–0001	600 V DOUBLE THROW MANUAL TRANSFER SWITCH
21	2440–SW–82–0003	600 V, 3P, SAFETY SWITCH FOR TRASH CLEANER POWER SUPPLY
22	2440–CHR–84–A001	125 Vdc BATTERY CHARGER "A"
23	2440–CHR–84–B001	125 Vdc BATTERY CHARGER "B"
24	2440–BAT–84–0001	125 Vdc BATTERY BANK
25	2440–DPB–84–A001	125 Vdc DISTRIBUTION PANEL "A"
26	2440–DPB–84–B001	125 Vdc DISTRIBUTION PANEL "B"
27	2440–CP–87–0101	SPILLWAY GATE No. 1 CONTROLLER
28	2440–CP–87–0201	SPILLWAY GATE No. 2 CONTROLLER
29	2440–CP–87–0301	SPILLWAY GATE No. 3 CONTROLLER
30	2440–CP–87–0401	SPILLWAY GATE No. 4 CONTROLLER
31	2440–CP–87–0501	SPILLWAY GATE No. 5 CONTROLLER
32	2440–TP–89–0001	TELECOM CONTROL PANEL
33	2440–TP–89–0002	TELECOM CONTROL PANEL
34	2440–FAP–92–0001	FIRE ALARM CONTROL PANEL
35	2440–GRD–91–0001	ELECTRICAL ROOM GROUND BAR
36	2440–GRD–91–0003	TELECOM GROUND BAR
37	2440–UH–82–0001	600 V, 3PH, ELECTRIC BLOWER UNIT HEATER
38	2440–UH–82–0002	600 V, 3PH, ELECTRIC BLOWER UNIT HEATER
39	2440–SW–82–0001	600 V, 3P SAFETY SWITCH FOR UNIT HEATER
40	2440–SW–82–0002	600 V, 3P SAFETY SWITCH FOR UNIT HEATER
41	2440–UPS–83–0001	120 Vac UPS
42	2440–LBS–81–0001	25 kV FUSED LOAD BREAK SWITCH
43	2440–CP–87–0001	MAIN SPILLWAY GATE CONTROLLER (FUTURE, BY CH0030)
44	2440–TP–89–0003	TELECOM CONTROL PANEL (FUTURE, BY CH0030)
45	(SEE NOTE 1)	HVAC CONTOL PANEL
46	(SEE NOTE 1)	ELECTRICAL ROOM EXHAUST FAN
47	(SEE NOTE 1)	GENERATOR ROOM DUCT–MOUNTED HEATING COIL
48	(SEE NOTE 1)	GENERATOR ROOM SUPPLY FAN
49	2440–GRD–91–0002	GENERATOR ROOM GROUND BAR
50	2440–CP–90–0001	EXTERIOR LIGHTING CONTROL PANEL
51	2440–DPB–83–0003	120 VAC UPS DISTRIBUTION PANEL.
52	2440–SW–82–0005	600 V, 3P SAFETY SWITCH FOR FUEL TRANSFER PUMP
53	2440–SW–82–0006	600 V, 3P SAFETY SWITCH FOR HEATING COIL
54	2440–SW–82–0007	600 V, 3P SAFETY SWITCH FOR SUPPLY FAN
55	2440–SW–82–0008	600 V, 3P SAFETY SWITCH FOR EXHAUST FAN
56	2440–SW–82–0009	600 V, 3P SAFETY SWITCH FOR EXHAUST FAN
57	2440–PO–82–0001	600 V INTERLOCKED SWITCH & RECEP. POWER OUTLET
58	2440–PO–82–0002	600 V INTERLOCKED SWITCH & RECEP. POWER OUTLET



NOTE:

1. SEE REFERENCE DRAWING MFA–SN–CD–2440–ME–PL–0001–01 FOR MECHANICAL EQUIPMENT TAG NUMBERS.

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0 5000 10000 15000 20000 mm
1 : SCALE 1:250

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Z	D1	12–JUL–2013	APPROVED FOR DESIGN
1	B1	30–OCT–2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA–SN–CD–2440–ME–PL–0001–01	SPILLWAY ELECTRICAL BUILDING PLAN AND SECTIONS HVAC
MFA–SN–CD–2440–EL–RT–0001–01	SPILLWAY ELECTRICAL BUILDING CABLE TRAY AND CONDUIT LAYOUT
MFA–SN–CD–2440–EL–SL–0001	SPILLWAY 600 V AC AUXILIARY SINGLE LINE DIAGRAM
MFA–SN–CD–3430–EL–LS–0007	ELECTRICAL SERVICES LAYOUT LEGEND

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12–JUL–2013	GENERAL REVISION.	NA	NC	GH

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LEAD REVIEWER: R. Kaushik Date (MM–DD–YYYY): 15–Aug–2013
NE–LCP MANAGEMENT: B. Barnes Date (MM–DD–YYYY): 16–Aug–2013
PROJECT MANAGER: Bruce Drover Date (MM–DD–YYYY): 16–Aug–2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND AND LABRADOR
WILLIAM C. CALDWELL
12–JUL–2013
Date
ENGINEERING & APPLIED SCIENCES

SNC•LAVALIN

DESIGNED BY N. ALAM / R. NOSEWORTHY	APPROVED Discipline Lead Engineer R. SANLIAN
DRAWN BY V. HERNANDEZ	APPROVED Engineering Manager G. SNYDER
VERIFIED BY W. CALDWELL	
DATE 04–APR–2012	SCALE AS SHOWN
SLI DOC No. 505573–3243–470D–0121_01	No. AND REV. MFA–SN–CD–2440–EL–LT–0002–01 D1

CLIENT: nalcor ENERGY
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS SPILLWAY DIVERSION PHASE ELECTRICAL ROOM EQUIPMENT LAYOUT

SUB-PKG: 0032-4701 PLATE 06

2013/08/21 4:16:21 PM
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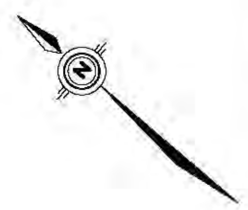
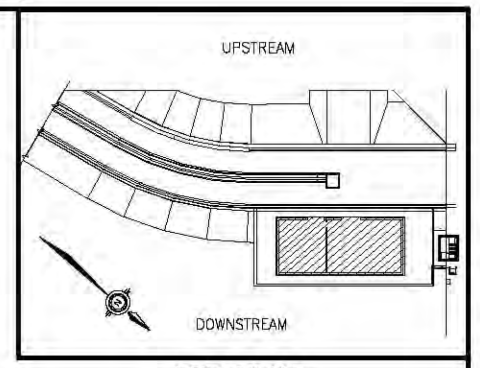




KEY PLAN

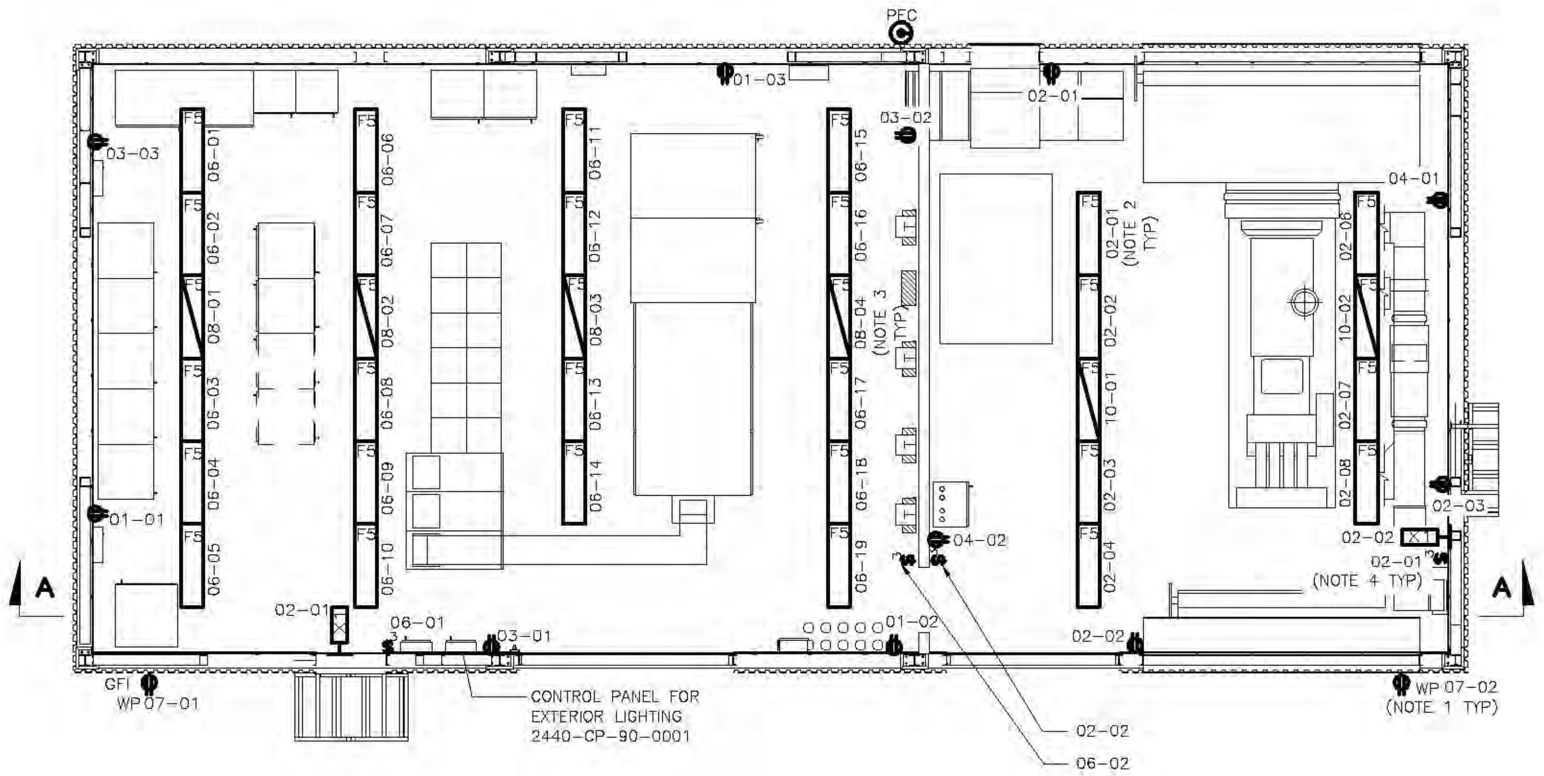
NOTES:

1–RECEPTACLE TAG NUMBERS ARE PREFIXED BY 2440–RC–630001.

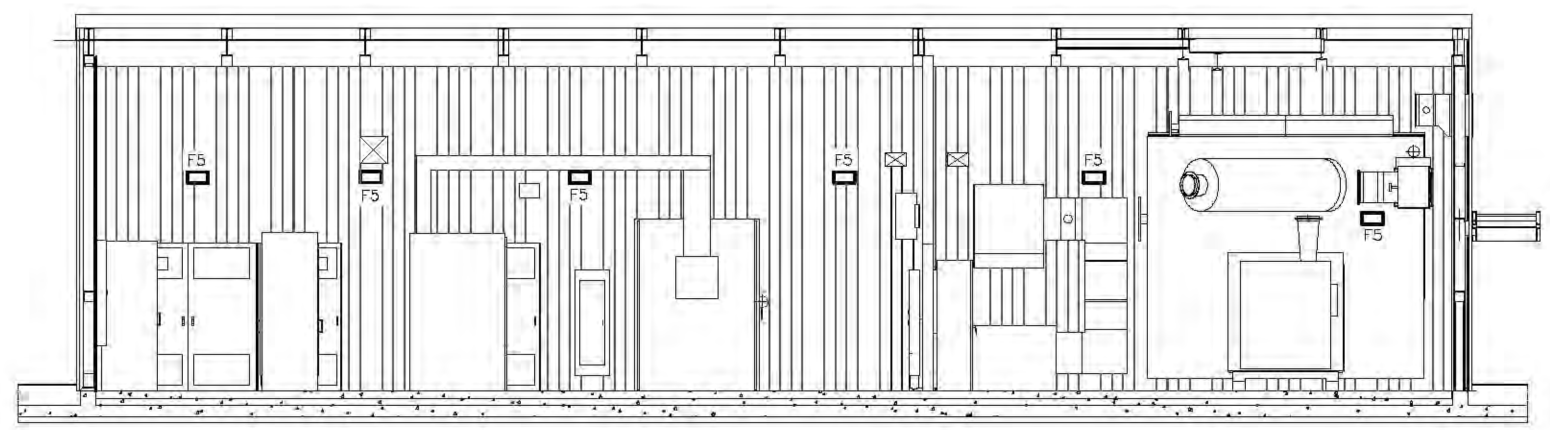
2–NORMAL LIGHTING FIXTURE TAG NUMBERS ARE PREFIXED BY 2440–LF–900001.

3–EMERGENCY LIGHTING AND EXIT SIGNS TAG NUMBERS ARE PREFIXED BY 2440–LF–900002.

4–SWITCH TAG NUMBERS ARE PREFIXED BY 2440–LF–900001.



LIGHTING PLAN VIEW AT EL 45.50



SECTION A–A

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1	B1	06–NOV–2012	ISSUED FOR BID/PURCHASE				

ISSUE REGISTER

No.	REFERENCE DRAWING	No.	REFERENCE DRAWING
MFA–SN–CD–2440–EL–LT–0002–01	SPILLWAY DIVERSION PHASE ELECTRICAL ROOM EQUIPMENT LAYOUT		
MFA–SN–CD–2440–EL–LT–0006–01	SPILLWAY ELECTRICAL AUXILIARIES INSTALLATION LAYOUT	MFA–SN–CD–3340–EL–DD–0019–01	POWERHOUSE INSTALLATION DETAILS LIGHTING & RECEPTACLES
MFA–SN–CD–3340–EL–DD–0045–01	SPILLWAY ELECTRICAL BUILDING CCTV; TEL; FIRE ALARM AND SECURITY SYSTEMS EQUIP. LAYOUT AND DETAILS	MFA–SN–CD–3340–EL–DD–0020–01	POWERHOUSE LUMINAIRE TYPES LIGHTING & RECEPTACLES
MFA–SN–CD–2440–EL–DR–0003–01	SPILLWAY 208/120 V DISTRIBUTION PANELS PANELBOARD SCHEDULES	MFA–SN–CD–2440–EL–RT–0001–01	SPILLWAY ELECTRICAL BUILDING CABLE TRAY AND CONDUIT LAYOUT
MFA–SN–CD–3430–EL–LS–0007–01	POWERHOUSE ELECTRICAL SERVICES LAYOUT LEGEND	MFA–SN–CD–2440–EL–DD–0006–01	SPILLWAY DIVERSION PHASE SURFACE GROUNDING
MFA–SN–CD–3430–EL–SD–0002–01	ELECTRICAL SERVICES IDENTIFICATION STANDARD	MFA–SN–CD–2440–EL–DR–0002–01	SPILLWAY 600/347 V DISTRIBUTION PANELS PANELBOARD SCHEDULES

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12–JUL–2013	GENERAL REVISION.	VJ	WC	GH

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LEAD REVIEWER: R. Kaushik — Date (dd-mmm-yyyy): 15-Aug-2013

NE–LCP MANAGEMENT: B. Barnes — Date (dd-mmm-yyyy): 16-Aug-2013

PROJECT MANAGER: Bruce Drover — Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP: REGISTERED PROFESSIONAL ENGINEER VICTOR JAREMKO SIGNATURE 12–JUL–2013 DATE NEWFOUNDLAND & LABRADOR

SNC·LAVALIN

CLIENT: nalcor energy

DESIGNED BY	V. JAREMKO	APPROVED Discipline Lead Engineer	R. SANLIAN
DRAWN BY	V. HERNANDEZ	APPROVED Engineering Manager	
VERIFIED BY	W. CALDWELL		
DATE	26–JUN–2012	SCALE	1:50

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS SPILLWAY DIVERSION PHASE LIGHTING LAYOUT AND DETAILS

SLI DOC No. 505573–3243–47DD–0123–SH1_01

NE DOC No. MFA–SN–CD–2440–EL–LT–0004–01 Rev. D1

FORMAT A0 (mm)

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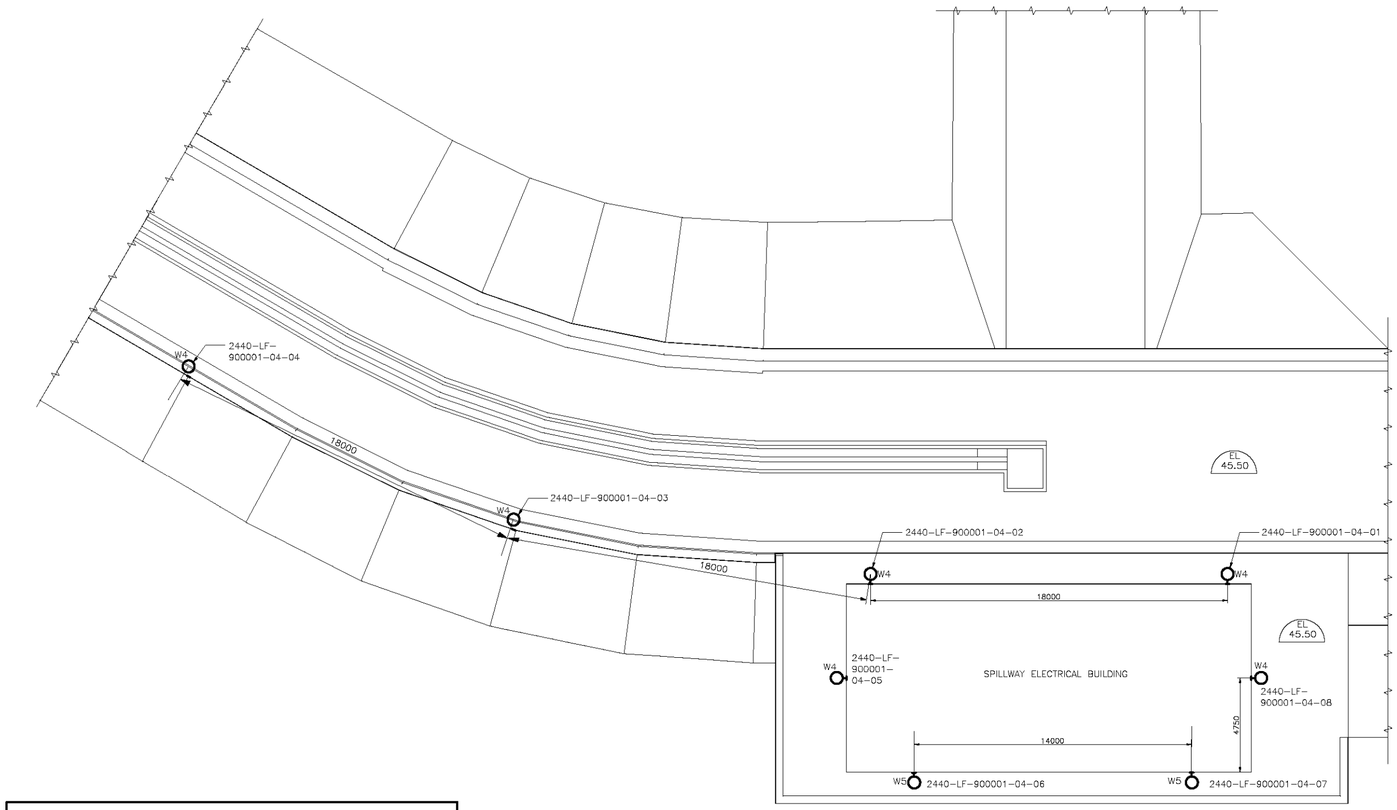
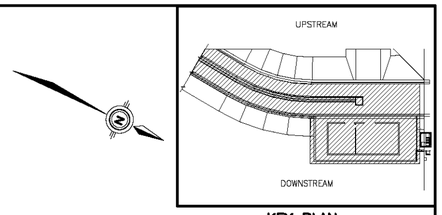
SUB-PKG: 0032-4701 PLATE 09



SPILLWAY ROADWAY AND AREA LIGHTING AT EL 45.50

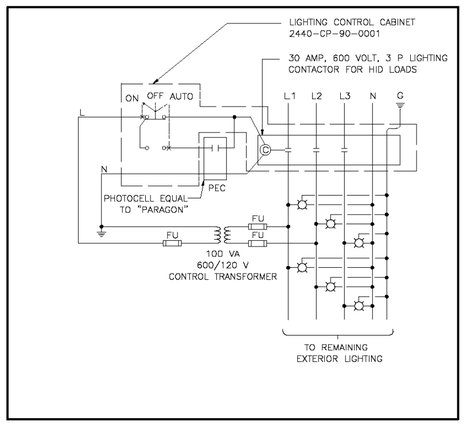


KEY PLAN

NOTES:

1- FLOODLIGHTING MOUNTED ON STEEL LAMPPOST AT EL 51.00.

2- WALL MOUNTED LIGHT FIXTURE, MOUNTED EL. 51.00.



CONTROL DIAGRAM EXTERIOR LIGHTING

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2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	B1	08-NOV-2012	ISSUED FOR BID/PURCHASE

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2440-EL-DR-0002-01	SPILLWAY 600/347 V DISTRIBUTION PANELS PANELBOARD SCHEDULES
MFA-SN-CD-2440-EL-DR-0003-01	SPILLWAY 208/120 V DISTRIBUTION PANELS PANELBOARD SCHEDULES
MFA-SN-CD-3340-EL-DD-0019-01	POWERHOUSE INSTALLATION DETAILS LIGHTING & RECEPTACLES
MFA-SN-CD-3340-EL-DD-0020-01	POWERHOUSE LUMINAIRE TYPES LIGHTING & RECEPTACLES
MFA-SN-CD-3430-EL-LS-0007-01	POWERHOUSE ELECTRICAL SERVICES LAYOUT LEGEND
MFA-SN-CD-3430-EL-SD-0002-01	ELECTRICAL SERVICES IDENTIFICATION STANDARD

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	NO CHANGES.	VJ	WC	GH

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LEAD REVIEWER: R. Kaushik — Date (dd-mmm-yyyy): 15-Aug-2013
NE-LCP MANAGEMENT: B. Barnes — Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER: Bruce Drover — Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP
VICTOR JAREMKO
12-JUL-2013

SNC·LAVALIN

DESIGNED BY V. JAREMKO	APPROVED Discipline Lead Engineer G. HAINES
DRAWN BY V. HERNANDEZ	APPROVED Engineering Manager G. SNYDER
VERIFIED BY W. CALDWELL	
DATE 26-JUN-2012	SCALE 1:100

CLIENT: nalcor ENERGY

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
DIVERSION PHASE
LIGHTING
LAYOUT AND DETAILS

SLI DOC No. 505573-3243-47DD-0123-SH2_01 | No. ADD. No. MFA-SN-CD-2440-EL-LT-0004-02 | REV. D1

CONTRACT NO. CONT.

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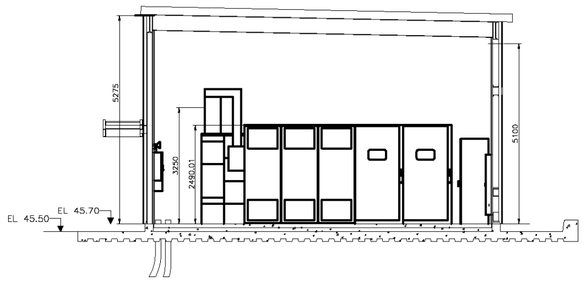
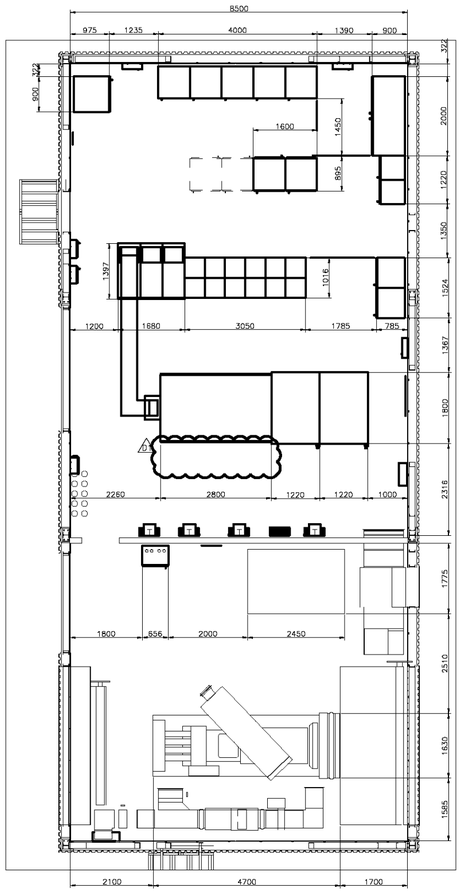
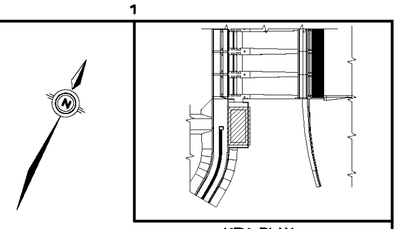
SUB-PK: 0032-4701 PLATE 10



SECTION A–A



SPILLWAY ELECTRICAL BUILDING AT EL 45.50



KEY PLAN

NOTES:

1– SEE REFERENCE DRAWING MFA–SN–CD–2440–EL–LT–0002–01 FOR EQUIPMENT IDENTIFICATION AND DESCRIPTION.

2– EQUIPMENT DIMENSIONS ARE ESTIMATED BASED ON DESIGN DATA INFORMATION.

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1	B1	06–NOV–2012	ISSUED FOR BID/PURCHASE

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA–SN–CD–2440–EL–RT–0001–01	SPILLWAY ELECTRICAL BUILDING CABLE TRAY AND CONDUIT LAYOUT
MFA–SN–CD–2440–EL–DD–0009–01	SPILLWAY DIVERSION PHASE SURFACE GROUNDING
MFA–SN–CD–2440–EL–LT–0004–01	SPILLWAY DIVERSION PHASE LIGHTING LAYOUT AND DETAILS
MFA–SN–CD–2440–EL–LT–0002–01	SPILLWAY DIVERSION PHASE ELECTRICAL ROOM EQUIPMENT LAYOUT
MFA–SN–CD–3340–EL–DD–0045–01	SPILLWAY ELECTRICAL BUILDING CCTV, TEL, FIRE ALARM AND SECURITY SYSTEMS EQUIP. LAYOUT AND DETAILS

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12–JUL–2013	REMOVED OLTC ON TRANSFORMER.	NA	RN	NRG

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LEAD REVIEWER: R. Kaushik — Date (dd–mmm–yyyy): 15-Aug-2013
NE–LCP MANAGEMENT: B. Barnes — Date (dd–mmm–yyyy): 16-Aug-2013
PROJECT MANAGER: Bruce Drover — Date (dd–mmm–yyyy): 16-Aug-2013

PROFESSIONAL STAMP

WILLIAM CALDWELL — 25–JUL–2013 — PROFESSIONAL ENGINEERING AND GEOSCIENCE NEWFOUNDLAND & LABRADOR

SNC•LAVALIN

DESIGNED BY: N. ALAM / R. NOSEWORTHY	APPROVED: Discipline Lead Engineer R. SANLIAN
DRAWN BY: V. HERNANDEZ	APPROVED: Engineering Manager G. SNYDER
VERIFIED BY: W. CALDWELL	
DATE: 17–SEP–2012	SCALE: 1 : 50

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
ELECTRICAL AUXILIARIES
INSTALLATION LAYOUT

SLI DOC No.: 505573–3243–47DD–0108_01

No. MFA No.: MFA–SN–CD–2440–EL–LT–0006–01 REV.: D1

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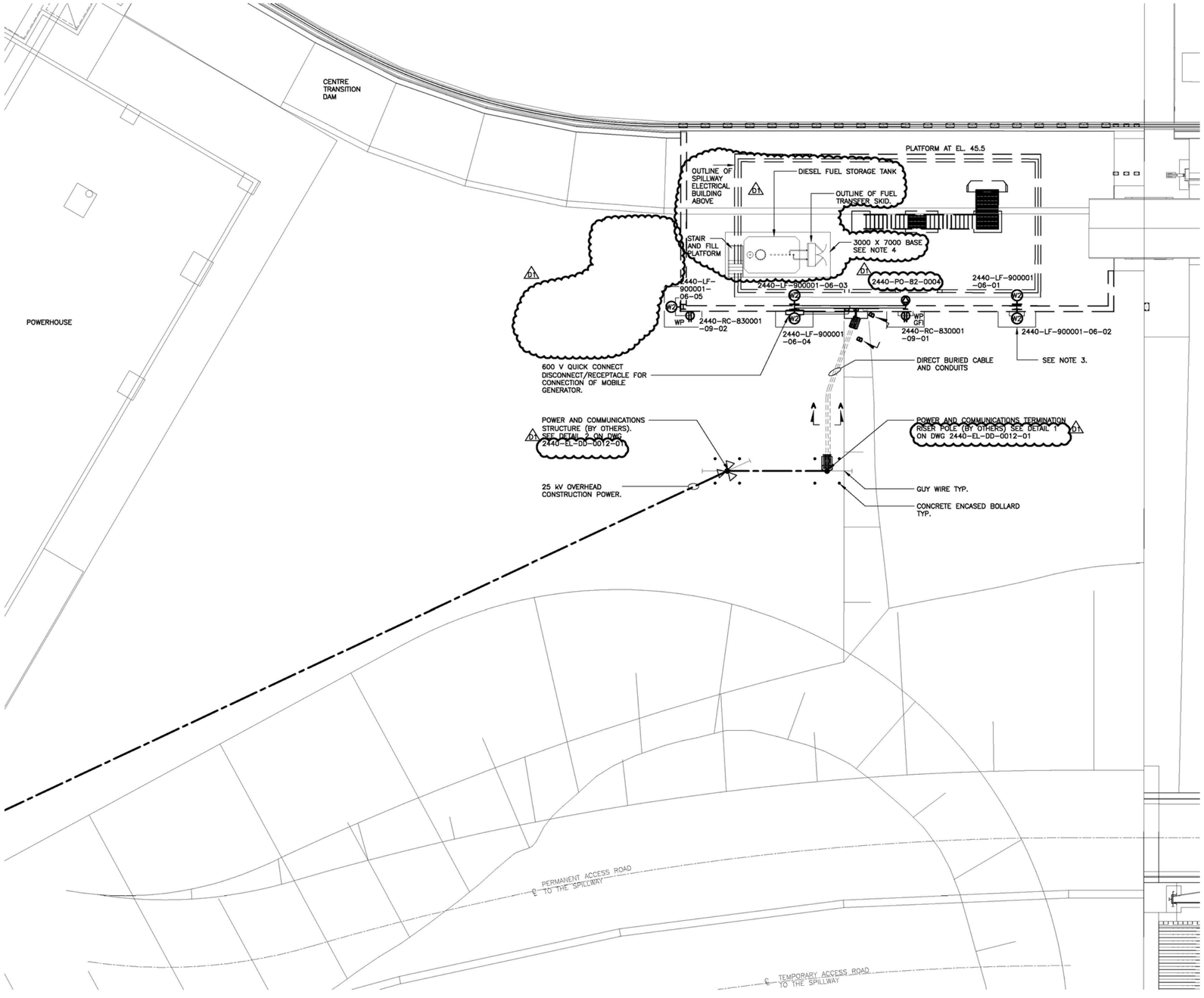
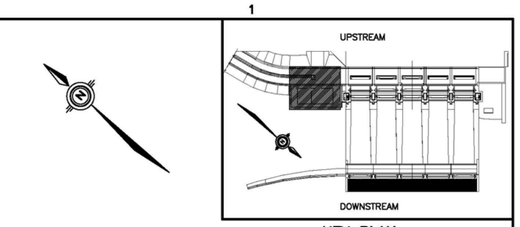


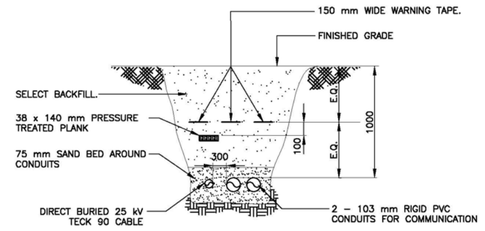
ELECTRICAL LAYOUT SITE PLAN AT EL 15.00 ±



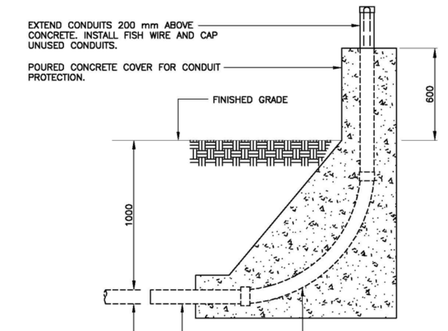
KEY PLAN

NOTES:

1. ELEVATIONS ARE IN METRES. DIMENSIONS ARE IN MILLIMETRES.
2. 25 kV LINE ROUTING TO SPILLWAY IS APPROXIMATE, CONSTRUCTED UNDER CONTRACT CD0512.
3. MOUNT LIGHTS ON STEEL COLUMNS AT 3.0 m ABOVE FINISHED GRADE. PROVIDE ALL NECESSARY HARDWARE (TYPICAL FOR ALL LIGHT FIXTURES).
4. DIESEL FUEL STORAGE TANK SIZE AND LOCATION TO BE CONFIRMED.



SECTION A–A
NTS



SECTION B–B
NTS

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SCALE 1:100

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	B1	08-NOV-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2440-EL-DR-0002-01	SPILLWAY – 600 / 347 V DISTRIBUTION PANELS PANELBOARD SCHEDULES
MFA-SN-CD-2440-EL-DR-0003-01	SPILLWAY – 208 / 120 V DISTRIBUTION PANELS PANELBOARD SCHEDULES
MFA-SN-CD-2440-EL-SL-0004-01	SPILLWAY – DIVERSION PHASE TEMPORARY POWER SINGLE LINE DIAGRAM
MFA-SN-CD-2440-EL-DD-0005-01	SPILLWAY – DIVERSION PHASE TEMPORARY POWER GENERAL LAYOUT
MFA-SN-CD-2440-EL-DD-0012-01	SPILLWAY – DIVERSION PHASE TEMPORARY POWER DETAILS
MFA-SN-CD-3430-EL-SD-0002-01	ELECTRICAL SERVICES IDENTIFICATION STANDARD

No.	REFERENCE DRAWING
MFA-SN-CD-3340-EL-DD-0019-01	POWERHOUSE INSTALLATION DETAILS LIGHTING AND RECEPTACLES
MFA-SN-CD-3340-EL-DD-0020-01	POWERHOUSE LUMINAIRE TYPES LIGHTING AND RECEPTACLES

No.	DATE	REVISION	MOD.	VER.	APP.

FOR INTERNAL USE ONLY

REVIEW CLASS: EQUIPMENT TAG NUMBER:

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☑ 1. REVIEWED AND ACCEPTED NO COMMENTS
☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED

LEAD REVIEWER: R. Kaushik — Date (dd-mmm-yyyy): 15-Aug-2013
NE-LCP MANAGEMENT: B. Barnes — Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER: Bruce Drover — Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS PROVINCE OF NEWFOUNDLAND AND LABRADOR
VICTOR JAREMKO
ENGINEER
12-AUG-2013
REV. C2
ORIGINAL SIGNED AND SEALED BY R. SANJAN UNDER REVISION C1.

SNC·LAVALIN

DESIGNED BY V. JAREMKO	APPROVED Discipline Lead Engineer G. HAINES
DRAWN BY T. SHEPPARD	APPROVED Engineering Manager G. SNYDER
VERIFIED BY W. CALDWELL	
DATE 23-SEP-2011	SCALE 1:100 U.N.O.

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
DIESEL FUEL TANK AREA
ELECTRICAL LAYOUT

SLI DOC No. 505573-3243-47DD-0137_01
NE DOC No. MFA-SN-CD-2440-EL-LT- 0008-01 Rev. D1

FORMAT: ISO (mm)
SUB-PKG: 0032-4701 PLATE 21

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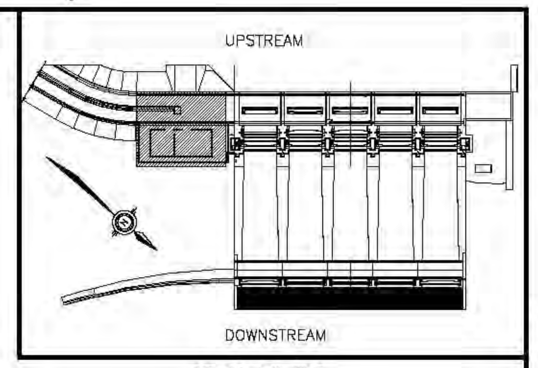
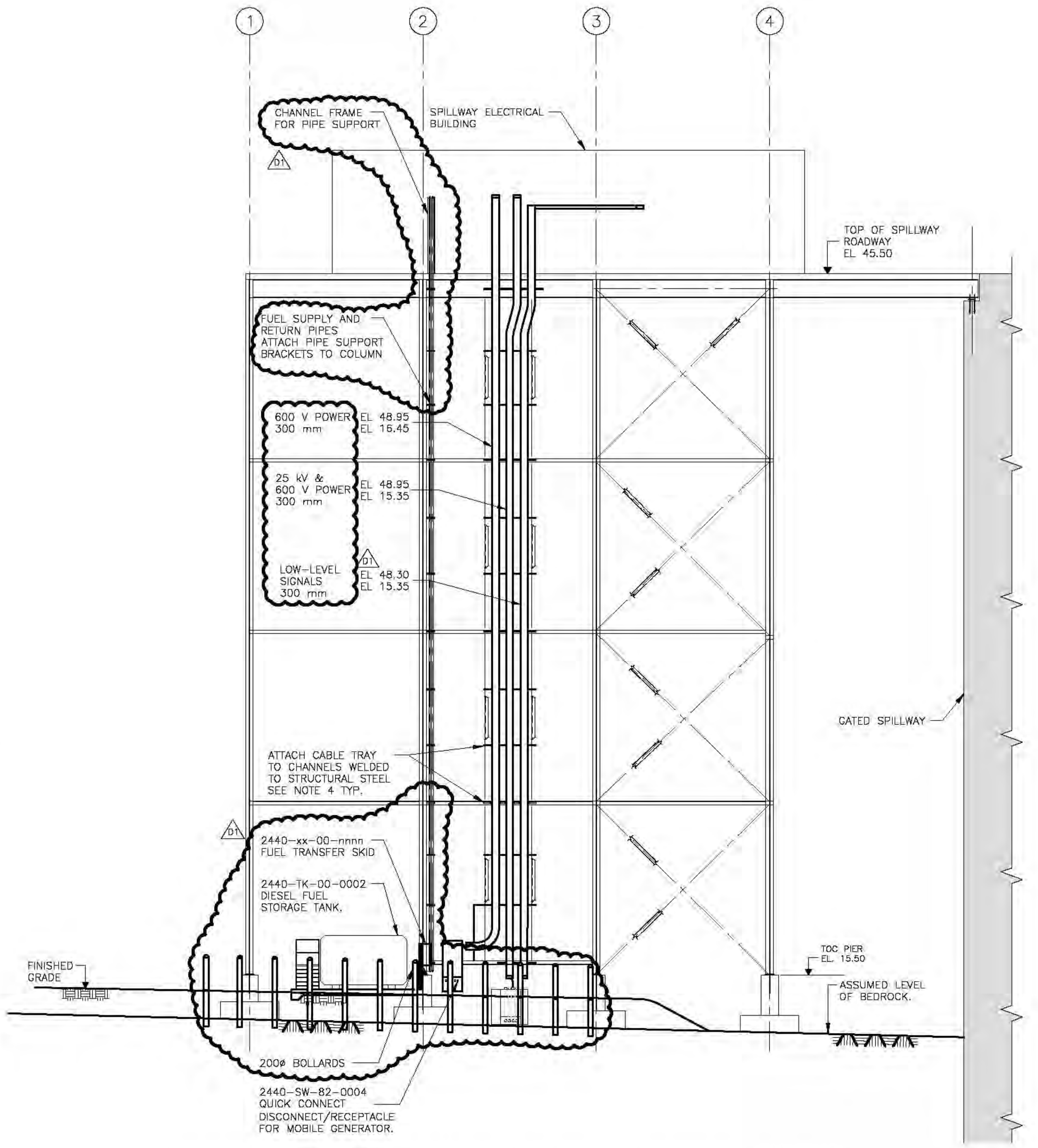
NOTES

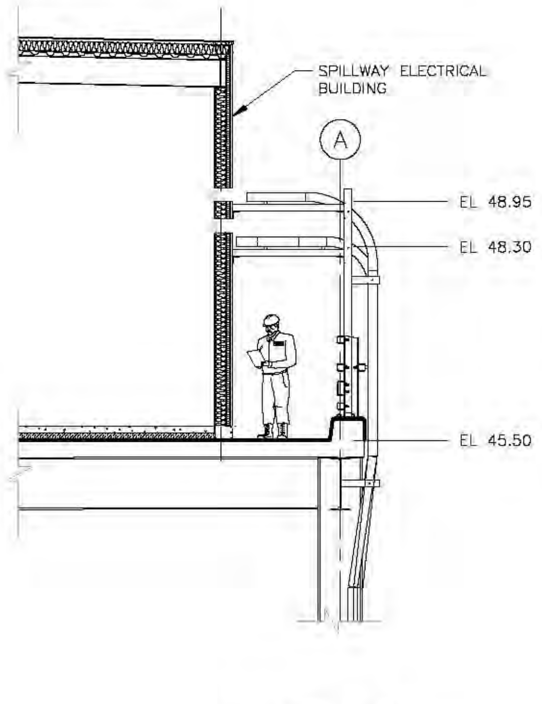
1. ELEVATIONS ARE IN METRES. DIMENSIONS ARE IN MILLIMETRES.
2. FOR CONTINUATION OF CABLE TRAY INSIDE THE ELECTRICAL BUILDING, SEE REFERENCE DRAWING: MFA-SN-CD-2440-EL-RT-0001-01 .
3. FOR CONTINUATION OF CABLE ROUTE UNDERGROUND TO TERMINATION POLE, SEE REFERENCE DRAWING: MFA-SN-CD-2440-EL-LT-0008-01.
4. FOR STRUCTURAL STEEL DETAILS, SEE REFERENCE DRAWING: MFA-SN-CD-2362-ST-PL-0001-01.



KEY PLAN



ELEVATION AT LINE A – CABLE TRAY TO SPILLWAY ELECTRICAL BUILDING
1:100



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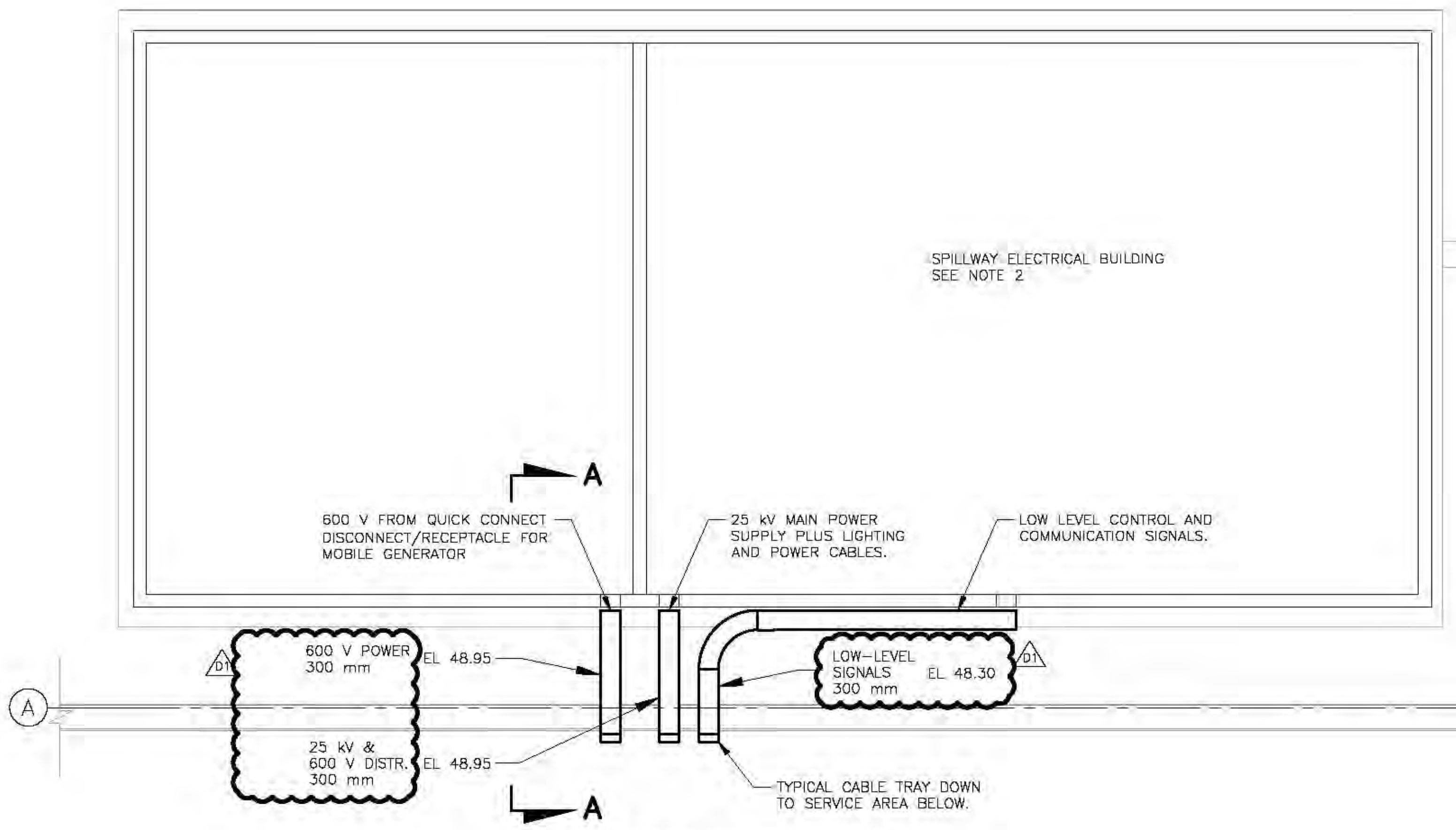
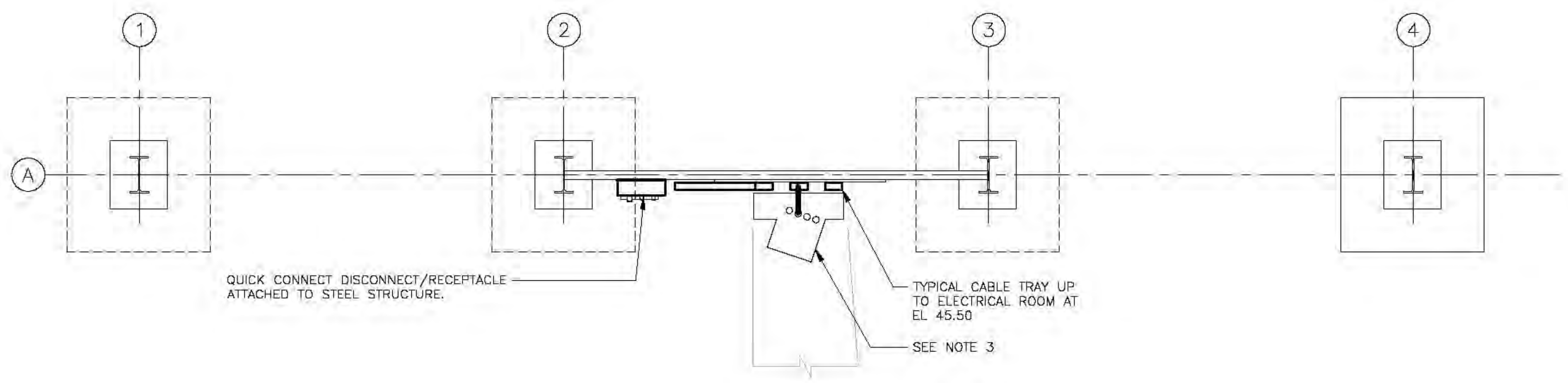


CABLE TRAY PLAN AT EL 45.50



CABLE TRAY PLAN AT EL 15.00 ±

NOT FOR CONSTRUCTION

SCALE 1:50 (0 1000 2000 3000 4000 5000 mm)

SCALE 1:100 (0 2000 4000 6000 8000 10000 mm)

This document has been signed and accepted electronically via Aconex.

ISSU	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	B1	05-NOV-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2362-ST-PL-0001-01	CENTRE TRANSITION DAM ELEVATED DECK-PLANS AND DETAILS STRUCTURAL STEEL
MFA-SN-CD-3430-EL-SD-0002-01	ELECTRICAL SERVICES IDENTIFICATION STANDARD
MFA-SN-CD-2440-EL-LT-0008-01	SPILLWAY DIESEL FUEL TANK AREA ELECTRICAL LAYOUT
MFA-SN-CD-2440-EL-DD-0005-01	SPILLWAY – DIVERSION PHASE TEMPORARY POWER GENERAL LAYOUT
MFA-SN-CD-2440-EL-SL-0002-01	SPILLWAY – DIVERSION PHASE TEMPORARY POWER DETAILS
MFA-SN-CD-2440-EL-RT-0001-01	SPILLWAY ELECTRICAL BUILDING CABLE TRAY AND CONDUIT LAYOUT

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	GENERAL REVISIONS AND REMOVED CABLE TRAY IDENTIFICATION AND NOTE 5.			

********** FOR INTERNAL USE ONLY **********
REVIEW CLASS: EQUIPMENT TAG NUMBER:
REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.
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☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED
LEAD REVIEWER: R. Kaushik Date (dd-mmm-yyyy): 15-Aug-2013
NE-LCP MANAGEMENT: B. Barnes Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER: Bruce Drover Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP: REGISTERED PROFESSIONAL ENGINEER VICTOR JAREMKO NEWFOUNDLAND & LABRADOR 12-AUG-2013

SNC·LAVALIN
CLIENT: nalcor energy

DESIGNED BY V. JAREMKO | APPROVED Discipline Lead Engineer G. HAINES
DRAWN BY T. SHEPPARD | APPROVED Engineering Manager G. SNYDER
VERIFIED BY W. CALDWELL
DATE 23-SEP-2011 | SCALE 1:50 U.N.O.

PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS SPILLWAY-DIVERSION PHASE CABLE TRAY AND CONDUIT BETWEEN ELECTRICAL BUILDING AND OUTDOOR INSTALLATIONS

SLI DOC No. 505573-3243-47DD-0136_01
NE DOC No. MFA-SN-CD-2440-EL-PL-0002-01 Rev. D1
FORMAT A0 (mm)

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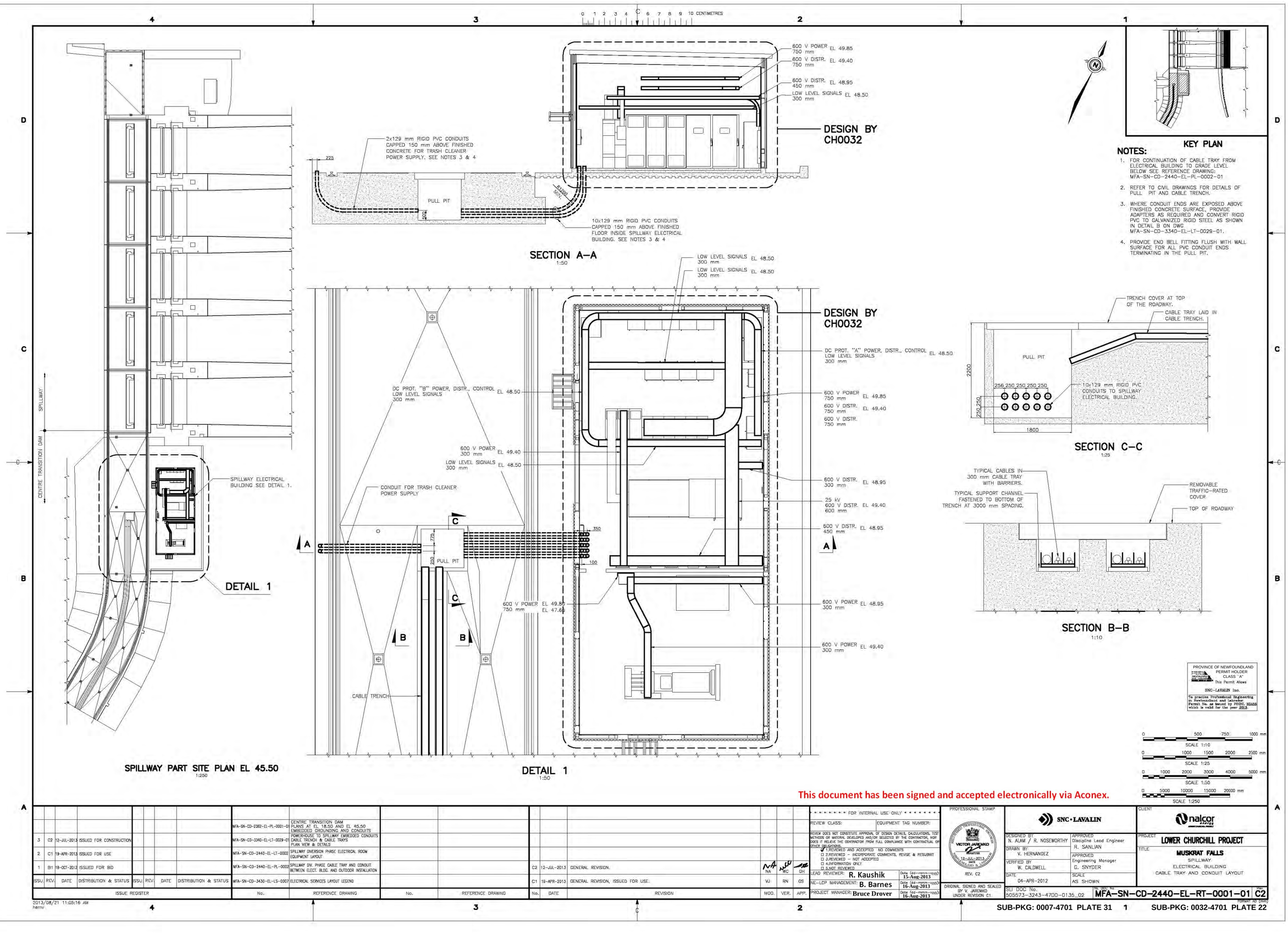

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador
Permit No. as issued by PEGNL: NO456
which is valid for the year 2013.

This document has been signed and accepted electronically via Aconex.

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
3	C2	12-JUL-2013	ISSUED FOR CONSTRUCTION
2	C1	19-APR-2013	ISSUED FOR USE
1	B1	18-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2362-EL-PL-0001-01	CENTRE TRANSITION DAM PLANS AT EL 18.50 AND EL 45.50 EMBEDDED GROUNDING AND CONDUITS
MFA-SN-CD-3340-EL-LT-0029-01	POWERHOUSE TO SPILLWAY EMBEDDED CONDUITS CABLE TRENCH & CABLE TRAYS PLAN VIEW & DETAILS
MFA-SN-CD-2440-EL-LT-0002	SPILLWAY DIVERSION PHASE ELECTRICAL ROOM EQUIPMENT LAYOUT
MFA-SN-CD-2440-EL-PL-0002	SPILLWAY DIV. PHASE CABLE TRAY AND CONDUIT BETWEEN ELECT. BLDG. AND OUTDOOR INSTALLATION
MFA-SN-CD-3430-EL-LS-0007	ELECTRICAL SERVICES LAYOUT LEGEND

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
C2	12-JUL-2013	GENERAL REVISION.	NA	WC	GH
C1	19-APR-2013	GENERAL REVISION, ISSUED FOR USE.	VJ	RN	GS

FOR INTERNAL USE ONLY

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☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: R. Kaushik Date (dd-mmm-yyyy) 15-Aug-2013
NE–LCP MANAGEMENT: B. Barnes Date (dd-mmm-yyyy) 16-Aug-2013
PROJECT MANAGER: Bruce Drover Date (dd-mmm-yyyy) 16-Aug-2013

PROFESSIONAL STAMP
VICTOR JAREMKO
12-JUL-2013
REV. C2
ORIGINAL SIGNED AND SEALED BY V. JAREMKO UNDER REVISION C1.

SNC·LAVALIN

DESIGNED BY	N. ALAM / R. NOSEWORTHY
DRAWN BY	V. HERNANDEZ
VERIFIED BY	W. CALDWELL
DATE	04-APR-2012
APPROVED	R. SANLIAN
APPROVED	G. SNYDER
SCALE	AS SHOWN

CLIENT: nalcor ENERGY
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
SPILLWAY
ELECTRICAL BUILDING
CABLE TRAY AND CONDUIT LAYOUT

SLI DOC No. 505573-3243-47DD-0135_02
No. NDEC Doc. No. MFA-SN-CD-2440-EL-RT-0001-01 REV. C2
CONTRACT NO. CH0032

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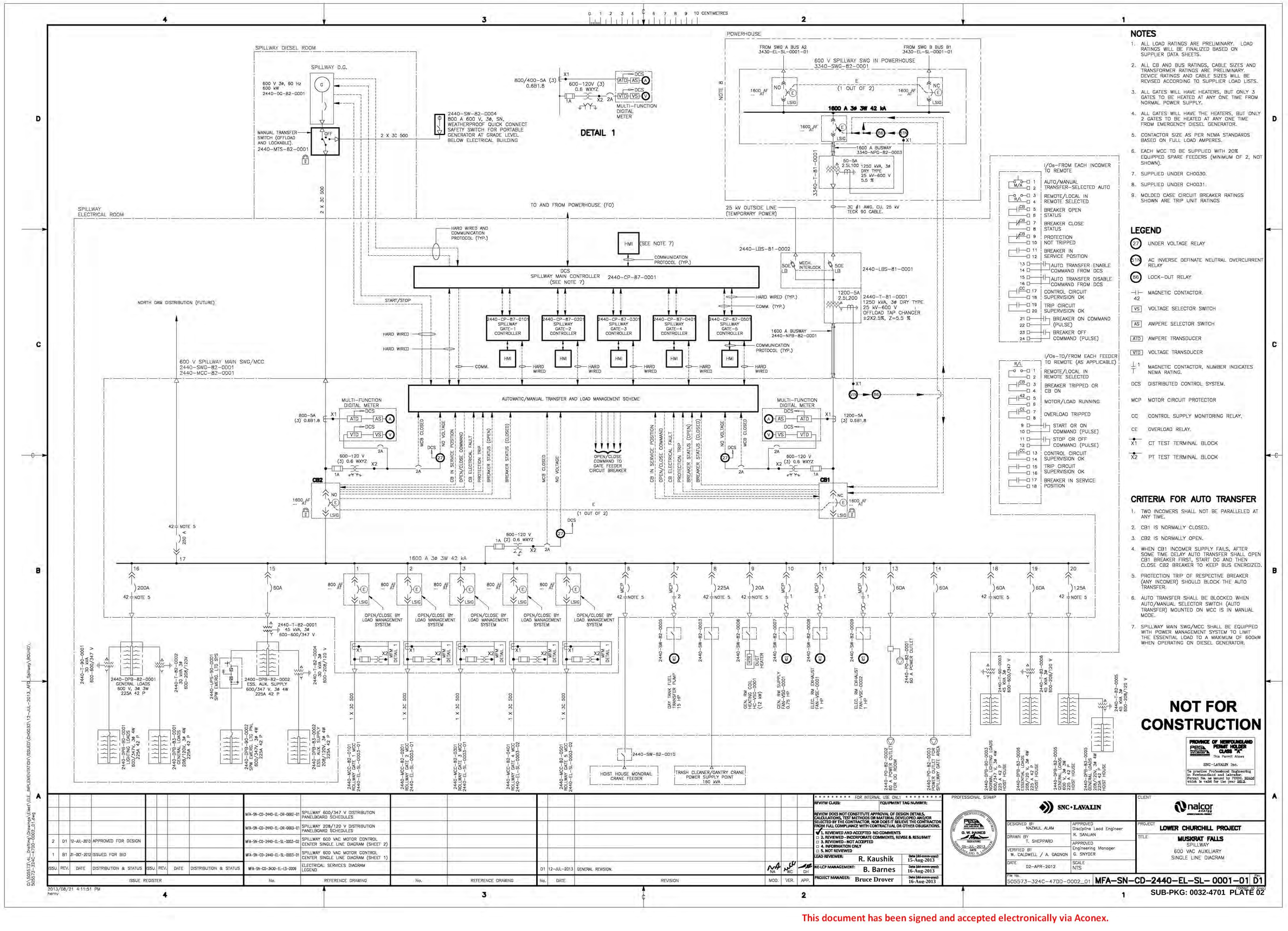
SUB-PKG: 0007-4701 PLATE 31 1 SUB-PKG: 0032-4701 PLATE 22



NOTES

1. ALL LOAD RATINGS ARE PRELIMINARY. LOAD RATINGS WILL BE FINALIZED BASED ON SUPPLIER DATA SHEETS.
2. ALL CB AND BUS RATINGS, CABLE SIZES AND TRANSFORMER RATINGS ARE PRELIMINARY. DEVICE RATINGS AND CABLE SIZES WILL BE REVISED ACCORDING TO SUPPLIER LOAD LISTS.
3. ALL GATES WILL HAVE HEATERS, BUT ONLY 3 GATES TO BE HEATED AT ANY ONE TIME FROM NORMAL POWER SUPPLY.
4. ALL GATES WILL HAVE THE HEATERS, BUT ONLY 2 GATES TO BE HEATED AT ANY ONE TIME FROM EMERGENCY DIESEL GENERATOR.
5. CONTACTOR SIZE AS PER NEMA STANDARDS BASED ON FULL LOAD AMPERES.
6. EACH MCC TO BE SUPPLIED WITH 20% EQUIPPED SPARE FEEDERS (MINIMUM OF 2, NOT SHOWN).
7. SUPPLIED UNDER CH0030.
8. SUPPLIED UNDER CH0031.
9. MOLDED CASE CIRCUIT BREAKER RATINGS SHOWN ARE TRIP UNIT RATINGS

LEGEND

- 27 — UNDER VOLTAGE RELAY
- 51N — AC INVERSE DEFINATE NEUTRAL OVERCURRENT RELAY
- 86 — LOCK-OUT RELAY
- 42 — MAGNETIC CONTACTOR.
- VS — VOLTAGE SELECTOR SWITCH
- AS — AMPERE SELECTOR SWITCH
- ATD — AMPERE TRANSDUCER
- VTD — VOLTAGE TRANSDUCER
- 1 — MAGNETIC CONTACTOR, NUMBER INDICATES NEMA RATING.
- DCS — DISTRIBUTED CONTROL SYSTEM.
- MCP — MOTOR CIRCUIT PROTECTOR
- CC — CONTROL SUPPLY MONITORING RELAY.
- CE — OVERLOAD RELAY.
- X1 — CT TEST TERMINAL BLOCK
- X2 — PT TEST TERMINAL BLOCK

CRITERIA FOR AUTO TRANSFER

1. TWO INCOMERS SHALL NOT BE PARALLELED AT ANY TIME.
2. CB1 IS NORMALLY CLOSED.
3. CB2 IS NORMALLY OPEN.
4. WHEN CB1 INCOMER SUPPLY FAILS, AFTER SOME TIME DELAY AUTO TRANSFER SHALL OPEN CB1 BREAKER FIRST, START DG AND THEN CLOSE CB2 BREAKER TO KEEP BUS ENERGIZED.
5. PROTECTION TRIP OF RESPECTIVE BREAKER (ANY INCOMER) SHOULD BLOCK THE AUTO TRANSFER.
6. AUTO TRANSFER SHALL BE BLOCKED WHEN AUTO/MANUAL SELECTOR SWITCH (AUTO TRANSFER) MOUNTED ON MCC IS IN MANUAL MODE.
7. SPILLWAY MAIN SWG/MCC SHALL BE EQUIPPED WITH POWER MANAGEMENT SYSTEM TO LIMIT THE ESSENTIAL LOAD TO A MAXIMUM OF 800kW WHEN OPERATING ON DIESEL GENERATOR.

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A" — This Permit Allows SNC-LAVALIN Inc. To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL 80160 which is valid for the year 2013.

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	B1	01-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2440-EL-DR-0002-01	SPILLWAY 600/347 V DISTRIBUTION PANELBOARD SCHEDULES
MFA-SN-CD-2440-EL-DR-0003-01	SPILLWAY 208/120 V DISTRIBUTION PANELBOARD SCHEDULES
MFA-SN-CD-2440-EL-SL-0003-02	SPILLWAY 600 VAC MOTOR CONTROL CENTER SINGLE LINE DIAGRAM (SHEET 2)
MFA-SN-CD-2440-EL-SL-0003-01	SPILLWAY 600 VAC MOTOR CONTROL CENTER SINGLE LINE DIAGRAM (SHEET 1)
MFA-SN-CD-3430-EL-LG-0006	ELECTRICAL SERVICES DIAGRAM LEGEND

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	GENERAL REVISION.	NA	NC	GH

REVIEW CLASS: — EQUIPMENT TAG NUMBER:

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- ☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER:	R. Kaushik	Date (dd-mmm-yyyy): 15-Aug-2013
NALCOR MANAGEMENT:	B. Barnes	Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER:	Bruce Drover	Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP — PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND AND LABRADOR — PERMIT HOLDER — G. W. HAINES — SIGNATURE — 05-JUL-2013 — DATE

SNC·LAVALIN

DESIGNED BY: NAZMUL ALAM	APPROVED: Discipline Lead Engineer R. SANJAN
DRAWN BY: T. SHEPPARD	APPROVED: Engineering Manager G. SNYDER
VERIFIED BY: W. CALDWELL / A. GAGNON	
DATE: 02-APR-2012	SCALE: NTS

CLIENT: nalcor ENERGY

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
600 VAC AUXILIARY
SINGLE LINE DIAGRAM

File No. 505573-324C-4700-0002_01

MFA-SN-CD-2440-EL-SL-0001-01 — REV. D1

SUB-PKG: 0032-4701 PLATE 02

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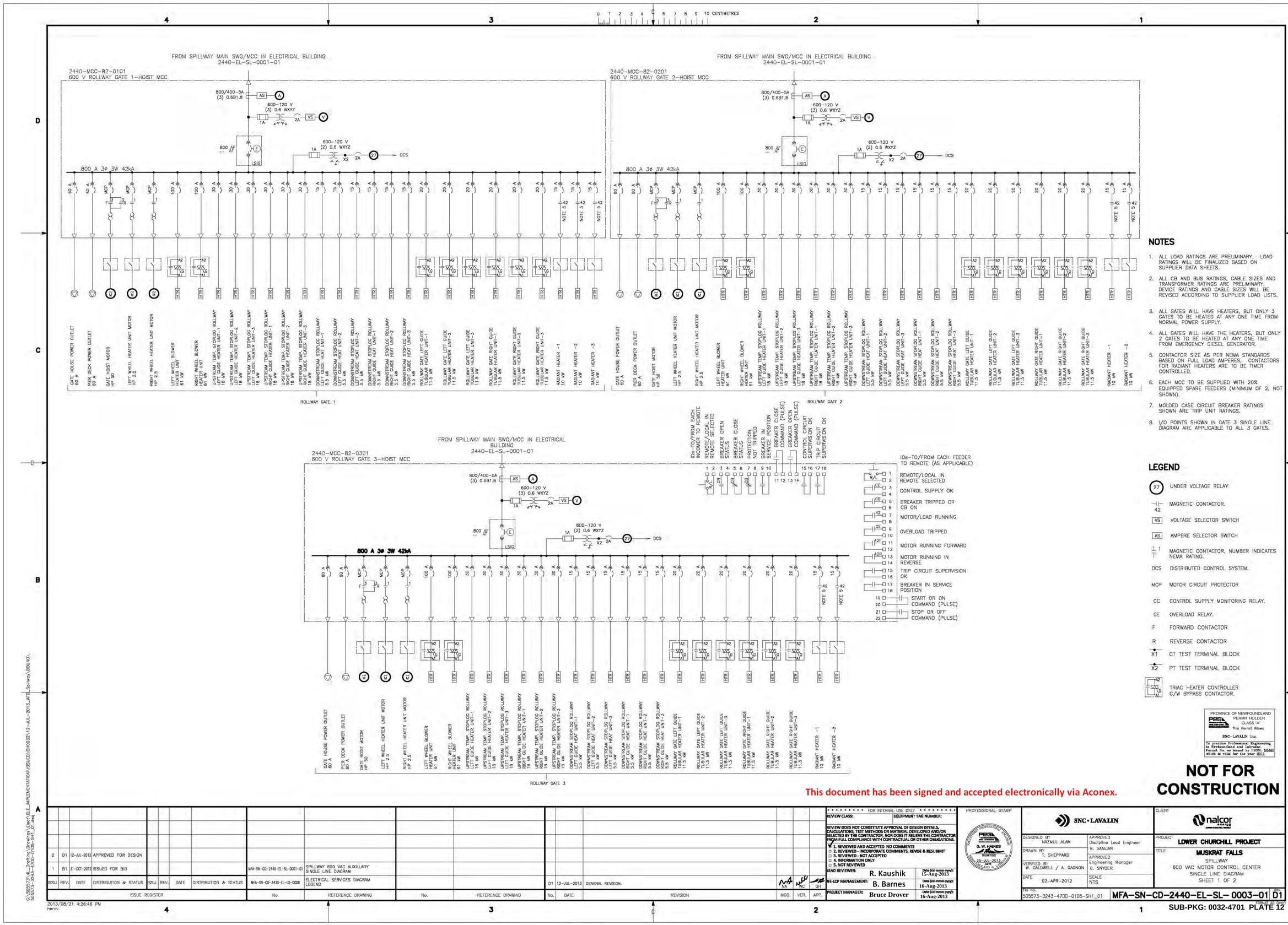

NOTES

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2. ALL CB AND BUS RATINGS, CABLE SIZES AND TRANSFORMER RATINGS ARE PRELIMINARY. DEVICE RATINGS AND CABLE SIZES WILL BE REVISED ACCORDING TO SUPPLIER LOAD LISTS.
3. ALL GATES WILL HAVE HEATERS, BUT ONLY 3 GATES TO BE HEATED AT ANY ONE TIME FROM NORMAL POWER SUPPLY.
4. ALL GATES WILL HAVE THE HEATERS, BUT ONLY 2 GATES TO BE HEATED AT ANY ONE TIME FROM EMERGENCY DIESEL GENERATOR.
5. CONTACTOR SIZE AS PER NEMA STANDARDS BASED ON FULL LOAD AMPERES. CONTACTORS FOR RADIANT HEATERS ARE TO BE TIMER CONTROLLED.
6. EACH MCC TO BE SUPPLIED WITH 20% EQUIPPED SPARE FEEDERS (MINIMUM OF 2, NOT SHOWN).
7. MOLDED CASE CIRCUIT BREAKER RATINGS SHOWN ARE TRIP UNIT RATINGS.
8. I/O POINTS SHOWN IN GATE 3 SINGLE LINE DIAGRAM ARE APPLICABLE TO ALL 3 GATES.

LEGEND

- (27) UNDER VOLTAGE RELAY
- 42 MAGNETIC CONTACTOR.
- VS VOLTAGE SELECTOR SWITCH
- AS AMPERE SELECTOR SWITCH
- 1 MAGNETIC CONTACTOR, NUMBER INDICATES NEMA RATING.
- DCS DISTRIBUTED CONTROL SYSTEM.
- MCP MOTOR CIRCUIT PROTECTOR
- CC CONTROL SUPPLY MONITORING RELAY.
- CE OVERLOAD RELAY.
- F FORWARD CONTACTOR
- R REVERSE CONTACTOR
- X1 CT TEST TERMINAL BLOCK
- X2 PT TEST TERMINAL BLOCK
- A2 / VZC / A1 TRIAC HEATER CONTROLLER C/W BYPASS CONTACTOR.

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL 101468 which is valid for the year 2013

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ISSU	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	B1	31-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2440-EL-SL-0001-01	SPILLWAY 600 VAC AUXILLARY SINGLE LINE DIAGRAM
MFA-SN-CD-3430-EL-LS-0006	ELECTRICAL SERVICES DIAGRAM LEGEND

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	GENERAL REVISION.	NA	WC	GH

* * * * * * * * FOR INTERNAL USE ONLY * * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

		Date (dd-mmm-yyyy)
LEAD REVIEWER:	R. Kaushik	15-Aug-2013
NE-LCP MANAGEMENT:	B. Barnes	16-Aug-2013
PROJECT MANAGER:	Bruce Drover	16-Aug-2013

PROFESSIONAL STAMP
PEGNL PROFESSIONAL ENGINEER D. W. HANNEN REGISTERED 02-JUL-2013 DATE

SNC·LAVALIN

DESIGNED BY NAZMUL ALAM	APPROVED Discipline Lead Engineer R. SANJAN
DRAWN BY T. SHEPPARD	APPROVED Engineering Manager C. SNYDER
VERIFIED BY W. CALDWELL / A. GAGNON	
DATE 02-APR-2012	SCALE NTS

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
600 VAC MOTOR CONTROL CENTER
SINGLE LINE DIAGRAM
SHEET 1 OF 2

File No. 505573-3243-4700-0105-SH1_01

MFA-SN-CD-2440-EL-SL- 0003-01 | REV. D1

FORMAT A0 (mm)

SUB-PKG: 0032-4701 PLATE 12

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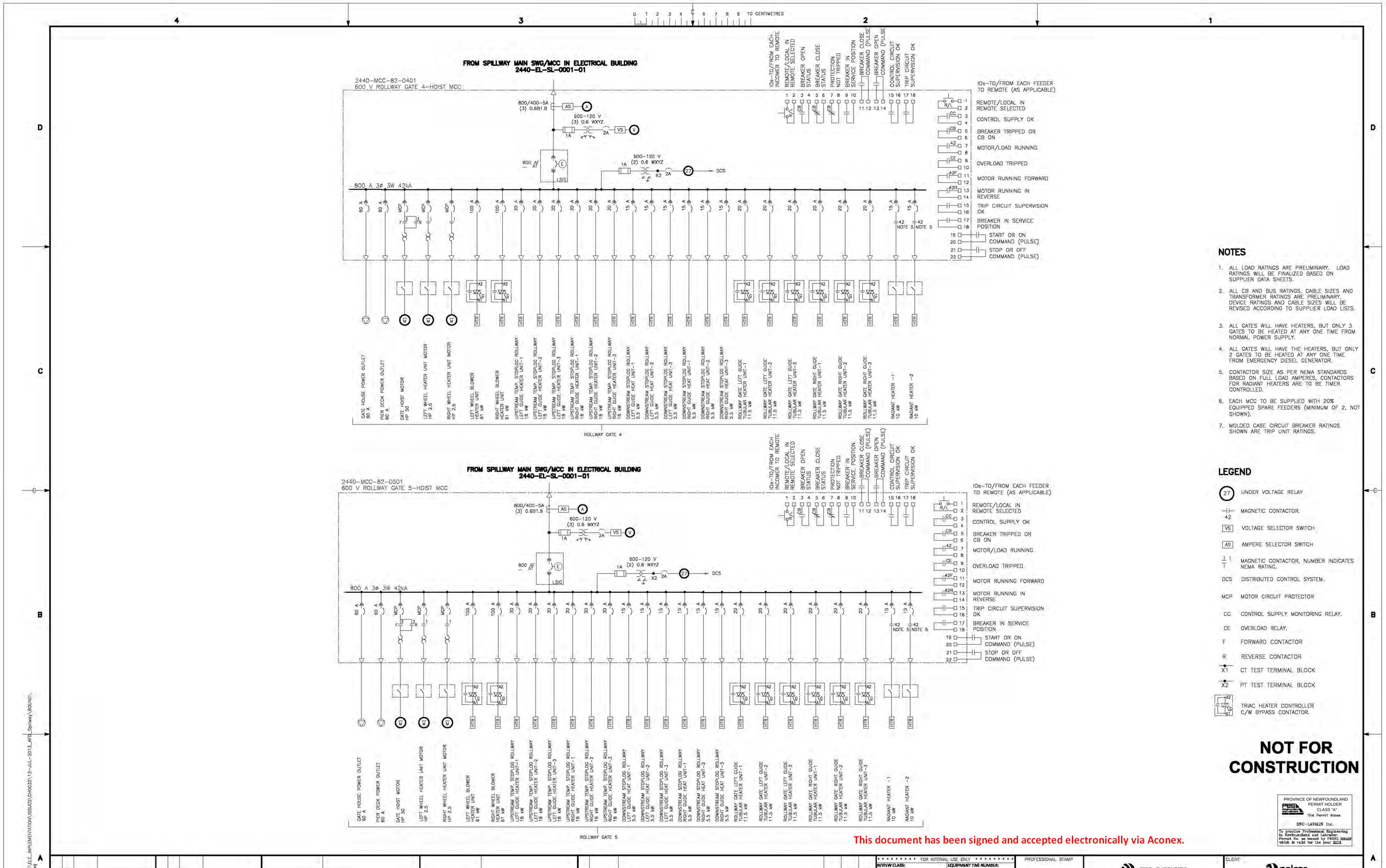

NOTES

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3. ALL GATES WILL HAVE HEATERS, BUT ONLY 3 GATES TO BE HEATED AT ANY ONE TIME FROM NORMAL POWER SUPPLY.
4. ALL GATES WILL HAVE THE HEATERS, BUT ONLY 2 GATES TO BE HEATED AT ANY ONE TIME FROM EMERGENCY DIESEL GENERATOR.
5. CONTACTOR SIZE AS PER NEMA STANDARDS BASED ON FULL LOAD AMPERES, CONTACTORS FOR RADIANT HEATERS ARE TO BE TIMER CONTROLLED.
6. EACH MCC TO BE SUPPLIED WITH 20% EQUIPPED SPARE FEEDERS (MINIMUM OF 2, NOT SHOWN).
7. MOLDED CASE CIRCUIT BREAKER RATINGS SHOWN ARE TRIP UNIT RATINGS.

LEGEND

27	UNDER VOLTAGE RELAY
42	MAGNETIC CONTACTOR.
VS	VOLTAGE SELECTOR SWITCH
AS	AMPERE SELECTOR SWITCH
1 T	MAGNETIC CONTACTOR, NUMBER INDICATES NEMA RATING.
DCS	DISTRIBUTED CONTROL SYSTEM.
MCP	MOTOR CIRCUIT PROTECTOR
CC	CONTROL SUPPLY MONITORING RELAY.
CE	OVERLOAD RELAY.
F	FORWARD CONTACTOR
R	REVERSE CONTACTOR
X1	CT TEST TERMINAL BLOCK
X2	PT TEST TERMINAL BLOCK
A2 G A1	TRIAC HEATER CONTROLLER C/W BYPASS CONTACTOR.

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL which is valid for the year 2013

This document has been signed and accepted electronically via Aconex.

ISSU	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	B1	31-OCT-2012	ISSUED FOR BID

No.	REFERENCE DRAWING
MFA-SN-CD-2440-EL-SL-0001-01	SPILLWAY 600 VAC AUXILLARY SINGLE LINE DIAGRAM
MFA-SN-CD-3430-EL-LS-0006	ELECTRICAL SERVICES DIAGRAM LEGEND

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	GENERAL REVISION.	NA	WC	GH

FOR INTERNAL USE ONLY

REVIEW CLASS: EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- ☑ 1. REVIEWED AND ACCEPTED NO COMMENTS
- ☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER:	R. Kaushik	Date (dd-mmm-yyyy): 15-Aug-2013
NE-LCP MANAGEMENT:	B. Barnes	Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER:	Bruce Drover	Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP

PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND AND LABRADOR
PEGNL PERMIT HOLDER
G. W. HAINES
SIGNATURE
25-JUL-2013
DATE

SNC·LAVALIN

DESIGNED BY: NAZMUL ALAM	APPROVED: Discipline Lead Engineer R. SANJAN
DRAWN BY: T. SHEPPARD	APPROVED: Engineering Manager G. SNYDER
VERIFIED BY: W. CALDWELL / A. GAGNON	
DATE: 02-APR-2012	SCALE: NTS

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
600 VAC MOTOR CONTROL CENTER
SINGLE LINE DIAGRAM
SHEET 2 OF 2

File No. S05573-3243-4700-0105-SH2_01

MFA-SN-CD-2440-EL-SL-0003-02 D1

CONTRACT NO. SUB-PKG: 0032-4701 PLATE 13

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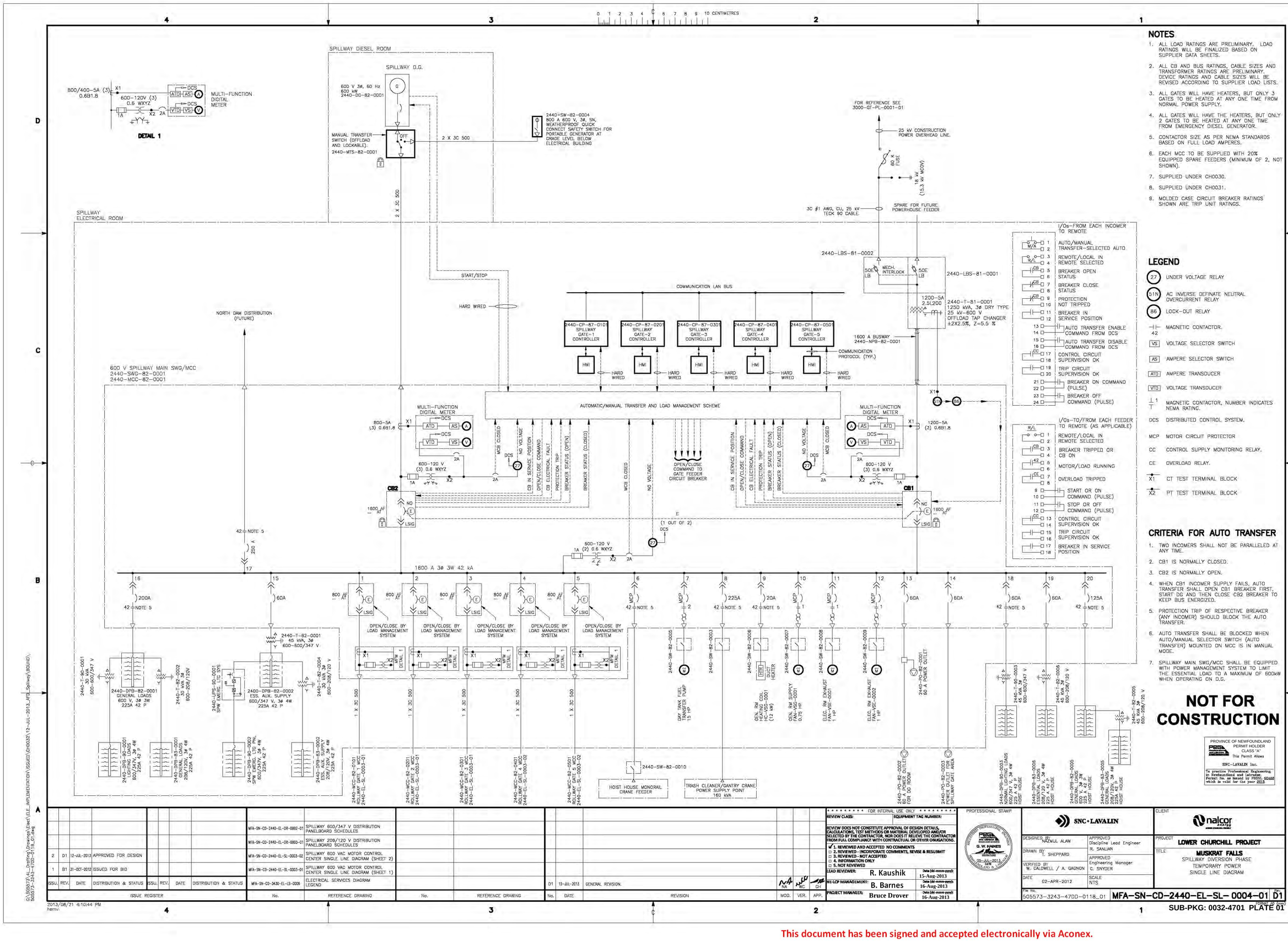

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3290-NPB-82-0001
600 V 1200 A BUSWAY

FROM 600 V SWG-A BUS-A1
3433-SWG-82-A001

FROM 600 V ESSENTIAL SERVICE MCC
3340-MCC-82-E001

TO FO CHAIN

TO AND FROM POWERHOUSE

TO FO CHAIN

DETAIL 1

800/400-5A (3) 0.6B1.8 — 600-120V (3) 0.6 WXYZ — MULTI-FUNCTION DIGITAL METER (MFM)

1200/600-5A (3) 0.6B1.8

MULTI-FUNCTION DIGITAL METER (MFM)

TO CB1 MFM — TO CB2 MFM — IRIG B TIME — RS-485

TO CB3 MFM — TO CB4 MFM — IRIG B TIME — RS-485

AUTO/MANUAL TRANSFER AND LOAD MANAGMENT SCHEME

CB1 — CB2 — CB3 — CB4

1200AF ... AT

1200AF SEE NOTE 8

BKR STAT. (CLOSED) — BKR STAT. (OPEN) — PROT. TRIP — CB ELECT. FAULT — CB ON/OFF COMMAND — CB IN SERV. POS.

MCB CLOSED — NO VOLTAGE

600-120V (2) 0.6 WXYZ — DCS (1 OUT OF 2)

I/Os-FROM EACH INCOMER TO REMOTE

1 AUTO/MANUAL TRANSFER-SELECTED AUTO
3 BREAKER OPEN STATUS
5 BREAKER CLOSED STATUS
7 PROTECTION NOT TRIPPED
9 BREAKER IN SERVICE POSITION
11 AUTO TRANSFER ENABLE COMMAND FROM DCS
13 AUTO TRANSFER DISABLE COMMAND FROM DCS
15 CONTROL CIRCUIT SUPERVISION OK
17 TRIP CIRCUIT SUPERVISION OK
19 REMOTE/LOCAL IN REMOTE SELECTED
21 BREAKER ON COMMAND (PULSE)
23 BREAKER OFF COMMAND (PULSE)

3290-MCC-82-B001
600 Vac INTAKE MAIN MCC/SECTION 2

I/Os-TO/FROM EACH FEEDER TO REMOTE (AS APPLICABLE)

1 REMOTE/LOCAL IN REMOTE SELECTED
3 BREAKER TRIPPED OR CB ON
5 MOTOR/LOAD RUNNING
7 OVERLOAD TRIPPED
9 MOTOR RUNNING FORWARD (FOR GATE MCC)
11 MOTOR RUNNING IN REVERSE (FOR GATE MCC)
13 START OR ON COMMAND (PULSE)
15 STOP OR OFF COMMAND (PULSE)
17 CONTROL CIRCUIT SUPERVISION OK
19 TRIP CIRCUIT SUPERVISION OK
21 BREAKER IN SERVICE POSITION

3290-MCC-82-A001
600 Vac INTAKE MAIN MCC/SECTION 1

1200 A 3ø 3W 42 kA

800AF ... AT

60A — SEE NOTE 3

82C3-0101 3C #2 AWG — 3290-T-90-0001 45 kVA, 3ø 600-600/347 V — 90C4-0001 4C #6 AWG — 3290-DPB-90-0001 LIGHTING LOADS 600/347 V 3ø,4W 100A 30P

82C3-0105 3C #12 AWG SW-82-0108 — INTAKE EXHAUST 3351-FAN-VIL-0001 1.0 HP

82C3-0104 3C #12 AWG SW-82-0109 — INTAKE EXHAUST 3351-FAN-VIL-0002 1.0 HP

82C3-0103 3C #12 AWG SW-82-0107 — LIFT MECH RM EXHAUST 3351-FAN-VEL-0001 0.75 HP

82C3-0102 3C 500 kcmil

82C3-0151 3C 500 kcmil

3290-T-82-0001 30 kVA 3ø 600-208/120 V — 82C3-0152 3C #2/0 AWG

3290-DPB-83-0001 GENERAL LOADS 600 V 225A 42P 3ø,3W — 82C3-0153 3C #4/0 AWG SW-82-0105 — TRASH CLEANER POWER SUPPLY 160 kVA

3290-DPB-83-0001 GENERAL LOADS 208/120V 3ø,4W 225A 42P

82C3-0154 3C 500 kcmil

82C3-0155 3C #12 AWG SW-82-0110 — INTAKE EXHAUST 3351-FAN-VIL-0003 1.0 HP

82C3-0156 3C #12 AWG SW-82-0111 — INTAKE EXHAUST 3351-FAN-VIL-0004 1.0 HP

NOTE 6

3290-MCC-82-1001 600 Vac U1 INTAKE HOIST MCC

3290-MCC-82-2001 600 Vac U2 INTAKE HOIST MCC

3290-MCC-82-3001 600 Vac U3 INTAKE HOIST MCC

3290-MCC-82-4001 600 Vac U4 INTAKE HOIST MCC

800/400-5A (3) 0.6B1.8 — 600-120V (3) 0.6 WXYZ — 600-120V (2) 0.6 WXYZ — 800AF ... AT — LSIG

800 A 3ø 3W 42 kA

MCP — F — R — 50A — 60A — 125A — NOTE 3 TYP

60 A — M1 — HTR

3290-T-82-1001 30 kVA 3ø 600-208/120 V

3290-T-82-2001 30 kVA 3ø 600-208/120 V

3290-T-82-3001 30 kVA 3ø 600-208/120 V

3290-T-82-4001 30 kVA 3ø 600-208/120 V

UNIT 1 INTAKE GATE LOADS

INTAKE GATE-1 HOIST MOTOR (35 HP) — INTAKE GATE-2 HOIST MOTOR (35 HP) — INTAKE GATE-3 HOIST MOTOR (35 HP) — GATE SHAFT HEATER GATE-1 41 kW — GATE SHAFT HEATER GATE-2 41 kW — GATE SHAFT HEATER GATE-3 41 kW — 60 A POWER OUTLET 2440-PO-82-1001 — 3290-DPB-82-1001 GENERAL LOADS 3ø,3W 225 A 42P — 3290-DPB-83-1001 GENERAL LOADS 208/120V 3ø,4W 225A 24P

UNIT 2 INTAKE GATE LOADS

INTAKE GATE-1 HOIST MOTOR (35 HP) — INTAKE GATE-2 HOIST MOTOR (35 HP) — INTAKE GATE-3 HOIST MOTOR (35 HP) — GATE SHAFT HEATER GATE-1 41 kW — GATE SHAFT HEATER GATE-2 41 kW — GATE SHAFT HEATER GATE-3 41 kW — 60 A POWER OUTLET 2440-PO-82-2001 — 3290-DPB-82-2001 GENERAL LOADS 3ø,3W 225A 42P — 3290-DPB-83-2001 GENERAL LOADS 208/120V 3ø,4W 225A 24P

UNIT 3 INTAKE GATE LOADS

INTAKE GATE-1 HOIST MOTOR (35 HP) — INTAKE GATE-2 HOIST MOTOR (35 HP) — INTAKE GATE-3 HOIST MOTOR (35 HP) — GATE SHAFT HEATER GATE-1 41 kW — GATE SHAFT HEATER GATE-2 41 kW — GATE SHAFT HEATER GATE-3 41 kW — 60 A POWER OUTLET 2440-PO-82-3001 — 3290-DPB-82-3001 GENERAL LOADS 600 V 225A 42P 3ø,3W — 3290-DPB-83-3001 GENERAL LOADS 208/120V 3ø,4W 225A 24P

UNIT 4 INTAKE GATE LOADS

INTAKE GATE-1 HOIST MOTOR (35 HP) — INTAKE GATE-2 HOIST MOTOR (35 HP) — INTAKE GATE-3 HOIST MOTOR (35 HP) — GATE SHAFT HEATER GATE-1 41 kW — GATE SHAFT HEATER GATE-2 41 kW — GATE SHAFT HEATER GATE-3 41 kW — 60 A POWER OUTLET 2440-PO-82-4001 — 3290-DPB-82-4001 GENERAL LOADS 600 V 225A 42P 3ø,3W — 3290-DPB-83-4001 GENERAL LOADS 208/120V 3ø,4W 225A 24P

15A — NOTE 3 TYP

10 kW HTR — 82C3-0107 3C #12 AWG — 3290-RH-82-1001

82C3-0108 3C #12 AWG — 3290-RH-82-1002

82C3-0109 3C #12 AWG — 3290-RH-82-1003

82C3-0110 3C #12 AWG — 3290-RH-82-1004

82C3-0111 3C #12 AWG — 3290-RH-82-1005

82C3-0112 3C #12 AWG — 3290-RH-82-1006

82C3-0113 3C #12 AWG — 3290-RH-82-1007

82C3-0114 3C #12 AWG — 3290-RH-82-2001

82C3-0115 3C #12 AWG — 3290-RH-82-2002

82C3-0116 3C #12 AWG — 3290-RH-82-2003

82C3-0117 3C #12 AWG — 3290-RH-82-2004

82C3-0118 3C #12 AWG — 3290-RH-82-2005

82C3-0119 3C #12 AWG — 3290-RH-82-2006

82C3-0120 3C #12 AWG — 3290-RH-82-2007

82C3-0157 3C #12 AWG — 3290-RH-82-3001

82C3-0158 3C #12 AWG — 3290-RH-82-3002

82C3-0159 3C #12 AWG — 3290-RH-82-3003

82C3-0160 3C #12 AWG — 3290-RH-82-3004

82C3-0161 3C #12 AWG — 3290-RH-82-3005

82C3-0162 3C #12 AWG — 3290-RH-82-3006

82C3-0163 3C #12 AWG — 3290-RH-82-3007

82C3-0164 3C #12 AWG — 3290-RH-82-4001

82C3-0165 3C #12 AWG — 3290-RH-82-4002

82C3-0166 3C #12 AWG — 3290-RH-82-4003

82C3-0167 3C #12 AWG — 3290-RH-82-4004

82C3-0168 3C #12 AWG — 3290-RH-82-4005

82C3-0169 3C #12 AWG — 3290-RH-82-4006

82C3-0170 3C #12 AWG — 3290-RH-82-4007

UNIT 1 — UNIT 2 — UNIT 3 — UNIT 4

NOTES

1. ALL LOAD RATINGS ARE PRELIMINARY. LOAD RATINGS WILL BE FINALIZED BASED ON SUPPLIER DATA SHEETS.
2. ALL CB AND BUS RATINGS, CABLE SIZES AND TRANSFORMER RATINGS ARE PRELIMINARY. DEVICE RATINGS AND CABLE SIZES WILL BE REVISED ACCORDING TO SUPPLIER LOAD LISTS.
3. CONTACTOR SIZE AS PER NEMA STANDARDS BASED ON FULL LOAD AMPERES. ALL CONTACTORS FOR RADIANT HEATERS ARE TO BE CONTROLLED BY TIMERS.
4. EACH MCC TO BE SUPPLIED WITH 20% EQUIPPED SPARE FEEDERS (MINIMUM OF 2, NOT SHOWN).
5. ALL POWER CABLES SHALL BE TECK90 TYPE UNLESS OTHERWISE INDICATED.
6. ALL INTAKE HOIST MCC'S AND INTAKE GATE LOADS WILL BE SUPPLIED AND INSTALLED BY PACKAGE CH0032.
7. I/O LIST ARE APPLICABLE FOR BOTH MAIN AND GATE MCC'S.
8. BREAKER EQUIPPED WITH NO PROTECTIVE ELEMENT.
9. MOLDED CASE CIRCUIT BREAKER RATINGS SHOWN ARE TRIP UNIT RATINGS.
10. ALL REMAINING EQUIPMENT AND LOADS TO BE SUPPLIED AND INSTALLED BY PACKAGE CH0031.
11. TYPICAL ALL CABLE TAGS ARE PREFIXED WITH 3290-.

LEGEND

- (27) UNDER VOLTAGE RELAY
- MAGNETIC CONTACTOR. 42
- VS VOLTAGE SELECTOR SWITCH
- AS AMPERE SELECTOR SWITCH
- ATD AMPERE TRANSDUCER
- VTD VOLTAGE TRANSDUCER
- MAGNETIC CONTACTOR, NUMBER INDICATES NEMA RATING.
- DCS DISTRIBUTED CONTROL SYSTEM.
- MCP MOTOR CIRCUIT PROTECTOR
- CC CONTROL SUPPLY MONITORING RELAY.
- CE OVERLOAD RELAY.
- F FORWARD CONTACTOR
- R REVERSE CONTACTOR
- X1 CT TEST TERMINAL BLOCK
- X2 PT TEST TERMINAL BLOCK
- E – ELECTRICAL INTERLOCK
- FO/CO – FIBRE/CO OPTIC TRANSCEIVER.

CRITERIA FOR AUTO TRANSFER

1. TWO INCOMERS SHALL NOT BE PARALLELED AT ANY TIME.
2. CB1,CB2 AND CB3 ARE NORMALLY CLOSED.
3. CB4 IS NORMALLY OPEN.
4. WHEN CB1 INCOMER SUPPLY FAILS, AFTER SOME DELAY, AUTO TRANSFER SHALL OPEN CB1 BREAKER FIRST THEN CLOSE CB4 BREAKER TO KEEP BUS ENERGIZED IF CB4 INCOMING SUPPLY IS AVAILABLE.
5. PROTECTION TRIP OF RESPECTIVE BREAKER (ANY INCOMER) SHOULD BLOCK THE AUTO TRANSFER.
6. AUTO TRANSFER SHALL BE BLOCKED WHEN AUTO/MANUAL SELECTOR SWITCH (AUTO TRANSFER) MOUNTED ON SWG IS IN MANUAL MODE.
7. AUTO TRANSFER SHALL BE BLOCKED WHEN REMOTE/LOCAL SELECTOR SWITCH MOUNTED ON SWITCHGEAR (FOR INCOMER) IS IN LOCAL MODE.
8. AUTO TRANSFER SHALL BE COORDINATED WITH UPSTREAM AUTO TRANSFER.
9. AUTO TRANSFER SHALL AUTOMATICALLY RETURN TO CB1 UPON RETURN OF VOLTAGE OF CB1 FEEDER.

NOT FOR CONSTRUCTION

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
4	D2	25-NOV-2013	ISSUED FOR BID
3	D1	10-SEP-2013	APPROVED FOR DESIGN
2	B2	08-NOV-2012	ISSUED FOR CHANGES
1	B1	29-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3430-EL-SL-0012-01	POWERHOUSE – 600 Vac MOTOR CONTROL CENTER – ESSENTIAL SERVICES MCC – SINGLE LINE DIAGRAM
MFA-SN-CD-3430-EL-SL-0006-01	POWERHOUSE 600 Vac SWITCHGEAR SINGLE LINE DIAGRAM (SWG–A)
MFA-SN-CD-3430-EL-SL-0001-01	POWERHOUSE 600 Vac AUXILIARY OPERATING SINGLE LINE DIAGRAM
MFA-SN-CD-3430-EL-LS-0006-01	ELECTRICAL SERVICES DIAGRAM LEGEND
MFA-SN-CD-3430-EL-SD-0002-01	ELECTRICAL SERVICES IDENTIFICATION STANDARDS

No.	DATE	REVISION	MOD.	VER.	APP.
D2	25-NOV-2013	GENERAL REVISION.	NA	WC	GH
D1	12-JUL-2013	GENERAL REVISION.	NA	WC	GH
B2	08-NOV-2012	ISSUED FOR CHANGES	NA	WC	RS

* * * * * * * * FOR INTERNAL USE ONLY * * * * * * * *

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- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Strong — Date (dd-mmm-yyyy): 2DEC 2013

NE-LOC MANAGEMENT: — Date (dd-mmm-yyyy): 2-Dec-2013

PROJECT MANAGER: — Date (dd-mmm-yyyy): 29-Nov-2013

PROFESSIONAL STAMP: PEGL Permit to Practice — MEER NAZMUL ALAM — SIGNATURE 29/NOV/13 — DATE — PROFESSIONAL ENGINEERS NEWFOUNDLAND & LABRADOR

REV. D2

ORIGINAL SIGNED AND SEALED BY G. HAINES UNDER REVISION D1.

SNC·LAVALIN

DESIGNED BY NAZMUL ALAM	APPROVED Discipline Lead Engineer R. SANLIAN
DRAWN BY T. SHEPPARD	APPROVED Engineering Manager G. SNYDER
VERIFIED BY W. CALDWELL / A. GAGNON	
DATE 08-JUN-2012	SCALE NTS

CLIENT: nalcor ENERGY

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS — INTAKE — 600 Vac MOTOR CONTROL CENTER — SINGLE LINE DIAGRAM

File No. 505573-3344-47DD-0147_03 | MFA-SN-CD-3290-EL-SL-0001-01 | Rev. D2

FORMAT A0 (mm)

SUB-PKG: 0032-4701 PLATE 14 1 SUB-PKG: 0031-4711 PLATE 12

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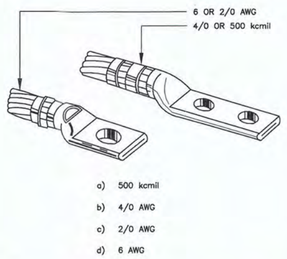
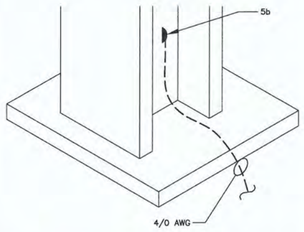
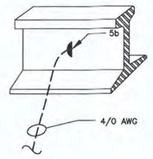


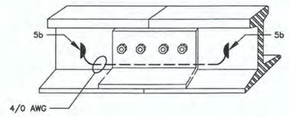
DETAIL 30 — TWO HOLE COMPRESSION TYPE LUG



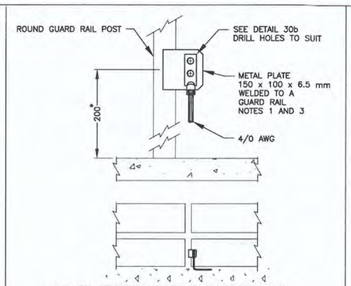
DETAIL 31 — CONNECTION TO A COLUMN



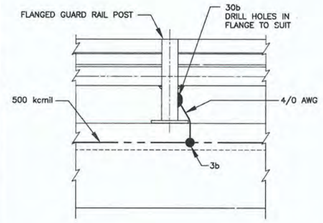
DETAIL 32 — CONNECTION TO A RAIL



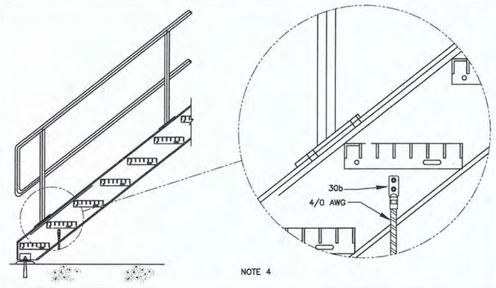
DETAIL 33 — RAIL JOINT CONNECTION



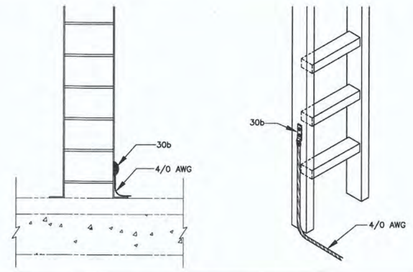
DETAIL 34 — CONNECTION TO ROUND GUARD RAIL POST



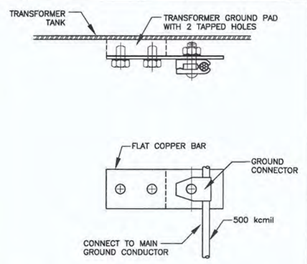
DETAIL 35 — CONNECTION TO FLANGED GUARD RAIL POST



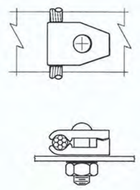
DETAIL 39 — STAIRWAY GROUNDING



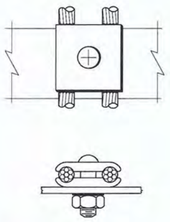
DETAIL 40 — GROUNDING OF LADDER WITH RECTANGULAR SIDE RAIL



DETAIL 45 — POWER TRANSFORMER GROUNDING

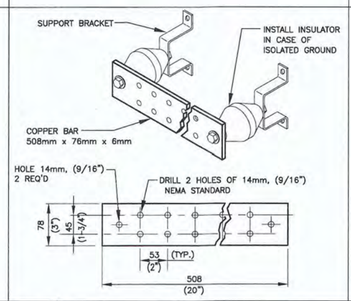


DETAIL 46 — SINGLE CONDUCTOR CONNECTOR TO A METAL SURFACE

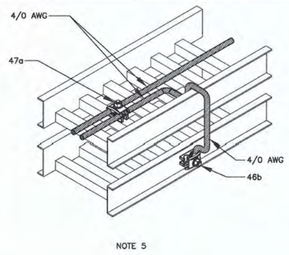


DETAIL 47 — DOUBLE CONDUCTOR CONNECTOR TO A METAL SURFACE

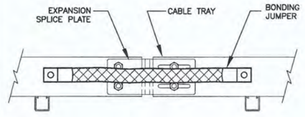
DETAIL 48 — CONDUCTOR COMPRESSION CONNECTOR



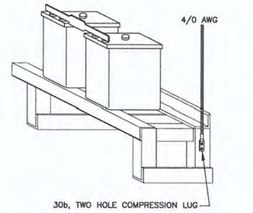
DETAIL 49 — INSTALLATION OF A GROUND BUS BAR ON A WALL



DETAIL 50 — GROUNDING STACKED OR SIDE BY SIDE CABLE TRAYS



DETAIL 51 — CABLE TRAY EXPANSION JOINT GROUNDING



DETAIL 52 — GROUNDING OF A BATTERY RACK

NOTES:

1. STEEL PLATE WELDED TO A METAL SURFACE INTENDED TO SIMPLIFY THE INSTALLATION, (IF REQUIRED).
2. UNLESS OTHERWISE NOTED, THE GROUNDING PLATES ARE TO BE MOUNTED AT 450 mm ABOVE THE FLOOR (MEASURED TO THE CENTRE OF THE PLATE).
3. AFTER WELDING, GALVANIZED SURFACES MUST BE CLEANED AND PAINTED WITH TWO (2) COATS OF "METAFLUX" BRAND "GALVANO SPRAY 70-45" ZINC COATING.
4. STAIR STRINGER TO BE BONDED AT THE TOP AND BOTTOM OF THE STAIRS.
5. THE CONTINOUS GROUNDING CONDUCTOR MUST BE CLAMPED TO THE CABLE TRAY EVERY 15 m, VERTICAL GROUND BONDING TO TAKE PLACE EVERY 15 m AND WHERE TRAY LEAVES THE BANK.

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL N0450 which is valid for the year 2013.

ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	C1	19-APR-2013	ISSUED FOR USE				
1	B1	31-JUL-2012	ISSUED FOR BID				

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3340-EL-DD-0018	POWERHOUSE INSTALLATION DETAILS EMBEDDED GROUNDING AND CONDUITS

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
C1	19-APR-2013	GENERAL REVISION, ISSUED FOR USE.	V.J.	R.N.	G.S.

* * * * * * * * FOR INTERNAL USE ONLY * * * * * * * *

REVIEW CLASS: EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- ☒ 1. REVIEWED AND ACCEPTED NO COMMENTS
- ☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy): 07-May-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy): 07-May-2013
PROJECT MANAGER: Date (dd-mmm-yyyy): 07 May 2013

PROFESSIONAL STAMP

PROFESSIONAL ENGINEERS PEGNL PROVINCE OF NEWFOUNDLAND AND LABRADOR — VICTOR JAREMKO — 19-APR-2013 DATE

SNC•LAVALIN

CLIENT: nalcor energy

DESIGNED BY V. JAREMKO	APPROVED Discipline Lead Engineer R. SANLIAN
DRAWN BY T. SHEPPARD	APPROVED Engineering Manager for W. CALDWELL / G. POWER
VERIFIED BY	
DATE 19-MAR-2012	SCALE N/A

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE
INSTALLATION DETAILS
SURFACE GROUNDING

File No. 505573-3344-47DD-0236_01

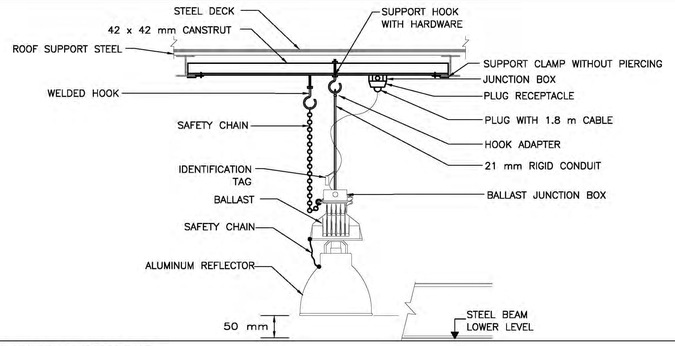
MFA-SN-CD-3340-EL-DD-0003-01 Rev. C1

FORMAT A0 (mm)

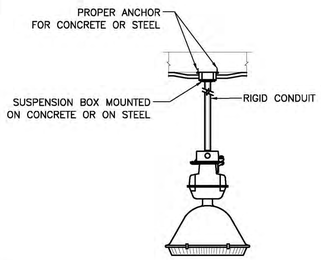
1 SUB-PKG: 0007-4701 PLATE 02
SUB-PKG: 0032-4701 PLATE 27

G:\505573\4_Drafting\Drawings\Elec\ELE_IMPLEMENTATION\3344\WORKING\505573-3344-47DD-0236_01W.dwg

2013/04/24 11:19:56 AM
BOUCR7

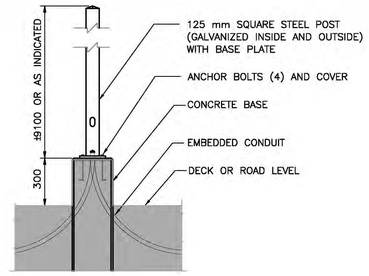


HIGH BAY LUMINAIRE INSTALLATION

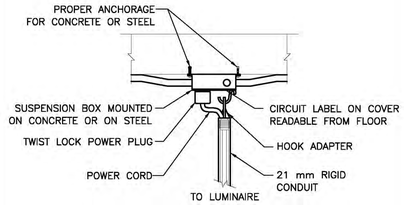


RECOMMENDED FOR LUMINAIRE:
H2, H3, H4, H5 & M3

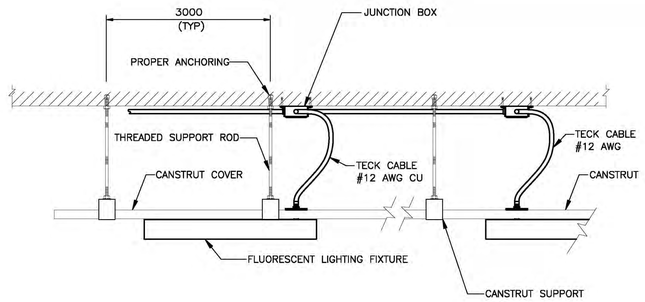
LOW-BAY LUMINAIRE INSTALLATION PENDANT



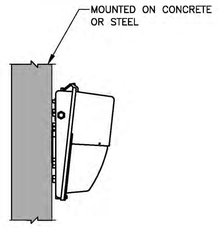
OUTDOOR HPS LAMP POST



LUMINAIRE INSTALLATION



SUSPENDED FLUORESCENT LUMINAIRE



WALL PACK LUMINAIRE INSTALLATION

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	C1	24-APR-2013	ISSUED FOR USE
1	B1	06-NOV-2012	ISSUED FOR BID/PURCHASE

ISSUE REGISTER

No.	REFERENCE DRAWING
3440-EL-DD-0020-01	POWERHOUSE LUMINAIRE TYPES LIGHTING & RECEPTACLES

No.	DATE	REVISION	MOD.	VER.	APP.
C1	24-APR-2013	ISSUED FOR USE	VJ	RN	GS

FOR INTERNAL USE ONLY

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: R. Kaushik — Date (dd-mmm-yyyy): 24-May-2013
N.L. I/P MANAGEMENT: R. Kaushik for Bob Barnes — Date (dd-mmm-yyyy): 24-May-2013
PROJECT MANAGER: S. O'Brien — Date (dd-mmm-yyyy): 24-May-2013

PROFESSIONAL ENGINEERS GOVERNED BY THE NEWFOUNDLAND & LABRADOR ENGINEERS ACT — PEGL PROFESSIONAL ENGINEER — VICTOR JAREMKO — SIGNATURE 22-04-13 DATE

SNC·LAVALIN

DESIGNED BY V. JAREMKO	APPROVED Discipline Lead Engineer R. SANLIAN
DRAWN BY T. SHEPPARD	APPROVED Engineering Manager G. SNYDER
VERIFIED BY W. CALDWELL/A. GAGNON	SCALE NTS
DATE 08-JUN-2012	

nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE AND SPILLWAY
INSTALLATION DETAILS
LIGHTING AND RECEPTACLES

File No. 505573-3344-47DD-0179_01 | MFA-SN-CD-3340-EL-DD-0019-01 | Rev. C1

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
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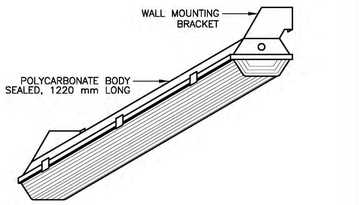
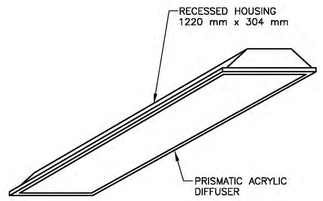
FORMAT_A0 (mm)

SUB-PKG: 0007-4702 PLATE 02
SUB-PKG: 0032-4701 PLATE 26



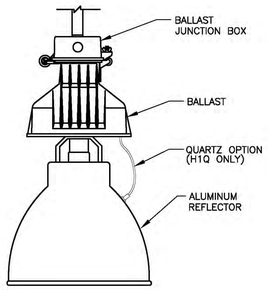
F1 = 2 x 32 W TUBES, 347 V.a.c. SUSPENDED
F2 = 2 x 32 W TUBES, 347 V.a.c. WALL MOUNTED

F1 & F2 TYPE LUMINAIRE — STAIRWAYS & DAMP LOCATION



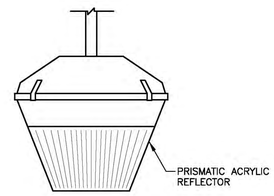
F8 = 2 x 32 W TUBES, 347 V.a.c.
F9 = 3 x 32 W TUBES, 347 V.a.c.

F8 & F9 TYPE LUMINAIRE — RECESSED



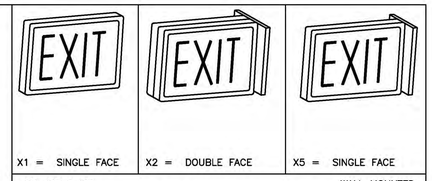
H1 = 1000 W MH, 347 V.a.c.
H1Q = 1000 W MH, 347 V.a.c. EQUIPED WITH QUARTZ OPTION

H1 & H1Q TYPE LUMINAIRE — HIGHBAY



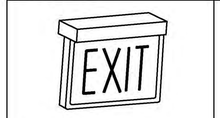
L2 = 250 W MH, 347 V.a.c.

L2 TYPE LUMINAIRE — LOWBAY

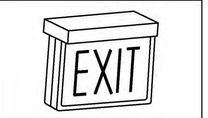


X1 = SINGLE FACE
X2 = DOUBLE FACE
X5 = SINGLE FACE

X1, X2 & X5 — WALL MOUNTED

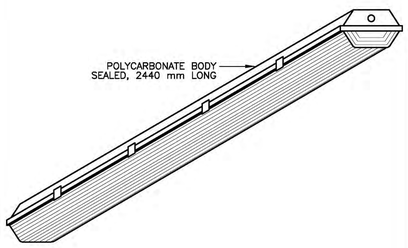


X3 = SINGLE FACE



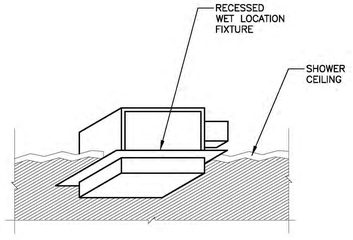
X4 = DOUBLE FACE

X3 & X4 — CEILING MOUNTED



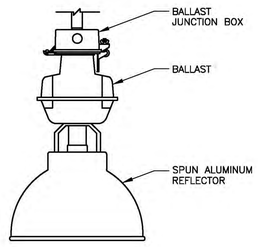
F3 = 4 x 32 W TUBES, 347 V.a.c. SUSPENDED
F4 = 4 x 32 W TUBES, 347 V.a.c. WALL MOUNTED

F3 & F4 TYPE LUMINAIRE — DAMP LOCATION



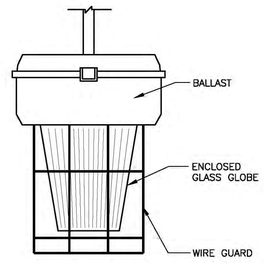
F10 = 13 W TWIN TUBES, 120 V.a.c.

F10 TYPE LUMINAIRE — SHOWER



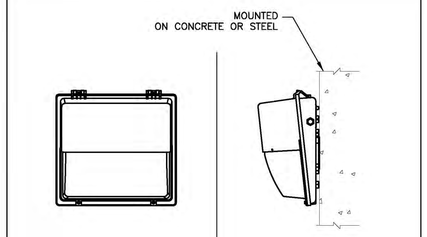
H2 = 400 W MH, 347 V.a.c.
H3 = 250 W MH, 347 V.a.c.

H2 & H3 TYPE LUMINAIRE — HIGHBAY



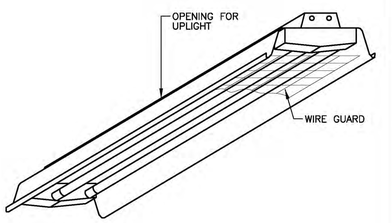
L3 = 250 W MH, 347 V.a.c.

L3 TYPE LUMINAIRE — HAZARDOUS LOCATIONS



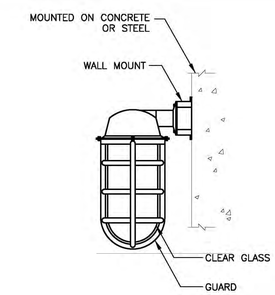
W1 = 100 W MH, 347 V.a.c.

W1 TYPE LUMINAIRE — WALL PACK



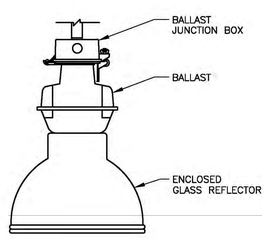
F5 = 2 x 32 W TUBES, 347 V.a.c., 1220 mm LONG
F6 = 4 x 32 W TUBES, 347 V.a.c., 2440 mm LONG

F5 & F6 TYPE LUMINAIRE — WIRE GUARDED



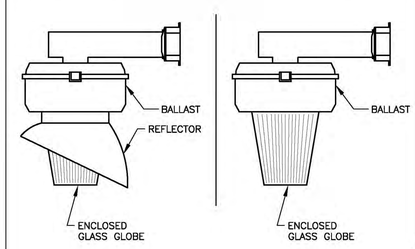
F11 = 26 W COMPACT FLUORESCENT, 347 V.a.c.

F11 TYPE LUMINAIRE



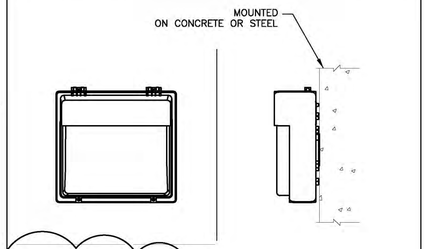
H4 = 400 W MH, 347 V.a.c.

H4 TYPE LUMINAIRE — HIGHBAY



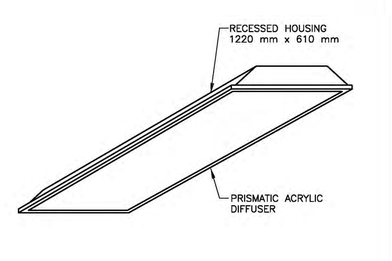
L4 = 100 W MH, 347 V.a.c. 30° REFLECTOR
L5 = 150 W MH, 347 V.a.c.
L6 = 150 W MH, 347 V.a.c. 30° REFLECTOR

L4, L5 & L6 TYPE LUMINAIRE — TURBINE / GENERATOR PIT



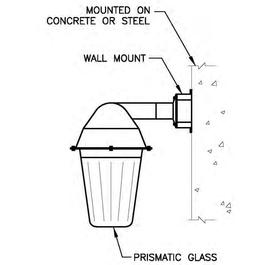
W2 = 250 W HPS, 347 V.a.c.
W3 = 400 W HPS, 347 V.a.c.
W4 = 150 W HPS, 347 V.a.c.
W5 = 100 W HPS, 347 V.a.c.
W6 = 70 W HPS, 347 V.a.c.

W2, W3, W4, W5 & W6 TYPE LUMINAIRE — EXTERIOR WALL PACK



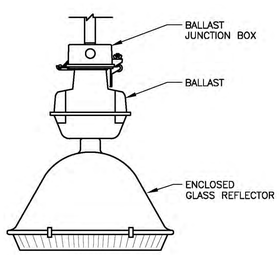
F7 = 4 x 32 W TUBES, 347 V.a.c.

F7 TYPE LUMINAIRE — OFFICE & CORRIDOR



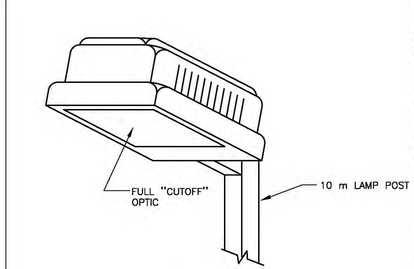
I1 = 50 W INCANDESCENT, 125 V.d.c
I2 = 100 W INCANDESCENT, 125 V.d.c

I1 & I2 TYPE LUMINAIRE — EMERGENCY



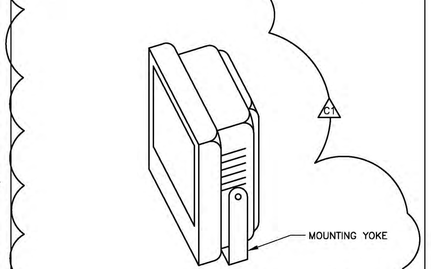
L1 = 250 W MH, 347 V.a.c.

L1 TYPE LUMINAIRE — LOWBAY



P1= 400 W HPS, 347 V.a.c. TYPE 4 OPTIC
P2= 400 W HPS, 347 V.a.c. TYPE 2 OPTIC
P3= 150 W HPS, 347 V.a.c. TYPE 3 OPTIC

P1 & P2 TYPE LUMINAIRE — PARKING AREA



P5= 70 W HPS, 347 V.a.c.

P5 TYPE LUMINAIRE — FLOODLIGHT

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador
Permit No. as issued by PEGNL N04586
which is valid for the year 2013

ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	C1	29-APR-2013	ISSUED FOR USE				
1	B1	19-OCT-2012	ISSUED FOR BID				

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3440-EL-DD-0019-01	POWERHOUSE & SPILLWAY INSTALLATION DETAILS LIGHTING & RECEPTACLES

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
C1	29-APR-2013	ADDED W5, W6 AND LUMINAIRE P5 – ISSUED FOR USE	VJ	RN	GS

* * * * * * * * FOR INTERNAL USE ONLY * * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

☑ 1. REVIEWED AND ACCEPTED NO COMMENTS
☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED

LEAD REVIEWER: R. Kaushik — Date (dd-mmm-yyyy): 24-May-2013
NE FOR MANAGEMENT: R. Kaushik for Bob Barnes — Date (dd-mmm-yyyy): 24-May-2013
PROJECT MANAGER: S. O'Brien — Date (dd-mmm-yyyy): 24-May-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS OF NEWFOUNDLAND AND LABRADOR
PEGL
VICTOR JAREMKO
SIGNATURE
29-04-13
DATE
PROFESSIONAL ENGINEERS OF NEWFOUNDLAND AND LABRADOR

SNC·LAVALIN

DESIGNED BY NAZMUL ALAM / V. JAREMKO	APPROVED Discipline Lead Engineer R. SANLIAN
DRAWN BY T. SHEPPARD	APPROVED Engineering Manager G. SNYDER
VERIFIED BY B. CALDWELL	
DATE 23-JUL-2012	SCALE AS NOTED

SLI DOC No. 505573-3344-47DD-0178_01
NE DOC No. MFA-SN-CD-3340-EL-DD-0020-01 Rev. C1

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
POWERHOUSE AND SPILLWAY
LUMINAIRE TYPES
LIGHTING AND RECEPTACLES

FORMAT A0 (mm)

1 SUB-PKG: 0007-4702 PLATE 01
SUB-PKG: 0032-4701 PLATE 25

G:\505573\4_Drafting\Drawings\Elect\ELE_IMPLEMENTATION\ISSUED\CH0007\2013-05-16_IFU_Lighting\BOUN0\505573-3344-47DD-0178_01.dwg
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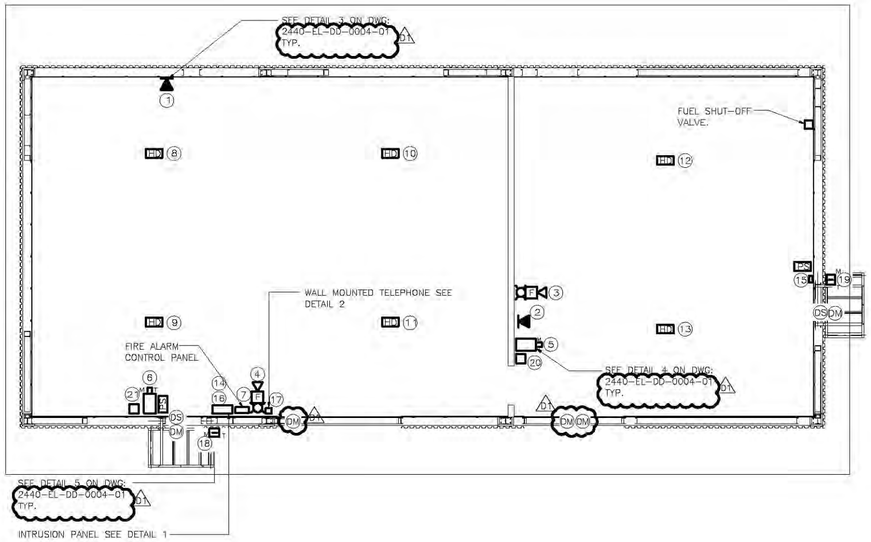
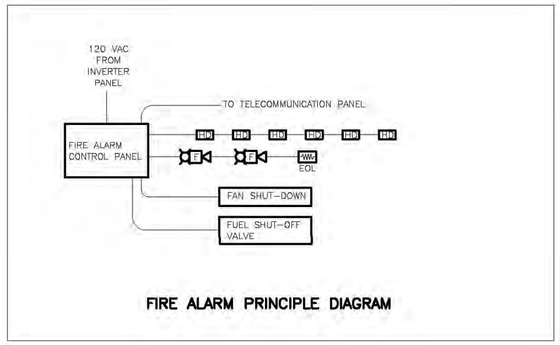
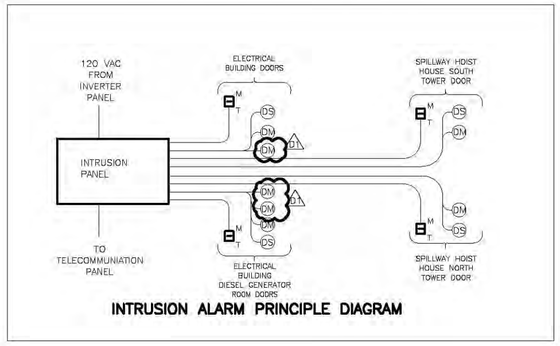
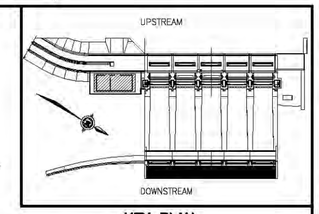




FIRE ALARM PRINCIPLE DIAGRAM



INTRUSION ALARM PRINCIPLE DIAGRAM



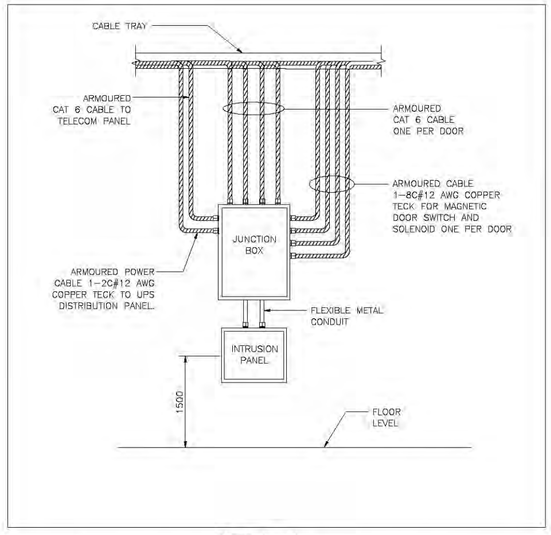
KEY PLAN

NOTES:

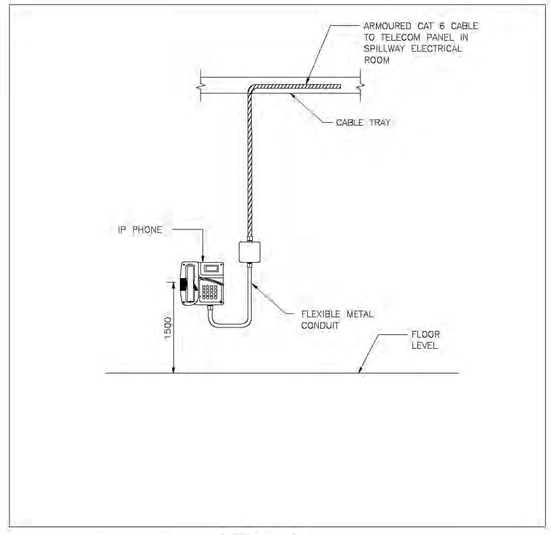
1. ALL CABLE ARMOUR TO BE CONNECTED TO GROUND BAR LOCATED IN THE JUNCTION BOXES AT BOTH ENDS OF ALL CABLE RUNS.

EQUIPMENT TAG NUMBER

1. 2440-LANJ-89-0001
2. 2440-LANJ-89-0002
3. 2440-HN-92-0001
4. 2440-HN-92-0002
5. 2440-CCTV-94-0001
6. 2440-CCTV-94-0002
7. 2440-FAP-92-0001
8. 2440-HS-92-0001
9. 2440-HS-92-0002
10. 2440-HS-92-0003
11. 2440-HS-92-0004
12. 2440-HS-92-0005
13. 2440-HS-92-0006
14. 2440-JB-93-0001
15. 2440-JB-93-0002
16. 2440-ACCC-93-0001
17. 2440-TEL-89-0001
18. 2440-ACCC-93-0002
19. 2440-ACCC-93-0003
20. 2440-JB-94-0001
21. 2440-JB-94-0002



DETAIL 1
TYPICAL INTRUSION PANEL INSTALLATION
N.T.S



DETAIL 2
TYPICAL TELEPHONE INSTALLATION
N.T.S

NOT FOR CONSTRUCTION

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL NO168 which is valid for the year 2013

This document has been signed and accepted electronically via Aconex.

1:50 -500 0 500 1500 2500 mm

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	12-JUL-2013	APPROVED FOR DESIGN
1	B1	09-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2440-EL-DD-0004-01	SPILLWAY CCTV SYSTEM,TELEPHONE, COMMUNICATION AND SECURITY SYSTEMS LAYOUT AND INSTALLATION DETAILS
MFA-SN-CD-2440-EL-RT-0001-01	SPILLWAY ELECTRICAL BUILDING CABLETRAY AND CONDUIT LAYOUT
MFA-SN-CD-2440-EL-LT-0002-01	SPILLWAY DIVERSION PHASE ELECTRICAL ROOM EQUIPMENT LAYOUT
MFA-SN-CD-3430-EL-LS-0007-01	POWERHOUSE ELECTRICAL SERVICES LAYOUT LEGEND

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	12-JUL-2013	REFERENCE NUMBERS UPDATED, MAGNETIC DOOR SWITCHES ADDED.	AC	WC	GH

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- ☑ 1.REVIEWED AND ACCEPTED, NO COMMENTS
- ☐ 2.REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3.REVIEWED – NOT ACCEPTED
- ☐ 4.INFORMATION ONLY
- ☐ 5.NOT REVIEWED

LEAD REVIEWER:	R. Kaushik	Date (dd-mmm-yyyy): 15-Aug-2013
NE-LCP MANAGEMENT:	B. Barnes	Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER:	Bruce Drover	Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEERS PEGNL PROVINCE OF NEWFOUNDLAND AND LABRADOR ANTOINE GAGNON 12-JUL-2013 DATE
ASSOCIATION OF PROFESSIONAL ENGINEERS AND GEOSCIENTISTS

SNC·LAVALIN

DESIGNED BY: A. GAGNON	APPROVED: Discipline Lead Engineer R. SANLIAN
DRAWN BY: T. SHEPPARD	APPROVED: Engineering Manager G. SNYDER
VERIFIED BY: N. ALAM	
DATE: 07-SEP-2012	SCALE: 1:50 UNO

SNC DOC No.: 505573-3243-47DD-0107_01
TRL DOC No.: MFA-SN-CD-3340-EL-DD-0045-01
REV: D1

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
SPILLWAY – ELECTRICAL BUILDING CCTV, TELEPHONE, COMMUNICATION, FIRE ALARM AND SECURITY SYSTEMS EQUIPMENT LAYOUT AND DETAILS

SUB-PKG: 0032-4701 PLATE 19

FORMAT A0 (mm)

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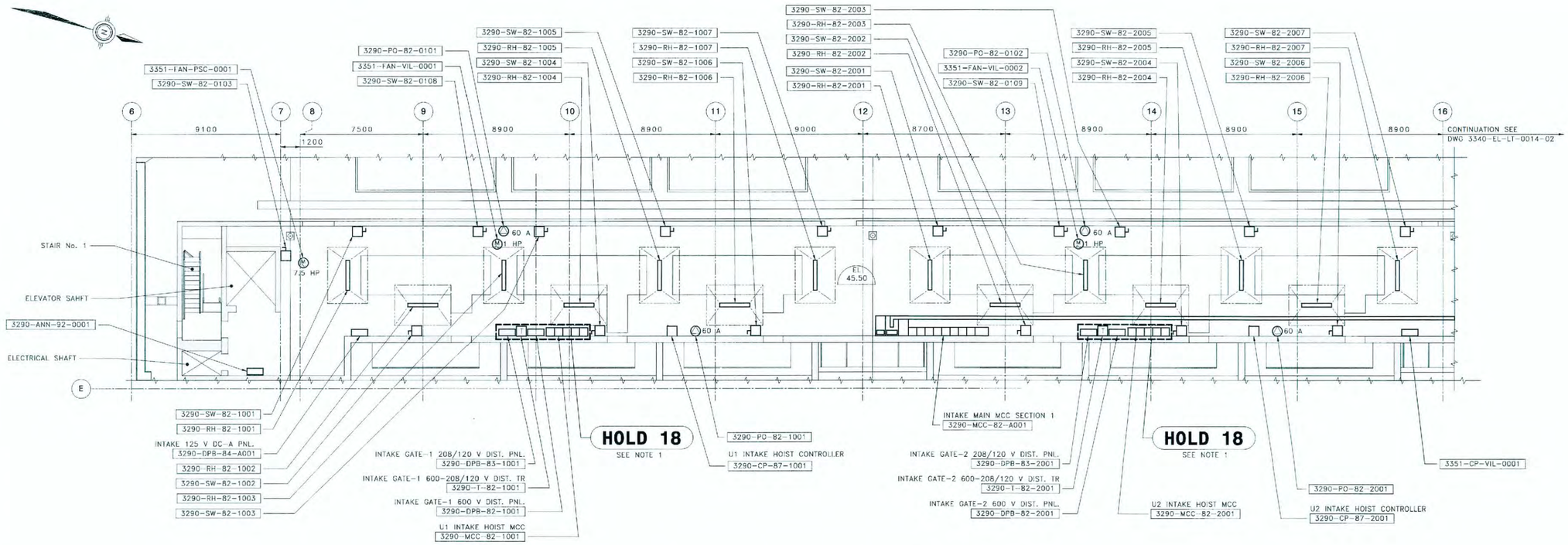
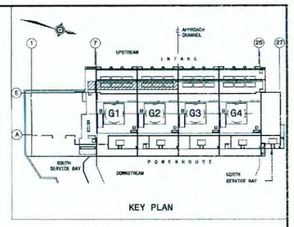
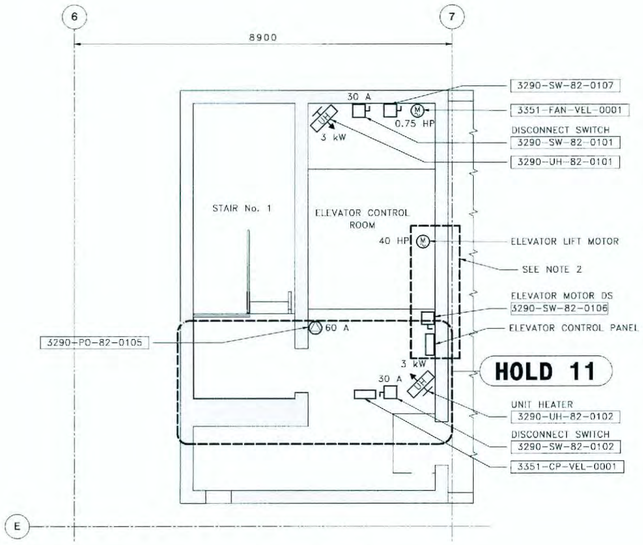


INTAKE DECK PLAN EL 45.50 – UNITS G1 AND G2



NOTES:

1. EQUIPMENT DESIGNED, SUPPLIED AND INSTALLED BY PACKAGE CH0032.
2. EQUIPMENT SUPPLIED AND INSTALLED BY PACKAGE CH0034.



ELEVATOR ROOM PLAN EL 50.80

1: 50

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL 102450
which is valid for the year 2013

0 1000 2000 3000 4000 5000 mm
SCALE 1:50

0 2000 4000 6000 8000 10000 mm
SCALE 1:100

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	C1	14-NOV-2013	ISSUED FOR CONSTRUCTION
2	D1	12-JUL-2013	APPROVED FOR DESIGN

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3430-EL-LT-0012-01	POWERHOUSE CROSS SECTION AT UNIT CENTERLINE ELECTRICAL EQUIPMENT LAYOUT
MFA-SN-CD-3340-EL-LT-0014-02	POWERHOUSE – INTAKE DECK PLAN EL 45.50 – ELECTRICAL EQUIPMENT LAYOUT – SHEET 2 OF 2
MFA-SN-CD-3430-EL-LS-0007-01	ELECTRICAL SERVICES LAYOUT LEGEND
MFA-SN-CD-3430-EL-SD-0002-01	ELECTRICAL SERVICES IDENTIFICATION STANDARDS
MFA-SN-CD-3350-ME-LS-0003-01	GENERAL WORKS EQUIPMENT AND SYSTEM CODES LEGEND

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
1	04-OCT-2013	ISSUED FOR USE	NA	WC	GH

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☐ 2.REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: 25 NOV 2013
NE-LCP MANAGEMENT: 2 Dec 2013
PROJECT MANAGER: 28 NOV 2013

PROFESSIONAL STAMP

PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND & LABRADOR
PEGL
MEER NAZMUL ALAM
PROFESSIONAL ENGINEER
25-NOV-2012
DATE

SNC·LAVALIN

DESIGNED BY NAZMUL ALAM	APPROVED Discipline Lead Engineer G. HAINES
DRAWN BY V. HERNANDEZ	APPROVED Engineering Manager G. SNYDER
VERIFIED BY D. GAGNON	
DATE 18-JAN-2012	SCALE 1:100 UNO

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS POWERHOUSE INTAKE DECK PLAN EL 45.50 ELECTRICAL EQUIPMENT LAYOUT SHEET 1 OF 2

SLI DOC No.	NE DOC No.	Rev.
SO5573-3344-47DD-0176-SH1_01	MFA-SN-CD-3340-EL-LT-0014-01	C1

FORMAT A0 (mm)

SUB-PKG: 0032-4701 PLATE 23 SUB-PKG: 0031-4705 PLATE 19

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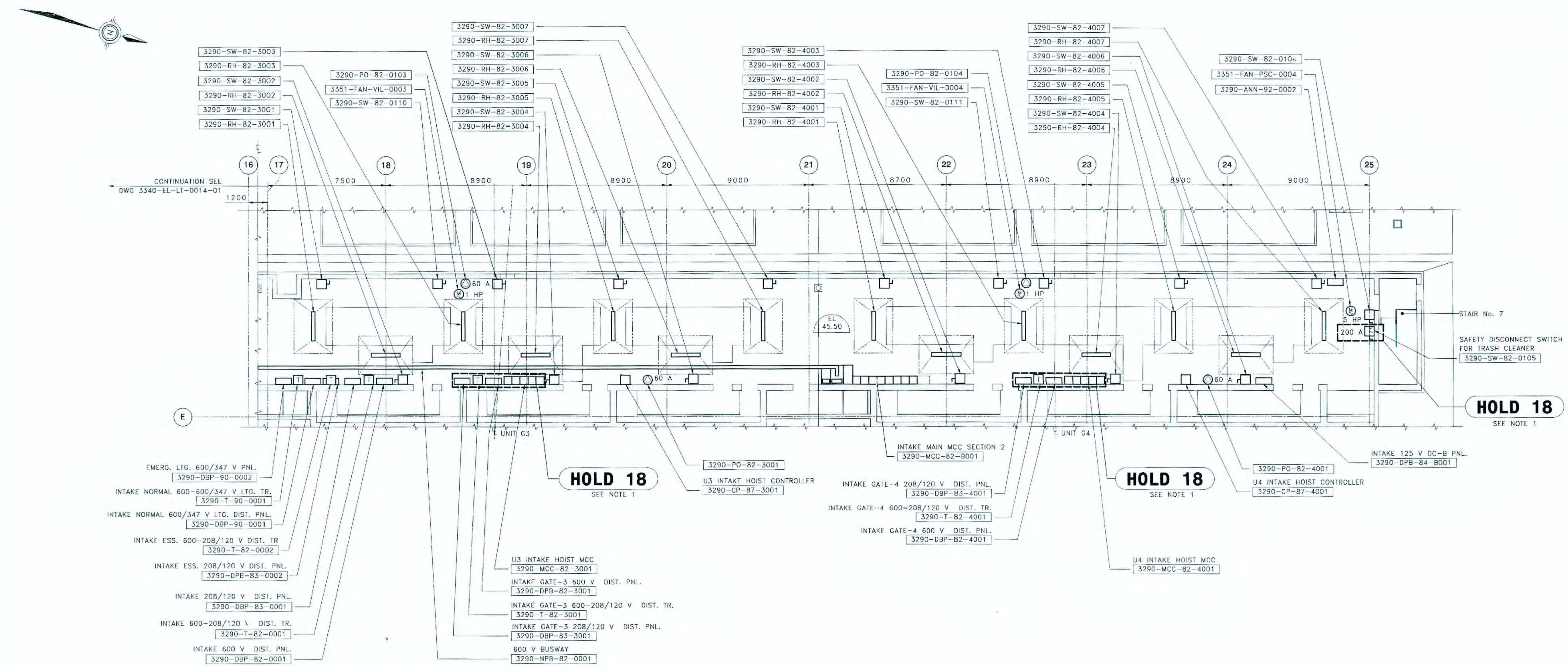
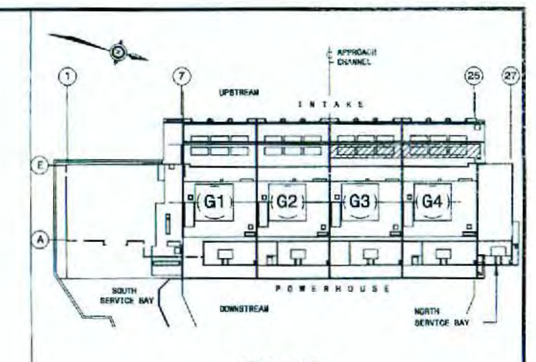


INTAKE DECK PLAN EL 45.50 – UNITS G3 AND G4



KEY PLAN

NOTE:

1. EQUIPMENT DESIGNED, SUPPLIED AND INSTALLED BY PACKAGE CH0032.

PROVINCE OF NEWFOUNDLAND PEGL PERMIT HOLDER CLASS "A" This Permit Allows SNC-LAVALIN Inc. To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL N0450 which is valid for the year 2013

SCALE 1:100 (0 2000 4000 6000 8000 10000 mm)

ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	C1	14-NOV-2013	ISSUED FOR CONSTRUCTION				
2	D1	17-JUL-2013	APPROVED FOR DESIGN				

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3340-EL-LT-0012-01	POWERHOUSE CROSS SECTION AT UNIT CENTERLINE ELECTRICAL EQUIPMENT LAYOUT
MFA-SN-CD-3340-EL-LT-0014-01	POWERHOUSE – INTAKE DECK PLAN EL 45.50 – ELECTRICAL EQUIPMENT LAYOUT – SHEET 1 OF 2
MFA-SN-CD-3430-EL-SS-0007-01	ELECTRICAL SERVICES LAYOUT LEGEND
MFA-SN-CD-3430-EL-SD-0007-01	ELECTRICAL SERVICES IDENTIFICATION STANDARDS
MFA-SN-CD-3350-ME-LS-0003-01	GENERAL WORKS EQUIPMENT AND SYSTEM CODES LEGEND

No.	DATE	REVISION	MOD.	VER.	APP.
1	04-OCT-2013	ISSUED FOR USE	NA	WC	GH

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☐ 2.REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: | Date: 2 DEC 2013
PROJECT MANAGER: | Date: 3 DEC 2013

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY NAZMUL ALAM
DRAWN BY V. HERNANDEZ
VERIFIED BY D. GAGNON
DATE 18-JAN-2012
APPROVED Discipline Lead Engineer G. HAINES
APPROVED Engineering Manager C. SNYDER
SCALE 1:100

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS POWERHOUSE INTAKE DECK PLAN EL 45.50 ELECTRICAL EQUIPMENT LAYOUT SHEET 2 OF 2

SLI DOC No. 505573-3344-4700-0176-SH2_01

MFA-SN-CD-3340-EL-LT-0014-02 | Rev. C1

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SUB-PKG: 0032-4701 PLATE 24

SUB-PKG: 0031-4705 PLATE 20

DIAGRAM	
	MANUALLY OPERATED DISCONNECT SWITCH
	MANUAL GANG OPERATED DISCONNECT SWITCH
M/LB	MOTOR OPERATED LOAD INTERRUPTER SWITCH
M	MOTOR OPERATED DISCONNECT SWITCH
M S	GROUND SWITCH–MANUAL GROUND SWITCH–HI SPEED MOTOR OPERATED GROUND SWITCH–HI SPEED SOLENOID OPERATED
	LIGHTNING ARRESTER
	CAPACITOR
	FUSE
	DUMMY FUSE
R	RESISTOR
	BROAD BAND LINE TRAP
	CURRENT TRANSFORMER
	BUSHING TYPE CURRENT TRANSFORMER
	CURRENT TRANSFORMER FOR SPLIT PHASE PROTECTION
	POTENTIAL TRANSFORMER C/W TWO SECONDARY WINDINGS
	CAPACITIVE VOLTAGE DIVIDER
	CABLE WITH TERMINATIONS
	ISOLATED PHASE BUS OR BUSWAY
DL	ISOLATED PHASE BUS OR BUSWAY REMOVABLE LINK
	MECHANICAL INTERLOCK
E	ELECTRICAL INTERLOCK
	THYRISTOR OR THYRISTOR BRIDGE
	WYE CONNECTION
	A.C. GENERATOR
	WYE–DELTA TRANSFORMER
	ZIG–ZAG DELTA TRANSFORMER
	AUTO TRANSFORMER (WITH DELTA TERTIARY WINDING)
	TRANSFORMER WITH ON LOAD TAP CHANGER (WITH ARROW IN DIRECTION OF REGULATED BUS)

DIAGRAM	
	OPEN CORNER DELTA
S	SHUNT
	BATTERY
E	ELECTRICALLY OPERATED CIRCUIT BREAKER (600 V AND BELOW)
	CIRCUIT BREAKER (600 V AND BELOW)
	CIRCUIT BREAKER WITH MAGNETIC TRIP (600 V AND BELOW)
	CIRCUIT BREAKER WITH MAGNETIC & THERMAL TRIP (600 V AND BELOW)
	VARIABLE REACTOR (CHOKE)
	REACTOR
	SPHERE GAP
	JUMPER
	CROSSING CONDUCTORS WITH CONNECTION
	GROUND
	LOCKABLE DEVICE
	DRAW–OUT
M	D.C. MOTOR
M 15 HP	A.C. MOTOR (15 HORSEPOWER)
MS	SYNCHRONOUS MOTOR
	POTENTIAL TRANSFORMER
5	CONTACTOR (No. INDICATES NEMA SIZE)
	THERMAL OVERLOAD
	HEATING ELEMENT
A	AMMETER
V	VOLTMETER
Hz	FREQUENCY METER
W	WATTMETER
WH	WATTHOURMETER
VAR	VARMETER

DIAGRAM	
VAR H	VARHOURMETER
	UNIT HEATER
60 A 60 A 60 A	600 V POWER OUTLET C/W FUSED SAFETY SWITCH, 3 PH, 3 W
	POWERHOUSE OVERHEAD CRANE FEEDER
	DIODE
	ZENER DIODE
	DEVICE (IDENTIFICATION NEAR SYMBOL)
24 CCT	24 CIRCUITS DISTRIBUTION PANEL
	RECTIFIER (BATTERY CHARGER)
	INVERTER
C	MAGNETIC CONTACTOR
*	RELAY COIL (ASTERISK DENOTES THE RELAY DESIGNATION)
	RELAY COIL TIMED ON
	RELAY COIL TIMED OFF
	SOLENOID COIL
17, 25	RELAY CONTACT LOCATION 17 = N.O. CONTACT ON LINE 17 25 = N.C. CONTACT ON LINE 25
	POWER APPARATUS HIGH VOLTAGE TERMINAL. TYPICALLY USED TO DENOTE TRANSFORMER BUSHINGS, BREAKER TERMINALS, ETC.
	TERMINAL ON SWITCHBOARD TERMINAL BLOCK
	TERMINAL ON POWER APPARATUS MAIN TERMINAL BLOCK, e.g. BREAKER, POWER TRANSFORMER.
	TERMINAL ON POWER APPARATUS SECONDARY TERMINAL BLOCK
	TERMINAL LOCATED IN THE SUPERVISORY JUNCTION BOX.
	TERMINAL LOCATED IN A MARSHALLING CABINET OR JUNCTION BOX.
	NORMALLY CLOSED (N.C.) CONTACT CLOSED (BREAK)
	NORMALLY OPEN (N.O.) CONTACT OPEN (MAKE)
	N.O. PUSHBUTTON
	N.C. PUSHBUTTON

DIAGRAM	
	EQUIPMENT TERMINAL
	N.O. ON DELAY
	N.C. ON DELAY
	N.O. OFF DELAY
	N.C. OFF DELAY
	FLOW SWITCH CLOSES ON FLOW INCREASE
	FLOW SWITCH OPENS ON FLOW INCREASE
	FLOAT SWITCH CLOSES ON LEVEL INCREASE
	FLOAT SWITCH OPENS ON LEVEL INCREASE
	PRESSURE SWITCH CLOSES ON PRESSURE INCREASE
	PRESSURE SWITCH OPENS ON PRESSURE INCREASE
	THERMOSTAT CLOSE ON TEMPERATURE INCREASE
	THERMOSTAT OPENS ON TEMPERATURE INCREASE
	N.O. LIMIT SWITCH
	N.O. LIMIT SWITCH HELD CLOSED
	N.C. LIMIT SWITCH
	N.C. LIMIT SWITCH HELD OPEN
1 R 2	PILOT LIGHT: A – AMBER B – BLUE R – RED C – CLEAR G – GREEN Y – YELLOW W – WHITE
	DELTA CONNECTED WINDINGS
	WYE CONNECTED WINDING WITH GROUNDED NEUTRAL
	3–PHASE, 4 WIRE, WYE UNGROUNDED
	3–PHASE, ZIGZAG, UNGROUNDED
	3–PHASE, ZIGZAG, GROUNDED
	GENERATOR FIELD WINDING
V	VACUUM CIRCUIT BREAKER
G	SF6–SULPHUR HEXAFLUORIDE CIRCUIT BREAKER
A	AIR BLAST CIRCUIT BREAKER

DIAGRAM	
AB	AIR CIRCUIT BREAKER
O	OIL CIRCUIT BREAKER
R	RECLOSER
MT	METERING TANK
M	METERING POINT
CS	CIRCUIT SWITCHER
SSM	STATION SERVICE METERING
RM	REVENUE METERING

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC–LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL 310458 which is valid for the year 2013

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	C1	12–JUL–2013	ISSUED FOR USE
1	B1	19–OCT–2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD. RN	VER. NA	APP. WC
C1	12–JUL–2013	NO CHANGES.			

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REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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☐ 2. REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED – NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED

		Date (dd-mmm-yyyy):
LEAD REVIEWER:	R. Kaushik	15-Aug-2013
RE-LCP MANAGEMENT:	B. Barnes	16-Aug-2013
PROJECT MANAGER:	Bruce Drover	16-Aug-2013

PROFESSIONAL STAMP

PROFESSIONAL ENGINEERS OF NEWFOUNDLAND AND LABRADOR — WILLIAM D. CALDWELL — 10458 — 25–JUL–2013 — DATE — PROVINCE OF NEWFOUNDLAND AND LABRADOR

SNC·LAVALIN

DESIGNED BY R. NOSEWORTHY	APPROVED Discipline Lead Engineer R. SANLIAN
DRAWN BY V. HERNANDEZ	APPROVED Engineering Manager G. SNYDER
VERIFIED BY NAZMUL ALAM	
DATE 06–JUL–2012	SCALE N/A

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE
ELECTRICAL SERVICES
DIAGRAM LEGEND

File No. 505573–3344–47DD–0103_01 | Dwg Code MFA–SN–CD–3430–EL–LS– | Class 0006 | Serial 01 | Sh C1 | Rev.

SUB-PKG: 0000-4701 PLATE 03

FORMAT A0 (mm)

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EQUIPMENT LAYOUT

T	DISTRIBUTION TRANSFORMER
J / F J	DISCONNECT SWITCH, UNFUSED DISCONNECT SWITCH, FUSED C1
J	COMBINATION MAGNETIC MOTOR STARTER AND DISCONNECT
	MANUAL MOTOR STARTER
M	D.C. MOTOR
M HP	A.C. MOTOR (HORSEPOWER AS INDICATED)
MS	SYNCHRONOUS MOTOR
HTR	CONVECTION HEATER
	HEATING ELEMENT
UH	UNIT HEATER
C1	RADIANT HEATER
	600 V POWER OUTLET
	DISTRIBUTION PANEL
T	DISTRIBUTION PANEL WITH DISTRIBUTION TRANSFORMER WALL MOUNTED ABOVE
	CONTROL PANEL, JUNCTION BOX OR AS IDENTIFIED
DG	EMERGENCY POWER GENERATOR (DIESEL GENERATOR SET)
	PUSHBUTTON STATION
T	THERMOSTAT
	VARIABLE FREQUENCY DRIVE (VFD)

LIGHTING

H1	LIGHTING FIXTURE, CEILING MOUNTED OR SUSPENDED H1 DENOTES FIXTURE TYPE (SEE NOTE 1)
W1	LIGHTING FIXTURE, WALL MOUNTED W1 DENOTES FIXTURE TYPE (SEE NOTE 1)
P1	LIGHTING FIXTURE, POLE MOUNTED P1 DENOTES FIXTURE TYPE (SEE NOTE 1)
F1	FLUORESCENT LIGHTING FIXTURE CEILING MOUNTED OR SUSPENDED, DIAGONAL SLASH INDICATES CONNECTION TO ESSENTIAL POWER. F1 DENOTES FIXTURE TYPE (SEE NOTE 1)
F2	FLUORESCENT LIGHTING FIXTURE WALL MOUNTED. F2 DENOTES FIXTURE TYPE (SEE NOTE 1)
X3	EXIT SIGN, CEILING MOUNTED (NOTES 1, 2) X3 DENOTES FIXTURE TYPE (SEE NOTE 1)
X2	EXIT SIGN, WALL MOUNTED (NOTES 1, 2) X2 DENOTES FIXTURE TYPE (SEE NOTE 1)
E	LIGHTING FIXTURE CEILING MOUNTED OR SUSPENDED FED BY AN EMERGENCY CIRCUIT
E	LIGHTING FIXTURE WALL MOUNTED FED BY AN EMERGENCY CIRCUIT
$a	LIGHT SWITCH SINGLE POLE, WALL MOUNTED a = SWITCH IDENTIFICATION
$3	3 WAY LIGHT SWITCH
$P	LIGHT SWITCH C/W PILOT LIGHT
$PD	LIGHT SWITCH WITH PRESENCE DETECTOR (ON–AUTO–OFF)
PD	CEILING MOUNTED PRESENCE DETECTOR FOR LIGHT SWITCHING
PEC	PHOTO–ELECTRIC CELL

RECEPTACLES

	SINGLE RECEPTACLE 120 V, 15 A
	DUPLEX RECEPTACLE 120 V, 15 A WP = WEATHERPROOF COVER GFI = GROUND FAULT INTERUPTER TL = TWIST LOCK
20A	DUPLEX RECEPTACLE 120 V, 20 A
20A	SINGLE RECEPTACLE 240 V, 20 A

LIGHTING (CONT'D)

C	CONTACTOR
	SELECTOR

GROUNDING

	T CONNECTION
	X CONNECTION
	GROUND CONDUCTOR 1 m LONG COILED UP FOR FUTURE CONNECTION
	EMBEDDED GROUND PLATE
	500 kcmil GROUND CONDUCTOR
	4/0 AWG GROUND CONDUCTOR
	2/0 AWG GROUND CONDUCTOR
UP	GROUND CONDUCTOR GOING UP
DN	GROUND CONDUCTOR GOING DOWN
UP/DN	GROUND CONDUCTOR GOING UP AND DOWN
	GROUND ROD
	GROUND TEST LINK

SWITCHYARD LAYOUT

M	MOTOR OPERATED DISCONNECT SWITCH MECHANISM
	MANUALLY OPERATED DISCONNECT SWITCH
	JUNCTION BOX
	CT AND CVT'S 3ø JUNCTION BOX
CD	COUPLING DEVICE BOX (LINE TUNING EQUIPMENT)
	CABLE TRENCH WITH ONE SEPARATOR
	LOW VOLTAGE BURIED DISTR. AND CONTROL CABLE
	BURIED ELECTRICAL DUCT CONTAINING CABLES FOR REVENUE METERING CT & CVT's

FIRE DETECTION SYSTEM

FP	FIRE ALARM PANEL
	ANNUNCIATOR PANEL
DCP	DELUGE CONTROL PANEL
FMC	FIRE MONITORING CABINET
FP E	FIRE PUMP E = ELECTRICAL P = PROPANE D = DIESEL
F PS A	ADDRESSABLE MANUAL PULLSTATION A = ABORT STATION (YELLOW) I = INITIATE STATION (BLUE)
	SUPERVISORY TAMPER SWITCH
	LOW PRESSURE SWITCH
F	MAGNETIC HOLD OPEN DEVICE F = FLOOR MOUNT W = WALL MOUNT
I	IONIZATION SMOKE DETECTOR
O	OPTICAL SMOKE DETECTOR
HD	HEAT DETECTOR
F wp	FIRE ALARM HORN wp = WEATHERPROOF
F	FIRE ALARM BELL
F	FIRE ALARM STROBE LIGHT
F	FIRE ALARM HORN/STROBE COMBINATION
F T or R	BEAM DETECTOR T = TRANSMIT R = RECEIVE
R	BEAM SMOKE DETECTOR REFLECTOR
E.O.L.	END OF LINE RESISTOR
DM	DUAL MONITORING MODULE
MM	MONITORING MODULE

FIRE DETECTION SYSTEM (CONT'D)

	CONTROL RELAY MODULE
FSH	HIGH FLOW SWITCH
ZSL	LIMIT SWITCH

TELECOMMUNICATION SYSTEM

	TELEPHONE OUTLET
W	TELEPHONE OUTLET WALL–MOUNTED
T	TELEPHONE OUTLET TABLE TOP
E	TELEPHONE OUTLET EXTERIOR
	DATA OUTLET
W	DATA OUTLET WALL–MOUNTED
	PUSH BUTTON
W	TELEPHONE OUTLET WALL–MOUNTED AND RINGING HORN
E W	TELEPHONE OUTLET EXTERIOR WALL–MOUNTED AND RINGING HORN
	TELEPHONE ACOUSTICAL CABINET (SYMBOL IS DRAWN TO SCALE ON LAYOUTS)
	TELEPHONE ACOUSTICAL BOOTH (SYMBOL IS DRAWN TO SCALE ON LAYOUTS)
	TELECOM OUTLET (TELEPHONE / DATA)
J	CONTROL/TELECOMMUNICATION JUNCTION BOX

CABLE TRAYS

	CABLE TRAY
	CABLE TRAY ELEVATION CHANGE (ARROW INDICATES UPPER LEVEL)
	CABLE TRAY SECTION
	CABLE TRAY SECTION WITH BARRIER STRIP

INTRUSION & BURGLAR ALARM SYSTEM

M T	INTRUSION ALARM CONTROL PANEL
M T	CARD ACCESS READER
M T	MOTION DETECTOR
M T	CAMERA
K	SECURITY SYSTEM KEYPAD ENTRY STATION.
DS	ELECTROMAGNETIC DOOR STRIKE WITH MONITORING CONTACT
DM	MAGNETIC DOOR SWITCH
KB	SECURITY SYSTEM MAGNETIC LOCK KEY BYPASS SWITCH
	ALARM BELL
	WALL HORN
M T	INTERCOM
M T	AUDIO DEVICE
	CONTROL TRANSFORMER (VOLTAGE AS INDICATED)

CONDUITS

	EMBEDDED CONDUIT
	SURFACE CONDUIT
UP	CONDUIT GOING UP
DN	CONDUIT GOING DOWN

NOTE

1. SEE DRAWING MFA–SN–CD–3340–EL–DD–0020–01 FOR LIGHTING FIXTURE TYPES.
2. THE ARROW INDICATES DIRECTION FROM WHICH THE EXIT IS READ, ADD ARROWS FOR ADDITIONAL DIRECTIONS.

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A" This Permit Allows SNC–LAVALIN Inc. To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL NG458 which is valid for the year 2013.

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	C1	16–MAY–2013	ISSUED FOR USE
1	B1	19–OCT–2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA–SN–CD–3340–EL–DD–0020–01	POWERHOUSE LUMINAIRE TYPES LIGHTING AND RECEPTACLES

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
C1	16–MAY–2013	ADDED FUSED SWITCH, RADIANT HEATER – ISSUED FOR USE	RN	NA	DS

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- ☒ 1. REVIEWED AND ACCEPTED NO COMMENTS
- ☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: R. Kaushik	Date (dd-mmm-yyyy): 24-May-2013
NE-LCP MANAGEMENT: R. Kaushik for Bob Barnes	Date (dd-mmm-yyyy): 24-May-2013
PROJECT MANAGER: S. O'Brien	Date (dd-mmm-yyyy): 24-May-2013

PROFESSIONAL STAMP: PEGNL PROFESSIONAL ENGINEER ROBERT SANLIAN 16–MAY–2013

SNC·LAVALIN

DESIGNED BY R. NOSEWORTHY	APPROVED Discipline Lead Engineer R. SANLIAN
DRAWN BY V. HERNANDEZ	APPROVED Engineering Manager G. SNYDER
VERIFIED BY NAZMUL ALAM	
DATE 06–JUL–2012	SCALE N/A

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS POWERHOUSE ELECTRICAL SERVICES LAYOUT LEGEND

File No.	Dwg Code	Class	Serial	Sh	Rev.
505573–3344–47DD–0104_01	MFA–SN–CD–3430–EL–LS–		0007–01		C1

FORMAT A0 (mm)

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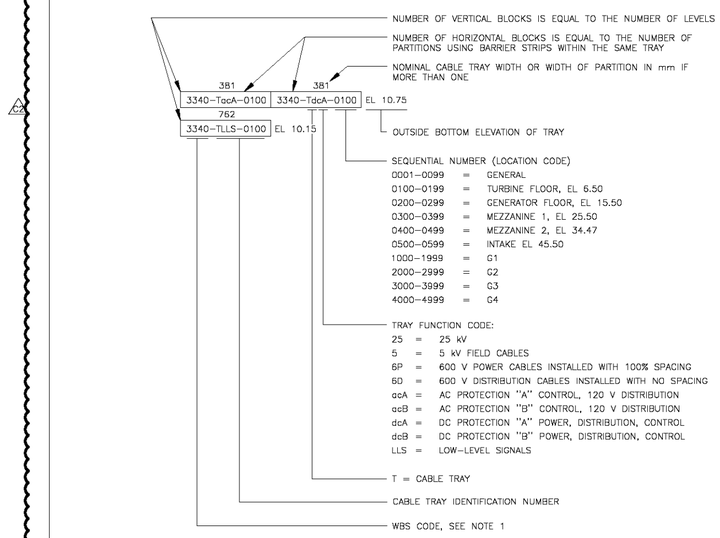
SUB-PKG: 0000-4701 PLATE 02

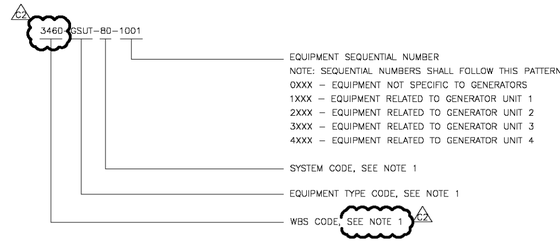
CABLE TRAYS



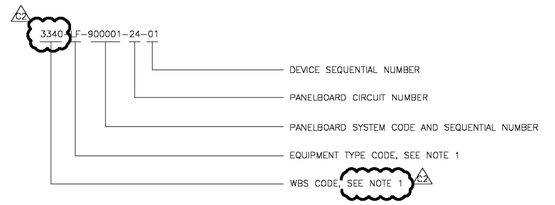
CABLE NUMBERING (SEE NOTE 2)

CONDUIT NUMBERING

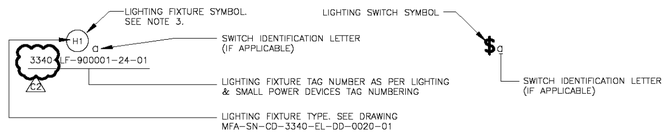
MAJOR ELECTRICAL EQUIPMENT TAG NUMBERING



LIGHTING & SMALL POWER DEVICES TAG NUMBERING



LIGHTING



NOTES:

1. FOR WBS CODES, EQUIPMENT TYPE CODES AND SYSTEM CODES, SEE REFERENCE DRAWING MFA-SN-CD-3350-ME-LS-0003-01. C2
2. REFER TO APPLICABLE CABLE SCHEDULE FOR CABLE TYPE DESCRIPTION.
3. FOR LIGHTING FIXTURE SYMBOL, SEE REFERENCE DRAWING MFA-SN-CD-3430-EL-LS-0007-01

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador, Permit No. as issued by PEGNL 10468 which is valid for the year 2013

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
3	C2	12-JUL-2013	ISSUED FOR USE
2	C1	16-MAY-2013	ISSUED FOR USE
1	B1	19-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3430-EL-LS-0007-01	POWERHOUSE ELECTRICAL SERVICES LAYOUT LEGEND
MFA-SN-CD-3340-EL-DD-0020-01	POWERHOUSE LUMINAIRE TYPES LIGHTING AND RECEPTACLES
MFA-SN-CD-3350-ME-LS-0003-01	GENERAL WORKS EQUIPMENT AND SYSTEM CODES LEGEND

No.	DATE	REVISION	MOD.	VER.	APP.
C2	12-JUL-2013	MODIFIED WBS CODES, CABLE TRAY IDENTIFICATION AND NOTE 1.	RN	WC	GH
C1	16-MAY-2013	ISSUED FOR USE.	RN	NA	GS

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☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED

LEAD REVIEWER: R. Kaushik — Date (dd-mmm-yyyy): 15-Aug-2013
NE-LCP MANAGEMENT: B. Barnes — Date (dd-mmm-yyyy): 16-Aug-2013
PROJECT MANAGER: Bruce Drover — Date (dd-mmm-yyyy): 16-Aug-2013

PROFESSIONAL STAMP
WILLIAM C. CALDWELL — 25-JUL-2013 — PROFESSIONAL ENGINEER — NEWFOUNDLAND & LABRADOR

SNC·LAVALIN

DESIGNED BY R. NOSEWORTHY	APPROVED Discipline Lead Engineer R. SANJAN
DRAWN BY T. SHEPPARD	APPROVED Engineering Manager G. SNYDER
VERIFIED BY W. CALDWELL / A. GAGNON	
DATE 06-AUG-2012	SCALE NTS

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
ELECTRICAL SERVICES
IDENTIFICATION STANDARD

File No. 505573-3344-47DD-0102_02 | Dwg Code MFA-SN-CD-3430-EL-SD-0002-01 | Class | Serial | Sh | Rev. C2

FORMAT A0 (mm)

SUB-PKG: 0000-4701 PLATE 01

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HVAC SCHEMATIC SYMBOLS

SYMBOL	DESCRIPTION
	SUPPLY GRILLE
	RETURN OR EXHAUST GRILLE
	MANUAL DAMPER
	BACK DRAFT DAMPER
M	MOTORIZED DAMPER
	BIDIRECTIONAL DAMPER
	LOUVER WITH BIRD SCREEN
	ROOF FAN
	WALL EXHAUST FAN
	CEILING FAN
	CENTRIFUGAL FAN
	AXIAL FAN
	PROPELLER FAN
H C	COOLING COIL
HG	REFRIGERANT GAS LINE
RL	REFRIGERANT LIQUID LINE
RS	REFRIGERANT SUCTION LINE
	FREE AIR CIRCULATION IN TUNNEL OR GALLERY
	CONTROL PANEL
D X	DIRECT EXPANSION COOLING COIL
H C	HEATING COIL
	FILTER
SD	SMOKE DETECTOR
	SILENCER
	ROOF AIR INTAKE OR EXHAUSTER

SYMBOL	DESCRIPTION
	HUMIDIFIER
	WELDING HOOD
	REMOVABLE INSECT SCREEN

HVAC DRAWING SYMBOLS

SYMBOL	DESCRIPTION
	POSITIVE PRESSURE DUCT FRONT
	POSITIVE PRESSURE DUCT UP
	POSITIVE PRESSURE DUCT DOWN OR BACK
	NEGATIVE PRESSURE DUCT FRONT
	NEGATIVE PRESSURE DUCT UP
	NEGATIVE PRESSURE DUCT DOWN OR BACK
	FLOW DIRECTION IN SUPPLY DUCT
	FLOW DIRECTION IN RETURN OR EXHAUST DUCT
UP	UP SLOPING DUCT IN DIRECTION OF ARROW
DN	DN SLOPING DUCT IN DIRECTION OF ARROW
A X B	DUCT WITH ACOUSTIC LINING
A X B	DUCT IDENTIFICATION FIRST NUMBER = SIDE SHOWN
A X B	CUT DUCT IDENTIFICATION FIRST NUMBER = HORIZONTAL
	FLEXIBLE JOINT
	BALANCING DAMPER
ROUND / SQUARE OR RECTANGULAR	TRANSITION PIECE
	AIRFLOW DIRECTION

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGL PERMIT HOLDER
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ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31-JUL-2013	APPROVED FOR DESIGN
1	B1	17-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-2013	NO CHANGES	SP	RDK	

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- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Jim Grant — Date (dd-mmm-yyyy): 09-AUG-2013
NE-LCP MANAGEMENT: — Date (dd-mmm-yyyy): 13-Aug-2013
PROJECT MANAGER: — Date (dd-mmm-yyyy): 13-AUG-2013

PROFESSIONAL STAMP

PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND & LABRADOR — PEGL — SCOTT M. PENNEY — REGISTERED — Aug 14/2013

SNC·LAVALIN

DESIGNED BY S. PENNEY	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY C. DALLAIRE/ J. SMITH	APPROVED Engineering Manager G. SNYDER
VERIFIED BY R. KOOB	
DATE 12-JUL-2012	SCALE NTS

CLIENT: nalcor energy — LOWER CHURCHILL MANAGEMENT CORPORATION

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
GENERAL WORKS
SCHEMATIC AND DRAWING SYMBOLS
HVAC

SLI DOC No. 505573-3343-45DD-0001_01 | NE DOC No. MFA-SN-CD-2000-ME-SC-0001-01 | Rev. D1

FORMAT A0 (mm)

SUB-PKG: 0000-4B01 PLATE 01

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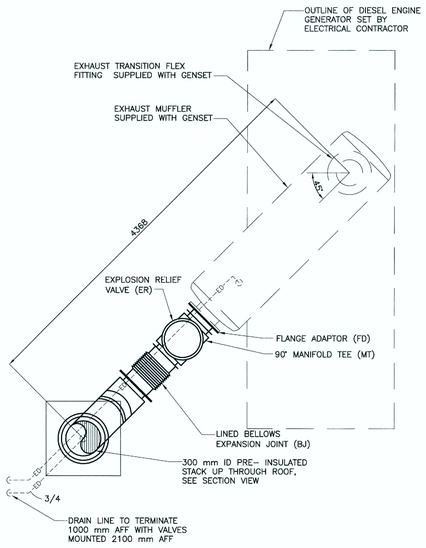
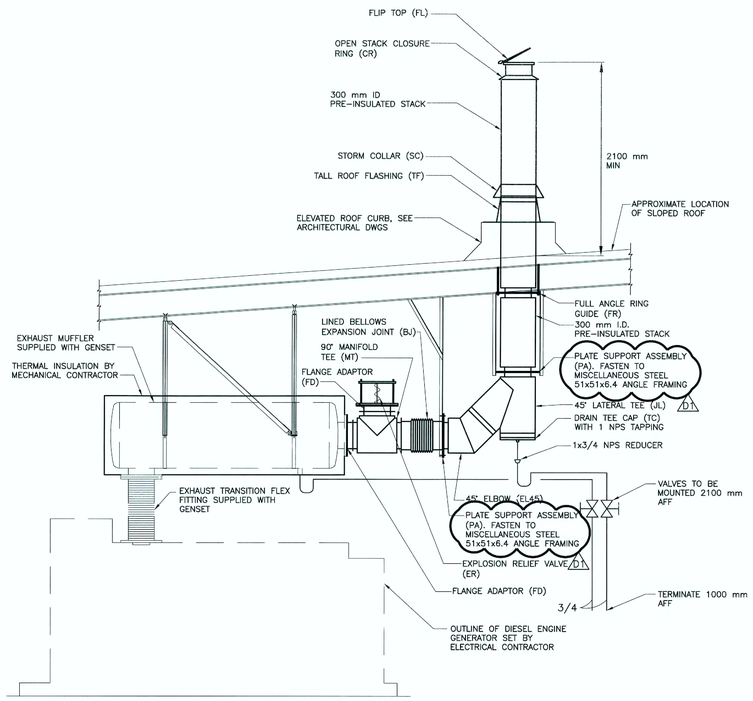


TOP VIEW

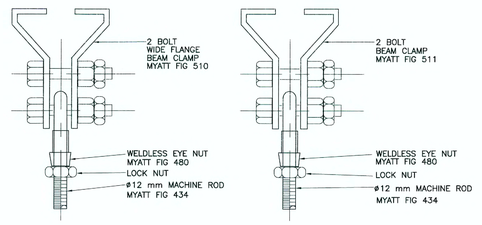


SECTION VIEW

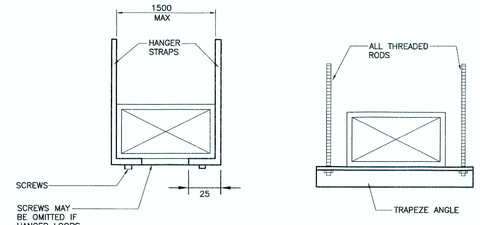
NOTE:

1. FOR EXACT LOCATION OF GENERATOR AND ENGINE EXHAUST STACK, REFER TO HVAC PLAN MFA-SN-CD-2440-ME-PL-0001-01

DETAIL 3
SPILLWAY DIESEL GENERATOR SET ENGINE EXHAUST SYSTEM
MFA-SN-CD-2440-ME-PL-0001-01
1:25



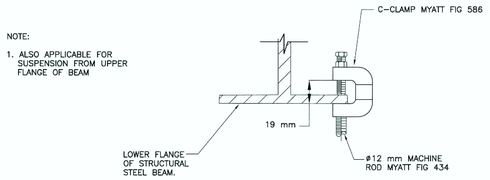
DETAIL 2
UPPER COMPONENT
SUSPENSION FROM LOWER FLANGE FOR NPS 3 1/2 OR LARGER
NTS



NOTES:

1. REFER TO SMACNA HVAC DUCT CONSTRUCTION STANDARDS TABLE 4-1 FOR MAXIMUM SPACING, STRAP AND ROD SIZING.
2. REFER TO SMACNA HVAC DUCT CONSTRUCTION STANDARDS TABLE 4-3 FOR TRAPEZE ANGLE SIZING.

DETAIL 1
RECTANGULAR DUCT HANGER DETAIL
NTS



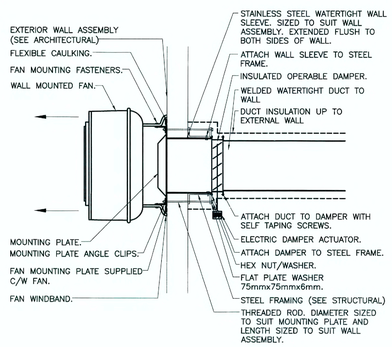
NOTE:

1. ALSO APPLICABLE FOR SUSPENSION FROM UPPER FLANGE OF BEAM

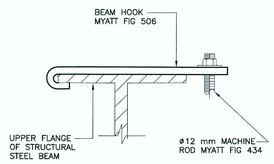
DETAIL 4
UPPER COMPONENT
SUSPENSION FROM LOWER FLANGE OF BEAMS
NTS

NOTES:

1. ALL CUTTING AND PATCHING OF WALL TO ACCOMMODATE DUCT INSTALLATION TO WALL MOUNTED EXHAUST FAN SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
2. CAULK AND SEAL ALL AROUND WALL OPENING AND MAKE WEATHERTIGHT.



DETAIL 7
EXHAUST FAN WALL MOUNTING DETAIL
NTS



DETAIL 6
UPPER COMPONENT
SUSPENSION FROM UPPER FLANGE OF BEAMS
NTS

ALL EQUIPMENT TAGS ON THIS DRAWING ARE PRECEDED WITH "2440-"

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGL PERMIT HOLDER
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SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador. Permit No. as issued by PEGNL is: 04896 which is valid for the year 2013

0 1000 1500 2000 2500 mm
SCALE 1:25

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31-JUL-2013	APPROVED FOR DESIGN
1	B1	17-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING	
D1	MFA-SN-CD-2440-ME-PL-0001-01	SPILLWAY – ELECTRICAL BUILDING – PLAN AND SECTIONS – HVAC
	MFA-SN-CD-2000-ME-SC-0001-01	GENERAL WORKS – SCHEMATIC AND DRAWING SYMBOLS – HVAC
	MFA-SN-CD-3350-ME-LS-0004-01	GENERAL WORKS – EQUIPMENT NUMBERING AND INSTRUMENTATION SYMBOLS
	MFA-SN-CD-3350-ME-LS-0003-01	GENERAL WORKS – EQUIPMENT AND SYSTEM CODES – LEGEND

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-2013	ANGLES STEEL ADDED AND DRAWINGS REFERENCES	SP	ROK	MG

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

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- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy): 09-AUG-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy): 13-Aug-2013
PROJECT MANAGER: Date (dd-mmm-yyyy): 13-AUG-2013

PROFESSIONAL STAMP

PROFESSIONAL ENGINEER — SCOTT M. PENNEY — SIGNATURE — PROVINCE OF NEWFOUNDLAND & LABRADOR

SNC·LAVALIN

DESIGNED BY S. PENNEY	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY J. SMITH	APPROVED Engineering Manager G. SNYDER
VERIFIED BY R. KOOB	
DATE 8-JUN-2012	SCALE 1:25 UNO

CLIENT: nalcor energy — LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
ELECTRICAL BUILDING
EXHAUST SYSTEM AND SUSPENSION DETAILS
HVAC

File No. 505573-3242-45DD-0013_01 | MFA-SN-CD-2440-ME-DD-0001-01 | Rev. D1

FORMAT A0 (mm)

SUB-PKG: 0032-4B01 PLATE 03

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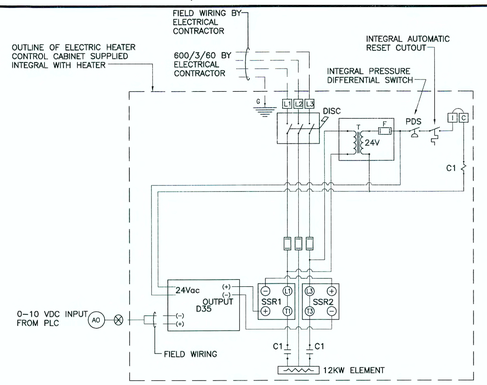
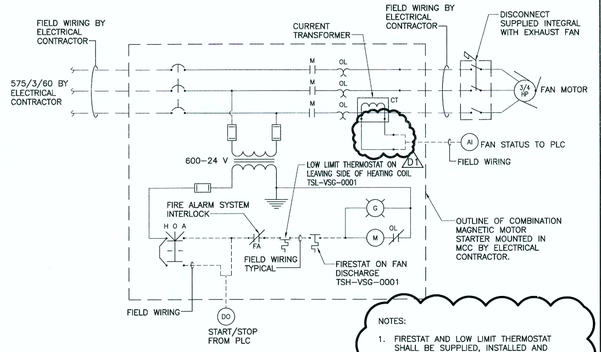


NOTES:

1. ALL COMPONENTS INDICATED WITHIN THE OUTLINE OF THE ELECTRIC DUCT HEATER CONTROL PANEL ARE TO BE SUPPLIED INTEGRAL WITH THE ELECTRIC HEATER.
2. ALL FIELD WIRING SHOWN SHALL BE THE RESPONSIBILITY OF THE CONTROL CONTRACTOR UNLESS NOTED OTHERWISE.

DETAIL 4
DUCT MOUNTED ELECTRIC HEATING COIL HC–VSG–0001 WIRING DIAGRAM
NTS

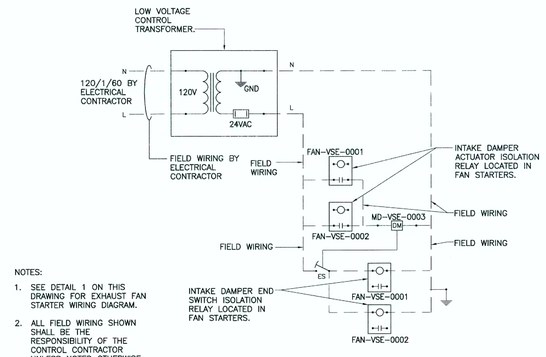


NOTES:

1. FIRESTAT AND LOW LIMIT THERMOSTAT SHALL BE SUPPLIED, INSTALLED AND CONNECTED BY THE CONTROL CONTRACTOR.
2. ALL FIELD WIRING SHOWN SHALL BE THE RESPONSIBILITY OF THE CONTROL CONTRACTOR UNLESS NOTED OTHERWISE.
3. CURRENT SENSOR SHALL BE SUPPLIED INTEGRAL WITH MOTOR STARTER AND WIRED TO A TERMINAL STRIP FOR CONNECTION BY THE CONTROL CONTRACTOR.

D1

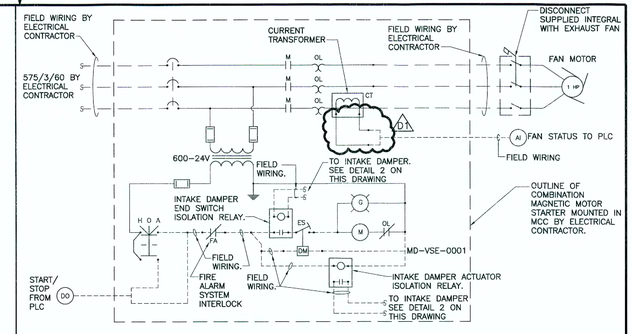
DETAIL 3
SUPPLY FAN FAN–VSG–0001 WIRING DIAGRAM
NTS



NOTES:

1. SEE DETAIL 1 ON THIS DRAWING FOR EXHAUST FAN STARTER WIRING DIAGRAM.
2. ALL FIELD WIRING SHOWN SHALL BE THE RESPONSIBILITY OF THE CONTROL CONTRACTOR UNLESS NOTED OTHERWISE.

DETAIL 2
MD–VSE–0003 INTAKE MOTORIZED DAMPER WIRING DIAGRAM
NTS

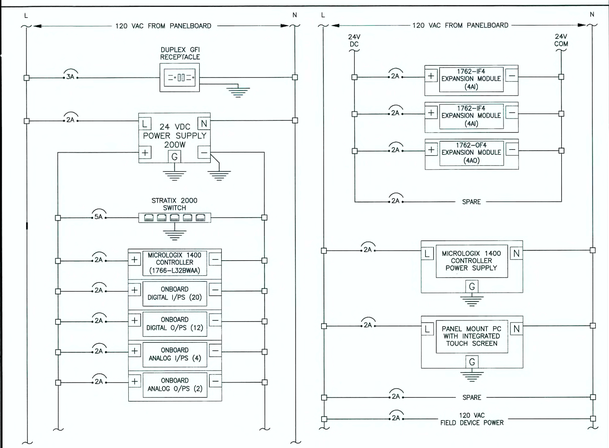


NOTES:

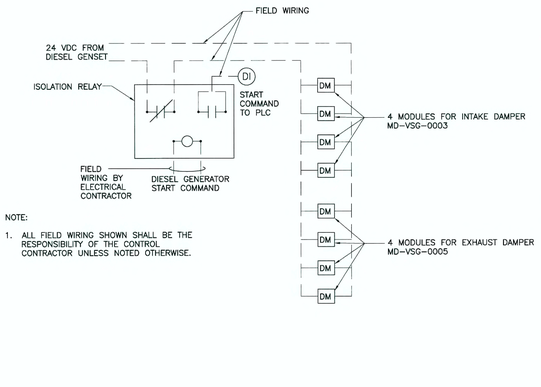
1. INTAKE DAMPER ACTUATOR ISOLATION RELAY SHALL BE EQUAL TO OMRON GENERAL PURPOSE LY RELAY WITH 24VAC, 46mA RATED COIL AND 24VAC, 15A RATED CONTACTS.
2. INTAKE DAMPER END SWITCH ISOLATION RELAY SHALL BE EQUAL TO OMRON GENERAL PURPOSE LY RELAY WITH 24VAC, 46mA RATED COIL AND 24VAC, 15A RATED CONTACTS.
3. DAMPER ACTUATOR AND ISOLATION RELAYS SHALL BE SUPPLIED AND INSTALLED BY THE CONTROL CONTRACTOR.
4. ALL FIELD WIRING SHOWN SHALL BE THE RESPONSIBILITY OF THE CONTROL CONTRACTOR UNLESS NOTED OTHERWISE. D1
5. CURRENT SENSOR SHALL BE SUPPLIED INTEGRAL WITH MOTOR STARTER AND WIRED TO A TERMINAL STRIP FOR CONNECTION BY THE CONTROL CONTRACTOR

D1

DETAIL 1
EXHAUST FAN FAN–VSE–0001 WIRING DIAGRAM
(SIMILAR FOR 2440–FAN–VSE–0002)
NTS



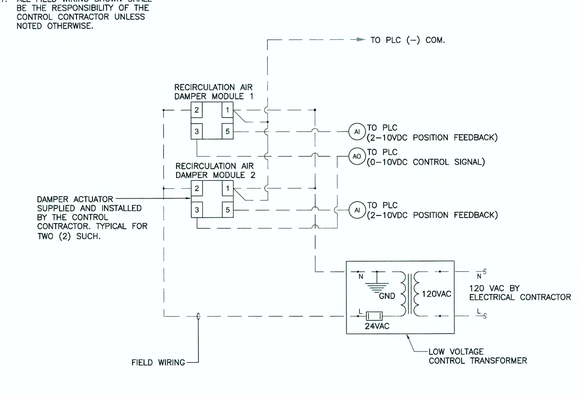
DETAIL 8
HVAC MASTER PLC MC–VSG–0001 CONTROL PANEL CP–VSG–0001 WIRING DIAGRAM
NTS



NOTE:

1. ALL FIELD WIRING SHOWN SHALL BE THE RESPONSIBILITY OF THE CONTROL CONTRACTOR UNLESS NOTED OTHERWISE.

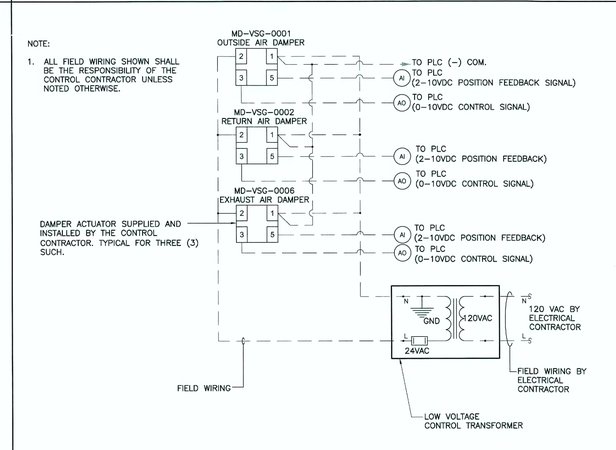
DETAIL 7
MD–VSG–0003 & MD–VSG–0005 DAMPER WIRING DIAGRAM
NTS



NOTE:

1. ALL FIELD WIRING SHOWN SHALL BE THE RESPONSIBILITY OF THE CONTROL CONTRACTOR UNLESS NOTED OTHERWISE.

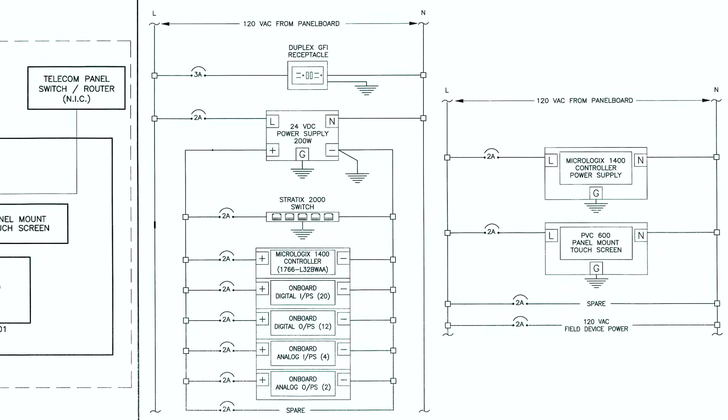
DETAIL 6
MD–VSG–0004 DAMPER WIRING DIAGRAM
NTS



NOTE:

1. ALL FIELD WIRING SHOWN SHALL BE THE RESPONSIBILITY OF THE CONTROL CONTRACTOR UNLESS NOTED OTHERWISE.

DETAIL 5
MD–VSG–0001, MD–VSG–0002 & MD–VSG–0006 DAMPER WIRING DIAGRAM
NTS



DETAIL 10
PROGRAMMABLE LOGIC CONTROL SYSTEM ARCHITECTURE
NTS

DETAIL 9
HVAC SLAVE PLC MC–VSE–0001 CONTROL PANEL CP–VSE–0001 WIRING DIAGRAM
NTS

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ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31–JUL–2013	APPROVED FOR DESIGN
1	B1	17–OCT–2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA–SN–CD–2440–ME–SC–0002–01	SPILLWAY – ELECTRICAL BUILDING – CONTROL AND INSTRUMENTATION SCHEMATIC – HVAC
MFA–SN–CD–2000–ME–SC–0001–01	GENERAL WORKS – SCHEMATIC AND DRAWING SYMBOLS – HVAC
MFA–SN–CD–3350–ME–LS–0004–01	GENERAL WORKS – EQUIPMENT NUMBERING AND INSTRUMENTATION SYMBOLS
MFA–SN–CD–3350–ME–LS–0003–01	GENERAL WORKS –EQUIPMENT AND SYSTEM CODES – LEGEND

D1

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31–JUL–2013	NOTES REVISED AND DRAWINGS REFERENCES	SP	RDK	RS

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- ☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
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LEAD REVIEWER:	Date (dd-mmm-yyyy): 09-AUG-2013
NE-LCP MANAGEMENT:	Date (dd-mmm-yyyy): 13-Aug-2013
PROJECT MANAGER:	Date (dd-mmm-yyyy): 13-AUG-2013

PROFESSIONAL STAMP

PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND & LABRADOR — PEGL — SCOTT M. PENNEY — 010458 — MUNICIPAL — ENGINEER

SNC·LAVALIN

DESIGNED BY S. PENNEY	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY J. SMITH	APPROVED Engineering Manager G. SNYDER
VERIFIED BY R. KOOB	
DATE 8–JUN–2012	SCALE NTS
File No. 505573–3242–45DD–0015_01	Rev. D1

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
ELECTRICAL BUILDING
CONTROL AND INSTRUMENTATION DETAILS
HVAC

MFA–SN–CD–2440–ME–DD–0002–01

FORMAT A0 (mm)

SUB-PKG: 0032-4B01 PLATE 05

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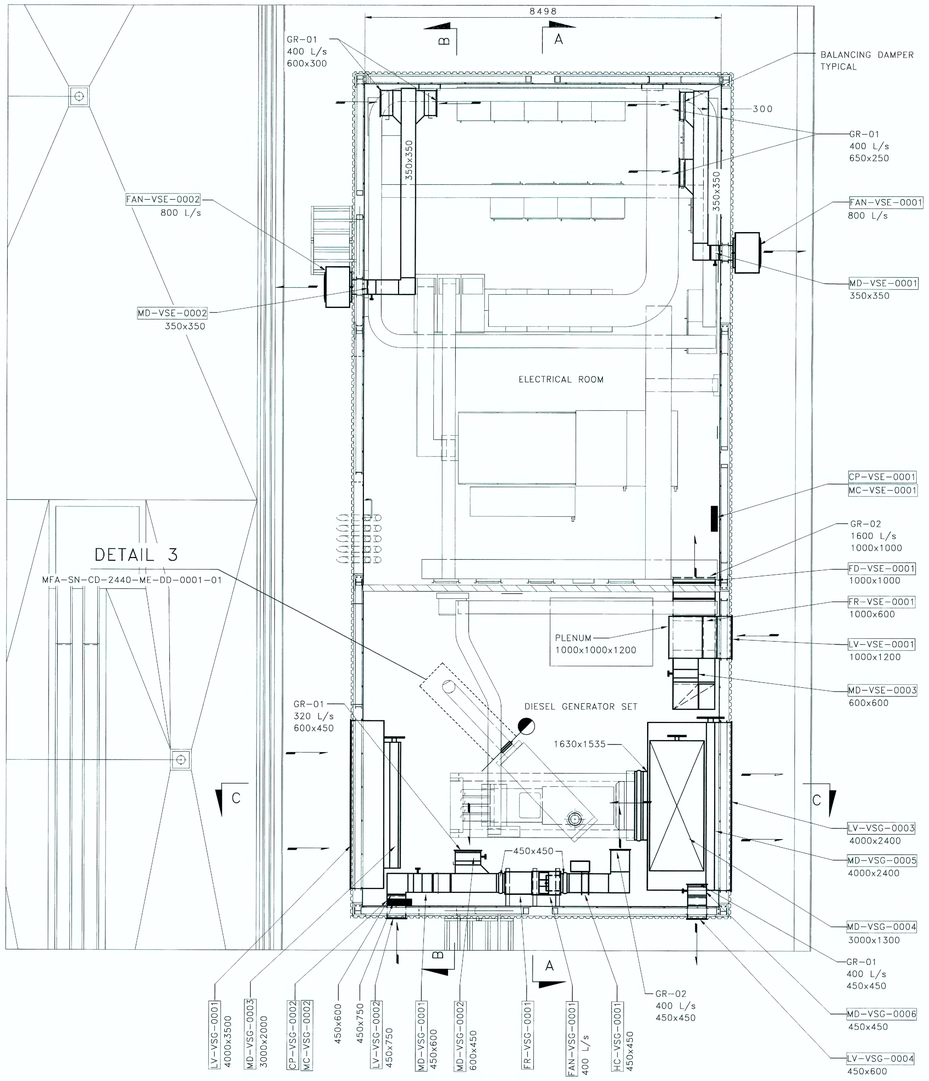
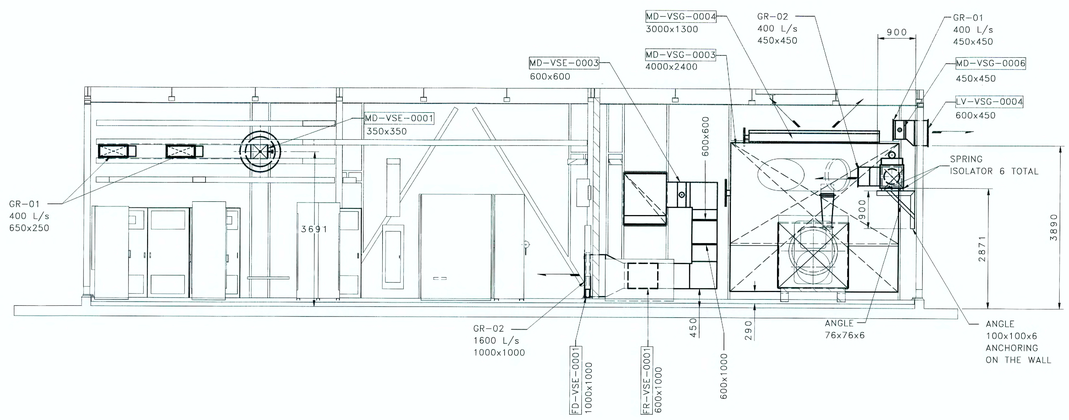
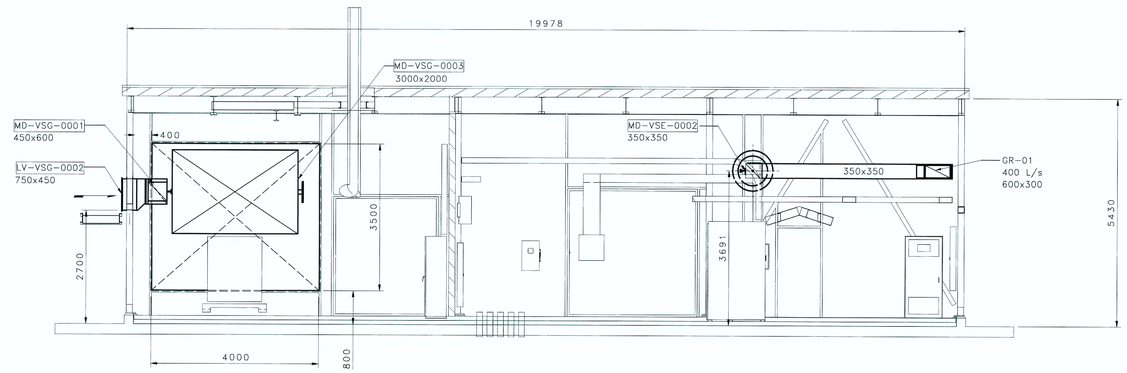


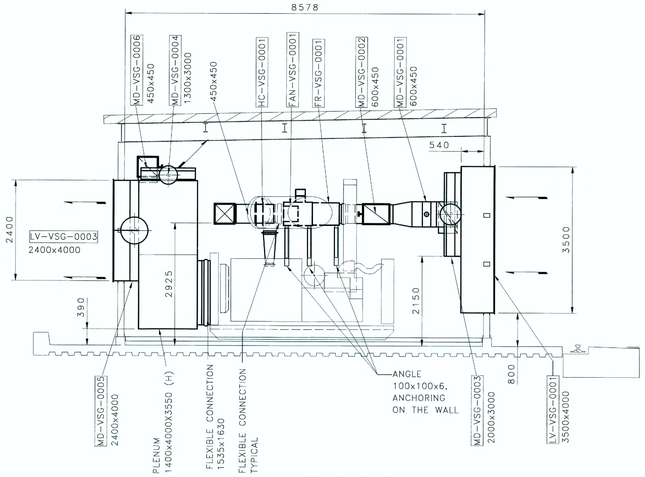
ELECTRICAL BUILDING AT EL 45.50



SECTION A–A



SECTION B–B



SECTION C–C

ALL EQUIPMENT TAGS ON THIS DRAWING ARE PRECEDED WITH "2440–"

0 1000 2000 3000 4000 5000 mm

SCALE 1:50

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PEGNL PERMIT HOLDER
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ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31-JUL-2013	APPROVED FOR DESIGN
1	B1	17-OCT-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2440-ME-DD-0001-01	SPILLWAY – ELECTRICAL BUILDING – EXHAUST SYSTEM AND SUSPENSION DETAILS – HVAC
MFA-SN-CD-2440-ME-SC-0001-01	SPILLWAY – ELECTRICAL BUILDING – SYSTEM SCHEMATIC AND DETAILS – HVAC
MFA-SN-CD-2000-ME-SC-0001-01	GENERAL WORKS – SCHEMATIC AND DRAWING SYMBOLS – HVAC
MFA-SN-CD-3350-ME-LS-0004-01	GENERAL WORKS – EQUIPMENT NUMBERING AND INSTRUMENTATION SYMBOLS
MFA-SN-CD-3350-ME-LS-0003-01	GENERAL WORKS – EQUIPMENT AND SYSTEM CODES – LEGEND

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-2013	GENERAL REVISION	SP	AMK	[illegible]

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☐ 3.REVIEWED – NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: [signature] Date (dd-mmm-yyyy): 09-AUG-2013
NE-LCP MANAGEMENT: [signature] Date (dd-mmm-yyyy): 13-Aug-2013
PROJECT MANAGER: [signature] Date (dd-mmm-yyyy): 13-AUG-2013

PROFESSIONAL STAMP

PROFESSIONAL ENGINEERS REGISTERED PROFESSIONAL ENGINEER PROVINCE OF NEWFOUNDLAND & LABRADOR PEGNL PERMIT HOLDER SCOTT M. PENNEY REGISTERED 14/5/2013 NEWFOUNDLAND & LABRADOR

SNC·LAVALIN

DESIGNED BY S. PENNEY	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY C. DALLAIRE	APPROVED Engineering Manager G. SNYDER
VERIFIED BY R. KOOB	
DATE 8-JUN-2012	SCALE 1 : 50

CLIENT: nalcor energy LOWER CHURCHILL PROJECT

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS SPILLWAY ELECTRICAL BUILDING PLAN AND SECTIONS HVAC

SC DOC No. 505573-3242-45DD-0011_01 | NL DOC No. MFA-SN-CD-2440-ME-PL-0001-01 | Rev. D1

FORMAT A0 (mm)

SUB-PKG: 0032-4B01 PLATE 01

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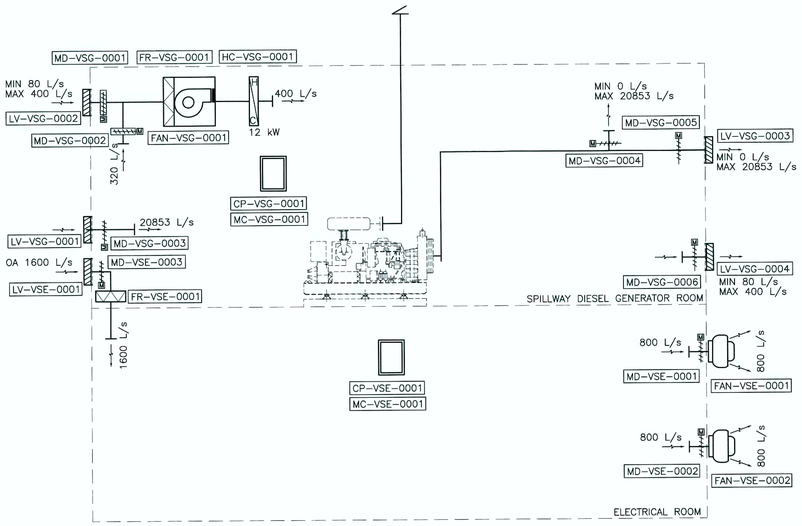
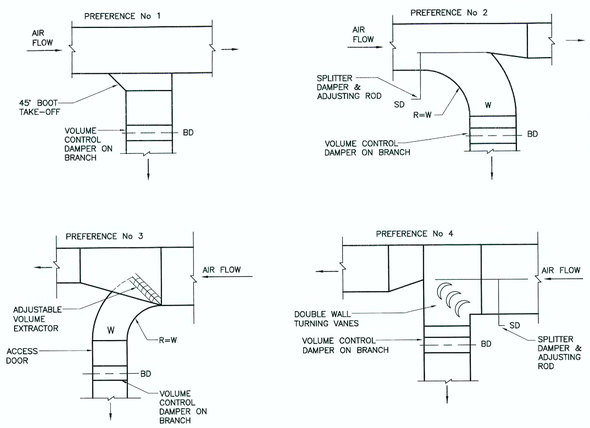
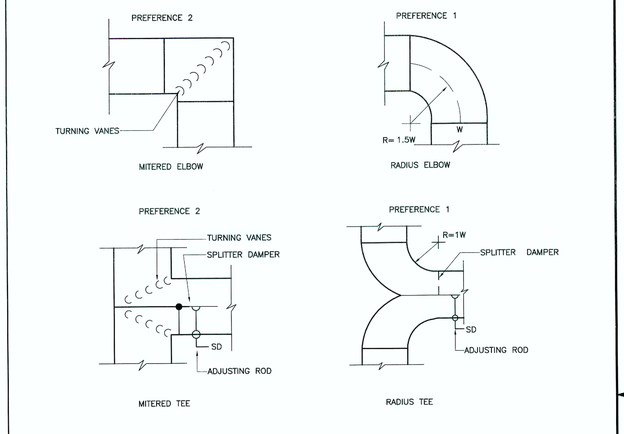


DETAIL 3
VSG AND VSE HVAC SYSTEM SCHEMATIC
NTS



DETAIL 2
TYPICAL TAKE-OFFS FOR LOW VELOCITY SUPPLY DUCTS
NTS



DETAIL 1
STANDARD DUCT FITTINGS
NTS

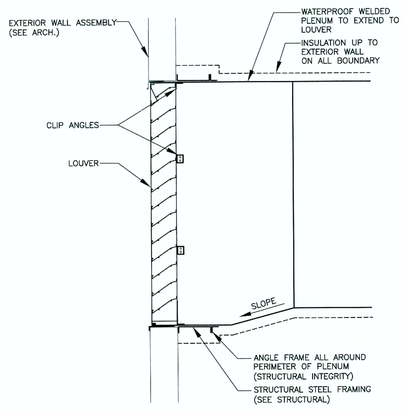
NOTES:

1. ALL CUTTING OF WALL, STRUCTURAL SUPPORTS, SEALING OF WALL OPENING AND NECCESARY SILLS, MOULDINGS AND FLASHING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.

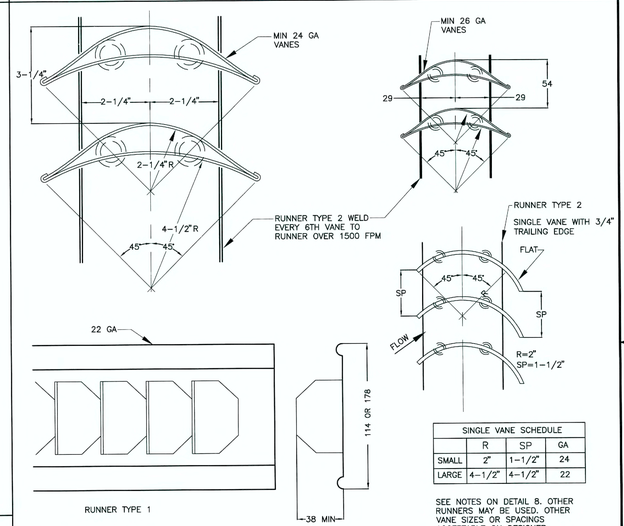
2. ALL INTAKE AND EXHAUST DUCTWORK 1.5 m BACK FROM LOUVER SHALL BE ALL WELDED WATERTIGHT CONSTRUCTION.

3. SUPPLY AND INSTALLATION OF LOUVER INTO FRAMED WALL OPENING SHALL BE THE RESPONSIBILITY OF THE MECHANICAL SUBCONTRACTOR.

4. EXACT OPENING SIZES REQUIRED TO ACCOMMODATE LOUVER SIZES SHALL BE FORWARDED TO THE CONTRACTOR BY THE MECHANICAL SUBCONTRACTOR.



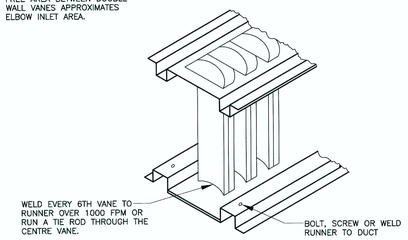
DETAIL 5
WALL LOUVER PLENUM AND DUCT CONNECTION DETAIL
NTS



SINGLE VANE SCHEDULE			
	R	SP	GA
SMALL	2"	1-1/2"	24
LARGE	4-1/2"	4-1/2"	22

SEE NOTES ON DETAIL 8. OTHER RUNNERS MAY BE USED. OTHER VANE SIZES OR SPACINGS ACCEPTABLE ON DESIGNER APPROVAL.

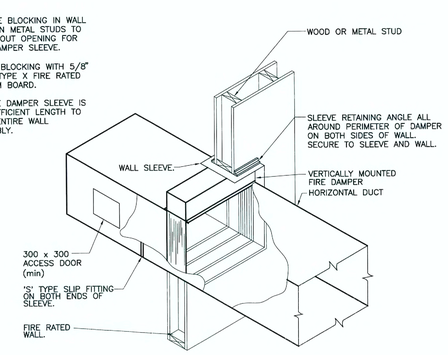
FREE AREA BETWEEN DOUBLE WALL VANES APPROXIMATES ELBOW INLET AREA.



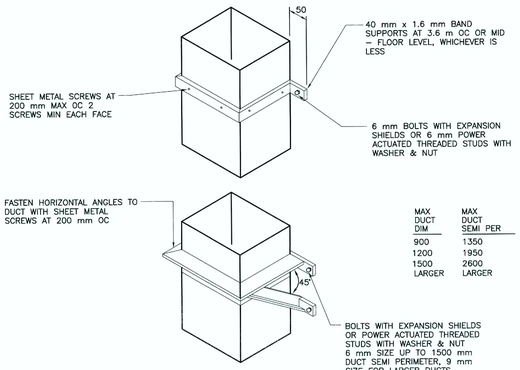
DETAIL 4
VANES AND VANE RUNNERS DETAIL
NTS

NOTES:

1. PROVIDE BLOCKING IN WALL BETWEEN METAL STUDS TO FRAME OUT OPENING FOR FIRE DAMPER SLEEVE.
2. COVER BLOCKING WITH 5/8" THICK TYPE X FIRE RATED GYPSUM BOARD.
3. ENSURE DAMPER SLEEVE IS OF SUFFICIENT LENGTH TO SPAN ENTIRE WALL ASSEMBLY.

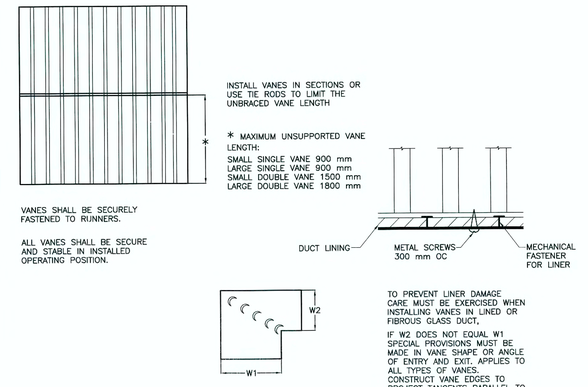


DETAIL 8
STUD WALL MOUNTED RECTANGULAR DUCT FIRE DAMPER DETAIL
NTS



MAX DUCT DIM	MAX DUCT SEMI PER	MIN ANGLE SIZE
900	1350	25x25x3
1200	1950	32x32x3
1500	2800	40x40x3
LARGER	LARGER	50x50x3

DETAIL 7
SUPPORTS FOR VERTICAL DUCTS
NTS



DETAIL 6
VANE SUPPORT DETAILS IN ELBOWS
NTS

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PEGL PERMIT HOLDER
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2	D1	31-JUL-2013	APPROVED FOR DESIGN				
1	B1	17-OCT-2012	ISSUED FOR BID				

ISSUE REGISTER

No.	REFERENCE DRAWING
D1	MFA-SN-CD-2440-ME-PL-0001-01 SPILLWAY – ELECTRICAL BUILDING – PLAN AND SECTIONS – HVAC
	MFA-SN-CD-2000-ME-SC-0001-01 GENERAL WORKS – SCHEMATIC AND DRAWING SYMBOLS – HVAC
	MFA-SN-CD-3350-ME-LS-0004-01 GENERAL WORKS – EQUIPMENT NUMBERING AND INSTRUMENTATION SYMBOLS
	MFA-SN-CD-3350-ME-LS-0003-01 GENERAL WORKS – EQUIPMENT AND SYSTEM CODES – LEGEND

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	31-JUL-2013	DRAWINGS REFERENCES	SP	ADK	AS

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LEAD REVIEWER: Date (dd-mmm-yyyy): 19-AUG-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy): 13-Aug-2013
PROJECT MANAGER: Date (dd-mmm-yyyy): 13-AUG-2013

PROFESSIONAL STAMP

REGISTERED PROFESSIONAL ENGINEER PEGL SCOTT M. PENNEY NEWFOUNDLAND & LABRADOR

SNC·LAVALIN

DESIGNED BY S. PENNEY	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY J. SMITH	APPROVED Engineering Manager G. SNYDER
VERIFIED BY R. KOOB	
DATE 8-JUN-2012	SCALE NTS
File No. 505573-3242-45DD-0012_01	MFA-SN-CD-2440-ME-SC-0001-01 Rev. D1

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
ELECTRICAL BUILDING
SYSTEM SCHEMATIC AND DETAILS
HVAC

FORMAT A0 (mm)

SUB-PKG: 0032-4B01 PLATE 02

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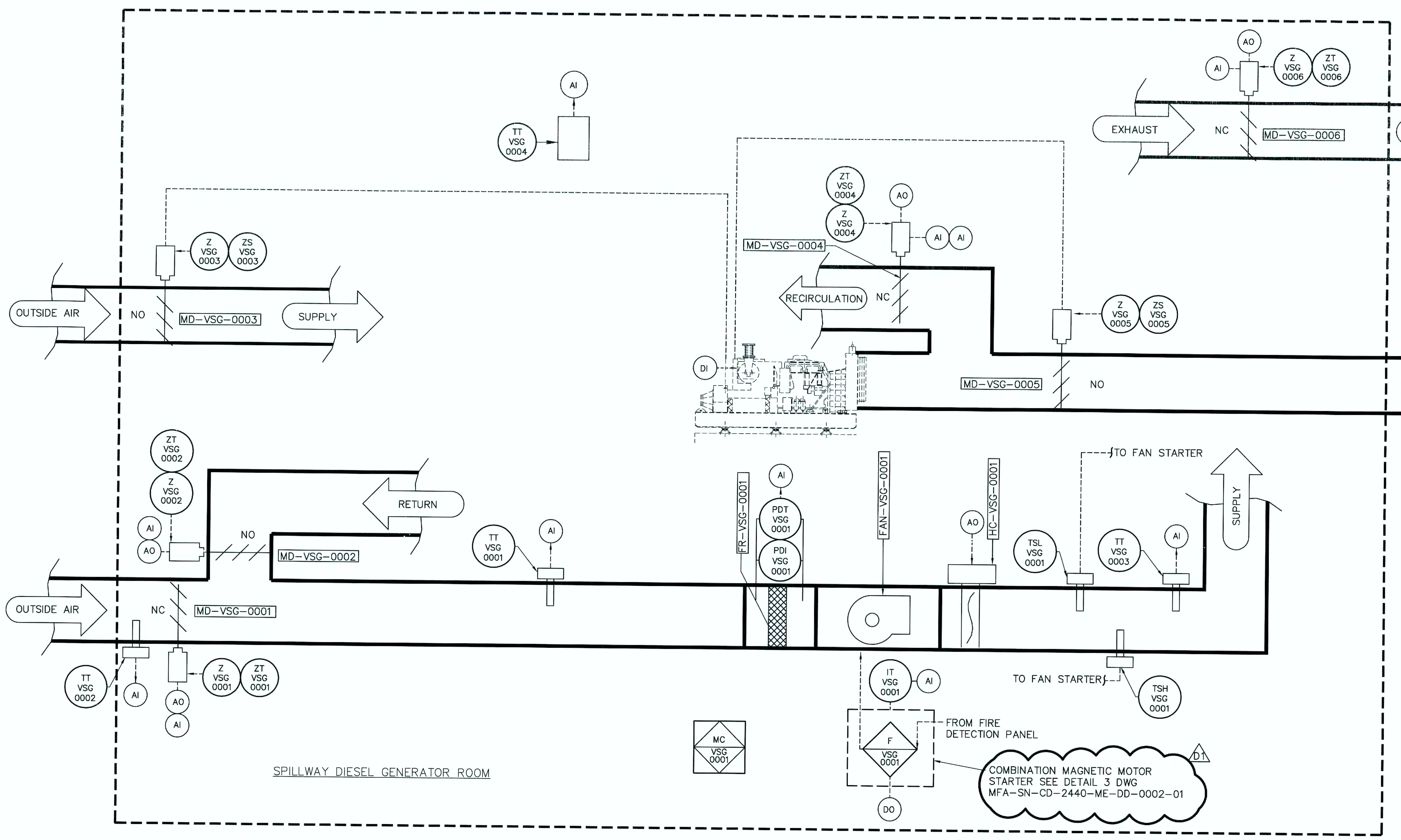
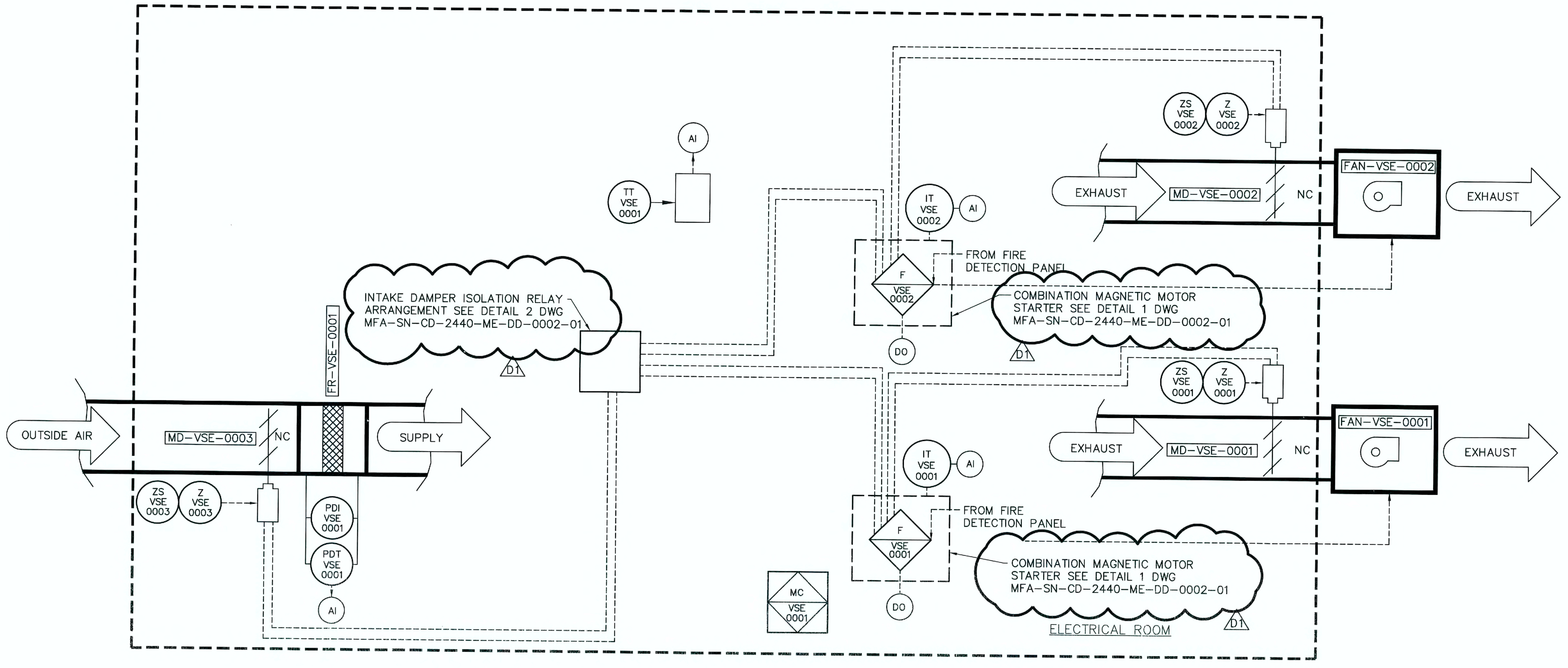


VENTILATION – DIESEL GENERATOR ROOM SYSTEM VSG



VENTILATION – ELECTRICAL ROOM SYSTEM VSE

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MC-VSG-0001 I/O SCHEDULE

MICROLOGIX 1400 — PLC # : 1 SLOT #: 0

POINT #	POINT TYPE	INSTRUMENT	DESCRIPTION
101	AI–1	TT–VSG–0001	FAN–VSG–0001 MIXED AIR TEMPERATURE
102	AI–2	TT–VSG–0002	FAN–VSG–0001 OUTDOOR AIR TEMPERATURE
103	AI–3	TT–VSG–0003	FAN–VSG–0001 SUPPLY AIR TEMPERATURE
104	AI–4	TT–VSG–0004	GENERATOR ROOM SPACE TEMPERATURE
105	AO–1	Z–VSG–0004	DIESEL GENERATOR RECIRC. DAMPER COMMAND
106	AO–2	HC–VSG–0001	ELECTRIC HEATING COIL CONTROL SIGNAL
107	DI–1	GENSET	DIESEL GENSET START COMMAND
108	DI–2	–	–
109	DI–3	–	–
110	DI–4	–	–
111	DI–5	–	–
112	DI–6	–	–
113	DI–7	–	–
114	DI–8	–	–
115	DI–9	–	–
116	DI–10	–	–
117	DI–11	–	–
118	DI–12	–	–
119	DI–13	–	–
120	DI–14	–	–
121	DI–15	–	–
122	DI–16	–	–
123	DI–17	–	–
124	DI–18	–	–
125	DI–19	–	–
126	DI–20	–	–
127	DO–1	STARTER	FAN–VSG–0001 START/STOP
128	DO–2	VIRTUAL	SPILLWAY GENERATOR ROOM HVAC ALARM – MAJOR
129	DO–3	VIRTUAL	SPILLWAY GENERATOR ROOM HVAC ALARM – MINOR
130	DO–4	–	–
131	DO–5	–	–
132	DO–6	–	–
133	DO–7	–	–
134	DO–8	–	–
135	DO–9	–	–
136	DO–10	–	–
137	DO–11	–	–
138	DO–12	–	–

1762–IF4 EXPANSION MODULE — PLC #: 1 SLOT #: 1

POINT #	POINT TYPE	INSTRUMENT	DESCRIPTION
139	AI–1	ZT–VSG–0001	GENERATOR ROOM INTAKE DAMPER POSITION
140	AI–2	ZT–VSG–0002	GENERATOR ROOM RETURN DAMPER POSITION
141	AI–3	ZT–VSG–0006	GENERATOR ROOM EXHAUST DAMPER POSITION
142	A1–4	PDT–VSG–0001	FAN–VSG–0001 FILTER DIFFERENTIAL PRESSURE

1762–IF4 EXPANSION MODULE — PLC #: 1 SLOT #: 2

POINT #	POINT TYPE	INSTRUMENT	DESCRIPTION
143	AI–1	IT–VSG–0001	FAN–VSG–0001 CURRENT SENSOR
144	AI–2	ZT–VSG–0004	DIESEL GENSET RECIRC. DAMPER 1 POSITION
145	AI–3	ZT–VSG–0004	DIESEL GENSET RECIRC. DAMPER 2 POSITION
146	AI–4		

1762–OF4 EXPANSION MODULE — PLC #: 1 SLOT #: 3

POINT #	POINT TYPE	INSTRUMENT	DESCRIPTION
147	AO–1	Z–VSG–0001	GENERATOR ROOM INTAKE DAMPER CONTROL
148	AO–2	Z–VSG–0002	GENERATOR ROOM RETURN DAMPER CONTROL
149	AO–3	Z–VSG–0006	GENERATOR ROOM EXHAUST DAMPER CONTROL
150	AO–4		

MC-VSE-0001 I/O SCHEDULE

MICROLOGIX 1400 — PLC # : 2 SLOT #: 0

POINT #	POINT TYPE	INSTRUMENT	DESCRIPTION
201	AI–1	TT–VSE–0001	ELECTRICAL ROOM SPACE TEMPERATURE
202	AI–2	IT–VSE–0001	FAN–VSE–0001 CURRENT SENSOR
203	AI–3	IT–VSE–0002	FAN–VSE–0002 CURRENT SENSOR
204	A1–4	PDT–VSE–0001	INTAKE FILTER DIFFERENTIAL PRESSURE
205	AO–1	–	–
206	AO–2	–	–
207	DI–1	–	–
208	DI–2	–	–
209	DI–3	–	–
210	DI–4	–	–
211	DI–5	–	–
212	DI–6	–	–
213	DI–7	–	–
214	DI–8	–	–
215	DI–9	–	–
216	DI–10	–	–
217	DI–11	–	–
218	DI–12	–	–
219	DI–13	–	–
220	DI–14	–	–
221	DI–15	–	–
222	DI–16	–	–
223	DI–17	–	–
224	DI–18	–	–
225	DI–19	–	–
226	DI–20	–	–
227	DO–1	STARTER	FAN–VSE–0001 START/STOP
228	DO–2	STARTER	FAN–VSE–0002 START/STOP
229	DO–3	VIRTUAL	SPILLWAY ELECTRICAL ROOM HVAC ALARM (MAJOR)
230	DO–4	VIRTUAL	SPILLWAY ELECTRICAL ROOM HVAC ALARM (MINOR)
231	DO–5	–	–
232	DO–6	–	–
233	DO–7	–	–
234	DO–8	–	–
235	DO–9	–	–
236	DO–10	–	–
237	DO–11	–	–
238	DO–12	–	–

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEG NL — PERMIT HOLDER
This Permit Allows
SNC-LAVALIN INC.
To practice Professional Geoscience in Newfoundland and Labrador.
Permit No. as issued by PEGNL N0458
which is valid for the year 2013

ISSUE REGISTER

ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	31–JUL–2013	APPROVED FOR DESIGN				
1	B1	17–OCT–2012	ISSUED FOR BID				

REFERENCE DRAWING

No.	REFERENCE DRAWING
MFA–SN–CD–2440–ME–DD–0002–01	SPILLWAY – ELECTRICAL BUILDING – CONTROL AND INSTRUMENTATION DETAILS – HVAC
MFA–SN–CD–2000–ME–SC–0001–01	GENERAL WORKS – SCHEMATIC AND DRAWING SYMBOLS– HVAC
MFA–SN–CD–3350–ME–LS–0004–01	GENERAL WORKS – EQUIPMENT NUMBERING AND INSTRUMENTATION SYMBOLS
MFA–SN–CD–3350–ME–LS–0003–01	GENERAL WORKS – EQUIPMENT AND SYSTEM CODES – LEGEND

REVISION

No.	DATE	REVISION	MOD.	VSG.	APP.
D1	31–JUL–2013	DRAWINGS REFERENCES	SP	RDK	JG

* * * * * * * * * FOR INTERNAL USE ONLY * * * * * * * * *
REVIEW CLASS: | EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- [x] 1. REVIEWED AND ACCEPTED NO COMMENTS
- [ ] 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- [ ] 3. REVIEWED - NOT ACCEPTED
- [ ] 4. INFORMATION ONLY
- [ ] 5. NOT REVIEWED

LEAD REVIEWER: Jim Grant — Date (dd-mmm-yyyy): 09-AUG-2013
NE-LCP MANAGEMENT: [signature] — Date (dd-mmm-yyyy): 13-Aug-2013
PROJECT MANAGER: [signature] — Date (dd-mmm-yyyy): 13-AUG-2013

PROFESSIONAL STAMP
REGISTERED PROFESSIONAL ENGINEER — PEG Newfoundland and Labrador — SCOTT M. PENNEY — SIGNATURE — DATE Aug/5/2013 — NEWFOUNDLAND & LABRADOR

SNC • LAVALIN

DESIGNED BY S. PENNEY	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY C. DALLAIRE	APPROVED Engineering Manager G. SNYDER
VERIFIED BY R. KOOB	
DATE 8–JUN–2012	SCALE NTS

CLIENT: nalcor energy — LOWER CHURCHILL PROJECT
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS SPILLWAY ELECTRICAL BUILDING CONTROL AND INSTRUMENTATION SCHEMATIC HVAC

File No. 505573–3242–45DD–0014_01
MFA–SN–CD–2440–ME–SC–0002–01 Rev. D1
FORMAT A0 (mm)

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EQUIPMENT CODES

ACCC	ACCESS CONTROL
ACD	AIR HANDLING UNIT – AIR CONDITIONING
ACU	AIR HANDLING UNIT – COOLING UNIT
AD	AIR DRYER
AHV	AIR HANDLING UNIT – HEATING/VENTILATING
AOA	AIR OPERATED ACTUATOR
AS	AIR SEPARATOR
ATD	ANGLE TRENCH DRAIN
ATS	AUTOMATIC TRANSFER SWITCH
AV	AUTOMATIC AIR VENT
AVR	AUTOMATIC VOLTAGE REGULATOR
BANDS	BAND SAW
BAT	BATTERY
BD	BUS DUCT
BDD	BI–DIRECTIONAL DAMPER
BGNR	BENCH GRINDER
BH	BASEBOARD HEATER
BP	BACK–FLOW PREVENTER
BS	BELT SANDER
BV	BREATHER VENT
CABL	BULK CABLE
CASS	COMPRESSED AIR SERVICE STATION
CB	CIRCUIT BREAKER
CBCP	CIRCUIT BREAKER CONTROL CABINET
CC	COOLING COIL
CCTV	CLOSE CIRCUIT SECURITY CAMERA
CCTVM	CLOSE CIRCUIT SECURITY MONITOR
CDTF	CONDUIT, FLEXIBLE
CDTR	CONDUIT, RIGID
CFR	CYCLONE FILTER
CGM	CRANE – GANTRY
CHL	CHLORINATOR
CHR	BATTERY CHARGER
CO	CLEAN–OUT
COM	COMPRESSOR
CP	CONTROL PANEL
CRN	CRANE – OVERHEAD
CSB	CRANE – SPREADER BEAM
CRP	CREEP DETECTOR
CT	CURRENT TRANSFORMER
CU	CONDENSING UNIT
DAM	PNEUMATICALLY ACTUATED DRAIN
DBD	BACK–DRAFT DAMPER
DF	DRINKING FOUNTAIN
DG	DIESEL GENERATOR
DGT	GUTTER DRAIN TRENCH
DP	DRILL PRESS
DPB	LV DISTRIBUTION PANEL BOARD
DS	DOSING SIPHON
DSD	DUCT SMOKE DETECTOR
DW	DISHWASHER
DY	DRYER
ELV	ELEVATOR
ELT	EMERGENCY LIGHTING FIXTURE COMBINE WITH RECHARGEABLE BATTERY UNIT
ES	EMERGENCY SHOWER
ESY	EMERGENCY SHOWER AND EYEWASH
EXC	EXCITATION SYSTEM CUBICLE
EXT	EXCITATION TRANSFORMER
EY	EMERGENCY EYEWASH
FA	FLAME ARRESTER
FAN	FAN
FAP	FIRE ALARM PANEL
FBH	FLEXIBLE BRAIDED HOSE
FD	FIRE DAMPER
FH	HYDRAULIC SELF–CLEANING FILTER
FHC	FIRE HOSE CABINET
FHY	FIRE HYDRANT
FLD	FLOOR DRAIN
FLDF	FLOOR DRAIN WITH FUNNEL
FLDSH	FLOOR DRAIN FOR SHOWER
FLDSOA	FLOOR DRAIN SIDE OUTLET AREA
FP	FILTER PRESS
FPC	FIRE ALARM CABINET
FR	FILTER
FSL	FULL SUPPLY LEVEL
FU	FUSE
FX	FIRE EXTINGUISHER
G	GENERATOR
GBS	GATE – BULKHEAD / STOPLOG
GCP	GOVERNOR CONTROL PANEL
GD	GUTTER DRAIN
GEB	GATE EMBEDDED SILL BEAM
GEG	GATE EMBEDDED GUIDES
GFAP	GENERATOR FIRE ALARM PANEL
GFPC	GENERATOR FIRE PROTECTION CABINET
GIN	GATE–INTAKE EMERGENCY CLOSURE
GLB	GATE–LIFT BEAM
GNC	GENERATOR NEUTRAL CABINET
GOV	GOVERNOR – HYDRAULIC
GR	GRILLE / DIFFUSER
GRD	GROUNDING MATERIAL
GSAC	GENERATOR SURGE ARRESTOR CUBICLE
GSP	GATE – SPILLWAY
GSUT	GENERATOR STEP–UP TRANSFORMER
HC	HEATING COIL
HE	HYDROEJECTOR
HGB	HOIST BRIDGE STRUCTURE
HGE	HOIST–GATE–ELECTRIC
HGH	HOIST–HOUSE–GATE
HGT	HOIST–TOWER–GATES
HN	HORN
HO	HOIST
HS	HEAT AND FIRE SENSOR
HTC	HEAT TRACE CONTROLER
HTCAB	HEAT TRACING CABLE
HTK	HYDROPNEUMATIC TANK
HTL	HANDLING TROLLEY
HU	AIR HUMIDIFIER
HYDP	HYDRAULIC PRESS
IB	INSULATED BRUSH
IC	INSTRUMENT CABINET
INTA	INTRUSION ALARM
INV	INVERTER
IP	INSTRUMENTATION PANEL
IPB	ISOLATED PHASE BUS
IRF	INTERMITTENT RECIRCULATION FILTERS
IT	CURRENT TRANSMITTER
IW	IRON WORKER
JB	JUNCTION BOX
JIBC	JIB CRANE
L	LATHE
LA	LIGHTNING ARRESTOR
LANJ	COMPUTER JACK
LAV	LAVATORY
LBS	LOAD BREAK SWITCH
LF	LIGHTING FIXTURE
LG	LEVEL GAUGE
LS	LEVEL SENSOR
LSP	LOUDSPEAKER
LU	LUBRICATOR
LV	LOUVER
M	MOTOR
MC	MAIN CONTROLLER
MCC	MOTOR CONTROL CENTER
MD	MOTORIZED DAMPER
MF	MUFFLER
MFH	MOBILE FIRE HOSE
MS	MOP SINK
MST	MOTOR STARTER
MTS	MANUAL TRANSFER SWITCH
MV	MOTORIZED VALVE
NGC	NEUTRAL GROUNDING CUBICLE
NPB	600V NON–SEGREGATED BUSWAY
ODR	OIL STORAGE DRUM
OFR	MOBILE OIL FILTER
OI	OIL INTERCEPTOR
OLTC	ON–LOAD TAP CHANGER
OPM	OIL MOBILE PUMPING UNIT
OR	OILER
OS	OIL SKIMMER
OTK	OLEOPNEUMATIC VALVE
OWS	OIL/WATER SEPARATOR
P	PUMP
PAD	PARKING AREA DRAIN
PADD	PUBLIC ADDRESS
PAT	PISTON ACCUMULATOR TANK
PCV	PRESSURE CONTROL VALVE
PD	PRESSURE DAMPER
PDBV	PIT DRAIN WITH BACKWATER VALVE
PEV	PRESSURE EXPANSION VALVE
PLC	PROGRAMMABLE LOGIC CONTROLLER
PLAC	PLASMA ARC CUTTER
PO	POWER OUTLET
PP	PROTECTION PANEL
PPT	PIPE PREP TOOL
PR	PRESSURE REGULATOR
PRA	PIPE RACK
PS	POWER SUPPLY
PSV	SAFETY OR RELIEF VALVE
PT	POTENTIAL TRANSFORMER
PTHDR	PIPE THREADER
PZ	PIEZOMETER
QD	QUICK DISCONNECT
RAD	RADIAL DRILL
RC	CONVENIENCE RECEPTACLE
RCT	RECTIFIER
RD	ROOF DRAIN
RDIM	ROOF DRAIN FOR INVERTED MEMBRANE
RDOW	ROOF DRAIN FOR OIL/WATER DRAINAGE SYSTEM
RES	RESISTOR
RH	RADIANT HEATER
RIS	REMOVABLE INSERT SCREEN
RJC	ROTOR JACKING CART
SA	SURGE ARRESTER
SDT	SEPTIC DOSING TANK
SEB	STOPLOG EMBEDDED SILL BEAM
SEG	STOPLOG EMBEDDED GUIDES
SEP	SEPARATOR
SF	FLOOR SINK
SFR	SAND FILTER
SGB	SHAFT GROUNDING BRUSH
SH	SHOWER
SK	SINK
SKD	SKID
SKM	MULTI–STATION SINK
SL	SILENCER
SM	STATIC MIXER
SOC	SIAMESE OUTLET CONNECTION
SPS	SEPTIC PUMPING STATION
SRA	STEEL RACK
SRN	SIREN
SS	SERVICE SINK
SST	STATION SERVICE TRANSFORMER
STF	FIRE STRAINER
STM	SELF CLEANING STRAINER
STR	STRAINER
STS	SUCTION STRAINER
SW	SWITCH
SWG	SWITCHGEAR
SYNC	SYNCHRONIZER
T	TRANSFORMER
TCH	OFF–LOAD TAP CHANGER
TD	TRENCH DRAIN
TDOW	TRENCH DRAIN FOR OIL/WATER DRAINAGE SYSTEM
TEL	TELEPHONE
TELJ	TELEPHONE JACK
TK	TANK
TP	TELECOMMUNICATION PANEL
TR	CABLE TRAY
TRC	TRASH CLEANING SYSTEM
TRK	TRASHRACK
TS	TEMPERATURE SENSOR
TSQ	SEPTIC TANK
TU	VARIABLE AIR VOLUME TERMINAL UNIT
TUR	TURBINE–VERTICAL KAPLAN
UCP	UNIT CONTROL PANEL
UH	UNIT HEATER
UM	ULTRASONIC MEASUREMENT
UPS	UNINTERRUPTIBLE POWER SUPPLY
UR	URINAL
UV	ULTRAVIOLET STERILIZER
VA	VALVE ACTUATOR
VAV	VACUUM AIR VENT
VBA	BALL VALVE
VBL	BLEED VALVE
VBR	VACUUM BREAKER
VBU	BUTTERFLY VALVE
VCH	CHECK VALVE
VD	DELUGE VALVE
VEC	ECCENTRIC VALVE
VFC	FLOW CONTROL VALVE
VGA	GATE VALVE
VGL	GLOBE VALVE
VKG	KNIFE GATE VALVE
VM	VERTICAL MILL
VNE	NEEDLE VALVE
VP	PLUG VALVE
VSD	VARIABLE SPEED DRIVE
V2W	TWO–WAY VALVE
V3W	THREE–WAY VALVE
V4W	FOUR–WAY VALVE
W	WELDER
WA	WATER ANALYSER
WC	WATER CLOSET
WFE	WELDING FUME EXTRACTOR
WH	WELDING HOOD
WHTR	WATER HEATER
WRC	600V WELDING RECEPTACLE
WM	WASHING MACHINE
WT	WORKING TABLE

SYSTEM CODES

HVAC

SYSTEM CODE	DESCRIPTION
EBR	EXHAUST – BATTERY ROOM
EDD	EXHAUST – DRAINAGE / DEWATERING GALLERY
EGR	EXHAUST – GARBAGE/RECYCLING/TRANS.
EKH	EXHAUST – KITCHEN HOOD
END	EXHAUST – NORTH DAM
EOR	EXHAUST – OIL STORAGE ROOM
ESB	EXHAUST – SERVICE BAY
ESC	EXHAUST – SMOKE VENT
ESP	EXHAUST – SANITARY PUMP ROOM
ESR	EXHAUST – OIL/WATER SEPARATOR
ESW	EXHAUST – SANITARY WASHROOMS
EWH	EXHAUST – WELDING HOOD
EWT	EXHAUST – WATER TREATMENT ROOM
PSC	PRESSURIZATION – STAIR CASES
VCC	VENTILATION – CONTROL / COMM. ROOM
VCD	VENTILATION – CENTER DAM
VCR	VENTILATION – COMPRESSOR ROOM
VDA	VENTILATION – DEWATERING GALLERY
VDT	VENTILATION – DRAFTUBE STOPLOGS AREA
VEG	VENTILATION – EMERGENCY GENERATOR
VEL	VENTILATION – ELEVATOR MACHINE ROOM
VER	VENTILATION – ELECTRICAL – CHARGER ROOM
VFP	VENTILATION – FIRE PUMP AREA
VIG	VENTILATION – INSPECTION GALLERY
VIL	VENTILATION – INTAKE BUILDING
VMR	VENTILATION – MACHINE ROOM
VMS	VENTILATION – MAINTENANCE SHOPS
VND	VENTILATION – NORTH DAM
VOF	VENTILATION – OFFICES
VSA	VENTILATION – SPIRAL CASE ACCESS
VSD	VENTILATION – SOUTH DAM
VSE	VENTILATION – SPILLWAY ELECTRICAL ROOM
VSG	VENTILATION – SPILLWAY EMERGENCY GENERATOR

PIPING

WBS	SYSTEM CODE	DESCRIPTION
3352	WPS	DOMESTIC WATER
3353	SDS	WASTEWATER
3441	ASS	LOW PRESSURE COMPRESSED AIR
3442	AHS	HIGH PRESSURE COMPRESSED AIR
3443	WFS	FIRE PROTECTION WATER
3444	WCD	CLEAR WATER DRAINAGE
3445	WDS	DEWATERING
3446	OLS	LUBRICATING/HYDRAULIC OIL HANDLING SYSTEM
3447	ODS	OILY WATER DRAINAGE
3448	WCS	RAW/COOLING WATER
3449	WSS	SERVICE WATER
344A	ABR	BRAKE AIR
344B	WTS	SHAFT SEAL WATER (FILTERED)
344C	WLS	PIEZOMETER AND WATER LEVEL

ELECTRICAL SYSTEMS

00	GENERAL
80	315 kV SYSTEM
81	15 kV & 25 kV SYSTEM
82	600 V SYSTEM
83	240/120 V & 208/120 V SYSTEM
84	125 V D.C. SYSTEM
85	48 V D.C. SYSTEM
86	PROTECTION SYSTEM
87	CONTROL & MONITORING SYSTEM
88	TELEPHONE SYSTEM
89	TELECOMMUNICATION SYSTEM
90	LIGHTING SYSTEM
91	GROUNDING SYSTEM
92	FIRE DETECTION AND ALARM SYSTEM
93	INTRUSION AND BURGLAR ALARM SYSTEM
94	CCTV SYSTEM
95	EXCITATION SYSTEM
96	GOVERNOR SYSTEM

WBS CODES

WBS	PHYSICAL COMPONENT DESCRIPTION
2371	NORTH DAM HVAC SYSTEM
2373	NORTH DAM ELECTRICAL SYSTEM
2374	SOUTH TRANSITION DAM HVAC SYSTEM
2376	SOUTH TRANSITION DAM ELECTRICAL SYSTEM
2377	CENTER TRANSITION DAM HVAC SYSTEM
2379	CENTER TRANSITION DAM ELECTRICAL SYSTEM
2440	SPILLWAY AUXILIARY SERVICES
3290	INTAKE AUXILIARY SERVICES
3340	POWERHOUSE BUILDING ELECTRICAL SERVICES
3351	POWERHOUSE BUILDING MECHANICAL HVAC SYSTEMS
3410	TURBINE
3411	GOVERNOR
3420	GENERATOR
3421	EXCITATION SYSTEM
3430	ELECTRICAL ANCILLARY/AUXILIARY SYSTEMS
3431	DC POWER/UPS SYSTEM
3432	MV SYSTEMS (601V–15kV)
3433	LV SYSTEMS (UP TO 600V)
3434	UNIT SERVICE TRANSFORMERS
3435	STATION SERVICE TRANSFORMERS
3436	BUS DUCT
3437	DIESEL GENERATORS
3438	GENERATOR CIRCUIT BREAKERS
3451	PROTECTION
3452	CONTROL AND MONITORING
3460	GENERATOR TRANSFORMERS

PROVINCE OF NEWFOUNDLAND
PEGNL PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC–LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL NO.458 which is valid for the year 2013

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
4	C2	01–DEC–2013	ISSUED FOR CONSTRUCTION
3	C1	21–JUN–2013	ISSUED FOR CONSTUCTION
2	B2	15–OCT–2012	ISSUED FOR ADDENDUM 1
1	B1	31–JUL–2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
C2	01–DEC–2013	EQUIPMENT CODES ADDED	M.L	R.K	R.K
C1	21–JUN–2013	GENERAL REVISION	M.L	R.K	R.K
B2	15–OCT–2012	"FLDSOA" FLOOR DRAIN CODE ADDED	M.L	R.K	R.K

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

☐ 1. REVIEWED AND ACCEPTED NO COMMENTS
☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 11-Dec-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy) 11 Dec 2013
PROJECT MANAGER: Date (dd-mmm-yyyy) 11 Dec 2013

PROFESSIONAL STAMP: PROFESSIONAL ENGINEERS PEGNL MARTIN LANDRY 01–DEC–2013 NEWFOUNDLAND & LABRADOR

SNC·LAVALIN

DESIGNED BY M. LANDRY	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY L. GIGUERE	APPROVED Engineering Manager G. SNYDER
VERIFIED BY R. KOOB	
DATE 12–MAR–2012	SCALE NTS

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
GENERAL WORKS
EQUIPMENT AND SYSTEM CODES
LEGEND

SLI DOC No.	NE DOC No.	Rev.
505573–3346–460D–0601_03	MFA–SN–CD–3350–ME–LS–0003–01	C2

FORMAT A0 (mm)

SUB–PKG: 0007–4601 PLATE 01

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2013.12.06/11:15am

SPECIFICATIONS CODES

SEE PIPING SPECIFICATION : MFA-SN-CD-3300-CV-TS-0001-01

PIPE LINE NUMBERING

3441-6-CB11-0001

- WBS CODE
- NOMINAL PIPE SIZE (NPT)
- PIPING SPECIFICATION
- SEQUENTIAL NUMBER

PIPING INSTRUMENTATION NUMBERING

3441 FI 0001

- WBS CODE
- INSTRUMENT CODE
- SEQUENTIAL NUMBER

VALVE NUMBERING

EXAMPLE :

3441-VBA01-0001

- SEQUENTIAL NUMBER
- VALVE NUMBER
- WBS CODE

PIPING SUPPORT NUMBERING

S-XXX-XX

- SUPPORT TYPE

PIPING EQUIPMENT NUMBERING

EXAMPLE :

3441-FR-0001

- SEQUENTIAL NUMBER
- EQUIPMENT CODE
- WBS CODE

HVAC INSTRUMENTATION NUMBERING

INSTRUMENT CODE — PS EBR 0001

- SYSTEM CODE
- SEQUENTIAL NUMBER

HVAC EQUIPMENT NUMBERING

EXAMPLE :

3551-FAN-EBR-0001

- SEQUENTIAL NUMBER
- SYSTEM CODE
- EQUIPMENT CODE
- WBS CODE

PIPING SEQUENTIAL NUMBERING

-0001 TO 0999 = FROM EL 33.60 TO 6.00
-1000 TO 1999 = UNIT G1
-2000 TO 2999 = UNIT G2
-3000 TO 3999 = UNIT G3
-4000 TO 4999 = UNIT G4
-5000 TO 5999 = TURBINE FLOOR
-6000 TO 6999 = GENERATOR FLOOR
-7000 TO 7999 = MEZZANINE 1
-8000 TO 8999 = MEZZANINE 2
-9000 TO 9999 = ROOF AND INTAKE DECK

ABBREVIATIONS

AD	ACCESS DOOR	MIN	MINIMUM
AFF	ABOVE FINISHED FLOOR	MOL	MAX OPERATING LEVEL
BO	BY OTHERS	NC	NORMALLY CLOSED
BOD	BOTTOM OF DUCT	NO	NORMALLY OPEN
BOP	BOTTOM OF PIPE	NF	NORMALLY FUNCTIONING
℄	CENTRE LINE	NI	NORMALLY IDLE
CO	CLEAN OUT	NTS	NOT TO SCALE
CONTRJ	CONTRACTION JOINT	OA	OUTSIDE AIR
CJ	CONSTRUCTION JOINT	PMF	PROBABLE MAXIMUM FLOOD
DIA	DIAMETER	R	RADIUS
DG	DOOR GRILLE	REF	REFERENCE
DN	DOWN	SD	SMOKE DETECTOR
EJ	EXPANSION JOINT	SOL	SOCKET WELD FITTING SOCKOLET
EL	ELEVATION	SYM	SYMMETRICAL
EMB	EMBEDDED	TOL	LATERAL THREADED FITTING THREADOLET
EXP	EXPOSED	TOD	TOP OF DUCT
FC	FAIL CLOSED	TOP	TOP OF PIPE
FO	FAIL OPENED	TWL	TAIL WATER LEVEL
FOR	FUEL OIL RETURN	TYP	TYPICAL
FOS	FUEL OIL SUPPLY	UP	UP
FOV	FUEL OIL VENT	UOS	UNLESS OTHERWISE SPECIFIED
GR	GRILLE	UNO	UNLESS NOTED OTHERWISE
INV	INVERT	WOL	LATERAL WELDED FITTING WELDOLET
MAX	MAXIMUM	WP	WORKING POINT

GENERAL SYMBOLS

DESCRIPTION	SYMBOL
LIMIT OF SUPPLY	OTHERS
SPECIFICATION CHANGE	CB11 SB11
CUT PIPE	
INSULATED PIPE	ISL ISL SYSTEM
EMBEDDED/EXPOSED PIPE LIMIT	EXPOSED EMBEDDED
HEAT TRACING	
ELECTRIC SIGNAL	
ELEVATION	EL XXX.XX
CONSTRUCTION NORTH	
COLD WATER	
HOT WATER	
VENT PIPE	
ANALOG INPUT	AI
ANALOG OUTPUT	AO
DIGITAL INPUT	DI
BENCH MARK	

HVAC SEQUENTIAL NUMBERING

-0001 TO 0999 = GENERAL AREAS
-1000 TO 1999 = UNIT G1
-2000 TO 2999 = UNIT G2
-3000 TO 3999 = UNIT G3
-4000 TO 4999 = UNIT G4

INSTRUMENTATION SYMBOLS (ISA)

CURRENT

INDICTIVE PROXIMITY SWITCH	IPS
CURRENT TRANSMITTER	IT
VOLTAGE, CAPACITOR	EC

FLOW

FLOW ALARM	FA
HIGH FLOW ALARM	FAH
LOW FLOW ALARM	FAL
FLOW CONTROL TRANSDUCER	FCT
FLOW CONTROL VALVE	FCV
FLOW ELEMENT	FE
FLOW SIGHT GLASS	FG
FLOWMETER INDICATOR	FI
FLOW INDICATOR TRANSMITTER	FIT
RESTRICTION ORIFICE FOR FLOW MEASUREMENT	FO
INTEGRATING FLOWMETER	FQI
FLOW SWITCH	FS
HIGH FLOW SWITCH	FSH
LOW FLOW SWITCH	FSL
FLOW TRANSMITTER	FT

GENERAL ALARM & OTHER FUNCTIONS

MULTIPLE ALARM	UAH UALH
ALARM FOR CLOSED ELEMENT	ZAL
ALARM FOR OPENED ELEMENT	ZAH
MOTORIZED VALVE	MV
SPEED PICK-UP	SE
SERVO VALVE	SV
WATER DETECTOR	WD
SOLENOID VALVE	YV
ACTUATOR	Z
POSITION TRANSDUCER	ZT

LEVEL

HIGH LEVEL ALARM	LAH
LOW LEVEL ALARM	LAL
EXTREME HIGH LEVEL ALARM	LAHH
EXTREME LOW LEVEL ALARM	LALL
LEVEL CONTROL VALVE	LCV
LEVEL ELEMENT	LE
LEVEL GAGE GLASS	LG
LEVEL INDICATOR	LI
LEVEL SWITCH	LS
LEVEL TRANSMITTER	LT
HIGH LEVEL SWITCH	LSH
EXTREME HIGH LEVEL SWITCH	LSHH
HIGH/LOW LEVEL SWITCH	LSLH
LOW LEVEL SWITCH	LSL
EXTREME LOW LEVEL SWITCH	LSLL

MOISTURE

MOISTURE TRANSMITTER	MT
MOISTURE LIMIT SWITCH	MSL
HIGH MOISTURE SWITCH	MSH

PRESSURE

DIFFERENTIAL PRESSURE CONTROLER	DPC
HIGH PRESSURE ALARM	PAH
EXTREME HIGH PRESSURE ALARM	PAHH
LOW PRESSURE ALARM	PAL
EXTREME LOW PRESSURE ALARM	PALL
PRESSURE CONTROL VALVE	PCV
HIGH DIFFERENTIAL PRESSURE ALARM	PDAH
DIFFERENTIAL PRESSURE INDICATOR	PDI
DIFFERENTIAL PRESSURE SWITCH	PDS
HIGH DIFFERENTIAL PRESSURE SWITCH	PDSH
PRESSURE INDICATOR	PI
PRESSURE SWITCH	PS
HIGH PRESSURE SWITCH	PSH
VERY HIGH PRESSURE SWITCH	PSHH
HIGH/LOW PRESSURE SWITCH	PSLH
LOW PRESSURE SWITCH	PSL
VERY LOW PRESSURE SWITCH	PSLL
SAFETY OR RELIEF VALVE	PSV
PRESSURE TRANSMITTER	PT

TEMPERATURE

HIGH TEMPERATURE ALARM	TAH
LOW TEMPERATURE ALARM	TAL
TEMPERATURE CONTROLLER	TC
TEMPERATURE CONTROL VALVE	TCV
TEMPERATURE ELEMENT	TE
TEMPERATURE INDICATOR THERMOMETER	TI
TEMPERATURE INDICATOR/TRANSMITTER	TIT
TEMPERATURE SWITCH	TS
HIGH TEMPERATURE SWITCH	TSH
LOW TEMPERATURE SWITCH	TSL
HIGH/LOW TEMPERATURE SWITCH	TSLH
TEMPERATURE TRANSMITTER	TT
TEMPERATURE WELL	TW

SWITCH

HAND SWITCH		HS
HAND VALVE		HV
POSITION SWITCH		ZS
POSITION SWITCH OPENED / CLOSED	ZSH	ZSL

INSTRUMENT PANEL

DUPLEX INSTRUMENT	
FIRE DETECTION PANEL	
REMOTE CONTROL PANEL	
LOCAL CONTROL PANEL	
LOCAL INSTRUMENT	
LOCAL PANEL MOUNTED INSTRUMENT	
CONTROL CIRCUIT	

NOTE:

1. THE INSTRUMENTATION SYMBOLS AND IDENTIFICATIONS ARE ACCORDING TO ANSI/ISA-5.1

PROVINCE OF NEWFOUNDLAND
PEGNL PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL NO450 which is valid for the year 2013.

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
3	C2	01-DEC-2013	ISSUED FOR CONSTRUCTION
2	C1	21-JUN-2013	ISSUED FOR CONSTUCTION
1	B1	31-JUL-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3350-ME-LS-0003-01 (505573-3346-46DD-0601)	EQUIPMENT AND SYSTEM CODES LEGEND

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
C2	01-DEC-2013	GENERAL SYMBOLS AND ABBREVIATIONS ADDED	M.L	R.K	R.K
C1	21-JUN-2013	REVISED PIPING SUPPORT NUMBERING	M.L	R.K	R.K

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- ☐ 1. REVIEWED AND ACCEPTED NO COMMENTS
- ☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 11-DEC-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy) 11 Dec 2013
PROJECT MANAGER: Date (dd-mmm-yyyy) 11 Dec 2013

PROFESSIONAL STAMP

PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND & LABRADOR — PEGNL — PERMIT HOLDER — MARTIN LANDRY — 11-DEC-2013

SNC·LAVALIN

DESIGNED BY M. LANDRY	APPROVED Discipline Lead Engineer R. KOOB
DRAWN BY L. GIGUERE	APPROVED Engineering Manager G. SNYDER
VERIFIED BY R. KOOB	
DATE 12-MAR-2012	SCALE NTS
SLI DOC No. 505573-3346-46DD-0602_02	NE DOC No. MFA-SN-CD-3350-ME-LS-0004-01 Rev. C2

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS GENERAL WORKS EQUIPMENT NUMBERING AND INSTRUMENTATION SYMBOLS

FORMAT A0 (mm)

SUB-PKG: 0007-4601 PLATE 02

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GENERAL NOTES:

1. GENERAL:

1.1 THE MECHANICAL AND ELECTRICAL EQUIPMENT SHOWN ON THE CIVIL/STRUCTURAL/ARCHITECTURAL DRAWINGS ARE FOR INFORMATION ONLY AND ARE NOT EXHAUSTIVE. THE MECHANICAL AND ELECTRICAL DRAWINGS SHALL BE READ CONJOINTLY WITH THE CIVIL/STRUCTURAL/ARCHITECTURAL DRAWINGS.

1.2 ALL DIMENSIONS ARE IN MILLIMETRES, COORDINATES AND ELEVATIONS ARE IN METRES, UNO.

1.3 DIMENSIONS SHALL NOT BE SCALED FROM THE DRAWINGS.

1.4 THESE GENERAL NOTES SHALL BE READ CONJOINTLY WITH THE SPECIFICATION.

2. CONCRETE:

2.1 THE CEMENT TYPE SHALL BE AS PER SPECIFICATION.

2.2 MIX DESIGN FOR CONCRETE CLASSES AS INDICATED ON THE CONCRETE DRAWINGS SHALL BE AS PER SPECIFICATION.

2.3 ALL EXPOSED CONCRETE EDGES FOR COLUMNS, BEAMS, TOP OF WALLS, OPENINGS, ETC. SHALL HAVE A 25 mm CHAMFER UNO.

2.4 ALL CONSTRUCTION JOINTS SHALL BE ROUGHENED TO EXPOSE THE AGGREGATES TO A FULL AMPLITUDE OF AT LEAST 5 mm UNO.

2.5 ALL PRIMARY CONCRETE SURFACES IN CONTACT WITH SECOND STAGE CONCRETE FOR GUIDES AND LINTELS OF TRASHRACKS, BULKHEAD GATES, HEAD GATE AND DRAFT TUBE GATES IN THE POWERHOUSE AS WELL AS FOR GUIDES OF STOPLOGS AND HEAD GATE IN THE SPILLWAY SHALL BE ROUGHENED TO EXPOSE THE AGGREGATES TO A FULL AMPLITUDE OF AT LEAST 5 mm.

2.6 SEE SPECIFICATION FOR CONTRACTION JOINT TREATMENT.

2.7 CONCRETE FLOOR HARDENER SHALL BE USED ON THE ELECTRICAL BUILDING FLOOR. REFER TO THE SPECIFICATION, UNO.

3. REINFORCEMENT:

3.1 ALL REINFORCEMENT (REINFORCING STEEL) SHALL BE GRADE 400R, UNO OR 400W WHERE WELDING OF BARS IS INDICATED.

3.2 DEVELOPMENT AND LAP SPLICE LENGTHS SHALL BE AS INDICATED IN TABLES 1 THROUGH 3, UNO.
THE "TOP BARS" CATEGORY INCLUDES HORIZONTAL REINFORCEMENT PLACED IN SUCH A WAY THAT MORE THAN 300 mm OF FRESH CONCRETE IS CAST IN THE MEMBER BELOW THE DEVELOPMENT LENGTH OR SPLICE. THE "TOP BARS" CATEGORY DOES NOT APPLY TO THE HORIZONTAL REINFORCEMENT OF WALLS, UNO.
THE "OTHER BARS" CATEGORY INCLUDES REINFORCEMENT THAT DOES NOT ENTER INTO THE "TOP BARS" CATEGORY.

TABLE 1: Fy = 400 MPa f'c = 25 MPa

	TOP BARS		OTHER BARS	
BAR SIZE	DEVELOPMENT LENGTH (mm)	LAP SPLICE LENGTH (CLASS B) (mm)	DEVELOPMENT LENGTH (mm)	LAP SPLICE LENGTH (CLASS B) (mm)
10M	380	490	300	380
15M	570	740	440	570
20M	750	980	580	750
25M	1170	1530	900	1170
30M	1410	1830	1080	1410
35M	1640	2130	1260	1640

TABLE 2: Fy = 400 MPa f'c = 30 MPa

	TOP BARS		OTHER BARS	
BAR SIZE	DEVELOPMENT LENGTH (mm)	LAP SPLICE LENGTH (CLASS B) (mm)	DEVELOPMENT LENGTH (mm)	LAP SPLICE LENGTH (CLASS B) (mm)
10M	350	450	300	350
15M	520	670	400	520
20M	690	890	530	690
25M	1070	1390	830	1070
30M	1290	1670	990	1290
35M	1500	1950	1160	1500

TABLE 3: Fy = 400 MPa f'c = 35 MPa

	TOP BARS		OTHER BARS	
BAR SIZE	DEVELOPMENT LENGTH (mm)	LAP SPLICE LENGTH (CLASS B) (mm)	DEVELOPMENT LENGTH (mm)	LAP SPLICE LENGTH (CLASS B) (mm)
10M	320	420	300	320
15M	480	620	370	480
20M	640	830	490	640
25M	990	1290	770	990
30M	1190	1550	920	1190
35M	1390	1800	1070	1390

4. FORMWORK:

4.1 CONCRETE COVER IS MEASURED FROM THE CONCRETE SURFACE TO THE NEAREST SURFACE OF REINFORCEMENT, (INCLUDING TRANSVERSE REINFORCEMENT HOOKED AROUND LONGITUDINAL BARS.)

ELEMENT	COVER BARS
CONCRETE PLACED AGAINST ROCK	75 mm
EXTERIOR EXPOSED FACES OF WALLS	75 mm
INTERIOR BEAMS AND SLABS	40 mm
EXTERIOR BEAMS AND SLABS	50 mm
INTERIOR EXPOSED FACES OF WALLS AND COLUMNS	50 mm
EXTERIOR FACES COVERED BY BACKFILL, ROCK FILL	75 mm
FACES IN THE HYDRAULIC PASSAGE	100 mm

4.2 CONCRETE FINISHES FOR THE FORMED AND UNFORMED SURFACES AS INDICATED ON THE CONCRETE DRAWINGS SHALL BE AS PER SPECIFICATION.

4.3 TIE ROD HOLES:

FOR VISIBLE WALL SURFACES, TIE ROD HOLES SHALL BE ALIGNED VERTICALLY AND HORIZONTALLY AND LATER SHALL BE FILLED WITH GROUT.

5. WATERSTOPS:

5.1 PVC WATERSTOP TYPES WSA AND WSB, AS DEFINED IN THE WATERSTOPS SPECIFICATION, SHALL BE USED AS FOLLOWS:
WSA : FOR CONSTRUCTION JOINTS
WSB : FOR CONTRACTION JOINTS

6. STRUCTURAL STEEL:

6.1 ALL STRUCTURAL STEEL WORKS INCLUDING MATERIAL, SHOP DRAWINGS, FABRICATION AND ERECTION SHALL COMPLY WITH THE SPECIFICATION: MFA-SN-CD-2000-MC-TS-0001-01 STRUCTURAL STEEL 05 12 00.

6.2 STRUCTURAL STEEL MEMBERS SHALL BE SHOP ASSEMBLED TO THE MAXIMUM DIMENSIONS THAT TRANSPORTATION AND HANDLING WILL ALLOW FOR DELIVERY TO THE SITE.

6.3 CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN OF ALL CONNECTIONS. THE DESIGN OF THE CONNECTIONS SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL, BEFORE THE COMMENCEMENT OF FABRICATION.

6.4 STEEL ASSEMBLIES FABRICATED IN THE SHOP SHALL BE WELDED.

6.5 ALL BUTT-WELDING OF ROLLED SHAPES OR OF WELDED PLATE SHAPES, IN A STRUCTURAL MEMBER, SHALL BE COMPLETE JOINT PENETRATION (FULL STRENGTH) VERIFIED 100%. AFTER THE BUTT-WELDING THE SURFACES SHALL BE GROUND SMOOTH.

6.6 CONNECTIONS DONE ON SITE SHALL BE BOLTED, UNLESS NOTED OTHERWISE ON DRAWINGS.

6.7 THE BOLTED CONNECTIONS SHALL BE BEARING TYPE, UNLESS NOTED OTHERWISE ON DRAWINGS. THE BOLT LENGTHS SHALL BE AS REQUIRED AND THEN INSTALLED IN ORDER TO HAVE THE THREADS EXCLUDED FROM THE SHEAR PLANE. FOR THE DESIGN OF THESE CONNECTIONS, SEE THE TECHNICAL SPECIFICATION FOR STRUCTURAL STEEL.

6.8 UNLESS NOTED OTHERWISE ON DRAWINGS, THE BOLTED CONNECTIONS FOR THE VERTICAL BRACINGS, SHALL BE SLIP-CRITICAL CONNECTION TYPE. THESE BOLTED CONNECTIONS SHALL HAVE THE PARTS PAINTED IN ORDER TO OBTAIN CLASS A CONTACT FOR SURFACES. THE BOLT LENGTHS SHALL BE AS REQUIRED AND THEN INSTALLED IN ORDER TO HAVE THE THREADS EXCLUDED FROM THE SHEAR PLANE.

6.9 BOLTS SHALL BE ASTM A325. THE BOLTS SHALL BE BLACK, EXCEPT FOR THE CONNECTIONS OF THE GALVANIZED STEELS WHERE THE BOLTS SHALL BE GALVANIZED UNO.

6.10 STRUTS AND TIES SHALL BE CONNECTED FOR A MINIMUM TENSILE FORCE OF 100 kN.

6.11 HOLLOW SECTIONS SHALL HAVE BOTH ENDS SEALED WITH 6 mm CAP PLATES. AT THE LOWEST POINT OF THE HOLLOW MEMBER, A 12 mm ø HOLE SHALL BE PROVIDED FOR AERATION AND DRAINAGE.

6.12 DECK FOR THE ROOFS SHALL BE GALVANIZED AS MENTIONED IN THE SPECIFICATION. THE CONTRACTOR SHALL VERIFY THE CONNECTIONS OF THE ROOF DECKS TO WITHSTAND EXTERIOR WIND SUCTION PLUS INTERNAL PRESSURE, BASED ON GEOGRAPHICAL LOCATION DATA IN THE CANADIAN NATIONAL BUILDING CODE.

6.13 GRATINGS SHALL BE TYPE 24-102 WITH BEARING BARS OF 32x4.8 BY FISHER AND LUDLOW OR APPROVED EQUIVALENT BY THE ENGINEER, UNLESS NOTED OTHERWISE ON THE DRAWINGS. THE STAIR TREADS SHALL BE IN GRATING WITH NOSING IN BENT CHECKERED PLATE TYPE 308x914 UNO, BY FISHER AND LUDLOW OR APPROVED EQUIVALENT BY THE ENGINEER.

6.14 EXTERIOR GRATINGS AND TREADS SHALL BE SERRATED.

6.15 STAIR TREADS AND LANDINGS, THE GUARD RAILS AND ALL THEIR CONNECTIONS SHALL WITHSTAND THE LOADINGS AS PER THE CANADIAN NATIONAL BUILDING CODE.

6.16 THE CONTRACTOR SHALL DO THE NECESSARY TOUCH UP OF ANY DAMAGED PAINT OR DAMAGED GALVANIZING OF THE BOLT HEADS AND NUTS AFTER THE FINAL TORQUE. CONNECTION SURFACES SHALL BE TOUCHED UP AS MENTIONED IN THE SPECIFICATION.

6.17 UNDERSIDE OF THE COLUMN BASE PLATES SHALL ONLY BE PAINTED WITH PRIMER, EXCEPT FOR A 25mm STRIP ON THE UNDERSIDE PERIMETER, WHICH SHALL RECEIVE NORMAL PAINT.

6.18 FOR THE STEEL ITEMS WHICH ARE REQUIRED TO BE GALVANIZED, ALL CONNECTED MATERIALS SHALL HAVE A MINIMUM CONTINUOUS SEAL WELD COMBINED WITH THE WELDING WHERE CAPACITY IS REQUIRED.

6.19 HILTI TYPE BOLTS INCLUDING THE NUTS AND WASHERS SHALL BE HOT DIP GALVANIZED AS PER THE DATA SHEET OF THE MANUFACTURER, OR IN STAINLESS STEEL AS REQUESTED ON THE DRAWINGS.

6.20 THE FOLLOWING STEEL ITEMS SHALL BE HOT DIP GALVANIZED:
- STAIRS
- LADDERS
- GRATINGS
- GUARD RAILS
- COVERS AND FRAMES
- SUPPORTING STEEL FIXED ON CONCRETE FOR GRATINGS.
- HIGH STRENGTH BOLTS ASTM A325 FOR CONNECTION OF GALVANIZED STEEL ONLY.
- ANCHOR BOLTS, NUTS, AND WASHERS
- ANCHOR BOLTS FOR GUARDRAILS AND RAILS, INCLUDING THEIR WASHERS AND NUTS. THE COATING FOR ANCHOR BOLTS SHALL ONLY BE THE PROJECTED LENGTH PLUS 60mm MIN
- EMBEDDED STEEL, UNLESS NOTED OTHERWISE.

IN ORDER TO AVOID DISTORTIONS OF SLENDER STEEL MEMBERS, THE CONTRACTOR MAY CHOOSE A DIFFERENT EQUIVALENT ZINC PROTECTION METHOD.

6.21 COLUMNS SHALL BE FIRST INSTALLED ON STEEL SHIM PACKS IN NUMBERS AS REQUIRED, FOR LEVELING OF THE BASE PLATES IT IS FORBIDDEN TO USE NUTS IN LIEU OF SHIM PACKS UNDER THE BASE PLATES.

6.22 GROUTING AT THE UNDERSIDE OF COLUMN BASE PLATES SHALL BE DONE WITH A RECOGNIZED NON-METALLIC NON-SHRINK CEMENT GROUT, AS PER THE SPECIFICATION.

6.23 ANCHOR BOLTS SHALL BE BY PORTLAND BOLT MANUFACTURING COMPANY OR APPROVED EQUIVALENT BY THE ENGINEER. THE STEEL GRADES SHALL BE AS INDICATED ON DRAWINGS.

6.24 ANCHOR BOLT LOCATIONS AND PROJECTIONS SHALL BE VERIFIED BY THE CONTRACTOR. THE ENGINEER SHALL BE INFORMED ABOUT ALL DISCREPANCIES.

6.25 FORCES: ALL FORCES AND MOMENTS GIVEN ON DRAWINGS ARE FACTORED AND EXPRESSED IN kN AND kNm.

6.26 THE CONNECTIONS SHALL BE DESIGNED USING THE FORCES GIVEN ON DRAWINGS AND FOLLOWING THE REQUIREMENT IN THE TECHNICAL SPECIFICATION.

6.27 THE SLIP-CRITICAL CONNECTION TYPE SHALL BE DESIGNED USING 80% OF THE FACTORED FORCES MENTIONED ON THE DRAWINGS AND THE BOLTS SHALL BE SLIP RESISTANCE FOLLOWING CSA S16-09, CLAUSE 13.12, SEE THE TABLE 3-11 IN THE CISC HANDBOOK OF STEEL CONSTRUCTION.

6.28 THE STRUCTURAL STEEL DIMENSIONS SHOWN ON DRAWINGS ARE AT 23° C. THE CONTRACTOR SHALL APPLY CORRECTIONS FOR THE DIMENSIONS DEPENDING ON THE ACTUAL TEMPERATURES AT THE TIME OF FABRICATION.

ABBREVIATIONS:

@ – AT (SPACING)
AB – ANCHOR BOLT
ADD – ADDITIONAL
Af – FACTORED AXIAL FORCE
ALT – ALTERNATE
B OR BOT – BOTTOM
BB – BENT BARS
BS – BOTH SIDES
℄ CL – CENTRELINE
C/C – CENTRE TO CENTRE
CHK'D PL – CHECKERED PLATE
CJ – CONSTRUCTION JOINT
CJP – COMPLETE JOINT PENETRATION
CJ+WS – CONSTRUCTION JOINT + WATERSTOP
COL – COLUMN
CONC – CONCRETE
CONC BLK – CONCRETE BLOCK
CONT'D – CONTINUED
CONT – CONTINUOUS
CONTR/ – CONTRACTION JOINT
COV – COVER
CP – CONTROL POINT
C/W – COMPLETE WITH
DEG or ° – DEGREE
DET – DETAIL
DEP – DEPTH
DIA OR ø – DIAMETER
DIAG – DIAGONAL
DN – DOWN
DO – DITTO (REPEAT)
DWG – DRAWING
DWLS – DOWELS
ED – EACH DIRECTION
EF – EACH FACE
EL – ELEVATION
ELECT – ELECTRICAL
EJ – EXPANSION JOINT
EP – EMBEDDED PART
EQ or = – EQUAL
EQ SP – EQUAL SPACE
ES – EACH SIDE
EQUIV – EQUIVALENT
EW – EACH WAY
EXIST – EXISTING
EXT – EXTERIOR
f'c – SPECIFIED COMPRESSIVE STRENGTH OF CONCRETE
FF – FAR FACE
FI – FIELD INSTRUCTION
FTG – FOOTING
FS– FAR SIDE, FLASHING SEAL
FSL – FULL SUPPLY LEVEL
FY – SPECIFIED YIELD STRENGTH OF STEEL RENFORCEMENT
GA – GAUGE
GALV – GALVANIZED
GL – GIRT LINE
GR – GUARDRAIL
GSU – GENERATOR STEP-UP
H OR HORIZ – HORIZONTAL
HB – HORIZONTAL BRACING
HP – HIGH POINT
HR – HANDRAIL
HSS – HOLLOW STRUCTURAL STEEL
ID – INSIDE DIAMETER
IF – INSIDE FACE, IN FACE
INT – INTERIOR
KB – KNEE BRACE
kN – KILONEWTON
kNm – KILONEWTON x METER
LG – LONG
LLH – LONG LEG HORIZONTAL
LLV – LONG LEG VERTICAL
LP – LOW POINT
LSL – LOW SUPPLY LEVEL
MAX – MAXIMUM
MAX WL – MAXIMUM WATER LEVEL
MC – MOMENT CONNECTION
Mg – MEGAGRAM
MECH – MECHANICAL
MEZZ – MEZZANINE
MISC – MISCELLANEOUS
MIN WL – MINIMUM WATER LEVEL
MIN – MINIMUM
MOL – MINIMUM OPERATING LEVEL
NA – NOT APPLICABLE
NF – NEAR FACE
NIC – NOT IN CONTRACT
NOM – NOMINAL
NTS – NOT TO SCALE
OD – OUTSIDE DIAMETER
OF – OUTSIDE FACE
OPP – OPPOSITE
OPNG – OPENING
/ OR & – AND
PL – PLATE
PMF – PROBABLE MAXIMUM FLOOD
PP – PARTIAL PENETRATION
PSA – PRINCIPAL STRUCTURES AXIS
PVC – POLYVINYLCHLORIDE
R – RADIUS
REF – REFERENCE TO INFORMATION BY OTHERS
REINF – REINFORCEMENT
RG – REMOVABLE GUARDRAIL
RH – REMOVABLE HANDRAIL
REQ'D – REQUIRED
REV – REVISION
SCH – SCHEDULE
SH – SHEET
SIM – SIMILAR
SPCS – SPACES
SS – STAINLESS STEEL
STA – STATION
STD – STANDARD
STIFF – STIFFENER
STR – STRUCTURAL
T – TOP
T&B – TOP AND BOTTOM
TEMP – TEMPORARY
THK – THICK, THICKNESS
T/O – TOP OF
TOG – TOP OF GRATING
TOC – TOP OF CONCRETE/CURB
TOR – TOP OF RAIL
TOS – TOP OF STEEL
TP – TANGENT POINT
TWL – TAIL WATER LEVEL
TYP – TYPICAL
UNO – UNLESS NOTED OTHERWISE
U/S – UNDERSIDE
VAR – VARIABLE, VARIES
VB – VERTICAL BRACING
Vf – FACTORED SHEAR FORCE
V OR VERT – VERTICAL
WL – WATER LEVEL
WP – WORKING POINT, WORK PACKAGE
WS – WATERSTOP
W/C – WATER CEMENT RATIO
X/S – EXTRA STRONG

+ NOTATION FOR TENSION FORCE
– NOTATION FOR COMPRESSION FORCE
± NOTATION FOR ALTERNATE FORCE, TENSION/COMPRESSION

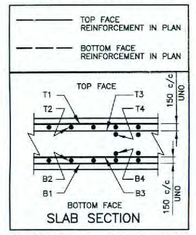
(+) MEMBER LOCATION ABOVE MAIN ELEVATION
(–) MEMBER LOCATION BELOW MAIN ELEVATION

D1

LEGEND:

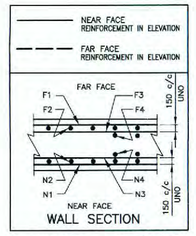
- ADJACENT CONCRETE
- CONCRETE BLOCK IN PLAN
- CONCRETE BLOCK IN ELEVATION
- PRIMARY CONCRETE
- SECONDARY CONCRETE (2nd STAGE)
- PRECAST CONCRETE
- RIGID INSULATION
- CHK'D PL
- STEEL
- GRATING
- CONCRETE FINISH FORMED SURFACES (XX)
- CONCRETE FINISH UNFORMED SURFACES (XX)
- CONCRETE CLASS (XX)
- CONCRETE COVER (COV XX)
- JOINT WITH WATERSTOP SEE SPECIFICATION
- ROCK
- BACKFILL
- GROUND
- SLAB/WALL THK VALUE – SLAB OR WALL THICKNESS
- BENCH MARK X
- EL. – PLAN ELEVATION
- A / A – SECTION SYMBOLS
- EL – ELEVATION
- EL – MAX OR MIN WATER LEVELS
- FLOW – DIRECTION OF FLOW

REBAR CONFIGURATION:



SLAB SECTION

TF – TOP FACE
T1 – TOP 1st LAYER
T2 – TOP 2nd LAYER
T3 – TOP 3rd LAYER
T4 – TOP 4th LAYER
BF – BOTTOM FACE
B1 – BOTTOM 1st LAYER
B2 – BOTTOM 2nd LAYER
B3 – BOTTOM 3rd LAYER
B4 – BOTTOM 4th LAYER



WALL SECTION

NF – NEAR FACE
N1 – NEAR 1st LAYER
N2 – NEAR 2nd LAYER
N3 – NEAR 3rd LAYER
N4 – NEAR 4th LAYER
FF – FAR FACE
F1 – FAR 1st LAYER
F2 – FAR 2nd LAYER
F3 – FAR 3rd LAYER
F4 – FAR 4th LAYER

NOTICE

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ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	01-AUG-2013	ISSUED FOR DESIGN
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LEAD REVIEWER: Date (dd-mmm-yyyy) 12-Aug-2013
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PROJECT MANAGER: Date (dd-mmm-yyyy) 12-Aug-2013

PROFESSIONAL STAMP: REGISTERED PROFESSIONAL ENGINEER C. Todd Snyder 01-AUG-2013 PROVINCE OF NEWFOUNDLAND

SNC·LAVALIN

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DATE 13-DEC-2012	SCALE NTS

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE, INTAKE AND SPILLWAY
GENERAL NOTES, LEGEND AND ABBREVIATIONS

SU DOC No. 505573-3241-40DD-0001_01
NE DOC No. MFA-SN-CD-2400-EN-LS-0001-01
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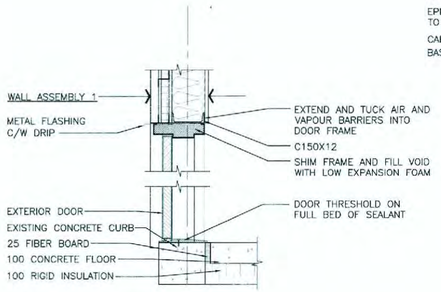

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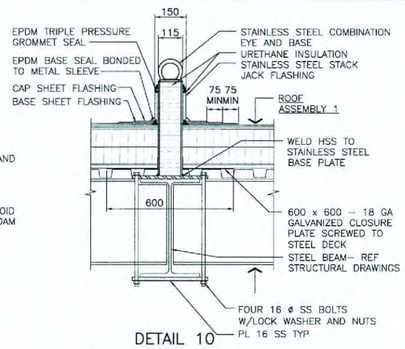

DETAIL 10
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(505573-3241-44DD-0001)
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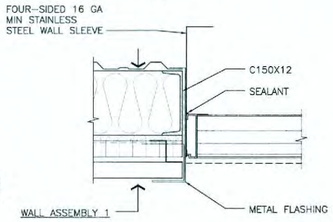

LOUVRE JAMB DETAIL
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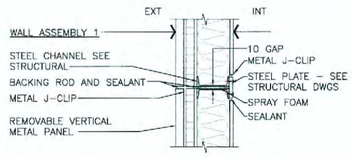

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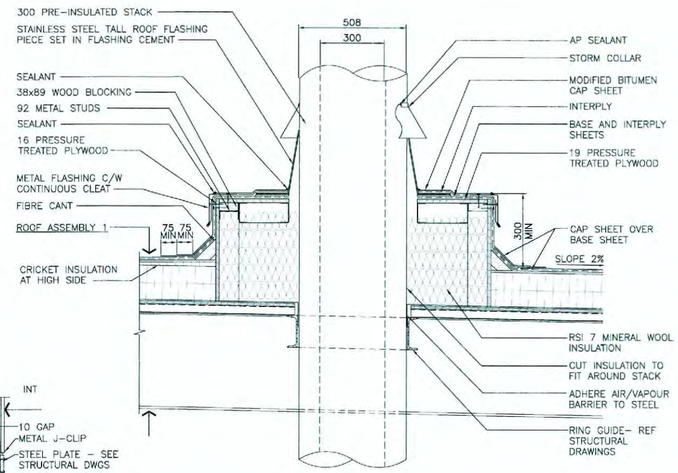

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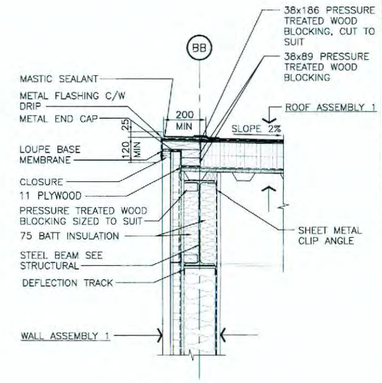

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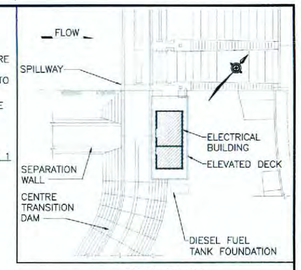
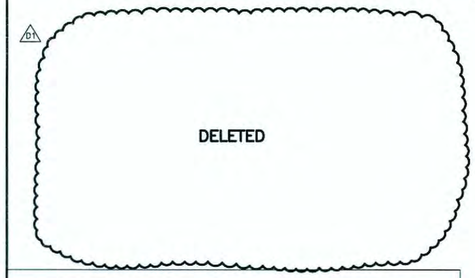
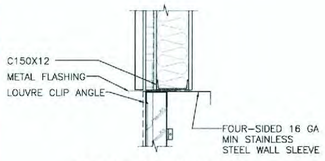


KEY PLAN

NOTES:
1. FOR GENERAL NOTES, LEGEND, AND ABBREVIATIONS SEE DWG MFA-SN-CD-2400-EN-LS-0001-01 (505573-3241-40DD-0001)
2. ROOF CURB TO BE CONSTRUCTED FROM 92 METAL STUDS
3. SEAL ALL PENETRATIONS ALL AROUND





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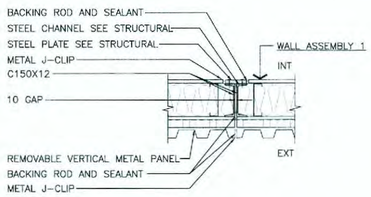

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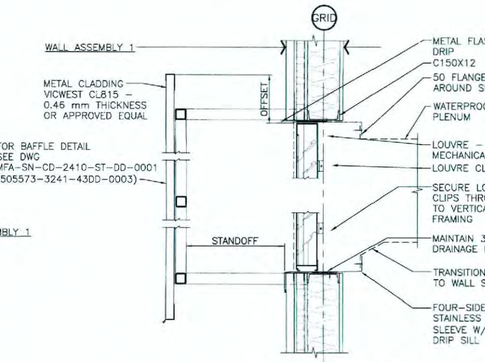

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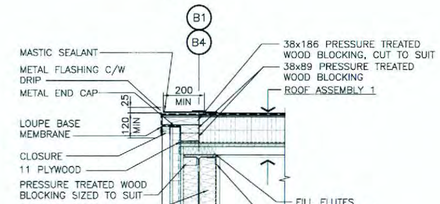

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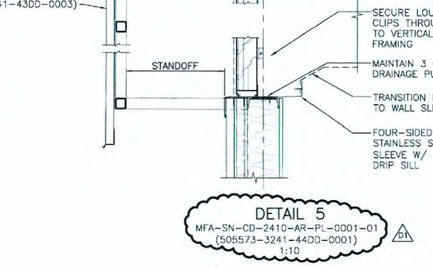

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(505573-3241-44DD-0002)
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DETAIL 3
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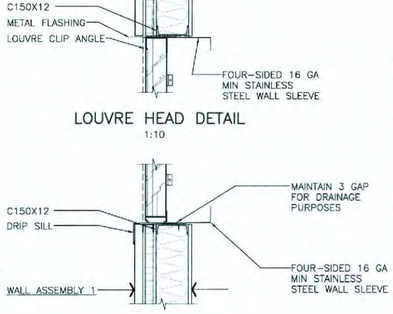
(505573-3241-44DD-0002)
1:10



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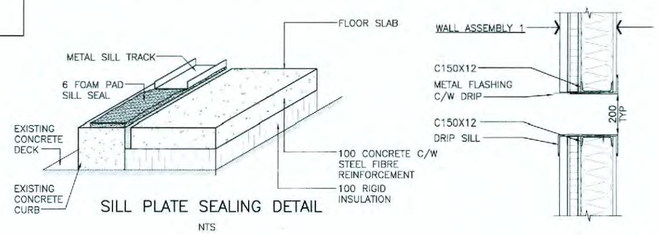


SILL PLATE SEALING DETAIL
NTS

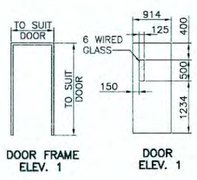
DETAIL 9
MFA-SN-CD-2410-AR-PL-0001-01
(505573-3241-44DD-0001)
1:10

DOOR SCHEDULE

DOOR No.	LOCATION FROM	LOCATION TO	DIMENSIONS W	DIMENSIONS H	DIMENSIONS Th.	DOOR Elev	DOOR Type	DOOR Fin	DOOR Hdwe	FRAME Elev	FRAME Type	FRAME Jamb	FRAME Fin	Fire Rating
X01	EXT	101	914	2134	-	2	HMG	PT	-	1	PS	1	PT	-
X02	EXT	102	914	2134	-	2	HMG	PT	-	1	PS	1	PT	-
101	101	102	914	2134	90	2	HMG	PT	-	1	PS	1	PT	90

DOOR SCHEDULE LEGEND

HMG	HOLLOW METAL GALVANIZED & INSULATED
PS	PRESSED STEEL
PT	PAINT
EXT	EXTERIOR
HDWE	HARDWARE



NOT FOR CONSTRUCTION

SCALE 1:10

SCALE 1:5

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	01-AUG-2013	ISSUED FOR DESIGN
1	00	10-JAN-2013	ISSUED FOR ADDENDUM

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2410-ST-DD-0001 (505573-3241-43DD-0003)	SPILLWAY – ELECTRICAL BUILDING BAFFLES – STRUCTURAL DETAILS STRUCTURAL STEEL
MFA-SN-CD-2410-ST-SN-0001-01 (505573-3241-43DD-0002)	SPILLWAY – ELECTRICAL BUILDING SECTIONS AND DETAILS – STRUCTURAL STEEL
MFA-SN-CD-2410-ST-PL-0001-01 (505573-3241-43DD-0001)	SPILLWAY – ELECTRICAL BUILDING PLAN AND ELEVATIONS – STRUCTURAL STEEL
MFA-SN-CD-2400-EN-LS-0001-01 (505573-3241-40DD-0001)	POWERHOUSE, INTAKE AND SPILLWAY GENERAL NOTES, LEGEND AND ABBREVIATIONS
MFA-SN-CD-2410-AR-PL-0001-01 (505573-3241-44DD-0001)	SPILLWAY – ELECTRICAL BUILDING PLANS AND ELEVATIONS – ARCHITECTURAL
MFA-SN-CD-2410-AR-SE-0001-01 (505573-3241-44DD-0002)	SPILLWAY – ELECTRICAL BUILDING SECTIONS – ARCHITECTURAL

No.	DATE	REVISION	MOD.	VER.	APP.
D1	01-AUG-2013	BAFFLE DETAILS AND CURB REVISED; BAFFLE SCHEDULE REMOVED			

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REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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- 1. REVIEWED AND ACCEPTED NO COMMENTS
- 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- 3. REVIEWED - NOT ACCEPTED
- 4. INFORMATION ONLY
- 5. NOT REVIEWED

LEAD DISCIPLINE: Date (dd-mmm-yyyy) 12-AUG-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy)
PROJECT MANAGER: Date (dd-mmm-yyyy)

PROFESSIONAL STAMP

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A" This Permit Allows SNC-LAVALIN Inc. To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL N0468 which is valid for the year 2013.

SNC·LAVALIN

DESIGNED BY T. SMITH	APPROVED Discipline Lead G. COOK
DRAWN BY A. GREEN	APPROVED Engineering Manager G. SNYDER
VERIFIED BY R. ABDULMAJEED	SCALE AS NOTED
DATE 28-SEP-2012	

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS SPILLWAY ELECTRICAL BUILDING DETAILS ARCHITECTURAL

File No. 505573-3241-44DD-0003_01

MFA-SN-CD-2410-AR-DD-0001-01 D1

FORMAT A0 (mm)

SUB-PKG: 0032-4101 PLATE 04

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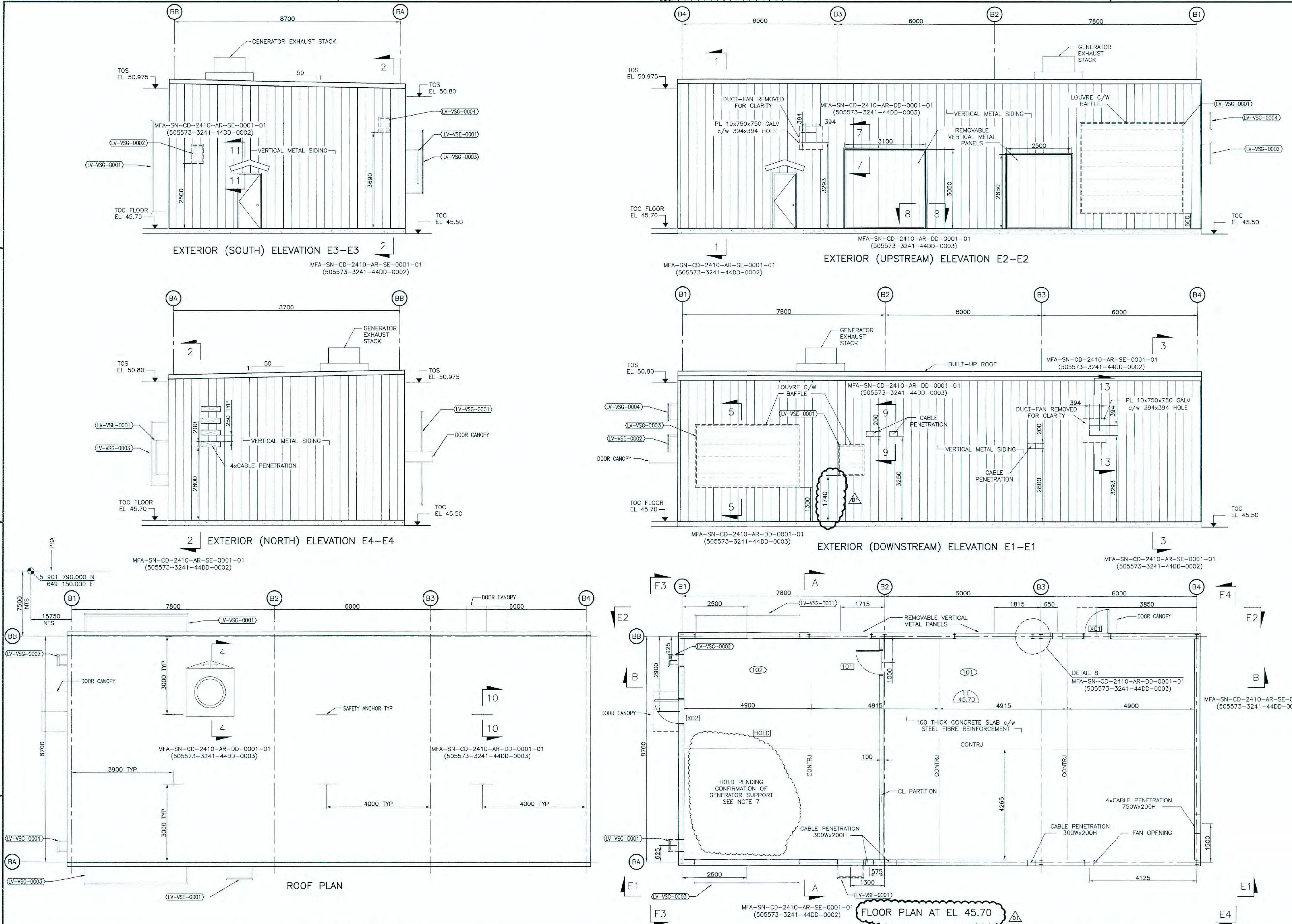

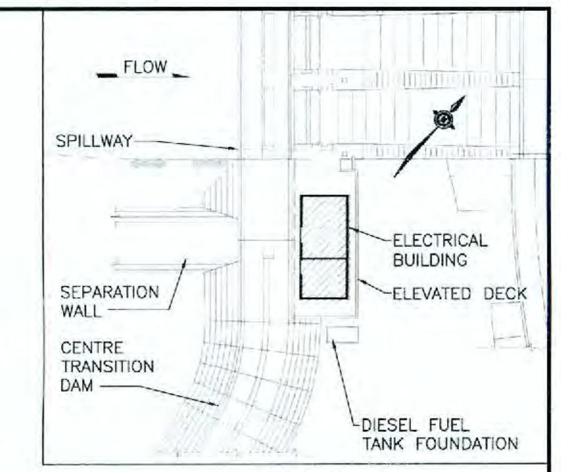

KEY PLAN

NOTES:

1. FOR GENERAL NOTES, LEGEND, AND ABBREVIATIONS SEE DWG MFA-SN-CD-2400-EN-LS-0001-01 (505573-3241-40DD-0001).
2. ALL MECHANICAL AND ELECTRICAL PENETRATIONS SHOWN ARE APPROXIMATE. COORDINATE ALL PENETRATIONS WITH MECHANICAL AND ELECTRICAL SUPPLIER DRAWINGS.
3. FOR MECHANICAL EQUIPMENT PENETRATIONS REFER TO DWG MFA-SN-CD-2440-ME-PL-0001-01 (505573-3242-45DD-0011).
4. FOR ELECTRICAL EQUIPMENT PENETRATIONS REFER TO DWG MFA-SN-CD-2440-EL-LT-0002-01 (505573-3243-47DD-0121).
5. FLOOR CONTRACTION JOINTS TO BE SAW CUT OR MADE USING ZIP-STRIPS AS PER SPECIFICATION.
6. CONCRETE SLAB TO CONTAIN STEEL FIBRE REINFORCEMENT, DRAMIX RC-65/60-BN 20Kg/m³ OR ACCEPTABLE ALTERNATE. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN RECOMMENDATIONS.
7. HOLD FLOOR SLAB PENDING CONFIRMATION OF GENERATOR SUPPORT.
8. CONCRETE FOR FLOOR SLAB SHALL BE TYPE BC-3-A BUT SHALL NOT BE AIR ENTRAINED.
9. CONCRETE FLOOR FINISH SHALL BE U3 WITH SURFACE HARDENER.

LEGEND:

X01 DENOTES DOOR NO.

00X DENOTES ROOM NO.

LV-XXX-XXXX – LOUVRE TAG – SEE BAFFLE SCHEDULE ON DRAWING MFA-SN-CD-2410-ST-DD-0001-01 (505573-3241-43DD-0003)

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A" This Permit Allows SNC-LAVALIN Inc. To practice Professional Engineering in Newfoundland and Labrador.

NOT FOR CONSTRUCTION

SCALE 1:50

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	01-AUG-2013	ISSUED FOR DESIGN
1	00	15-JAN-2013	ISSUED FOR ADDENDUM 1

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2410-ST-PL-0001-01 (505573-3241-43DD-0001)	SPILLWAY – ELECTRICAL BUILDING PLAN AND ELEVATIONS – STRUCTURAL STEEL
MFA-SN-CD-2400-EN-LS-0001-01 (505573-3241-40DD-0001)	POWERHOUSE, INTAKE AND SPILLWAY GENERAL NOTES, LEGEND AND ABBREVIATIONS
MFA-SN-CD-2440-ME-PL-0001-01 (505573-3242-45DD-0011)	SPILLWAY – ELECTRICAL BUILDING PLAN AND SECTIONS – HVAC
MFA-SN-CD-2440-EL-LT-0002-01 (505573-3243-47DD-0121)	SPILLWAY – DIVERSION PHASE ELECTRICAL ROOM EQUIPMENT LAYOUT
MFA-SN-CD-2410-AR-SE-0001-01 (505573-3241-44DD-0002)	SPILLWAY – ELECTRICAL BUILDING SECTIONS – ARCHITECTURAL
MFA-SN-CD-2410-AR-DD-0001-01 (505573-3241-44DD-0003)	SPILLWAY – ELECTRICAL BUILDING DETAILS – ARCHITECTURAL
MFA-SN-CD-2410-ST-DD-0001-01 (505573-3241-43DD-0003)	SPILLWAY – ELECTRICAL BUILDING BAFFLES – STRUCTURAL DETAILS STRUCTURAL STEEL
MFA-SN-CD-2410-ST-SN-0001-01 (505573-3241-43DD-0002)	SPILLWAY – ELECTRICAL BUILDING SECTIONS AND DETAILS – STRUCTURAL STEEL

No.	DATE	REVISION
D1	01-AUG-2013	FLOOR JOINT LOCATIONS AND BAFFLE LOCATIONS REVISED

********** FOR INTERNAL USE ONLY **********

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- [x] 1. REVIEWED AND ACCEPTED NO COMMENTS
- [ ] 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- [ ] 3. REVIEWED - NOT ACCEPTED
- [ ] 4. INFORMATION ONLY
- [ ] 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy): 12-Aug-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy): 12-Aug-2013
PROJECT MANAGER: Date (dd-mmm-yyyy): 12-Aug-2013

PROFESSIONAL STAMP
Newfoundland and Labrador Association of Architects — Licensed to Practise — Nathaniel Salfas, NLAA — Expires Dec 31 2013 — Date 01-AUG-2013

SNC·LAVALIN

DESIGNED BY T. SMITH	APPROVED Discipline Lead G. COOK
DRAWN BY A. GREEN	APPROVED Engineering Manager G. SNYDER
VERIFIED BY R. ABDULMAJEED	
DATE 28-SEP-2012	SCALE 1:50

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS SPILLWAY ELECTRICAL BUILDING PLANS AND ELEVATIONS ARCHITECTURAL

File No. 505573-3241-44DD-0001_01

MFA-SN-CD-2410-AR-PL-0001-01 Rev. D1

FORMAT A0 (mm)

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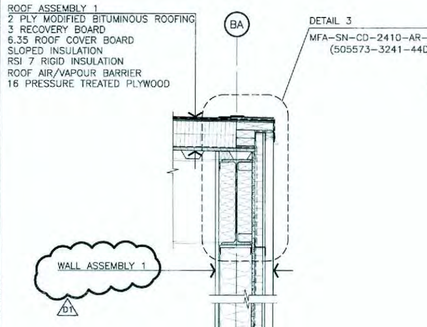

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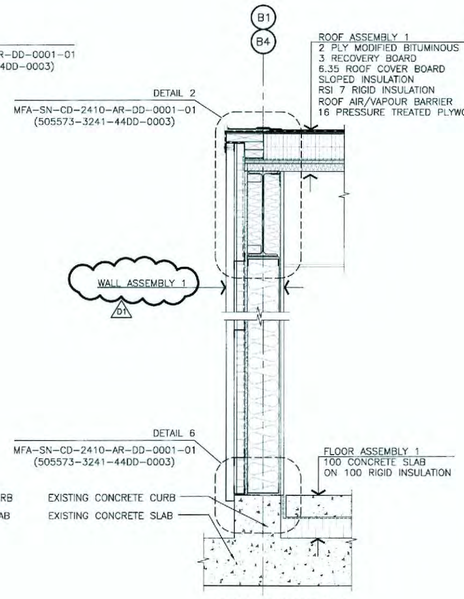

WALL SECTION 2
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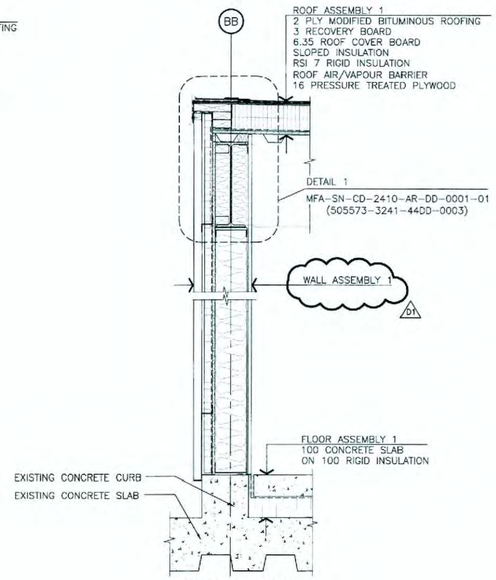

WALL SECTION 1
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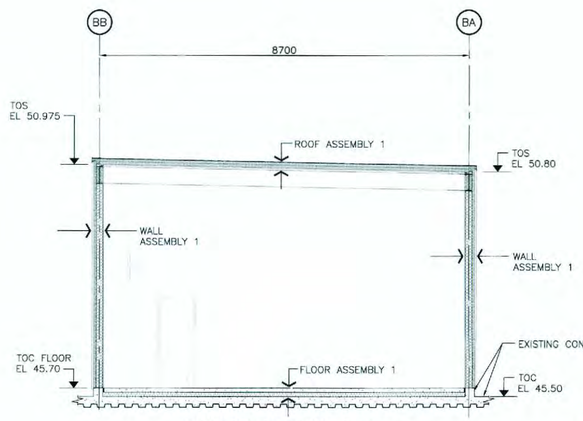

BUILDING SECTION A–A
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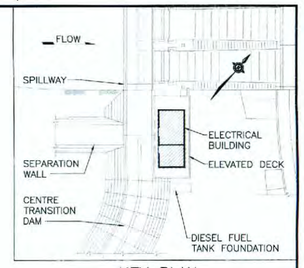
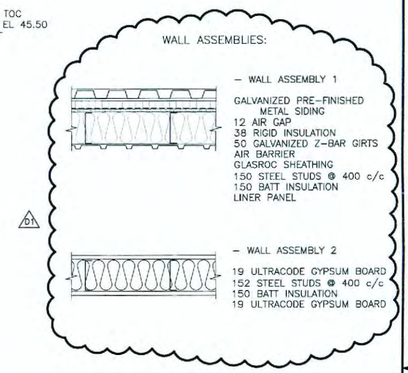
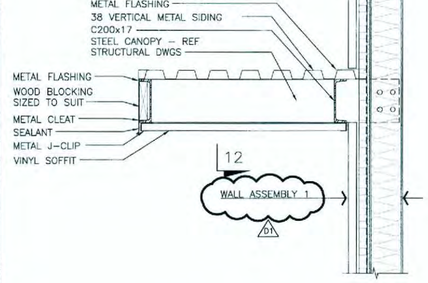


KEY PLAN

NOTE:
1. FOR GENERAL NOTES, LEGEND, AND ABBREVIATIONS SEE DWG MFA-SN-CD-2400-EN-LS-0001-01 (505573-3241-40DD-0001)
2. STEEL STUDS SHALL BE 600S162-97
3. STEEL TRACKS SHALL BE 600T150-54
4. GYPSUM INSTALLATION TO BE IN ACCORDANCE WITH UL491 WALL ASSEMBLY REQUIREMENTS





CANOPY
SECTION 11–11
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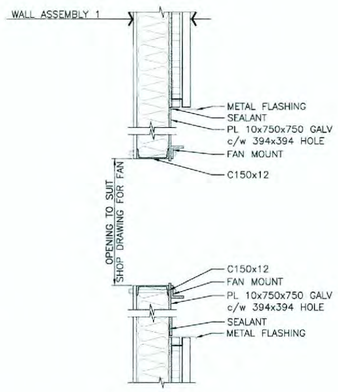

FAN
SECTION 13–13
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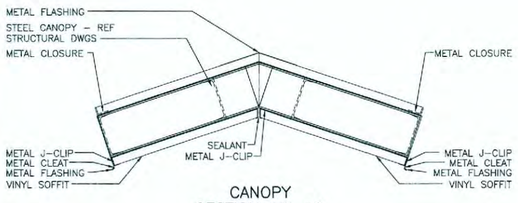

CANOPY
SECTION 12–12
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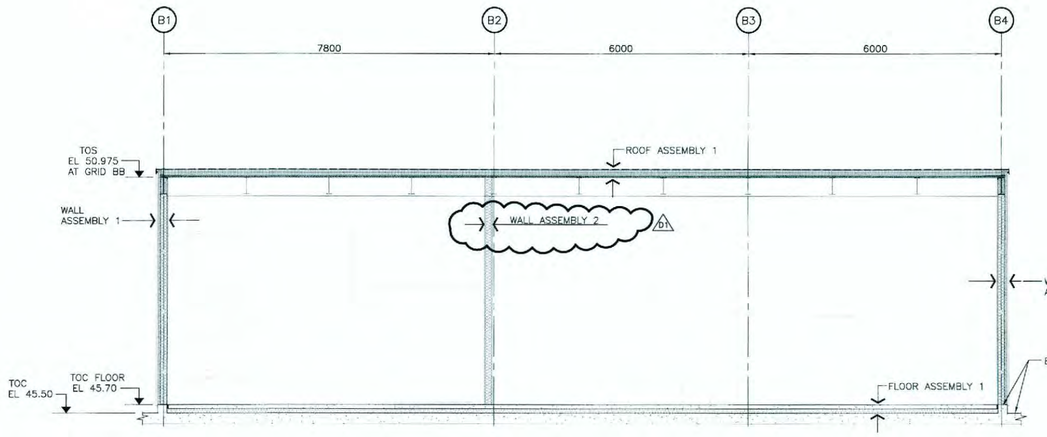

BUILDING SECTION B–B
MFA-SN-CD-2410-AR-PL-0001-01
(505573-3241-44DD-0001)
1:50

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL NO455
which is valid for the year 2013.

NOT FOR CONSTRUCTION

0 1000 2000 3000 4000 5000 mm
SCALE 1:50

0 500 750 1000 mm
SCALE 1:10

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	01-AUG-2013	ISSUED FOR DESIGN
1	00	15-JAN-2013	ISSUED FOR ADDENDUM 1

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2410-SI-SN-0001-01 (505573-3241-43DD-0002)	SPILLWAY – ELECTRICAL BUILDING SECTIONS AND DETAILS – STRUCTURAL STEEL
MFA-SN-CD-2410-SE-PL-0001-01 (505573-3241-43DD-0001)	SPILLWAY – ELECTRICAL BUILDING PLAN AND ELEVATIONS – STRUCTURAL STEEL
MFA-SN-CD-2400-EN-LS-0001-01 (505573-3241-40DD-0001)	POWERHOUSE, INTAKE AND SPILLWAY GENERAL NOTES, LEGEND AND ABBREVIATIONS
MFA-SN-CD-2410-AR-PL-0001-01 (505573-3241-44DD-0001)	SPILLWAY – ELECTRICAL BUILDING PLANS AND ELEVATIONS – ARCHITECTURAL
MFA-SN-CD-2410-AR-DD-0001-01 (505573-3241-44DD-0003)	SPILLWAY – ELECTRICAL BUILDING DETAILS – ARCHITECTURAL

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	01-AUG-2013	NOTES ADDED, WALL ASSEMBLIES REVISED, WALL ASSEMBLY LIST CREATED			

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☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED

LEAD REVIEWER: | Date (dd-mmm-yyyy)
RE-ECI MANAGEMENT: | Date (dd-mmm-yyyy)
PROJECT MANAGER: | Date (dd-mmm-yyyy)

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY T. SMITH	APPROVED Discipline Lead G. COOK
DRAWN BY A. GREEN	APPROVED Engineering Manager G. SNYDER
VERIFIED BY R. ABDULMAJEED	
DATE 28-SEP-2012	SCALE AS NOTED

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
ELECTRICAL BUILDING
SECTIONS
ARCHITECTURAL

File No. 505573-3241-44DD-0002_01 | MFA-SN-CD-2410-AR-SE-0001-01 | Rev. D1

FORMAT A0 (mm)

SUB-PKG: 0032-4104 PLATE 03

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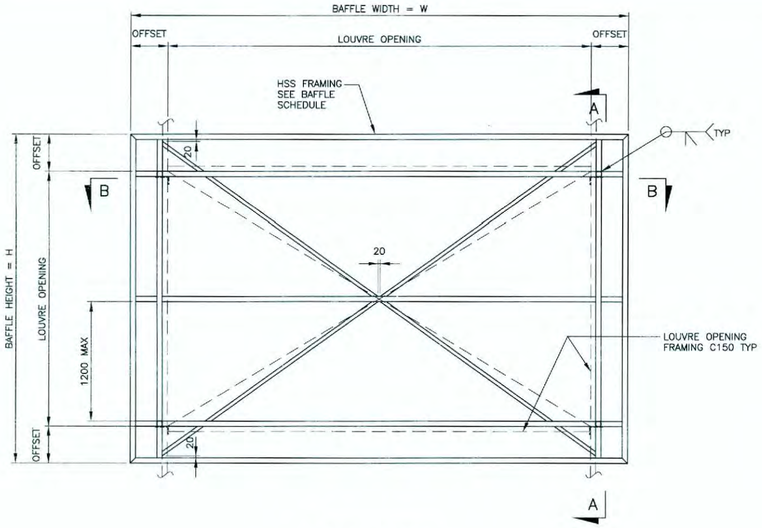

TYPICAL BAFFLE
ELEVATION
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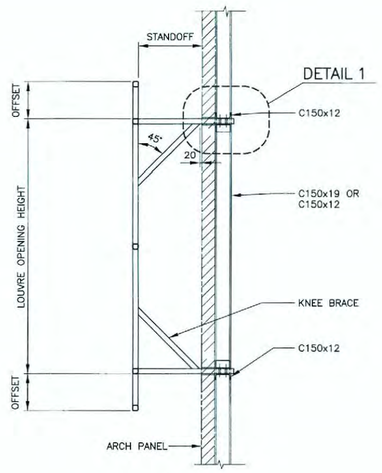

SECTION A–A
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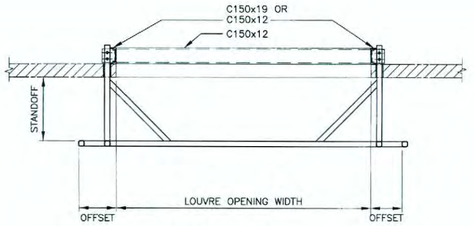

SECTION B–B
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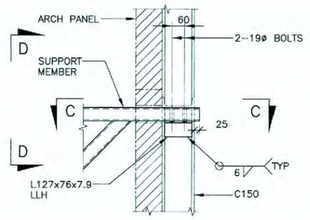
NOTE:

1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS SEE DWG MFA–SN–CD–2400–EN–LS–0001–01 (505573–3241–40DD–0001)

BAFFLE SCHEDULE

BAFFLE LOCATION AS IDENTIFIED BY LOUVRE TAG NUMBER	BAFFLE W	BAFFLE H	OFFSET MIN.	STANDOFF	FRAMING TYPE	REMARKS
LV–VSG–0001	4600	4100	300	600	L	
LV–VSG–0002	1050	1350	300	300	N	
LV–VSG–0003	4600	3000	300	600	M	
LV–VSG–0004	1050	1200	300	300	N	
LV–VSE–0001	1600	1800	300	400	N	



DETAIL 1
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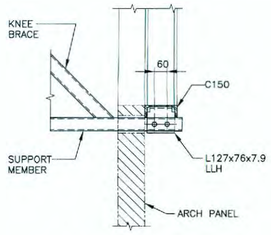

SECTION C–C
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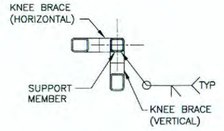

SECTION D–D
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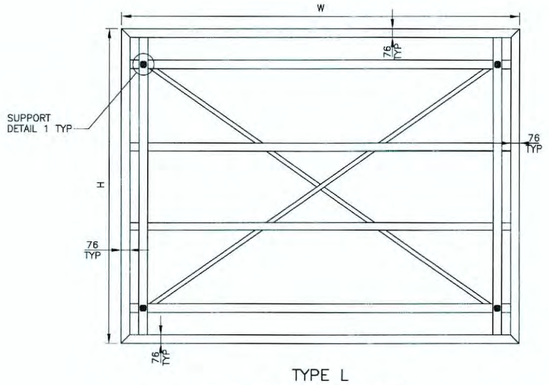
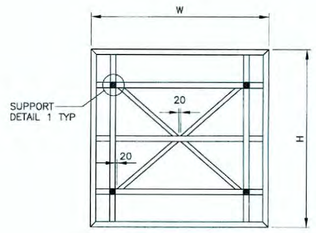


TYPE L

FRAME MEMBERS: HSS 102x76x6.4
DIAGONAL MEMBERS: HSS 51x51x6.4
SUPPORT MEMBERS: HSS 64x64x6.4
KNEE BRACE: HSS 64x64x6.4

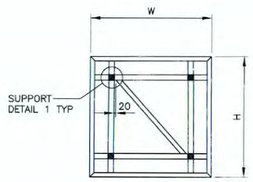
NTS



TYPE M

FRAME MEMBERS: HSS 64x64x6.4
DIAGONAL MEMBERS: HSS 51x51x6.4
SUPPORT MEMBERS: HSS 64x64x6.4
KNEE BRACE: HSS 64x64x6.4

NTS



TYPE N

FRAME MEMBERS: HSS 51x51x6.4
DIAGONAL MEMBER: HSS 51x51x6.4
SUPPORT MEMBERS: HSS 51x51x6.4
KNEE BRACE: HSS 51x51x6.4

NTS

PROVINCE OF NEWFOUNDLAND
PEGL PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC–LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador
Permit No. as issued by PEGNL 10458
which is valid for the year 2013

NOT FOR CONSTRUCTION

0 500 750 1000 mm
SCALE 1:10
0 1000 1500 2000 mm
SCALE 1:20

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	01–AUG–2013	ISSUED FOR DESIGN
1	A1	25–JUL–2013	ISSUED FOR REVIEW

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA–SN–CD–2410–AR–DD–0701–01 (505573–3241–4400–0003)	SPILLWAY – ELECTRICAL BUILDING DETAILS – ARCHITECTURAL
MFA–SN–CD–2400–EN–LS–0001–01 (505573–3241–40DD–0001)	POWERHOUSE, INTAKE AND SPILLWAY GENERAL NOTES, LEGEND AND ABBREVIATIONS

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
D1	01–AUG–2013	ISSUED FOR DESIGN			

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- ☑ 1. REVIEWED AND ACCEPTED NO COMMENTS
- ☐ 2. REVIEWED – INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3. REVIEWED – NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy)
RE–LCP MANAGEMENT: Date (dd-mmm-yyyy)
PROJECT MANAGER: Date (dd-mmm-yyyy)

PROFESSIONAL STAMP
PROVINCE OF NEWFOUNDLAND AND LABRADOR PEGL PERMIT HOLDER CLASS "A" DOMINIC THERIAULT 10458 SIGNATURE 01-AUG-2013 DATE

SNC•LAVALIN

DESIGNED BY D. THERIAULT	APPROVED Discipline Lead Engineer S. CHORNY
DRAWN BY A.MERCER	APPROVED Engineering Manager G. SNYDER
VERIFIED BY For S. KLAM	
DATE 06–JUN–2013	SCALE AS NOTED

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
ELECTRICAL BUILDING
BAFFLES – STRUCTURAL DETAILS
STRUCTURAL STEEL

File No. 505573–3241–43DD–0003_00

MFA–SN–CD–2410–ST–DD–0001–01 D1 Rev.

FORMAT A0 (mm)

SUB-PKG: 0032-4101 PLATE 07

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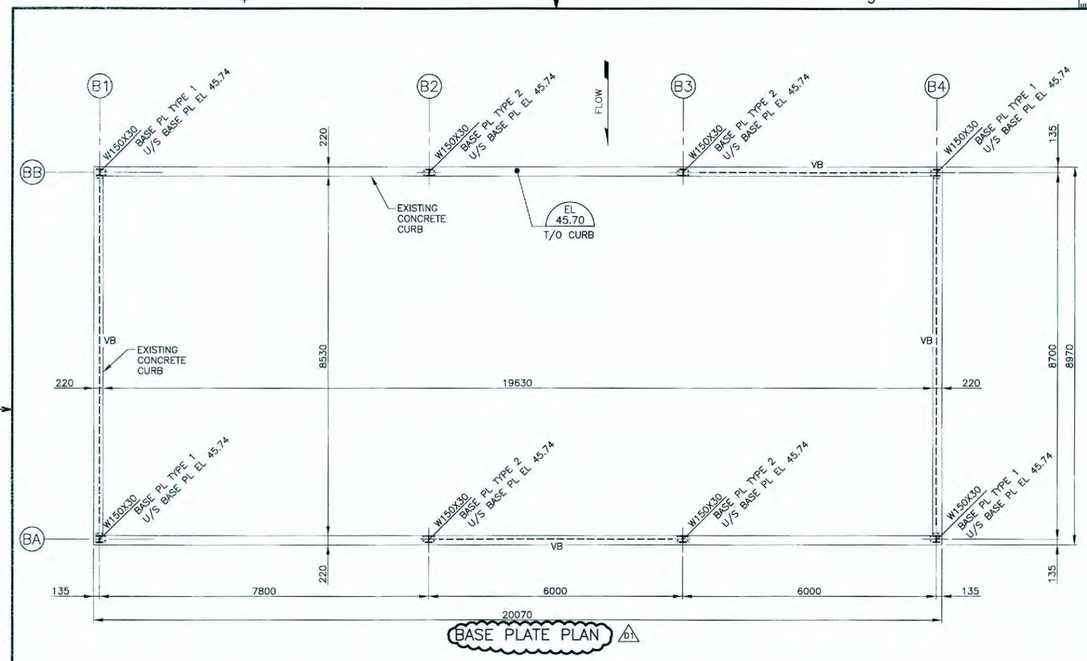
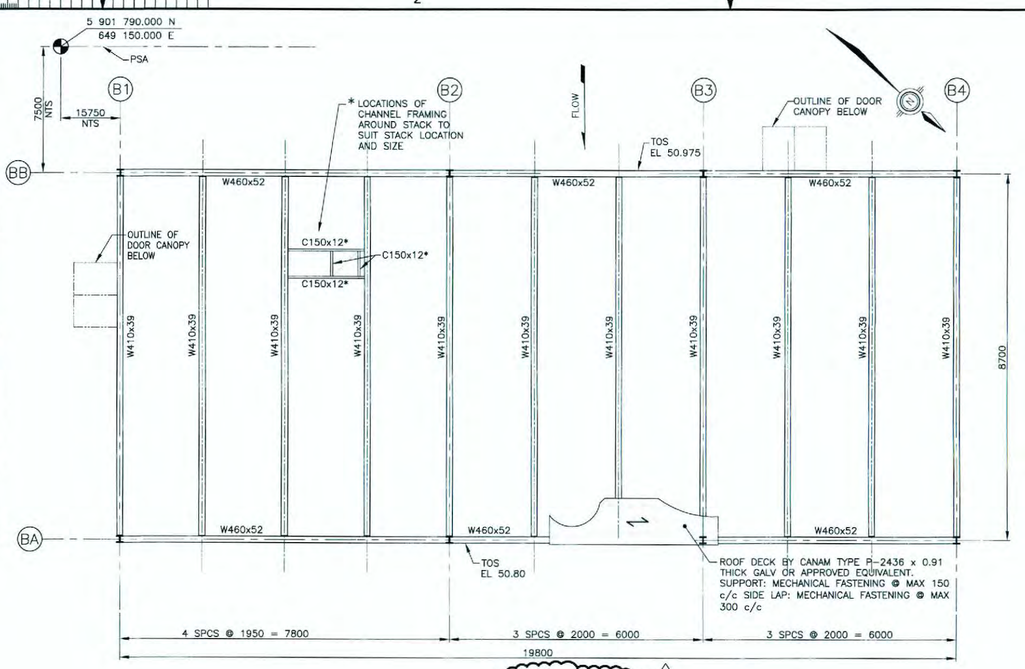
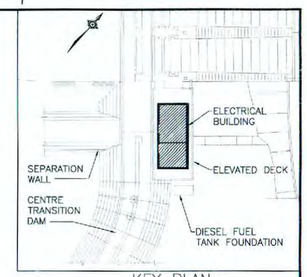


BASE PLATE PLAN (D1)





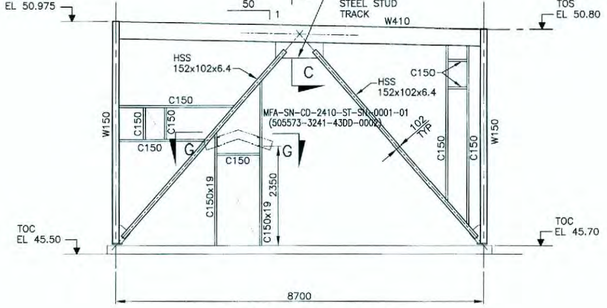
KEY PLAN

NOTES:

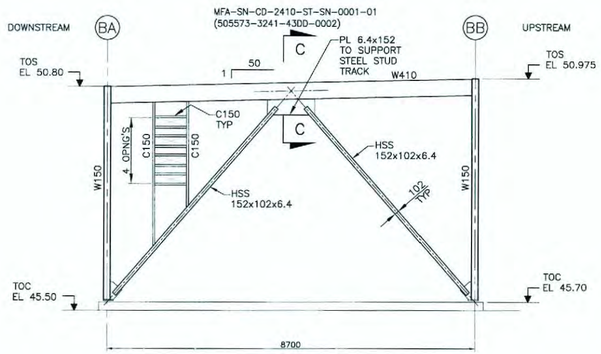
1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS SEE DWG MFA-SN-CD-2400-EN-LS-0001-01 (505573-3241-400D-0001)
2. COORDINATE ALL OPENINGS WITH MECHANICAL AND ELECTRICAL REQUIREMENTS AND VENDOR DRAWINGS.
3. ALL CHANNEL FRAMING AROUND OPENINGS SHALL BE C150x12 UNO.

ROOF LOADS:

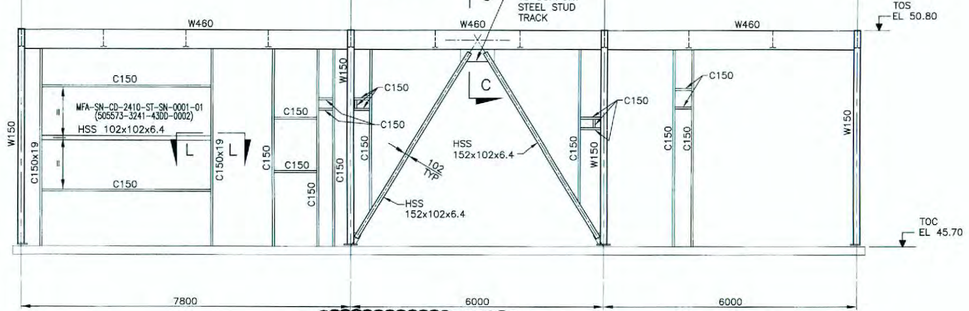
– STRUCT STEEL SELF-WEIGHT	: 0.40 kPa
– DECK SELF-WEIGHT AND ARCH	: 0.50 kPa
– LIVE LOAD	: 1.00 kPa
– SNOWLOAD	: 5.80 kPa



ELEVATION ON LINE B1

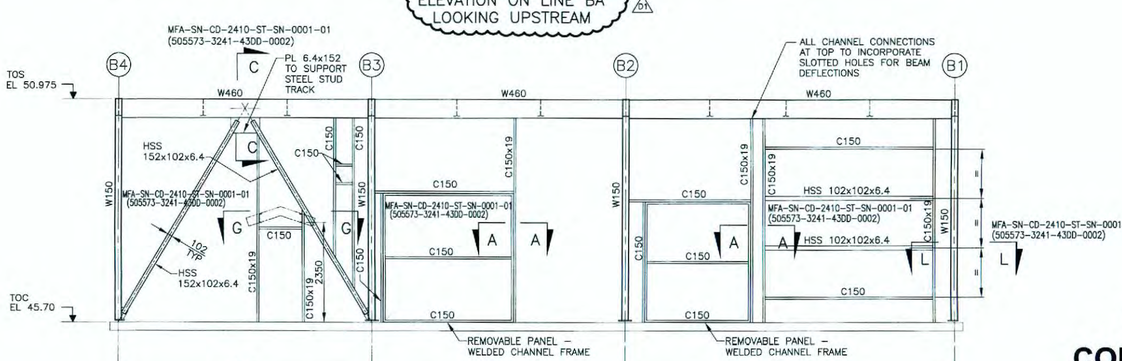


ELEVATION ON LINE B4



ROOF PLAN
TOS AS INDICATED
MFA-SN-CD-2410-ST-SN-0001-01 (505573-3241-430D-0002)

ELEVATION ON LINE BA LOOKING UPSTREAM (D1)



ELEVATION ON LINE BB LOOKING DOWNSTREAM

PROVINCE OF NEWFOUNDLAND
PEGNL PERMIT HOLDER CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL 102458 which is valid for the year 2013.

NOT FOR CONSTRUCTION

0 1000 2000 3000 4000 5000 mm
SCALE 1:50

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	01-AUG-2013	ISSUED FOR DESIGN
1	00	22-JAN-2013	ISSUED FOR ADDENDUM 1

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2410-AR-CD-0001-01 (505573-3241-440D-0003)	SPILLWAY – ELECTRICAL BUILDING DETAILS – ARCHITECTURAL
MFA-SN-CD-2410-AR-SE-0001-01 (505573-3241-440D-0002)	SPILLWAY – ELECTRICAL BUILDING SECTIONS – ARCHITECTURAL
MFA-SN-CD-2410-AR-PL-0001-01 (505573-3241-440D-0001)	SPILLWAY – ELECTRICAL BUILDING PLANS AND ELEVATIONS – ARCHITECTURAL
MFA-SN-CD-2400-EN-LS-0001-01 (505573-3241-400D-0001)	POWERHOUSE, INTAKE AND SPILLWAY GENERAL NOTES, LEGEND AND ABBREVIATIONS
MFA-SN-CD-2410-ST-SN-0001-01 (505573-3241-430D-0002)	SPILLWAY – ELECTRICAL BUILDING SECTIONS AND DETAILS – STRUCTURAL STEEL

No.	DATE	REVISION	MOD.	VER.	APP.
D1	01-AUG-2013	MONORAIL DELETED; CURBS REVISED, LOVRE LOCATIONS REVISED			

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

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- [x] 1. REVIEWED AND ACCEPTED NO COMMENTS
- [ ] 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- [ ] 3. REVIEWED - NOT ACCEPTED
- [ ] 4. INFORMATION ONLY
- [ ] 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy) 12-Aug-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy) 12-Aug-2013
PROJECT MANAGER: Date (dd-mmm-yyyy) 12-Aug-2013

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY D. THERIAULT	APPROVED Discipline Lead Engineer S. CHORNY
DRAWN BY F. MARTIN	APPROVED Engineering Manager G. SNYDER
VERIFIED BY T. SMITH	
DATE 27-SEPT-2012	SCALE 1:50
SLI DOC No. 505573-3241-43DD-0001_01	NE DOC No. MFA-SN-CD-2410-ST-PL-0001-01 Rev. D1

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS SPILLWAY ELECTRICAL BUILDING PLANS AND ELEVATIONS STRUCTURAL STEEL

FORMAT A0 (mm)

SUB-PKG: 0032-4101 PLATE 05

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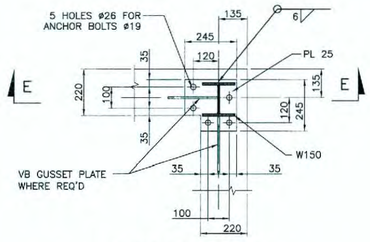

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(505573-3241-43DD-0001-SH1)
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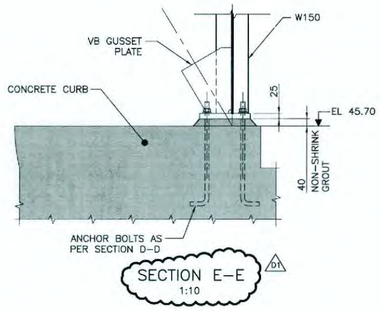

SECTION E-E
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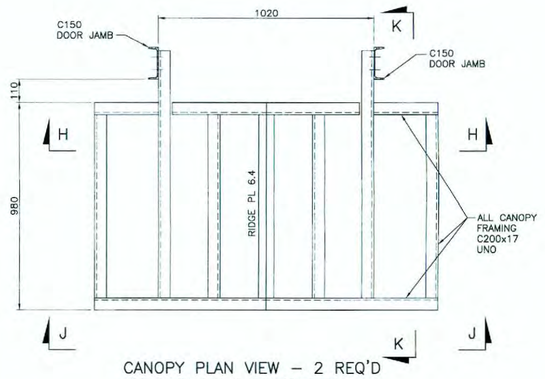
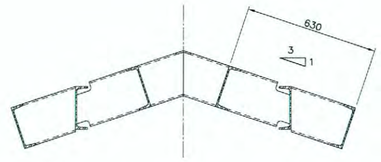


CANOPY PLAN VIEW – 2 REQ'D
NOTE: CANOPY FRAMING SHALL BE WELDED CONNECTIONS TO FACILITATE A SINGLE ERECTION LIFT

SECTION G-G
MFA-SN-CD-2410-ST-PL-0001-01
(505573-3241-43DD-0001)
1:10

NOTE:
1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS SEE DWG MFA-SN-CD-2400-EN-LS-0001-01 (505573-3241-4000-0001)



SECTION H-H
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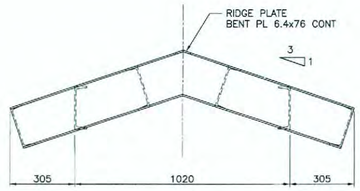
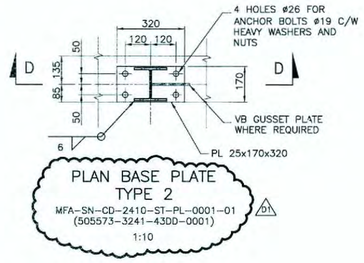


SECTION J-J
1:10



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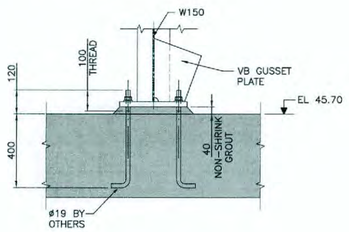

SECTION D-D
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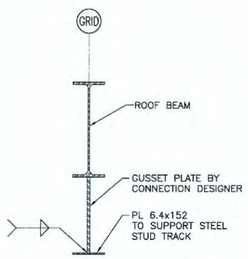

SECTION C-C
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(505573-3241-43DD-0001)
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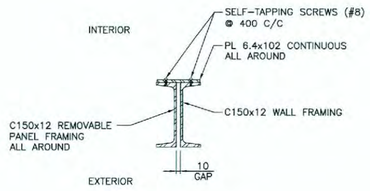

SECTION A-A
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(505573-3241-43DD-0001)
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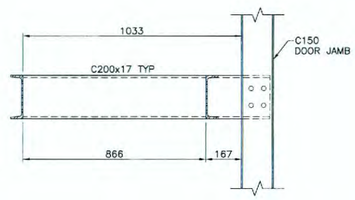

SECTION K-K
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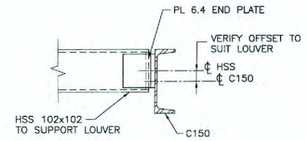

SECTION L-L
MFA-SN-CD-2410-ST-PL-0001-01
(505573-3241-43DD-0001)
1:5

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS 'A'
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL NO400 which is valid for the year 2013.

NOT FOR CONSTRUCTION

0 100 200 300 400 500 mm
SCALE 1:5

0 500 750 1000 mm
SCALE 1:10

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	D1	01-AUG-2013	ISSUED FOR DESIGN
1	00	22-JAN-2013	ISSUED FOR ADDENDUM 1

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2410-AR-DD-0001-01 (505573-3241-44DD-0003)	SPILLWAY – ELECTRICAL BUILDING DETAILS – ARCHITECTURAL
MFA-SN-CD-2410-AR-SE-0001-01 (505573-3241-44DD-0002)	SPILLWAY – ELECTRICAL BUILDING SECTIONS – ARCHITECTURAL
MFA-SN-CD-2410-AR-PL-0001-01 (505573-3241-44DD-0001)	SPILLWAY – ELECTRICAL BUILDING PLANS AND ELEVATIONS – ARCHITECTURAL
MFA-SN-CD-2400-EN-LS-0001-01 (505573-3241-4000-0001)	POWERHOUSE, INTAKE AND SPILLWAY GENERAL NOTES, LEGEND AND ABBREVIATIONS
MFA-SN-CD-2410-ST-PL-0001-01 (505573-3241-43DD-0001)	SPILLWAY – ELECTRICAL BUILDING PLANS AND ELEVATIONS – STRUCTURAL STEEL

No.	DATE	REVISION	MOD.	VER.	APP.
D1	01-AUG-2013	MONORAIL DELETED; CURBS REVISED	DT	MS	MK

* * * * * * * * FOR INTERNAL USE ONLY * * * * * * * *
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☑ 1. REVIEWED AND ACCEPTED NO COMMENTS
☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED
LEAD DISCIPLINE: NE-LCP MANAGEMENT — Date (dd-mmm-yyyy): 12-AUG-2013
PROJECT MANAGER — Date (dd-mmm-yyyy): 12-AUG-2013

PROFESSIONAL STAMP
PROFESSIONAL ENGINEER — DOMINIC THERIAULT — REGISTERED — 01-AUG-2013 — NEWFOUNDLAND & LABRADOR

SNC·LAVALIN

DESIGNED BY	D. THERIAULT	APPROVED Discipline Lead Engineer	S. CHORNY
DRAWN BY	F. MARTIN	APPROVED Engineering Manager	G. SNYDER
VERIFIED BY	T. SMITH	SCALE	AS NOTED
DATE	27-SEPT-2012		

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS SPILLWAY ELECTRICAL BUILDING SECTIONS AND DETAILS STRUCTURAL STEEL

SLI DOC No. 505573-3241-43DD-0002_01 | NE DOC No. MFA-SN-CD-2410-ST-SN-0001-01 | Rev. D1
FORMAT A0 (mm)
SUB-PKG: 0032-4101 PLATE 06

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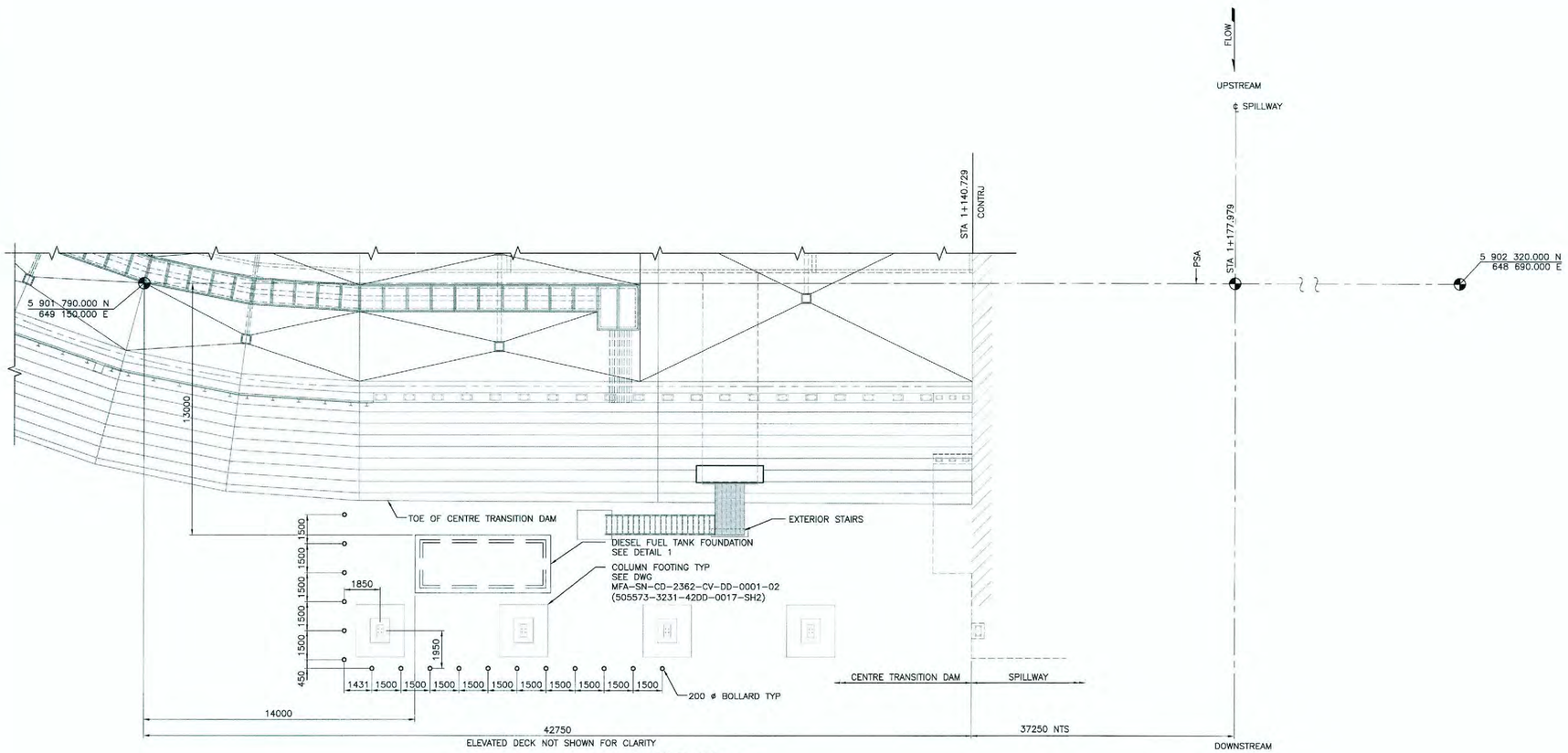
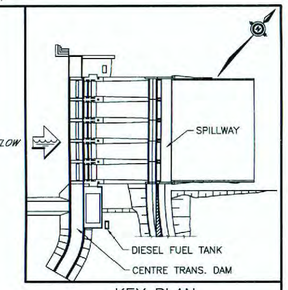
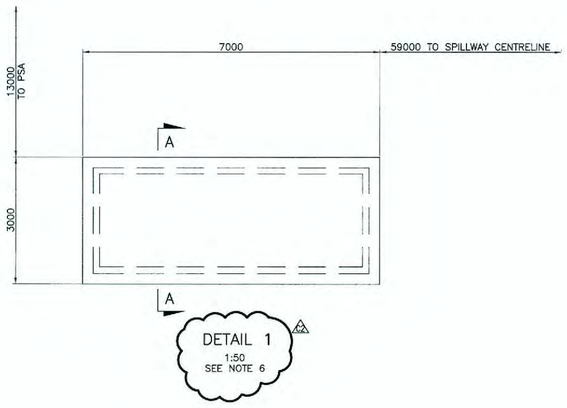


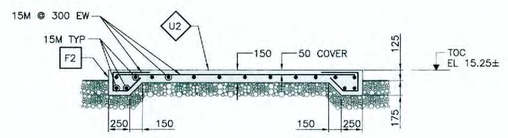


KEY PLAN

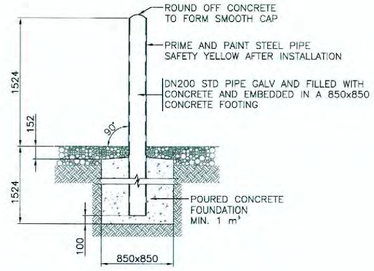
LOCATION PLAN
1:100



DETAIL 1
1:50
SEE NOTE 6



SECTION A–A
1:25



TYPICAL BOLLARD DETAIL
1:25

NOTES:

1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS SEE DWG MFA-SN-CD-3300-CV-LS-0002-01 (505573-3331-42DD-0100)
2. ALL COORDINATES ARE REFERENCED TO UTM NAD83, ZONE 20.
3. ALL CONCRETE SHALL BE CLASS BC-3.
4. ALL STATIONS SHOWN ARE ALONG THE PRINCIPAL STRUCTURES AXIS (PSA).
5. SUBSURFACE GRANULAR MATERIALS UNDER THE FOUNDATION SHALL BE COMPACTED TO 100% MODIFIED PROCTOR DENSITY.
6. SIZE AND LOCATION OF TANK FOUNDATION TO BE CONFIRMED FOLLOWING SUBMISSION OF TANK SHOP DRAWINGS BY OTHERS. OBTAIN APPROVAL FROM ENGINEER PRIOR TO START OF ANY CONSTRUCTION.

PROVINCE OF NEWFOUNDLAND
PEGNL PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL 102458 which is valid for the year 2013

0 1000 1500 2000 2500 mm
SCALE 1:25

0 1000 2000 3000 4000 5000 mm
SCALE 1:50

0 2000 4000 6000 8000 10000 mm
SCALE 1:100

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
3	C2	01-AUG-2013	ISSUED FOR CONSTRUCTION
2	C1	27-MAR-2013	ISSUED FOR CONSTRUCTION
1	B1	15-OCT-2012	ISSUED FOR ADDENDUM 1

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2362-CV-00-0001-02 (505573-3231-4200-0017-SH2)	CENTRE TRANSITION DAM REINFORCEMENT – SHEET 2 OF 2
MFA-SN-CD-3300-CV-LS-0002-01 (505573-3331-4200-0100)	GENERAL NOTES, LEGEND AND ABBREVIATIONS

No.	DATE	REVISION	MOD.	VER.	APP.
C2	01-AUG-2013	FUEL TANK AND BOLLARDS RELOCATED	C.T.S.	S.A.	S.C.
C1	27-MAR-2013	BOLLARD DETAIL MODIFIED; WORK POINT ADDED			

FOR INTERNAL USE ONLY

REVIEW CLASS: EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- [x] 1. REVIEWED AND ACCEPTED NO COMMENTS
- [ ] 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- [ ] 3. REVIEWED - NOT ACCEPTED
- [ ] 4. INFORMATION ONLY
- [ ] 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy): 12-AUG-2013
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy): 12-Aug-2013

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY T. SMITH	APPROVED Discipline Lead Engineer S. CHORNY
DRAWN BY L. KEOUGH	APPROVED Engineering Manager G. SNYDER
VERIFIED BY S. CHORNY	
DATE 17-SEPT-2012	SCALE AS NOTED

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
DIESEL FUEL TANK FOUNDATION
PLAN AND DETAILS
CONCRETE

File No. 505573-3231-42DD-0018_02

MFA-SN-CD-2440-CV-PL-0001-01 Rev. C2

FORMAT A0 (mm)

SUB-PKG: 0032-4101 PLATE 08

SUB-PKG: 0007-4105 PLATE 18

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EXHIBIT 2

COMPENSATION

1 GENERAL

1.1 Company shall compensate Contractor for the Work, in accordance with the provisions of this Agreement. Subject to any additional compensation pursuant to a Change Order, only those lump sum amounts, unit rates and prices specifically identified in this Exhibit 2 shall be paid by Company to Contractor for the Work and costs not identified are deemed to be included in the lump sum amounts, unit rates and prices for the Work. Company does not guarantee a minimum or a maximum amount of Work.

1.2 All lump sum amounts, rates and prices stated in this Exhibit 2 shall be all-inclusive to meet all requirements outlined in this Agreement.

1.3 No payment in excess of the agreed Contract Price will be made without a formal Change Order to the Agreement. The actual final agreed costs for all Work will be drawn down against the agreed Contract Price and Contractor shall be responsible for monitoring its actual costs against the Contract Price on a weekly basis.

1.4 Invoices shall be issued by Contractor in accordance with Article 12 of the Agreement, Exhibit 2 – Compensation, Exhibit 3 – Coordination Procedures and Exhibit 13 – Provincial Benefits.

2 FIXED LUMP SUM

2.1 The following provisions in this Section 2 apply only to Work completed on a lump sum basis.

2.2 All of the payment items stated in Appendix A – Schedule of Price Breakdown of this Agreement are fixed price and their aggregate total will form the fixed lump sum price of the Agreement.

2.3 Each item stated in Appendix A – Schedule of Price Breakdown shall include all elements necessary to achieve completion of the item, whether specifically identified, or whether inherent in the Work.

2.4 Pursuant to Article 12 of the Agreement, payment for each item shall be on a lump sum basis and shall be made progressively as the Contractor has satisfied the requirements of each payment item and in accordance with the Milestone Payment Schedule attached as Appendix B to this Exhibit 2

2.5 Before making its application for payment under the Agreement, the Contractor shall submit to the Engineer a schedule of values of the various parts of the Work and totalling the full amount of the fixed lump sum price. The schedule shall be used as a guideline for applications for payment.

2.6 Measurement of lump sum price items shall be undertaken on a monthly basis (or as required) by Contractor and Company. Progress achieved against each item from the schedule of values and/or milestone event and approved by Company shall form the basis of interim measurement and payment of each lump sum. Only Company approved lump sum progress payments shall be invoiced by Contractor.

3 UNIT PRICES

3.1 The following provisions in this Section 3 apply only to Work completed on a unit price basis.

3.2 Where applicable, full compensation for Unit Price Work shall be determined in accordance with the Unit Prices set forth in Appendix A – Schedule of Price Breakdown, or as otherwise agreed between Company and Contractor.

3.3 Any quantities of units estimated are not guaranteed, as independent circumstances shall control actual quantities performed and payment shall only be for actual quantities of Work installed and not any estimated quantities. There are no provisions in this Agreement for adjustment of the Unit Prices due to installed quantity variances (increases/decreases) from the estimated quantities.

3.4 Measurement of unit price items shall be undertaken on a monthly basis (or as required) by Contractor and Company. Such measurement shall form the basis of all progress and final payments for unit price Work. Only Company approved unit price measurement shall be invoiced by Contractor.

3.5 Unless otherwise specifically stated, all Unit Prices shall be complete and inclusive of all costs required for the Work.

4 OPTION PRICE FOR SECONDARY CONCRETE WORK

4.1 Notwithstanding references to secondary concrete work in Exhibit 1 – Scope of Work, the Parties have agreed to exclude the secondary concrete work from the Work on the basis set out in Sections 4.2 to 4.4 inclusive.

4.2 Company has the option, which may be exercised at its sole discretion, to add the secondary concrete work back into the Work for the fixed price of $20,000,000.00 Canadian dollars. This option remains available to Company until February 4, 2014 at which time this option shall expire.

4.3 If Company elects to exercise the option set out in Section 4.2:

(a) Company shall issue a Notice to Contractor on or before February 4, 2014 that it is exercising the option;

(b) within a reasonable time of such Notice, Company shall issue a Change Order consistent with the provisions of the Agreement; and

(c) the provisions of this Agreement, and Exhibit 1 – Scope of Work regarding secondary concrete work in particular, shall apply.

4.4 As an alternative to Section 4.2 above, the Parties may also negotiate an open book target cost model prior to February 4, 2014.

4.5 A concrete batch plant will be installed at the Muskrat Falls work site by one of Company's Other Contractors. Contractor can choose to obtain concrete supply from the Company's Other Contractor or is free to seek alternative suppliers. If the Contractor chooses to obtain concrete supply from Company's Other Contractor, the price shall be $350/m3 for supply only at batch plant. This price excludes costs for transport from the plant to the pour site for which Contractor will be responsible. If the actual price at the batch plant is higher than $350/m3, the Contract Price will be adjusted upward based on the difference between the actual price and $350/m3, times the actual quantity purchased by Contractor. These costs will be subject to verification by Company. If the actual price is lower than $350/m3, the Contract Price shall not be adjusted.

5 REIMBURSABLE WORK

5.1 The following provisions in this Section 4 apply only to Work completed on a reimbursable basis.

5.2 Where applicable, full compensation to Contractor for full and complete performance of any Work performed on a reimbursable basis shall be the sum of the following costs and mark-ups:

(a) Sum of Contractor's Labour Rates, detailed in Appendix D – Personnel Rate Schedule multiplied by approved hours of Work, detailed on timesheets approved by Company;

(b) Sum of Contractor's Equipment Rates, detailed in Appendix E – Equipment Rate Schedule multiplied by approved hours of use, detailed on timesheets approved by Company; and,

(c) Company approved material expenses, travel and mileage expenses, and third party expenses.

Contractor shall advise Company in writing when it has expended seventy-five percent (75%) of the total estimated price.

The Labour and Equipment Rates will not be adjusted for any reason whatsoever except as a result of the issuance of a Change Order by Company.

5.3 When Contractor is requested to purchase materials on a reimbursable basis:

(a) All actual costs to Contractor for materials supplied for incorporation into the permanent facility, excluding consumables, expendables, and small tools which cost Contractor less than $2,000.00 Canadian or as listed in Appendix D – Personnel Rate Schedule shall be at actual invoiced cost to Contractor (exclusive of tax), including transportation to Site, as substantiated by invoices certified paid or by such documentation as may be required by Company, plus a mark-up of 15%.

(b) Contractor shall solicit a minimum of three bids for material purchases of $30,000.00 Canadian and greater.

(c) Contractor shall supply a copy of supplier's invoice with each Invoice.

(d) Company reserves the right to provide, at no cost to Contractor, materials, equipment, services, supplies or incidentals required to perform the Work.

5.4 When Contractor is requested to supply equipment on a reimbursable basis:

(a) All costs of Contractor for Contractor-owned equipment shall be at the rates set forth in Appendix E – Equipment Rate Schedule.

(b) When Contractor's equipment does not resemble the equipment having rental rates listed in Appendix E – Equipment Rate Schedule the agreed rental rate shall be incorporated into the Agreement by Change Order prior to rental.

(c) All costs of Contractor for equipment which is rented from third parties and does not resemble the equipment having rental rates listed in Appendix E – Equipment Rate Schedule must be approved by Company in writing prior to rental and shall be at actual cost to Contractor, including transportation to Site, as substantiated by invoices certified paid or by such documentation as may be required by Company plus a mark-up of 15%

(d) For reimbursable Work, Company reserves the right to substitute and provide, at no cost to Contractor, equipment to perform the Work. Contractor shall not be allowed to claim for loss of profit and/or any other of its own costs resulting from such substitution by Company.

5.5 When Contractor requires third party services to assist with Work being performed on a reimbursable basis:

(a) Contractor shall secure Company pre-approval of any third party services, materials, tools, supplies and consumables that are required for the performance of the Work and are additional to that which is included in the rates and lump sum prices outlined herein. Company shall reimburse Contractor for the actual, documented and necessary costs of such materials, tools, supply, consumables, equipment and/or services.

(b) All third party services provided for performance of the Work which has been previously approved by Company shall be at actual cost to Contractor of such third party service provided by others plus a mark-up of 15%

(c) In no instance shall the third party rates plus mark-up exceed Contractor's rates for similar work or equipment.

(d) To be eligible for reimbursement, invoicing for third party services shall be fully supported by Billing Information and any other documentation that Engineer may reasonably require.

5.6 Travel, including travel time and mileage are included in the Contract Price.

The Company shall provide room and board for Contractor's planned workforce and staff on Site. In the event Contractor's actual workforce and staff on Site exceed plan and Company does not have space (available rooms) at the camp, then the Company shall pay Contractor compensation for room and board, and travel costs, as the case may be, per the applicable collective agreement for trades.

5.7 For all Work carried out on a reimbursable basis, Contractor shall prepare Time Sheets for all personnel, equipment, material and third party services assigned to the performance of the Work which will be approved and signed daily by the Engineer's Representative. Copies of time sheets shall accompany all Contractor invoices.

5.8 When Contractor uses assets of an associated company (i.e, common ownership, subsidiary, strategic partner, licensee, etc.) to undertake reimbursable Work then only one (1) mark-up shall be allowed on the actual associated company base cost for the Work.

6 OPERATIONAL SPARES

Appendix C of this Exhibit 2 details Contractor's recommended two (2) year operational spares and the associated unit prices. For the Term of the Agreement, Company may, at its sole discretion, purchase any number and any type of operational spares listed in

Appendix C – Operating Spares Price Schedule of this Exhibit 2, at the unit prices outlined therein.

The unit prices specified shall include all costs associated with design, manufacture, testing, preservation, storage, transport and delivery of the spares and all associated documentation. Spares shall be delivered to the Site in accordance with Incoterms 2010, Delivered Duty Paid (DDP). Supply shall be deemed to be complete upon delivery of the operational spares and all associated documentation.

Company will issue a Company Approved Change Order to Contractor covering all purchases of operating spares.

7 CHANGES

Whenever possible, Changes will be evaluated and agreed by the Parties on a lump sum basis. In the event that the Parties cannot agree on a lump sum price for a Change, Contractor will present Company with a cost estimate of the Change, based on the rates and prices in Appendices D and E. Where Changes are carried out on a reimbursable basis, Contractor shall ensure that it provides a copy of the associated Company Approved Change Order, along with all documentation necessary which clearly supports the charges submitted for payment and clearly demonstrates achievement of criteria, progress of the Change Work, or achievement of the Milestones contained therein, as the case may be.

Rates and prices outlined in Appendices D and E will apply only for increases in the Work. For decreases in the Work, the Parties will negotiate the cost of the scope reduction on a lump sum basis.

8 STANDBY TIME

When the Work is suspended by Company for a reason that is not related to the Contractor's performance of the Work, the Company shall compensate the Contractor for standby costs which are incurred by the Contractor. For all standby time approved by Company, Contractor shall prepare daily time sheets for all labour and equipment assigned to the performance of the Work, which will be reviewed, and if approved, signed by the Engineer's Representative. Copies of time sheets shall accompany all Contractor invoices. Rates outlined in Appendix E – Equipment Standby Rate Schedule shall apply when Contractor submits an invoice for payment of equipment standby costs. Payment for such standby will be limited to not more than eight hours in a twenty-four hour day or forty hours in a week.

No compensation will be allowed for equipment that is inoperable due to breakdown, unavailability, or the like. No payment will be allowed for equipment that is not operating because the work has been suspended by the Contractor for his own reasons.

9 MILESTONE PAYMENT SCHEDULE

Appendix B of this Exhibit 2 includes the Milestone Payment Schedule provided by Contractor. Company will pay the Milestone payments due to Contractor upon successful completion of Milestone which shall be accompanied by all relevant supporting documentation as Company or Engineer may require to verify completion of the progress.

10 PROJECT LABOUR AGREEMENT

A Project Labour Agreement (PLA) and Special Project Order (SPO) declaration are planned for the Site. Company recognizes that the PLA may affect rates provided in Appendix D – Personnel Rate Schedule. Company will adjust the rates up or down for the difference between the rates provided in Appendix D – Personnel Rate Schedule and the actual rates stated by the PLA, where applicable.

The Contractor shall be bound to the terms of the PLA, become a member of the Project Employers' Association and name at least one (1) staff person to be responsible for daily Labour Relations matters at the Site. Prior to working at Site, all Contractor's Personnel will be required to attend an LCP Site orientation session that includes health, safety and environment obligations; human resources policies, including respectful workplace, cultural sensitivity, gender equity and diversity; labour relations, including PLA overview, site standards, corrective action and dispute resolution.

Appendix F of this Exhibit 2 details the estimated trade person-hours which shall be an accurate estimate of the person-hours required by trade classification to complete the Scope of Work.

11 LIQUIDATED DAMAGES FOR DELAY AND PERFORMANCE INCENTIVES

11.1 Liquidated Damages

Contractor is responsible to achieve completion of all Milestones in accordance with the Milestone Schedule. For certain Milestones, as listed below, Company has made a reasonable and genuine pre-estimate of the damages that it would suffer (Liquidated Damages) if these particular Milestone dates are not achieved. If Contractor fails to achieve any of these Milestones by the associated Milestone dates listed in the Milestone Schedule, Contractor shall pay Company, as liquidated damages and not as a penalty, the amount listed for each and every calendar day by which the completion of such Milestone is delayed.

Milestone No.	Milestone	Liquidated Damages per calendar day of delay
M3a	Hydro-Mechanical primary embedded parts required for the Spillway slab delivered to Site	$5,000.00
M3b	Hydro-Mechanical primary embedded parts for the South Pier delivered to Site (figure 1)	$5,000.00
M3c	Hydro-Mechanical primary embedded parts for the Pier 1 delivered to Site	$5,000.00
M3d	Hydro-Mechanical primary embedded parts for the Pier 2 delivered to Site	$10,000.00
M3e	All remaining Hydro-Mechanical primary embedded parts required for all Piers as shown in figure 1 delivered to site. Includes Pier 3, Pier 4 and North Pier.	$10,000.00
M3f	All Hydro-Mechanical primary embedded parts required for downstream stoplogs delivered to site.	$10,000.00
M3g	All Rollway Hydro-Mechanical primary embedded parts delivered to site	$10,000.00
M4	Spillway all hydro-mechanical& electrical systems (including Trash Cleaner) commissioned and ready for river diversion	$25,000.00
M20a	Draft Tube Units 1& 2 Hydro-Mechanical, primary embedded parts, Delivered to Site	$10,000.00
M20b	Draft Tube Units 3 & 4 Hydro-Mechanical, primary embedded parts, Delivered to Site	$10,000.00
M21a	All Intake Unit 1 – Hydro-Mechanical primary embedded parts, delivered to Site	$5,000.00
M21b	All Intake Unit 2 – Hydro-Mechanical Primary embedded parts, delivered to Site	$10,000.00
M21c	All Intake Unit 3 – Hydro-Mechanical primary embedded parts, delivered to Site	$10,000.00
M21d	All Intake Unit 4 – Hydro-Mechanical Primary embedded parts, delivered to Site	$10,000.00
M23	All Intake hydro-mechanical work (including trash cleaner) commissioned and ready for reservoir impoundment	$25,000.00

The period of delay for such Milestone shall exclude each day of extension of time granted by Company in accordance with Articles 26, 31, 34 and 36 of the Agreement.

11.2 Performance Incentives

Company will pay the following performance incentives if Contractor achieves the performance goals listed.

Item No.	Performance Goal	Bonus
1	If Contractor achieves Milestone M4 by the associated Milestone date listed in the Interface and Milestone Schedule, Company will pay a bonus of :	$2,500,000.00
2	If Contractor achieves Milestone M23 by the associated Milestone date listed in the Interface and Milestone Schedule, Company will pay a bonus of:	$2,500,000.00
	TOTAL MAXIMUM PERFORMANCE INCENTIVE PAYMENTS	$5,000,000.00

12 CONTRACT PRICE

12.1 The Contract Price is, for most purposes of the Agreement, comprised of the two (2) lump sums in the amounts and currencies set out in Appendix A to this Exhibit. Except for the purposes described in Section 12.2 below, the Contract Price may be adjusted in accordance with the terms of the Agreement.

12.2 For the purposes of the Performance Security requirements in Article 7, a single currency Contract Price shall apply without change and shall be the amount calculated below, being the sum of the amounts in Appendix A converted to Canadian dollars using the exchange rate shown below.

Item	Amount	Currency	Exchange	$CDN Equivalent
A	$122,932,996	$ Can	1.0	$122,932,996
B	€60,880,279	$ Euro	1.347	$ 82,005,736
Contract Price				$204,938,732

12.3 For the purpose of limits of liability pursuant to Article 21.14 and Article 36.3, and insurance pursuant to Article 20.1(a), single lump sum Contract Price is required. That Contract Price shall be the greater of:

(a) the amounts referenced in Section 12.1, as may have been adjusted in accordance with the terms of the Agreement, converted to an equivalent $CDN value using the exchange rates listed in Section 12.2; or
(b) the Contract Price determined in Section 12.2.

In the event the Contract Price is adjusted by currency amounts not outlined in Section 12.2, those amounts shall be converted to a $CDN equivalent value using the applicable exchange rate published by the Bank of Canada on the Effective Date.

EXHIBIT 2 - APPENDIX A

SCHEDULE OF PRICE BREAKDOWN

LOWER CHURCHILL PROJECT MUSKRAT FALLS CH0032 SUPPLY AND INSTALL POWERHOUSE AND SPILLWAY HYDRO-MECHANICAL EQUIPMENT				SCHEDULE OF PRICE BREAKDOWN INTAKE, DRAFT TUBE & SPILLWAY (ALL INCLUSIVE SCOPE A&B)					PART 1 - APPENDIX A2.1 505573-CH0032-S1AF-I-2061 Rev. 00.0	
ISSUED FOR: CONTRACT DATE: NOV 15, 2013				CONTRACTOR'S NAME: ANDRITZ HYDRO CANADA INC.						
PRICE ITEM No	REFER-ENCE	WBS CODE		PRICE ITEM DESCRIPTION	UNIT OF MEASURE	ESTIMATED QUANTITY	MAN HOURS (AT SITE)	TOTAL (CAD)	TOTAL (EURO) 1 EUR = 1.347 CAD	TOTAL (USD) 1 USD = 1 CAD
		CODE	SUBCODE							
	2	0000		SCOPE A&B - INDIRECT COSTS					1.3470	1.00
	2.1		2400	INTAKE, DRAFT TUBE & SPILLWAY - GENERAL						
AB-1	2.1.2		2400.01	Mobilization	Lot	1		470,435	455,698	0
AB-2	2.1.3		2400.02	Management	Lot	1		757,018	6,550,970	0
AB-3	2.1.4		2400.03	Employee Training	Lot	1		58,539	29,575	0
AB-4	2.1.5		2400.04	Health and Safety Requirements	Lot	1		14,150	0	0
AB-5	2.1.6		2400.05	Environmental Requirements	Lot	1		5,306	0	0
AB-6	2.1.7		2400.06	Quality Assurance / Quality Control	Lot	1		77,180	1,069,570	0
AB-7	2.1.8		2400.07	Letter of Credit, per Article 7 of Agreement	Lot	1		731,324	0	0
AB-8	2.1.9		2400.08	Parent Guarantee per Article 7 of the Agreement	Lot	1		0	0	0
AB-9	2.1.10		2400.09	Performance Bond per Article 7 of the Agreement	Lot	1		3,505,824	0	0
AB-10	2.1.11		2400.10	Insurance, per Article 18 of Agreement	Lot	1		0	0	0
AB-11	2.1.12		2400.11	Warranty, per Article 17 Agreement	Lot	1		0	0	0
AB-12	2.1.13		2400.12	Demobilization	Lot	1		429,527	0	0
				SUB-TOTAL - INTAKE, DRAFT TUBE & SPILLWAY - GENERAL				6,049,304	8,105,813	0
	3	0000		SCOPE A - INTAKE AND DRAFT TUBE HYDRO-MECHANICAL						
	3.1			PHASE A : INTAKE AND DRAFT TUBE- ENGINEERING						
AB-13	3.1.1		3240.01	INTAKE PRIMARY ANCHORS	Lot	1		10,726	53,946	0
AB-14	3.1.2		3240.02	INTAKE EMBEDDED PARTS	Lot	1		13,112	90,335	0
AB-15	3.1.3		3240.03	INTAKE TRASHRACKS	Lot	1		9,000	27,612	0
AB-16	3.1.4		3240.04	INTAKE BULKHEAD GATES	Lot	1		21,001	210,695	0
AB-17	3.1.5		3240.05	INTAKE GATES	Lot	1		11,034	58,654	0
AB-18	3.1.6		3240.06	INTAKE HOISTS	Lot	1		8,508	20,111	0
AB-19	3.1.7		3330.01	INTAKE ELECTRICAL AUXILIARIES	Lot	1		351,013	20,111	0
AB-20	3.1.8		3330.02	DRAFT TUBE PRIMARY ANCHORS	Lot	1		8,531	20,466	0
AB-21	3.1.9		3330.03	DRAFT TUBE EMBEDDED PARTS	Lot	1		8,780	24,252	0
AB-22	3.1.10		3330.04	DRAFT TUBE STOPLOGS	Lot	1		8,827	24,973	0
AB-23	3.1.11		3330.05	DRAFT TUBE GALLERY OVERHEAD CRANE	Lot	1		7,823	9,653	0
				SUB-TOTAL - PHASE A: INTAKE AND DRAFT TUBE - ENGINEERING				458,356	560,808	0
	3.2			PHASE B : INTAKE AND DRAFT TUBE - FABRICATION AND SUPPLY						
AB-24	3.2.1		3240.07	INTAKE PRIMARY ANCHORS	Lot	1		1,514,197	0	0
AB-25	3.2.2		3240.08	INTAKE EMBEDDED PARTS	Lot	1		394,969	6,025,912	0
AB-26	3.2.3		3240.09	INTAKE TRASHRACKS	Lot	1		206,190	3,145,782	0
AB-27	3.2.4		3240.10	INTAKE BULKHEAD GATES	Lot	1		25,311	386,156	0
AB-28	3.2.5		3240.11	INTAKE GATES	Lot	1		346,251	5,282,652	0
AB-29	3.2.6		3240.12	INTAKE HOISTS	Lot	1		600,625	9,163,547	0
AB-30	3.2.7		3330.06	INTAKE ELECTRICAL AUXILIARIES	Lot	1		1,974,743	0	0
AB-31	3.2.8		3330.07	DRAFT TUBE PRIMARY ANCHORS	Lot	1		837,810	0	0
AB-32	3.2.9		3330.08	DRAFT TUBE EMBEDDED PARTS	Lot	1		68,504	1,045,150	0
AB-33	3.2.10		3330.09	DRAFT TUBE STOPLOGS	Lot	1		83,357	1,271,753	0
AB-34	3.2.11		3330.10	DRAFT TUBE GALLERY OVERHEAD CRANE	Lot	1		18,155	276,992	0
				SUB-TOTAL - PHASE B: INTAKE AND DRAFT TUBE - FABRICATION AND SUPPLY				6,070,110	26,597,944	0
	3.3			PHASE C : INTAKE AND DRAFT TUBE - INSTALLATION						
AB-35	3.3.1		3240.13	INTAKE PRIMARY ANCHORS	Lot	1		505,331	0	0
AB-36	3.3.2		3240.14	INTAKE EMBEDDED PARTS	Lot	1		7,398,328	0	0
AB-37	3.3.3		3240.15	INTAKE TRASHRACKS	Lot	1		2,977,263	0	0
AB-38	3.3.4		3240.16	INTAKE BULKHEAD GATES	Lot	1		2,479,505	0	0
AB-39	3.3.5		3240.17	INTAKE GATES	Lot	1		1,757,603	0	0
AB-40	3.3.6		3240.18	INTAKE HOISTS	Lot	1		12,272,323	0	0
AB-41	3.3.7		3330.11	INTAKE ELECTRICAL AUXILIARIES	Lot	1		12,336,529	0	0
AB-42	3.3.8		3330.12	DRAFT TUBE PRIMARY ANCHORS	Lot	1		649,711	0	0
AB-43	3.3.9		3330.13	DRAFT TUBE EMBEDDED PARTS	Lot	1		6,203,404	0	0

LOWER CHURCHILL PROJECT MUSKRAT FALLS CH0032 SUPPLY AND INSTALL POWERHOUSE AND SPILLWAY HYDRO-MECHANICAL EQUIPMENT				SCHEDULE OF PRICE BREAKDOWN INTAKE, DRAFT TUBE & SPILLWAY (ALL INCLUSIVE SCOPE A&B)					PART 1 - APPENDIX A2.1 S05573-CH0032-51AF-I-2061 Rev. 00.0	
ISSUED FOR: CONTRACT DATE: NOV 15, 2013				CONTRACTOR'S NAME: ANDRITZ HYDRO CANADA INC.						
PRICE ITEM No	REFERENCE	WBS CODE		PRICE ITEM DESCRIPTION	UNIT OF MEASURE	ESTIMATED QUANTITY	MAN HOURS (AT SITE)	TOTAL (CAD)	TOTAL (EURO) 1 EUR = 1.347 CAD	TOTAL (USD) 1 USD = 1 CAD
		CODE	SUBCODE							
AB-44	3.3.10		3330.14	DRAFT TUBE STOPLOGS	Lot	1		2,683,555	0	0
AB-45	3.3.11		3330.15	DRAFT TUBE GALLERY OVERHEAD CRANE	Lot	1		4,331,920	7,808	0
				SUB-TOTAL - PHASE C: INTAKE AND DRAFT TUBE - INSTALLATION				**53,595,472**	**7,808**	**0**
	3.4			**PHASE D : INTAKE AND DRAFT TUBE - COMMISSIONING**						
AB-46	3.4.1	3200	3240	INTAKE TRASHRACKS	Lot	1		209,672	445,441	0
AB-47	3.4.2		3240.22	INTAKE BULKHEAD GATES	Lot	1		152,865	129,455	0
AB-48	3.4.3		3240.23	INTAKE GATES	Lot	1		249,138	496,896	0
AB-49	3.4.4		3240.24	INTAKE HOISTS	Lot	1		254,711	31,232	0
AB-50	3.4.5		3240.25	INTAKE ELECTRICAL AUXILIARIES	Lot	1		244,681	0	0
AB-51	3.4.6		3240.26	DRAFT TUBE STOPLOGS	Lot	1		193,581	199,961	0
AB-52	3.4.7		3240.27	DRAFT TUBE GALLERY OVERHEAD CRANE	Lot	1		145,403	15,616	0
				SUB-TOTAL - PHASE D: INTAKE AND DRAFT TUBE - COMMISSIONING				**1,450,051**	**1,318,601**	**0**
	4	0000		**SCOPE B - SPILLWAY HYDRO-MECHANICAL**						
	4.1		2420	**PHASE A: SPILLWAY HYDRO-MECHANICAL - ENGINEERING**						
AB-53	4.1..1		2420.01	SPILLWAY PRIMARY ANCHORS	Lot	1		12,797	85,556	0
AB-54	4.1..2		2420.02	SPILLWAY EMBEDDED PARTS	Lot	1		18,023	165,267	0
AB-55	4.1..3		2420.03	SPILLWAY STOPLOGS AND LIFT BEAMS	Lot	1		12,742	84,704	0
AB-56	4.1..4		2420.04	SPILLWAY GATES	Lot	1		10,884	56,371	0
AB-57	4.1..5		2420.05	SPILLWAY HOIST	Lot	1		7,823	9,653	0
AB-58	4.1..6		2420.06	SPILLWAY TOWERS, BRIDGE STRUCTURE & HOIST HOUSE	Lot	1		10,595	51,934	0
AB-59	4.1..7		2420.07	SPILLWAY EMBEDDED GUIDE HEATERS	Lot	1		8,427	18,857	0
AB-60	4.1..8		2420.08	SPILLWAY ROLLWAY MODIFICATIONS	Lot	1		8,302	16,964	0
AB-61	4.1..9		2420.09	SPILLWAY MISCELLANEOUS ITEMS	Lot	1		7,190	0	0
AB-62	4.1.10		2420.10	SPILLWAY TEMPORARY POWER	Lot	1		192,745	0	0
AB-63	4.1.11		2420.10	SPILLWAY ELECTRICAL AUXILIARIES	Lot	1		1,061,378	0	0
AB-64	4.1.12		2420.10	SPILLWAY ELECTRICAL BUILDING - MECHANICAL AUXILIARIES	Lot	1		86,637	0	0
AB-65	4.1.13		2420.10	TRASH CLEANING SYSTEM	Lot	1		8,244	16,089	0
				SUB-TOTAL - PHASE A: SPILLWAY - ENGINEERING				**1,445,788**	**505,395**	**0**
	4.2		2420	**PHASE B: SPILLWAY HYDRO-MECHANICAL - FABRICATION AND SUPPLY**						
AB-66	4.2.1		2420.11	SPILLWAY PRIMARY ANCHORS	Lot	1		258,220	0	0
AB-67	4.2.2		2420.12	SPILLWAY EMBEDDED PARTS	Lot	1		200,548	3,059,702	0
AB-68	4.2.3		2420.13	SPILLWAY STOPLOGS AND LIFT BEAMS	Lot	1		127,122	1,939,469	0
AB-69	4.2.4		2420.14	SPILLWAY GATES	Lot	1		235,202	3,588,417	0
AB-70	4.2.5		2420.15	SPILLWAY HOIST	Lot	1		246,171	3,755,741	0
AB-71	4.2.6		2420.16	SPILLWAY TOWERS, BRIDGE STRUCTURE & HOIST HOUSE	Lot	1		310,721	4,740,573	0
AB-72	4.2.7		2420.17	SPILLWAY EMBEDDED GUIDE HEATERS	Lot	1		739,696	47,321	0
AB-73	4.2.8		2420.18	SPILLWAY ROLLWAY MODIFICATIONS	Lot	1		38,521	587,704	0
AB-74	4.2.9		2420.19	SPILLWAY MISCELLANEOUS ITEMS	Lot	1		5,489	83,754	0
AB-75	4.2.10		2420.20	SPILLWAY TEMPORARY POWER	Lot	1		124,815	0	0
AB-76	4.2.11		2420.21	SPILLWAY - ELECTRICAL AUXILIARIES	Lot	1		5,504,126	0	0
AB-77	4.2.12		2420.22	SPILLWAY ELECTRICAL BUILDING - MECHANICAL AUXILIARIES	Lot	1		881,390	0	0
AB-78	4.2.13		2420.23	SPILLWAY - ELECTRICAL BUILDING - STRUCTURAL AND ARCHITECTURAL	Lot	1		339,001	0	0
AB-79	4.2.14		2420.24	TRASH CLEANING SYSTEM	Lot	1		325,929	4,972,602	0
				SUB-TOTAL - PHASE B: SPILLWAY - FABRICATION AND SUPPLY				**9,336,952**	**22,775,283**	**0**
	4.3		2420	**PHASE C: SPILLWAY HYDRO-MECHANICAL - INSTALLATION**						
AB-80	4.3.1		2420.25	SPILLWAY PRIMARY ANCHORS	Lot	1		20,419	0	0
AB-81	4.3.2		2420.26	SPILLWAY EMBEDDED PARTS	Lot	1		3,687,548	0	0
AB-82	4.3.3		2420.27	SPILLWAY STOPLOGS AND LIFT BEAMS	Lot	1		1,437,432	0	0
AB-83	4.3.4		2420.28	SPILLWAY GATES	Lot	1		1,343,465	0	0
AB-84	4.3.5		2420.29	SPILLWAY HOIST	Lot	1		8,677,931	0	0

LOWER CHURCHILL PROJECT MUSKRAT FALLS CH0032 SUPPLY AND INSTALL POWERHOUSE AND SPILLWAY HYDRO-MECHANICAL EQUIPMENT				SCHEDULE OF PRICE BREAKDOWN INTAKE, DRAFT TUBE & SPILLWAY (ALL INCLUSIVE SCOPE A&B)					PART 1 - APPENDIX A2.1 505573-CH0032-51AF-I-2061 Rev. 00.0	
ISSUED FOR: CONTRACT DATE: NOV 15, 2013				CONTRACTOR'S NAME: ANDRITZ HYDRO CANADA INC.						
PRICE ITEM No	REFERENCE	WBS CODE		PRICE ITEM DESCRIPTION	UNIT OF MEASURE	ESTIMATED QUANTITY	MAN HOURS (AT SITE)	TOTAL (CAD)	TOTAL (EURO) 1 EUR = 1.347 CAD	TOTAL (USD) 1 USD = 1 CAD
		CODE	SUBCODE							
AB-85	4.3.6		2420.30	SPILLWAY TOWERS, BRIDGE STRUCTURE & HOIST HOUSE	Lot	1		4,083,732	0	0
AB-86	4.3.7		2420.31	SPILLWAY EMBEDDED GUIDE HEATERS	Lot	1		1,531,400	0	0
AB-87	4.3.8		2420.32	SPILLWAY ROLLWAY MODIFICATIONS	Lot	1		2,250,116	0	0
AB-88	4.3.9		2420.33	SPILLWAY MISCELLANEOUS ITEMS	Lot	1		1,020,933	0	0
AB-89	4.3.10		2420.34	SPILLWAY TEMPORARY POWER	Lot	1		1,461,409	0	0
AB-90	4.3.11		2420.35	SPILLWAY - ELECTRICAL AUXILIARIES	Lot	1		9,022,750	0	0
AB-91	4.3.12		2420.36	SPILLWAY ELECTRICAL BUILDING - MECHANICAL AUXILIARIES	Lot	1		3,646,059	0	0
AB-92	2.5.13		2420.37	SPILLWAY - ELECTRICAL BUILDING - STRUCTURAL AND ARCHITECTURAL	Lot	1		3,453,395	0	0
AB-93	2.5.14		2420.38	TRASH CLEANING SYSTEM	Lot	1		2,041,866	0	0
				SUB-TOTAL - PHASE C: SPILLWAY - INSTALLATION				**43,678,455**	**0**	**0**
	4.4		2420	**PHASE D: SPILLWAY HYDRO-MECHANICAL - COMMISSIONING**						
AB-94	4.4.1		2420.39	SPILLWAY STOPLOGS AND LIFT BEAMS	Lot	1		29,533	294,827	0
AB-95	4.4.2		2420.40	SPILLWAY GATES	Lot	1		59,285	670,856	0
AB-96	4.4.3		2420.41	SPILLWAY HOISTS	Lot	1		17,872	39,040	0
AB-97	4.4.4		2420.42	SPILLWAY EMBEDDED GUIDE HEATERS	Lot	1		15,570	3,904	0
AB-98	4.4.5		2420.43	SPILLWAY MISCELLANEOUS ITEMS	Lot	1		10,209	0	0
AB-99	4.4.6		2420.44	SPILLWAY TEMPORARY POWER	Lot	1		42,312	0	0
AB-100	4.4.7		2420.45	SPILLWAY ELECTRICAL AUXILIARIES	Lot	1		556,554	0	0
AB-101	4.4.8		2420.46	SPILLWAY ELECTRICAL BUILDING - MECHANICAL AUXILIARIES	Lot	1		45,709	0	0
AB-102	4.4.9		2420.47	SPILLWAY ELECTRICAL BUILDING - STRUCTURAL & ARCHITECTURAL	Lot	1		15,314	0	0
AB-103	4.4.10		2420.48	TRASH CLEANING SYSTEM - STOPLOG HANDLING	Lot	1		10,209	0	0
AB-104	4.4.11		2420.49	SPILLWAY AFTER ROLLWAY MODIFICATIONS	Lot	1		10,209	0	0
				DURING DIVERSION PHASE						
AB-105	4.4.12		2420.50	TRASH CLEANING SYSTEM - FULL COMMISSIONING	Lot	1		10,209	0	0
				AT RESERVOIR FULL SUPPLY LEVEL						
AB-106	4.4.13		2420.51	SPILLWAY AT FULL SUPPLY LEVEL	Lot	1		10,209	0	0
				TRAINING						
AB-107	4.4.14		2420.52	TRAINING OF COMPANY PERSONNEL	Lot	1		15,314	0	0
				SUB-TOTAL - PHASE D: SPILLWAY - COMMISSIONING				**848,508**	**1,008,627**	**0**
		CALCULATED TOTAL PRICE OF PROPOSAL TAXES EXCLUDED (ITEMS AB-1 - AB-108)							$	204,938,732
	5			**OPTION AVAILABLE UNTIL FEBRUARY 4TH 2014**						
AB-1	5.1			Second stage concreting including concrete forms, concrete supply and placement to be performed by Contractor if this option is exercised prior to the date indicated	Lot	1		20,000,000	0	0
				SUB-TOTAL - ALTERNATE SUPPLY				**20,000,000**	**0**	**0**

EXHIBIT 2 - APPENDIX B

MILESTONE PAYMENT SCHEDULE

ANDRITZ HYDRO CANADA INC.
Scope A + Scope B

Part 1
Appendix A2.2
Milestone Payment Schedule
Package Number: CH0032

ANDRITZ Hydro

	Activity	Sub-Activity	Payment Type	Month	Invoiced amount CAD	Invoiced amount EUR	Criteria
					122,932,996	60,880,279	
0A	LNTP - Deliverable 1	Engineering and Project Management	Milestone	Nov-13	1,000,000	1,000,000	Engineering and Project Management deliverables as per LNTP
0B	LNTP - Deliverable 2	Engineering and Project Management	Milestone	Nov-13	500,000	500,000	Engineering and Project Management deliverables as per LNTP
0C	LNTP - Deliverable 2A	Engineering and Project Management	Milestone	Nov-13	2,500,000		Engineering and Project Management deliverables as per LNTP
0D	LNTP - Deliverable 3	Engineering and Project Management	Milestone	Dec-13	500,000	500,000	Engineering and Project Management deliverables as per LNTP
1	General	Issuance of Securities	Milestone	Jan-14	5,000,000		Copy of LoC & Bonds
2	General	Project Management	Milestone	Jan-14	2,000,000		Issuance of Insurance Certificates
3	General	Project Management	Milestone	Jan-14	500,000	500,000	Acceptance of Project Execution Plan / Quality Plan / EHS Plan
4	Engineering	25%	Progress	Feb-14		1,500,000	Progress report
5	Engineering	50%	Progress	Jul-14		1,500,000	Progress report
6	Engineering	75%	Progress	Dec-14		1,500,000	Progress report
7	Engineering	100%	Progress	May-15		1,500,000	Progress report
8	Supply	Intake and Draft Tube Anchors	Milestone	Jul-14	4,500,000		QA/Shipping Release
9	Supply	Intake Embedded Parts	Milestone	Aug-15		6,000,000	QA/Shipping Release
10	Supply	Intake Trashrack	Milestone	Jul-15		4,000,000	QA/Shipping Release
11	Supply	Intake Bulkhead and Main Gates	Milestone	Jan-16		5,000,000	QA/Shipping Release
12	Supply	Intake Hoists	Milestone	Oct-15		9,000,000	QA/Shipping Release
13	Supply	Draft Tube Embedded Parts	Milestone	May-15		1,500,000	QA/Shipping Release
14	Supply	Draft Tube Stop Logs	Milestone	Sep-15		1,500,000	QA/Shipping Release
15	Supply	Draft Tube Crane	Milestone	May-15		500,000	QA/Shipping Release
16	Supply	Spillway Anchors	Milestone	Jun-14	4,500,000		QA/Shipping Release
17	Supply	Spillway Embedded Parts	Milestone	Oct-14		3,500,000	QA/Shipping Release
18	Supply	Spillway Stop Logs and Lifting Beams	Milestone	Nov-14		2,500,000	QA/Shipping Release
19	Supply	Spillway Gates	Milestone	Feb-15		4,000,000	QA/Shipping Release
20	Supply	Spillway Hoists	Milestone	Apr-15		4,500,000	QA/Shipping Release
21	Supply	Spillway Towers	Milestone	Mar-15		5,000,000	QA/Shipping Release
22	Supply	Trash Cleaning System	Milestone	Mar-15		5,000,000	QA/Shipping Release
23	Instalaltion / Commissioning	3%	Progress	Mar-15	3,000,000		Progress report
24	Instalaltion / Commissioning	6%	Progress	Apr-15	3,000,000		Progress report
25	Instalaltion / Commissioning	9%	Progress	May-15	3,000,000		Progress report
26	Instalaltion / Commissioning	12%	Progress	Jun-15	3,000,000		Progress report
27	Instalaltion / Commissioning	15%	Progress	Jul-15	3,000,000		Progress report
28	Instalaltion / Commissioning	18%	Progress	Aug-15	3,000,000		Progress report
29	Instalaltion / Commissioning	21%	Progress	Sep-15	3,000,000		Progress report
30	Instalaltion / Commissioning	24%	Progress	Oct-15	3,000,000		Progress report
31	Instalaltion / Commissioning	27%	Progress	Nov-15	3,000,000		Progress report
32	Instalaltion / Commissioning	30%	Progress	Dec-15	3,000,000		Progress report
33	Instalaltion / Commissioning	33%	Progress	Jan-16	3,000,000		Progress report
34	Instalaltion / Commissioning	36%	Progress	Feb-16	3,000,000		Progress report
35	Instalaltion / Commissioning	39%	Progress	Mar-16	3,000,000		Progress report
36	Instalaltion / Commissioning	42%	Progress	Apr-16	3,000,000		Progress report
37	Instalaltion / Commissioning	45%	Progress	May-16	3,000,000		Progress report
38	Instalaltion / Commissioning	48%	Progress	Jun-16	3,000,000		Progress report
39	Instalaltion / Commissioning	51%	Progress	Jul-16	3,000,000		Progress report
40	Instalaltion / Commissioning	54%	Progress	Aug-16	3,000,000		Progress report
41	Instalaltion / Commissioning	57%	Progress	Sep-16	3,000,000		Progress report
42	Instalaltion / Commissioning	60%	Progress	Oct-16	3,000,000		Progress report
43	Instalaltion / Commissioning	63%	Progress	Nov-16	3,000,000		Progress report
44	Instalaltion / Commissioning	66%	Progress	Dec-16	3,000,000		Progress report
45	Instalaltion / Commissioning	69%	Progress	Jan-17	3,000,000		Progress report
46	Instalaltion / Commissioning	72%	Progress	Feb-17	3,000,000		Progress report
47	Instalaltion / Commissioning	75%	Progress	Mar-17	3,000,000		Progress report
48	Instalaltion / Commissioning	78%	Progress	Apr-17	3,000,000		Progress report
49	Instalaltion / Commissioning	81%	Progress	May-17	3,000,000		Progress report
50	Instalaltion / Commissioning	84%	Progress	Jun-17	3,000,000		Progress report
51	Instalaltion / Commissioning	87%	Progress	Jul-17	3,000,000		Progress report
52	Instalaltion / Commissioning	90%	Progress	Aug-17	3,000,000		Progress report
53	Instalaltion / Commissioning	93%	Progress	Sep-17	3,000,000		Progress report
54	Instalaltion / Commissioning	96%	Progress	Oct-17	3,000,000		Progress report
55	Instalaltion / Commissioning	99%	Progress	Nov-17	3,000,000		Progress report
56	General	Substantial Completion	Milestone	Jun-18	2,932,996	380,279	Substantial Completion Certificate
					122,932,996	60,880,279	

EXHIBIT 2 - APPENDIX C

OPERATING SPARES PRICE SCHEDULE

ANDRITZ Hydro

1. Bidder will provide its recommended two (2) year operating spares along with pricing.

2. Bidder is required to provide itemized lists of all recommended spares and special tools and equipment. The lists should clearly define quantities, descriptions and unit prices for all line items.

3. The attached list "Spare Parts in Specifications" is to be used for reference purposes only and is not to be considered in any way as complete.

4. Bidder will include the following information:
   a) Expected usage rate of consumable spare parts.
   b) Sources of spare parts.
   c) Lead times required for delivery.
   d) Any discounts proposed for initial and subsequent spare parts orders.
   e) An indication of the size and mass of large items for shipping purposes.

The information included in this Appendix A2.3 will be used to form Appendix C – Operating Spares Price Schedule of Exhibit 2 – Compensation.

Andritz Answer

Andritz Hydro does not recommend any spare part other than the Capital spares already listed in the Technical Specifications and included in the Contract Price.

EXHIBIT 2 - APPENDIX D

PERSONNEL RATE SCHEDULE

Part 1
Appendix A2.4
Personnel Rate Schedule
Package Number: CH0032

ANDRITZ Hydro

PERSONNEL RATE SCHEDULE

2015 (May 1st, 2015 to April 30, 2016)										
Trade or Classification (1)	Base Rate (2)	Vacation Pay (3)	Payroll Allowances and Burdens (4)	Small Tools (5)	Consumables and PPE (6)	Overhead & Profit (7)	Regular Time Rate (8)	Overtime Rate Rate (1.5x)	Overtime Rate Rate (2.0x)	Second and Third Shift Premium (Per Hour)
Millwright Journeyman	$37.29	$4.85	$21.67	$1.86	$3.73	$27.37	$96.77	$145.15	$193.54	$7.79
Millwright Working Foreman	$41.02	$5.33	$23.13	$2.05	$4.10	$29.83	$105.47	$158.20	$210.94	$7.71
Millwright Non-Working Foreman	$42.88	$5.57	$23.86	$2.14	$4.29	$31.06	$109.81	$164.71	$219.61	$7.68
Millwright General Foreman	$44.75	$5.82	$24.60	$2.24	$4.48	$32.29	$114.17	$171.25	$228.33	$7.65
Electrician Journeyman	$39.37	$5.12	$19.91	$1.97	$3.94	$27.73	$98.03	$147.05	$196.07	$7.47
Electrician Welder	$41.34	$5.37	$20.56	$2.07	$4.13	$28.98	$102.45	$153.48	$204.50	$7.43
Electrician Foreman	$43.31	$5.63	$20.63	$2.17	$4.33	$30.00	$106.07	$159.11	$212.14	$7.35
Electrician General Foreman	$45.28	$5.89	$20.99	$2.26	$4.53	$31.14	$110.09	$165.13	$220.18	$7.29
Pipefitter Journeyman	$40.32	$4.03	$21.78	$2.02	$4.03	$28.47	$100.65	$150.98	$201.31	$7.49
Pipefitter Foreman	$46.37	$4.64	$22.86	$2.32	$4.64	$31.88	$112.70	$169.05	$225.40	$7.29
Boilermaker Journeyman	$36.58	$4.39	$23.45	$1.83	$3.66	$27.57	$97.48	$146.22	$194.96	$7.99
Boilermaker Foreman	$39.63	$4.76	$24.00	$1.98	$3.96	$29.32	$103.65	$155.48	$207.30	$7.85
Boilermaker General Foreman	$40.73	$4.89	$24.20	$2.04	$4.07	$29.95	$105.88	$158.82	$211.76	$7.80
Ironworker Journeyman (Structural)	$37.28	$5.03	$20.94	$1.86	$3.73	$27.15	$96.00	$143.99	$191.99	$7.73
Ironworker Foreman (Structural)	$42.87	$5.79	$21.97	$2.14	$4.29	$30.39	$107.44	$161.17	$214.89	$7.52
Carpenter Journeyman	$35.96	$4.67	$19.51	$1.80	$3.60	$25.85	$91.39	$137.09	$182.79	$7.52
Carpenter Foreman	$41.35	$5.38	$20.50	$2.07	$4.14	$28.96	$102.39	$153.58	$204.78	$7.43
Painter Journeyman (Group 1)	$35.34	$4.59	$19.39	$1.77	$3.53	$25.49	$90.11	$135.17	$180.23	$7.65
Painter Journeyman (Group 2)	$38.34	$4.98	$19.94	$1.92	$3.83	$27.22	$96.23	$144.35	$192.47	$7.53
Painter Foreman (Group 1) - Working Foreman	$36.84	$4.79	$19.66	$1.84	$3.68	$26.35	$93.17	$139.76	$186.35	$7.59
Painter Foreman (Group 2) - Working Foreman	$39.84	$5.18	$20.21	$1.99	$3.98	$28.08	$99.29	$148.94	$198.59	$7.48
Labourer Class 1	$33.96	$4.41	$20.42	$1.70	$3.40	$25.20	$89.08	$133.62	$178.16	$7.87
Labourer Class 4	$34.11	$4.43	$20.44	$1.71	$3.41	$25.28	$89.39	$134.08	$178.77	$7.86
Teamster Group 1 (Heavy Trucks)	$38.95	$5.06	$15.67	$1.95	$3.90	$25.84	$91.37	$137.06	$182.75	$7.04
Teamster Group 2 (Dual Axle/Tandem Axle)	$38.74	$5.04	$15.63	$1.94	$3.87	$25.72	$90.95	$136.42	$181.89	$7.04
Teamster Group 3 (Single Axle)	$38.53	$5.01	$15.60	$1.93	$3.85	$25.60	$90.52	$135.78	$181.03	$7.05
Teamster Group 4 (Warehouse)	$38.95	$5.06	$15.67	$1.95	$3.90	$25.84	$91.37	$137.06	$182.75	$7.04
Teamster Group 5 (Primary Care Paramedics)	$44.36	$5.77	$16.66	$2.22	$4.44	$28.97	$102.41	$153.61	$204.82	$6.93
Teamster Group 6 (Fire Prevention Officers)	$50.07	$6.51	$17.71	$2.50	$5.01	$32.26	$114.06	$171.09	$228.11	$6.83
Teamster Group 7 (Dump Truck)	$97.50	$12.68	$26.38	$4.88	$9.75	$59.63	$210.81	$316.21	$421.62	$6.49
Operating Engineer Group 1 - OE	$38.05	$4.95	$20.40	$1.90	$3.81	$27.26	$96.36	$144.54	$192.72	$7.60
Operating Engineer Group 2 - OE	$37.05	$4.82	$20.22	$1.85	$3.71	$26.68	$94.32	$141.48	$188.64	$7.64
Operating Engineer Group 3 - OE	$36.65	$4.76	$20.14	$1.83	$3.67	$26.45	$93.50	$140.26	$187.01	$7.65
Operating Engineer Group 4 - OE	$35.66	$4.64	$19.96	$1.78	$3.57	$25.88	$91.48	$137.23	$182.97	$7.70
Operating Engineer Group 5 - OE	$34.92	$4.54	$19.83	$1.75	$3.49	$25.45	$89.98	$134.96	$179.95	$7.73
Operating Engineer Group 1 - Clerical	$28.81	$3.75	$18.71	$1.44	$2.88	$21.92	$77.51	$116.27	$155.02	$8.07
Operating Engineer Group 2 - Clerical	$31.03	$4.03	$19.12	$1.55	$3.10	$23.20	$82.04	$123.06	$164.08	$7.93
Operating Engineer Group 3 - Clerical	$32.37	$4.21	$19.36	$1.62	$3.24	$23.98	$84.77	$127.16	$169.55	$7.86

Part 1
Appendix A2.4
Personnel Rate Schedule
Package Number: CH0032

ANDRITZ Hydro

2016 (May 1st, 2016 to April 30, 2017)										
Trade or Classification (1)	Base Rate (2)	Vacation Pay (3)	Payroll Allowances and Burdens (4)	Small Tools (5)	Consumables and PPE (6)	Overhead & Profit (7)	Regular Time Rate (8)	Overtime Rate Rate (1.5x)	Overtime Rate Rate (2.0x)	Second and Third Shift Premium (Per Hour)
Millwright Journeyman	$39.20	$5.10	$22.42	$1.96	$3.92	$28.63	$101.22	$151.84	$202.45	$7.75
Millwright Working Foreman	$43.12	$5.61	$23.96	$2.16	$4.31	$31.22	$110.37	$165.55	$220.73	$7.68
Millwright Non-Working Foreman	$45.08	$5.86	$24.72	$2.25	$4.51	$32.51	$114.94	$172.40	$229.87	$7.65
Millwright General Foreman	$47.04	$6.12	$25.49	$2.35	$4.70	$33.80	$119.51	$179.26	$239.01	$7.62
Electrician Journeyman	$41.58	$5.41	$20.32	$2.08	$4.16	$29.00	$102.54	$153.81	$205.08	$7.40
Electrician Welder	$43.66	$5.68	$20.99	$2.18	$4.37	$30.32	$107.19	$160.58	$213.97	$7.37
Electrician Foreman	$45.74	$5.95	$21.08	$2.29	$4.57	$31.40	$111.03	$166.54	$222.05	$7.28
Electrician General Foreman	$47.82	$6.22	$21.46	$2.39	$4.78	$32.60	$115.27	$172.90	$230.54	$7.23
Pipefitter Journeyman	$42.59	$4.26	$22.19	$2.13	$4.26	$29.75	$105.17	$157.76	$210.35	$7.41
Pipefitter Foreman	$48.98	$4.90	$23.33	$2.45	$4.90	$33.35	$117.90	$176.85	$235.80	$7.22
Boilermaker Journeyman	$38.79	$4.65	$23.85	$1.94	$3.88	$28.84	$101.95	$152.93	$203.90	$7.88
Boilermaker Foreman	$41.84	$5.02	$24.40	$2.09	$4.18	$30.58	$108.12	$162.19	$216.25	$7.75
Boilermaker General Foreman	$42.94	$5.15	$24.60	$2.15	$4.29	$31.21	$110.35	$165.53	$220.70	$7.71
Ironworker Journeyman (Structural)	$39.48	$5.33	$21.34	$1.97	$3.95	$28.43	$100.50	$150.75	$201.00	$7.64
Ironworker Foreman (Structural)	$45.40	$6.13	$22.43	$2.27	$4.54	$31.86	$112.63	$168.94	$225.25	$7.44
Carpenter Journeyman	$38.17	$4.96	$19.92	$1.91	$3.82	$27.13	$95.90	$143.85	$191.80	$7.54
Carpenter Foreman - Non-working Foreman	$43.89	$5.71	$20.96	$2.19	$4.39	$30.43	$107.57	$161.35	$215.14	$7.35
Painter Journeyman (Group 1)	$37.46	$4.87	$19.88	$1.87	$3.75	$26.75	$94.58	$141.87	$189.16	$7.57
Painter Journeyman (Group 2)	$40.46	$5.26	$20.43	$2.02	$4.05	$28.48	$100.70	$151.05	$201.40	$7.47
Painter Foreman (Group 1) - Working Foreman	$38.96	$5.06	$20.16	$1.95	$3.90	$27.62	$97.64	$146.46	$195.28	$7.52
Painter Foreman (Group 2) - Working Foreman	$41.96	$5.45	$20.70	$2.10	$4.20	$29.35	$103.76	$155.64	$207.52	$7.42
Labourer Class 1	$36.17	$4.70	$20.82	$1.81	$3.62	$26.47	$93.59	$140.38	$187.18	$7.76
Labourer Class 4	$36.32	$4.72	$20.85	$1.82	$3.63	$26.56	$93.89	$140.84	$187.79	$7.76
Teamster Group 1 (Heavy Trucks)	$41.16	$5.35	$16.08	$2.06	$4.12	$27.12	$95.88	$143.82	$191.76	$6.99
Teamster Group 2 (Dual Axle/Tandem Axle)	$40.95	$5.32	$15.04	$2.05	$4.10	$27.00	$95.45	$143.18	$190.91	$6.99
Teamster Group 3 (Single Axle)	$40.74	$5.30	$16.00	$2.04	$4.07	$26.88	$95.03	$142.54	$190.05	$7.00
Teamster Group 4 (Warehouse)	$41.16	$5.35	$16.08	$2.06	$4.12	$27.12	$95.88	$143.82	$191.76	$6.99
Teamster Group 5 (Primary Care Paramedics)	$46.57	$6.05	$17.07	$2.33	$4.66	$30.24	$106.92	$160.38	$213.84	$6.89
Teamster Group 6 (Fire Prevention Officers)	$52.28	$6.80	$18.11	$2.61	$5.23	$33.54	$118.57	$177.85	$237.13	$6.80
Teamster Group 7 (Dump Truck)	$99.71	$12.96	$26.79	$4.99	$9.97	$60.90	$215.32	$322.97	$430.63	$6.48
Operating Engineer Group 1 - OE	$40.26	$5.23	$20.81	$2.01	$4.03	$28.53	$100.87	$151.30	$201.74	$7.52
Operating Engineer Group 2 - OE	$39.26	$5.10	$20.62	$1.96	$3.93	$27.95	$98.83	$148.24	$197.66	$7.55
Operating Engineer Group 3 - OE	$38.86	$5.05	$20.55	$1.94	$3.89	$27.72	$98.01	$147.02	$196.02	$7.57
Operating Engineer Group 4 - OE	$37.87	$4.92	$20.37	$1.89	$3.79	$27.15	$95.99	$143.99	$191.99	$7.60
Operating Engineer Group 5 - OE	$37.13	$4.83	$20.23	$1.86	$3.71	$26.72	$94.48	$141.73	$188.97	$7.63
Operating Engineer Group 1 - Clerical	$31.02	$4.03	$19.12	$1.55	$3.10	$23.20	$82.02	$123.03	$164.04	$7.93
Operating Engineer Group 2 - Clerical	$33.24	$4.32	$19.52	$1.66	$3.32	$24.48	$86.55	$129.82	$173.10	$7.81
Operating Engineer Group 3 - Clerical	$34.58	$4.50	$19.77	$1.73	$3.46	$25.25	$89.28	$133.92	$178.56	$7.75

Part 1
Appendix A2.4
Personnel Rate Schedule
Package Number: CH0032

ANDRITZ Hydro

2017 (May 1st, 2017 to April 30, 2018)										
Trade or Classification (1)	Base Rate (2)	Vacation Pay (3)	Payroll Allowances and Burdens (4)	Small Tools (5)	Consumables and PPE (6)	Overhead & Profit (7)	Regular Time Rate (8)	Overtime Rate Rate (1.5x)	Overtime Rate Rate (2.0x)	Second and Third Shift Premium (Per Hour)
Millwright Journeyman	$40.73	$5.29	$23.02	$2.04	$4.07	$29.64	$104.79	$157.19	$209.58	$7.72
Millwright Working Foreman	$44.80	$5.82	$24.61	$2.24	$4.48	$32.32	$114.28	$171.42	$228.57	$7.65
Millwright Non-Working Foreman	$46.84	$6.09	$25.42	$2.34	$4.68	$33.67	$119.04	$178.56	$238.08	$7.62
Millwright General Foreman	$48.88	$6.35	$26.22	$2.44	$4.89	$35.02	$123.80	$185.70	$247.60	$7.60
Electrician Journeyman	$43.35	$5.64	$20.64	$2.17	$4.34	$30.02	$106.15	$159.23	$212.30	$7.35
Electrician Welder	$45.52	$5.92	$21.33	$2.28	$4.55	$31.39	$110.99	$166.28	$221.57	$7.31
Electrician Foreman	$47.69	$6.20	$21.43	$2.38	$4.77	$32.53	$115.00	$172.51	$230.01	$7.23
Electrician General Foreman	$49.85	$6.48	$21.83	$2.49	$4.99	$33.77	$119.41	$179.12	$238.82	$7.19
Pipefitter Journeyman	$44.41	$4.44	$22.51	$2.22	$4.44	$30.77	$108.80	$163.20	$217.60	$7.35
Pipefitter Foreman	$51.07	$5.11	$23.70	$2.55	$5.11	$34.52	$122.06	$183.09	$244.12	$7.17
Boilermaker Journeyman	$40.56	$4.87	$24.17	$2.03	$4.06	$29.85	$105.53	$158.30	$211.07	$7.81
Boilermaker Foreman	$43.61	$5.23	$24.73	$2.18	$4.36	$31.60	$111.71	$167.56	$223.41	$7.68
Boilermaker General Foreman	$44.71	$5.37	$24.93	$2.24	$4.47	$32.23	$113.93	$170.90	$227.86	$7.64
Ironworker Journeyman (Structural)	$41.24	$5.57	$21.67	$2.06	$4.12	$29.45	$104.11	$155.48	$208.21	$7.57
Ironworker Foreman (Structural)	$47.43	$6.40	$22.80	$2.37	$4.74	$33.03	$116.78	$174.39	$233.57	$7.39
Carpenter Journeyman	$39.94	$5.19	$20.24	$2.00	$3.99	$28.15	$99.51	$149.27	$199.02	$7.47
Carpenter Foreman - Non-working Foreman	$45.93	$5.97	$21.34	$2.30	$4.59	$31.60	$111.73	$167.60	$223.46	$7.30
Painter Journeyman (Group 1)	$39.14	$5.09	$20.19	$1.96	$3.91	$27.72	$98.01	$147.01	$196.02	$7.51
Painter Journeyman (Group 2)	$42.14	$5.48	$20.74	$2.11	$4.21	$29.45	$104.13	$156.19	$208.26	$7.41
Painter Foreman (Group 1) - Working Foreman	$40.64	$5.28	$20.46	$2.03	$4.06	$28.59	$101.07	$151.60	$202.14	$7.46
Painter Foreman (Group 2) - Working Foreman	$43.64	$5.67	$21.01	$2.18	$4.36	$30.32	$107.19	$160.78	$214.38	$7.37
Labourer Class 1	$37.94	$4.93	$21.14	$1.90	$3.79	$27.49	$97.20	$145.80	$194.40	$7.69
Labourer Class 4	$38.09	$4.95	$21.17	$1.90	$3.81	$27.58	$97.50	$146.26	$195.01	$7.68
Teamster Group 1 (Heavy Trucks)	$42.93	$5.58	$16.40	$2.15	$4.29	$28.14	$99.49	$149.24	$198.54	$6.95
Teamster Group 2 (Dual Axle/Tandem Axle)	$42.72	$5.55	$16.36	$2.14	$4.27	$28.02	$99.06	$148.60	$197.68	$6.96
Teamster Group 3 (Single Axle)	$42.51	$5.53	$16.32	$2.13	$4.25	$27.90	$98.64	$147.95	$196.83	$6.96
Teamster Group 4 (Warehouse)	$42.93	$5.58	$16.40	$2.15	$4.29	$28.14	$99.49	$149.24	$198.54	$6.95
Teamster Group 5 (Primary Care Paramedics)	$48.34	$6.28	$17.39	$2.42	$4.83	$31.26	$110.53	$165.79	$220.61	$6.86
Teamster Group 6 (Fire Prevention Officers)	$54.05	$7.03	$18.43	$2.70	$5.41	$34.56	$122.18	$183.26	$243.91	$6.78
Teamster Group 7 (Dump Truck)	$101.48	$13.19	$27.11	$5.07	$10.15	$61.92	$218.93	$328.39	$437.41	$6.47
Operating Engineer Group 1 - OE	$42.03	$5.46	$21.13	$2.10	$4.20	$29.55	$104.48	$156.72	$208.96	$7.46
Operating Engineer Group 2 - OE	$41.03	$5.33	$20.95	$2.05	$4.10	$28.97	$102.44	$153.66	$204.88	$7.49
Operating Engineer Group 3 - OE	$40.63	$5.28	$20.87	$2.03	$4.06	$28.74	$101.62	$152.43	$203.25	$7.50
Operating Engineer Group 4 - OE	$39.64	$5.15	$20.69	$1.98	$3.96	$28.17	$99.60	$149.41	$199.21	$7.54
Operating Engineer Group 5 - OE	$38.90	$5.06	$20.56	$1.95	$3.89	$27.75	$98.09	$147.14	$196.19	$7.57
Operating Engineer Group 1 - Clerical	$32.79	$4.26	$19.44	$1.64	$3.28	$24.22	$85.63	$128.45	$171.26	$7.83
Operating Engineer Group 2 - Clerical	$35.01	$4.55	$19.84	$1.75	$3.50	$25.50	$90.16	$135.24	$180.32	$7.73
Operating Engineer Group 3 - Clerical	$36.35	$4.73	$20.09	$1.82	$3.64	$26.27	$92.89	$139.34	$185.78	$7.67

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*All currency in CAD.

NOTES

Column 1: Trades and specialities required for the execution of the Work.
Column 2: Base rate is per the Project Labour Agreement.
Column 3: Vacation pay includes vacations, statutory holidays, sick and other leave with pay.
Column 4: Payroll allowances and burdens includes, but not limited to, unemployment insurance, workers' compensation, payroll tax, and other taxes and insurance measured by payroll, established employee benefits such as pension, health, and life insurance, bonus programs, fringe benefits, indemnity funds, training, and all other contributions or premiums as per the Project Labour Agreement or government regulations, as applicable.
Column 5: Small Tools includes all tools with a replacement value of less than two thousand ($2,000.00) Canadian Dollars. Refer to Attachment 1, Item 3 for a typical listing of these types of small tools. Such items shall be furnished by the Contractor complete with all accessories and expendable operating parts and shall be maintained in good condition including the replacement of parts as may be necessary.
Column 6: Consumables whether recoverable or non-recoverable (refer Attachment 1, Item 2) and Personal Protective Equipment (refer Attachment 1, Item 1).
Column 7: Overhead and Profit includes, but not limited to, all home/corporate office expenses, administration (Health and Safety Supervisors, Planners, Project Controls, Estimators, etc.) and supervision (Project Manager, Superintendent) costs.
Column 8: The Regular Time rate includes the total of columns 2 to 7.

Overtime rates (1.5x and 2.0x) include the regular time rate plus the overtime premium as per the Project Labour Agreement . Only the costs relative to those benefits and/or burdens that specifically apply when additional hours are worked shall be added. Other benefits, burdens and overhead will not be reimbursed since the full costs to the Contractor for these items has already been compensated in the regular time rate.

Second and Third Shift Premium is the incremental charge applied to the Regular Time Rate and Overtime Rates for second and third shift personnel.

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ATTACHMENT 1

The following lists include, but are not limited to, items that Company classifies as "Personal Protective Equipment", "Consumables", and "Small Tools", whether recoverable or non-recoverable.

1. PERSONAL PROTECTIVE EQUIPMENT

All personal protective equipment shall meet the requirements of Occupational Health and Safety Regulations.

APRON, WELDERS
BELT, SAFETY
BLANKET, FIRE
BLOCK, WELDING HELMET
BOOT, SAFETY, ALL TYPES
BRACKET, FOR FACE SHIELD
BRACKET, FIBER BROW, SAFETY SHIELD
CAPS, PLASTIC SAFETY (FOR REBAR)
CURTAIN, WELDER
DUST MASK
DISPOSABLE MASK
EYESHIELD, FOR BENCH GRINDER
FIRST AID SUPPLIES
FLARE, ROAD, NON-ELECTRIC
GLASSES, SAFETY
GLOVES, WORK, ALL TYPES
GOGGLES, SAFETY
GUARDS, SHIN
GUARDS, TOE, METAL W/STRAP
HALF FACE or FULL FACE RESPIRATOR WITH CARTRIDGES – ALL TYPES
HARD HAT
HEARING PROTECTION
HOOD, WELDING
INSECTICIDE
LANYARD FOR SAFETY BELTS
LENS, WELDING
LIFE LINE
LOCKS
MOUNTING VISOR AND KWIK-KLIP
PULLER, FUSE SAFETY
RAIN WEAR, JACKET AND OVERALLS
SAFETY HARNESS
SIREN, ELECTRIC
STRAP, CHIN
SWEAT BANDS
TABLET, SALT
VISOR, SHIELD, CLEAR
WELDING SHIELDS

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2. CONSUMABLES

ABRASIVES
ACID
ADAPTORS, TOOL – all types
ADHESIVE
ALCOHOL
ANTIFREEZE
ANTI-SPLATTER SPRAY
APRON, WELDERS
ARBORS, HOLE SAW
AUGER, HAND - post hole digger
BADGES
BAG, DUST – for belt sander
BAG, BOLT
BANDS, SAFETY HAT
BARRELS, WATER or TRASH
BATTERY – flashlight and lantern
BELTING, BELT DRESSING
BINS, TRASH
BITS – small hand tool, all types
BLADES – small hand tool, all types
BLANKET – wool, rubber
BOX, CARDBOARD
BRACKET, FLOAT HANDLE
BRICK, RUBBING
BROOM – all types
BRUSH – all types
BUCKET – all types
BULB – blow out, dust
BULB – flashlight, lantern, light
BURLAP
CABLES, RIGGING
CAN, OIL
CAN, SAFETY
CARBIDE
CARBORUNDUM – Blocks, Stones Walk
EXPANDER, TUBEROLLS AND MANDRELS
FASTENERS
FEELER STOCK
FILE, METAL CUTTING
FILE, WOOD CUTTING
FILTER – for vacuum cleaner
FILTERS
FISHTAPE, HAND
FITTINGS, ALEMITE & HOSE
FLAMBEAU, KEROSENE
FLASHLIGHT
FLINT
FLUID CLEANING
FLUX - brazing, welding
FORK, SEED
FORM TIES
FRAME, HACKSAW
FUELS (for construction equipment)
FUNNELS, ALL TYPES
FUSE (except for permanent plant use)
GARBAGE BAGS
GASKETS, HOSE
GLOVES, WORK, all types
GLUE
GLYCERINE
GOGGLES, WORK, all types
GRAPHITE
GREASE
GRIPS, PLASTIC for pliers
GROMMETS
GUIDE, HINGE-BUTT for router
GUN, CAULKING
GUN, GREASE
HASPS
PAD, POLISHING
PADLOCKS
PAINT (for erection marking)
PAINT STICK
PAN, DRAIN
PAPER – sand, toilet
PASTE – solder
PATTERNS
PENCIL, CARPENTER
PENS, WRITING, MARKING
PETROLEUM JELLY
PICK, CLAY
PLUG, PIPE TEST
PLUNGER, BATHROOM
POCKET, LINEMAN'S
POUCH, CANVAS
POUCH, ROD
POWDER, SCOURING
PULLER, WIRE
PUMICE
PUNCH AND CHISEL SETS
PUNCH, CONDUIT
PUNCH, PIN SET
PUTTY
RAGS
RAKE, GARDEN
RAKE, CONCRETE
RAKE, ROAD
REAMER, TAPER PIN (Hand Only)
RIGGING HOOKS
ROPE, MANILA
ROPE, POLYPROPYLENE
ROPE, WIRE
RULE - Extension, Wood, Fiberglass, Folding
WASHERS
WASHING POWDER
WASHROOM SUPPLIES
WASTE – Cotton
WATER CANS
WELD ROD
WELDING GASES
WHEEL, DEPRESSED CENTER
WHEELBARROW, All Types
WHEEL ABRASIVE
WHEEL, WIRE
WICKS, LANTERN
WIRE - tie & miscellaneous
WOOL – steel
WRAP AROUNDS

ANDRITZ Hydro

CHAIN, SAFETY
CHAIN, LOADBINDER
CHALK
CHALK LINE BOX
CHAMOIS
CHARCOAL AND COKE
CHISEL – all types
CHOKER – all types
CHUCKS, TOOL – all types
CLAMP, CABLE
CLAMP, HOSE
CLEANER, DRAIN
CLEANER, HAND
CLEANER, TIP
CLIPS, WIRE ROPE
CLOTH, DROP, PAINTER'S
CLOTH, EMERY
CLOTH, STRAINING
COAL and COKE
COMPOUND - cleaning, pipe, thread grinding
COMPOUND, SWEEPING
COMPOUND, WIRE PULLING
CONNECTORS – Cord, Cotter Pins
CORD, PLUMB BOB
CORD, SASH
CORK
CRAYON, LUMBER
CRAYON – Temperature Indicating
CREOSOTE
CUP – drinking
CUTTER WHEELS – tools, all types
DIE NUTS – Hexagon Rethread
DIES, BUTTON
DIES, KNOCKOUT
DIES, PIPE – for Hand Threaders Only
DIES, TMB – 8, Compression Tools
DIPPERS
HATCHET
HINGES
HOE
HOOK, SNAP
HOOK, TIMBER
HOSE, AIR, ¾" /Dia. Max. (Air Tools Only)
HOSE WATER to ¾"
HOSE, GREASE, GUN
HOSE, TWIN WELDING
ICE
INK, LAYOUT – for Millwrights
IRON, CAULKING
IRON, PACKING
IRON, YARNING
JAW, BOLT CUTTER REPLACEMENT
JITTERBUG – Concrete Hand
JOINT RUNNER
KEEL (lumber crayon)
KEY, CHUCK
KEY, EJECTOR for Roto Hammers
KEY, HEX
LASHING, WIRE ROPE
LATCHES
LATTERNS, 6 VOLT LENS - Welding
LIGHTER, SPARK
LIME, MARKING
LINE, FISH
LITHARGE
LUBRICANT – thread cutting, electric wire pulling
LUGS
MARKER, METAL
MARKER, PIPE CONTOUR
MENDERS, HOSE
MIRROR, INSPECTION
MOP
NAILS
RULE, TAPE
RUST PREVENTIVE
SANDBLAST NOZZLES
SCISSORS, ELECTRICIAN
SCRAPER, HAND
SCRAPER, SIDEWALK
SCRAPER, WALL
SCREEN CLOTH – Wire
SCREW RUNNER
SCREW STARTER
SCREWDRIVER, All Types
SHACKLES
SHEATH, PLUMB BOB
SHIMS
SILICONE SPRAY
SOAP
SOAP STONE
SOLDER
SOLVENT
SPONGE
STAKE - survey
STAPLES
STRING, NYLON
TACKS
TAG, BLANK, WIRE TWIST
TARPAULIN
TAP, TAPER, HAND
TAPE - adhesive, masking, friction, rubber, plumbers, etc.
TEMPIL STICKS
THIMBLES, WIRE ROPE
TIP, TORCH WELDING
TOOL BOXES, BINS
TOOL, BRUSHING for Vacuum cleaner
TOOL, CREVICE, 15" for Vacuum
TOOL, MAJOR FLOOR, 14"
TOOL STEEL
TOWEL – Paper

ANDRITZ Hydro

DISC, GRINDING
DISINFECTANT
DISPENSER, PAPER CUP
DRESSING, BELT
DRILL BIT – Small Hand Tool, All Types
EDGER, CONCRETE HAND
ELECTRODE HOLDERS
NIPPLES, HOSE
NOZZLE, WATER
NUT RUNNER
NUT SETTER
OFFICE SUPPLIES
OIL - all types
PACKING MATERIAL
TORCH, HEATING
TORCH, CUTTING
TROWEL, HAND
TRUNBUCKLES
TURPENTINE
TWINE
VISQUEEN – Non-reinforced

ANDRITZ Hydro

3. SMALL TOOLS

ADAPTER - hose, pipe thread
ADZE
ANVIL
APRON
ARBOUR
AUGER, GASOLINE (Post Hole Digger)
AWL
AXE
BABBITT
BANDING MACHINE – Hand Type
BAR- claw, crow, pinch, etc.
BARREL- trash
BASE, MAGNETIC/DAILY TEST INDICATOR
BELT- safety w/strap
BENDER - hydraulic, manual
BENDER, CABLE
BENDER, PIPE
BENDER, TUBING
BENDER, LOAD
BEVEL
BEVELLER - load
BINDER - load
BIT - auger, carpenter
BLOCK - chain, rope, cable, etc.
BLOCKS, WOOD
BLOCKS, METAL – Snatch
BLOWER – Pneumatic Powered
BOB, PLUMB
BOSUN CHAIRS
BOX - tool box or tool bag
BOX, GANG (Craft Storage)
BRACE - ratchet
BROOMS
BURNER, WEED
DOOR HANGING KIT
DRESSER - grinding wheel
DRILL - all types: hand, electric, pneumatic
DRILL PRESS
DRILL STAND - bench
DYNAMOMETER
ELCOMETER - paint thickness gauge
EMBOSSER, TAPE, HAND
ETCHER, ELECTRIC
EXPANDER- tube
EXTENSION, SOCKET SET
EXTENSION CORD
EXTRACTOR - pipe & screw
FAN - electric
FILE - hand
FLARING TOOL
FLASHLIGHT - c/w bulb & batteries
FLATTER - blacksmith
FLOAT, CONCRETE – Hand Only
FORGE - blacksmith
FORK - barn
FULLER - blacksmith
FURNACE, PROPANE – Melting
GAD
GAUGE- drill, feeler, wire thickness, tire, etc.
GRINDER- electric, pneumatic
GRAB, PIPE OF 20"
GRINDER, ELECTRIC
GRIP- cable
GROOVING, TOOL
GUN- grease caulking, paint, heat (115V), pop rivet, powder actuated, soldering
MOVER - freight car, hand
NAILER, AIR
NIBBLER, SHEET METAL
NIPPER
NOTCHER, PIPE
NOZZLE - hose, weld
NUT - die, driver
OILER - can, hand
OVEN - welding rod
PAIL
PEDESTAL, GRINDER
PIN, BARREL
PIN, BULL
PIN, DRAFT
PINCER
PLANE – wood
PLANE, BENCH JACK
PLANE, BLOCK
PLANE, ELECTRIC
PLANE, VERSI
PLANNER, POWER BLOCK – Electric HD
PLIERS – all types
PLUMB BOB
POINT - trammel
POLE - pike, range
POT - melting, fire, welding rod, lead
POUCH - tool
PRESTOLITE OUTFIT
PROTRACTOR
PULLER, FUSE SAFETY
PULLER, WHEEL GEAR
PULLER- nail, wire, spike road
PULLEY, CABLE
PULLEY, WELL
PUMP- hand, barrel, sump, test
SOLDERING IRON
SPADE
SPEED, PORTABLE
SPIKE- marlin
SPRAYER, ORCHARD
SPREADER, FLANGE
SQUARE- combination, framing, etc.
SQUEEGEE
STAND, DRILL
STAND, GRINDER
STAND, PIPE
STAND, REEL, TELESCOPING SCREW
STAPLE- tacker
STAPLER, ELECTRIC OR HAND
STAR DRILL
STEAM HEATER
STENCIL- steel, brass, paper
STONE - OIL
STRAIGHT EDGE
STRAINER- air line
STRAPPER
STRIPPER- wire
SUPPORT, PIPE – Roller type
SWEDGING TOOL KIT
SWIVEL
TACHOMETER
TAMPER- hand, pneumatic
TANK, LP – 20# only
TAP- bolt, pipe, wrench
TAPE- steel measuring
TAPEWRITER, EMBOSSING – Hand type
TAPPER
TELEPHONE- hand set, electrician's testing

ANDRITZ Hydro

CABLE - welding, electrode, ground, etc.
CALLIPERS
CANS
CART - concrete
CART, WELDING BOTTLE 2
CASTERS
CAULKING TOOL - yarning iron
CENTER FINDER SET - Wiggler
CHAIN - surveyor, measuring, steel loading
CHAIR, BOSUN'S
CHARGER - battery
CHUCK - taper, drill
CLAMP - pipe, aligning, saw, carpenter, etc.
CLIMBER – Adjustable w/Pad and Straps
CLIPPER - bolt
COOLER - drinking water
COMBINATION SETS – 6" to 18"
CONNECTOR - welding, cable
CONVEYOR - gravity, roller
CORD - electric extension
COUPLING - hose
CREEPER, FLOOR
CRIMPER, BAND
CRIMPER - electrician's
CRIMPING TOOL - Wire
CUTTER - bar, wire, pipe-hand, pipe-geared, gasket, etc.
CYLINDER, HYDRAULIC – for Porta Powers
DIE- pipe, bolt, c/w head, stock
DIGGER - hand, pneumatic
DIVIDER – wing
DIVIDER, SPRING TYPE
DOLLY, BARREL
HACKSAW, POWER
HAMMERS - all types: pneumatic, hand
HANDLES - all types
HATCHET & HANDLE - for hand threader sets
HATCHET, WRENCH
HEATER - portable: fuel, electric (115V), LP, Kerosene
HOD - brick, mortar
HOE
HOIST - portable, all types
HOOD - welding, sandblasting
HOOK - packing, eye, cant, lug, etc.
HORSES - mason, saw
INDICATOR - dial, test
IRON - tire
JACK - flange, hydraulic, mechanical, screw
JIG - weld coupon bending test
KEY - welding, gas tank
KNIFE - draw, putty
KNOCKOUT, HAND
LADDER - steel, extension, etc.
LADLE - melting, lead
LANTERNS - all types
LEAD JOINT RUNNER
LEVEL - hand, line, etc.
LIGHT - portable, flood, drop
LINE - mason, chalk
LUBRICATOR - air line
MALLET
MANDREL - all types
MARKER, LIME, ROLLING
MATTOCK
MAUL
MEGGER METER
METER - vibration
METER, AMP – Clamp-on w/Case
PUNCH- center, back out, arch, knockout, hob, gasket, sheet metal, stud, etc.
RADIO- portable, 2 way, intercom
RASP
REAMER- pipe, bridge burring, etc.
REAMER, INNER, OUTER – for copper tubing
REAMER, SPIRAL – Pipe only
REAMER, STRAIGHT – Pipe only
REEL, TIE WIRE
REGULATOR- welding gas
RESPIRATOR- dusts c/w refill
RIGGERS ROPE- manila, wire
RIVERTER, HAND
ROLLER, PIPE
ROLLER, paint
ROUTER, ELECTRIC
RULES- all types
RUSH DRILL
SANDER- disc, belt
SAW - portable, all types: hand, power
SCALER, NEEDLE
SCRAPER- bearing, miscellaneous
SCREW STOP
SCREW PLANE (set)
SCRIBER SET- nail, rivet
SHARPENER, DRILL BIT
SHEAR- bar, tinners
SHEAR, ANGLE IRON
SHEARS, ELECTRIC, HAND
SHEARS, TRIMMING, ROTARY
SHEAVES, CABLE, TRAY METAL
SHEETING- plastic, paper
SHIELD- face
SHOVEL
SIREN, ELECTRIC
SLEEVE- morse, taper, shank
TEMPLATE, HINGE-BUTT
TESTER- battery, hardness, antifreeze, circuit, insulation, motor rotation, etc.
THIMBLE- pipe
THREADER- pipe chain, etc.
TONGS, BRICK CARRIER
TONGS, CHAIN
TONGS, PIPE
TONGS, SHEET METAL
TONG- blacksmith, pipe,
TOOL, FLARING
TOOL, PICK UP, MAG
TOOL, SOIL PIPE ASSEMBLY
TOOL- clamping (hose)
TOOLS- cement worker
TORCH- blow, soldering
Cutting, propane, acetylene, prestolite
TRANSFORMER- dry type
TROLLEY
TROWEL
TRUCK- hand
TURNBUCKLE
TWISTER- wire
UMBRELLA
UNIVERSAL – for socket sets
VACUUM CLEANER, HD
VIBRATOR, CONCRETE- pneumatic, Electric
VISE, MACHINIST
VISE, PIPE
WEDGE
WELDING TOOLS
WELDING & CUTTING OUTFIT (Oxy/Acetelyne)
WHEEL- grinding
WHEELBARROW
WINCH- hand
WRENCHES- all types

ANDRITZ Hydro

DOLLY, BEAM
DOLLY, CATERPILLAR
DOLLY, MACHINE
DOLLY, PIPE
DOLLY, PRY
DOLLY, WAREHOUSE
DOLLY BAR - pivot
METER, MILLIVOLT
METER, MOISTURE
METER, VOLT
MICROMETER
MIRROR, INSEPCTION
MITER BOX – Electric or hand
MORTISER, LOCK - Electric
SLING- canvas, pipe, wire, rope, nylon
SNIP- tinner
SNIPS, AVIATION, HAND
SNIPS, METAL CUT, HAND
SNIPS, TRIM HAND
SOCKET for hand tools only
SOCKET SET

ANDRITZ Hydro

Muskrat Falls - Package CH0032 - Proposed Rates (Office and Site Staff) for Change Orders

Trade or	Regular Time Rate	Regular Time Rate	Regular Time Rate	Regular Time Rate	Regular Time Rate	Regular Time Rate
Classification (1)	2013	2014	2015	2016	2017	2018
Project/Commercial Manager	188.00	194.00	200.00	206.00	212.00	218.00
Project/System Engineer	188.00	194.00	200.00	206.00	212.00	218.00
Planner/Procurement	160.00	165.00	170.00	175.00	180.00	185.00
Scheduler	160.00	165.00	170.00	175.00	180.00	185.00
Sourcing Quality Assurance	160.00	165.00	170.00	175.00	180.00	185.00
Mechanical Engineer	155.00	160.00	165.00	170.00	175.00	180.00
Electrical Engineer	155.00	160.00	165.00	170.00	175.00	180.00
Draft Person	155.00	160.00	165.00	170.00	175.00	180.00
Document Control	98.00	101.00	104.00	107.00	110.00	113.00
Field Engineer	109.00	112.00	115.00	118.00	122.00	126.00
Site Manager/Construction Superintendent	130.00	134.00	138.00	142.00	146.00	150.00
Installation Supervision	136.00	140.00	144.00	148.00	152.00	157.00
Commissioning Engineer	152.00	157.00	162.00	167.00	172.00	177.00
Environment, Health & Safety	120.00	124.00	128.00	132.00	136.00	140.00
Site Quality Assurance	105.00	108.00	111.00	114.00	117.00	121.00
Site Administration	90.00	93.00	96.00	99.00	102.00	105.00

Notes:

1. 3% of inflation per annum is applied for the above office and site staff rates.

2. Travel and Living expenses are not included above and will be charged to Company at cost plus 15%.

EXHIBIT 2 - APPENDIX E

EQUIPMENT RATE SCHEDULE

Part 1
Appendix A2.5
Equipment Rate Schedule
Package Number: CH0032

ANDRITZ Hydro

EQUIPMENT RATE SCHEDULE

Equipment	Manufacturer and Model Number	Size	Year	Quantity Available	Hourly Usage Rate CAD	Daily Usage Rate CAD	Weekly Usage Rate CAD
4 TO 1 MULTIPLIER - 1/2 IN 3/4 OUT	N/A	N/A	N/A	As Required	$ 6.79	$ 27.14	$ 97.94
6 TO 1 MULTIPLIER	N/A	N/A	N/A	As Required	$ 8.85	$ 35.40	$ 106.20
AIR COMPRESSOR - 450-CFM	N/A	N/A	N/A	As Required	$ 62.54	$ 250.16	$ 1,115.10
CHAIN FALL – 3 TON c/w 20 Ft Fall	N/A	N/A	N/A	As Required	$ 10.03	$ 40.12	$ 127.44
CHAIN FALL – 5 TON c/w 20 Ft Fall	N/A	N/A	N/A	As Required	$ 16.52	$66.08	$ 226.56
COME - A - LONG – 3 TON	N/A	N/A	N/A	As Required	$ 8.85	$ 35.40	$ 96.76
DRILL - MAGNETIC 5/8" [PORTA MAG]	N/A	N/A	N/A	As Required	$ 12.98	$ 51.92	$ 198.24
EXT. HIGH VOLTAGE POWER CHORD 50 FT	N/A	N/A	N/A	As Required	$ 3.54	$ 14.16	$ 46.02
FAN - AIR MOVER - 20" ELECTRIC (Exhaust Fan)	N/A	N/A	N/A	As Required	$ 12.98	$ 51.92	$ 140.42
FORK LIFT 5000#	N/A	N/A	N/A	As Required	$ 33.34	$ 133.34	$ 472.00
FULL FACE RESPIRATOR	N/A	N/A	N/A	As Required	$ 3.84	$ 15.34	$ 59.00
GAS DETECTOR [PULL TUBE SNIFFER]	N/A	N/A	N/A	As Required	$ 14.16	$ 56.64	$ 140.42
GAS GENERATOR 110 VOLT	N/A	N/A	N/A	As Required	$ 18.88	$ 75.52	$ 305.62
HYDRAULIC TORQUE WRENCH 1-1/2" DRIVE c/w PUMP	N/A	N/A	N/A	As Required	$ 69.62	$ 278.48	$ 1,008.90
IMPACT WRENCH - 1" [ELECTRIC]	N/A	N/A	N/A	As Required	$ 14.75	$ 59.00	$ 219.48
INSTRUMENTATION BOX	N/A	N/A	N/A	As Required	$ 23.60	$ 94.40	$ 236.00
PIPE THREADER – #535 c/w UNI HEAD	N/A	N/A	N/A	As Required	$ 13.28	$ 53.10	$ 228.92

ANDRITZ Hydro

Equipment	Manufacturer and Model Number	Size	Year	Quantity Available	Hourly Usage Rate CAD	Daily Usage Rate CAD	Weekly Usage Rate CAD
RADIO - 2 WAY C/W HOLSTER & SPEAKER (c/w charger)	N/A	N/A	N/A	As Required	$ 2.95	$ 11.80	$ 59.00
SAFETY HARNESS c/w SHOCK ABSORBING LANYARD	N/A	N/A	N/A	As Required	$ 2.95	$ 11.80	$ 59.00
SHACKLE 35 TON	N/A	N/A	N/A	As Required	$ 14.75	$ 59.00	$ 147.00
SMOKE EATERS	N/A	N/A	N/A	As Required	$ 5.61	$ 22.42	$ 114.46
SOCKET SET 1" DRIVE [IMPERIAL] c/w RATCHET	N/A	N/A	N/A	As Required	$ 14.75	$ 59.00	$ 147.50
SUMP PUMP	N/A	N/A	N/A	As Required	$ 7.38	$ 29.50	$ 82.60
TEMPERATURE GUN	N/A	N/A	N/A	As Required	$ 7.67	$ 30.68	$ 155.76
TOOL CONTAINER - 20' STANDARD (Empty)	N/A	N/A	N/A	As Required	$ 33.63	$ 134.52	$ 187.62
TRANSFORMER STEP DOWN 600V TO 480V	N/A	N/A	N/A	As Required	$ 16.23	$ 64.90	$ 250.16
TRANSFORMER STEP UP 480 TO 600 VOLT	N/A	N/A	N/A	As Required	$ 16.23	$ 64.90	$ 250.16
WELDER - 400 AMP ELECTRIC - C/W 150' CABLE	N/A	N/A	N/A	As Required	$ 18.29	$ 73.16	$ 142.78
WELDER PANEL - 575V or 460V x 6 OUTLET	N/A	N/A	N/A	As Required	$ 8.56	$ 34.22	$ 175.82
WRENCH - COMBINATION SET 11/2" TO 21/2"	N/A	N/A	N/A	As Required	$ 14.75	$ 59.00	$ 147.50
VEHICLE - BOOM TRUCK - 15 TON	N/A	N/A	N/A	1	$ 194.70	$ 778.80	$ 3,894.00
TRUCK - 1 TON FLATDECK	N/A	N/A	N/A	1	$ 29.50	$ 118.00	$ 708.00
MOBILE CRANE 160T	N/A	N/A	N/A	1	$2,227.50	$8,910.00	$44,550.00
MOBILE CRANE 90T	N/A	N/A	N/A	1	$1,471.50	$5,886.00	$29,430.00
MOBILE CRANE 60T	N/A	N/A	N/A	1	$1,077.30	$4,309.20	$21,546.00
BOOM TRUCK 30T	N/A	N/A	N/A	1	$823.50	$3,294.00	$16,470.00

ANDRITZ Hydro

1. The rates include the cost of equipment rental, fuel, lubricants, tires, expendable parts, service, maintenance, calibration, repairs, storage, insurance, licenses, depreciation, interest, taxes, overhead, mark-up and profit.

2. The rates include labour and equipment for fuelling, lubricating, servicing, maintaining, repairing, spare parts and installation.

3. The rates exclude operator's labour costs which shall be compensated as per Article 26 and Exhibit 2 Compensation and Exhibit 3 Coordination Procedures.

4. Rates are applicable to actual operating and standby time.

5. For any equipment not listed, rental rates will be agreed to in writing by Company prior to the deployment and use of such equipment. Equipment rented or leased from a Third party shall be compensated as per Article 26 and Exhibit 2 Compensation and Exhibit 3 Coordination Procedures. Third Party leasing shall be approved by Company in advance of the deployment and use of such equipment..

6. If approved by Company, the time required to mobilize and demobilize equipment not located at the Work Site and which is to be deployed at the Work Site on Change Order Work will be compensated. Compensation will be as per Article 26 and Exhibit 2 Compensation and Exhibit 3 Coordination Procedures.

ANDRITZ Hydro

EQUIPMENT STANDBY RATE SCHEDULE

Equipment	Manufacturer and Model Number	Size	Year	Quantity Available	Hour CAD	Day CAD	Week CAD
VEHICLE - BOOM TRUCK - 15 TON	N/A	N/A	N/A	1	$ 194.70	$ 778.80	$ 3,894.00
TRUCK - 1 TON FLATDECK	N/A	N/A	N/A	1	$ 29.50	$ 118.00	$ 708.00
MOBILE CRANE 160T	N/A	N/A	N/A	1	$2,227.50	$8,910.00	$44,550.00
MOBILE CRANE 90T	N/A	N/A	N/A	1	$1,471.50	$5,886.00	$29,430.00
MOBILE CRANE 60T	N/A	N/A	N/A	1	$1,077.30	$4,309.20	$21,546.00
BOOM TRUCK 30T	N/A	N/A	N/A	1	$823.50	$3,294.00	$16,470.00

*Indicate currency. If necessary, provide separate information by currency and rationale for currencies used.

STANDBY RATE NOTES

1. The standby rates include cost of equipment rental, insurance, licenses, depreciation, interest, taxes, overhead, mark-up and profit.

2. The standby rates exclude operator's labour costs.

EXHIBIT 2 - APPENDIX F

ESTIMATED TRADE PERSON-HOUR SCHEDULE

Part 1
Appendix A2.7
Estimated Trade Person-Hour Schedule
Package Number: CH0032

ESTIMATED TRADE PERSON-HOUR SCHEDULE

Trade Type	Trade Classification	Number of LOA Person-Days	Travel KMs	Regular Time Person-Hours	Overtime (1.5x) Person-Hours	Overtime (2.0x) Person-Hours	Second Shift Person-Hours	Third Shift Person-Hours	Travel Time Hours	Total Person-Hours
Boilermakers	General Foreperson	0	0	0	0	0	0	0	0	0
	Foreperson	0	0	0	0	0	0	0	0	0
	Assistant Foreperson	0	0	0	0	0	0	0	0	0
	Journeyperson	0	0	0	0	0	0	0	0	0
	Helper	0	0	0	0	0	0	0	0	0
	Apprentice - 3rd year	0	0	0	0	0	0	0	0	0
	Apprentice - 2nd year	0	0	0	0	0	0	0	0	0
	Apprentice - 1st year	0	0	0	0	0	0	0	0	0
Bricklayers	Group 1 - General Foreperson	0	0	0	0	0	0	0	0	0
	Group 1 - Foreperson	0	0	0	0	0	0	0	0	0
	Journeyperson - Group 2	0	0	0	0	0	0	0	0	0
	Journeyperson - Group 3	0	0	0	0	0	0	0	0	0
	Journeyperson - Group 4	0	0	0	0	0	0	0	0	0
	Apprentice - 1st 6 months	0	0	0	0	0	0	0	0	0
	Apprentice - 2nd 6 months	0	0	0	0	0	0	0	0	0
	Apprentice - 3rd 6 months	0	0	0	0	0	0	0	0	0
	Apprentice - 4th 6 months	0	0	0	0	0	0	0	0	0
	Apprentice - 5th 6 months	0	0	0	0	0	0	0	0	0
	Apprentice - 6th 6 months	0	0	0	0	0	0	0	0	0
	Apprentice - 7th 6 months	0	0	0	0	0	0	0	0	0
	Apprentice - 8th 6 months	0	0	0	0	0	0	0	0	0
Refractory	Group 1 – General Foreperson	0	0	0	0	0	0	0	0	0
	Group 1 – Refractory Foreperson	0	0	0	0	0	0	0	0	0
	Journeyperson - Group 5	0	0	0	0	0	0	0	0	0
	Journeyperson - Group 6	0	0	0	0	0	0	0	0	0
	Apprentice - 1st 1,200 hours	0	0	0	0	0	0	0	0	0
	Apprentice - 2nd 1,200 hours	0	0	0	0	0	0	0	0	0
	Apprentice - 3rd 1,200 hours	0	0	0	0	0	0	0	0	0
	Apprentice - 4th 1,200 hours	0	0	0	0	0	0	0	0	0

Part 1
Appendix A2.7
Estimated Trade Person-Hour Schedule
Package Number: CH0032

Trade Type	Trade Classification	Number of LOA Person-Days	Travel KMs	Regular Time Person-Hours	Overtime (1.5x) Person-Hours	Overtime (2.0x) Person-Hours	Second Shift Person-Hours	Third Shift Person-Hours	Travel Time Hours	Total Person-Hours
Carpenters	General Foreperson	0	0	0	0	0	0	0	0	0
	Non-working Foreperson	0	0	0	0	0	0	0	0	0
	Working Foreperson	0	0	0	0	0	0	0	0	0
	JourneyPerson, Carpenter, Welder, Scaffolder	0	0	0	0	0	0	0	0	0
	Apprentice – 1st	0	0	0	0	0	0	0	0	0
	Apprentice – 2nd	0	0	0	0	0	0	0	0	0
	Apprentice – 3rd	0	0	0	0	0	0	0	0	0
	Apprentice – 4th	0	0	0	0	0	0	0	0	0
Electricians	General Foreperson	0	0	0	0	0	0	0	0	0
	Non-working Foreperson	1697	22050	9663	2416	4831	0	0	0	16910
	Working Foreperson	0	0	0	0	0	0	0	0	0
	Apprentice/JourneyPerson Electrician Welder/Welder	0	0	0	0	0	0	0	0	0
	Journeyperson	2857	36167	16328	4082	8164	0	0	0	28574
	Apprentice - 1st year	1429	18083	8164	2041	4082	0	0	0	14287
	Apprentice - 2nd year	0	0	0	0	0	0	0	0	0
	Apprentice - 3rd year	0	0	0	0	0	0	0	0	0
	Apprentice - 4th year	0	0	0	0	0	0	0	0	0
Labourers	Class 1	14910	186900	85130	21283	42566	0	0	0	148979
	Class 2	0	0	0	0	0	0	0	0	0
	Class 3	0	0	0	0	0	0	0	0	0
	Class 4	0	0	0	0	0	0	0	0	0
	Class 5	0	0	0	0	0	0	0	0	0
	Class 6	0	0	0	0	0	0	0	0	0
	Class 7	0	0	0	0	0	0	0	0	0
	Class 8	0	0	0	0	0	0	0	0	0
	Class 9	0	0	0	0	0	0	0	0	0
	Class 10	0	0	0	0	0	0	0	0	0
	Class 11	0	0	0	0	0	0	0	0	0
	Class 12	0	0	0	0	0	0	0	0	0

Part 1
Appendix A2.7
Estimated Trade Person-Hour Schedule
Package Number: CH0032

Trade Type	Trade Classification	Number of LOA Person-Days	Travel KMs	Regular Time Person-Hours	Overtime (1.5x) Person-Hours	Overtime (2.0x) Person-Hours	Second Shift Person-Hours	Third Shift Person-Hours	Travel Time Hours	Total Person-Hours
Insulators	General Foreperson	0	0	0	0	0	0	0	0	0
	Foreperson	0	0	0	0	0	0	0	0	0
	Working Foreperson	0	0	0	0	0	0	0	0	0
	Journey Person Mechanic	0	0	0	0	0	0	0	0	0
	Apprentice - 1st year	0	0	0	0	0	0	0	0	0
	Apprentice - 2nd year	0	0	0	0	0	0	0	0	0
	Apprentice - 3rd year	0	0	0	0	0	0	0	0	0
	Apprentice - 4th year	0	0	0	0	0	0	0	0	0
Hotel Employees and Restaurant Employees	Chef (General Foreperson)	0	0	0	0	0	0	0	0	0
	1st Cook (Foreperson)	0	0	0	0	0	0	0	0	0
	Baker, Meat Cutter & Foreperson	0	0	0	0	0	0	0	0	0
	2nd Cook, Inventory Attendant, Service Attendant & Front Desk Attendant	0	0	0	0	0	0	0	0	0
	3rd Cook, Baker's Helper & Bartender	0	0	0	0	0	0	0	0	0
	Salad/Sandwich Person & Commissary	0	0	0	0	0	0	0	0	0
	General Help	0	0	0	0	0	0	0	0	0
	Foreperson	0	0	0	0	0	0	0	0	0
	Camp Attendant Housekeeping	0	0	0	0	0	0	0	0	0
	Security Crew Chief (General Foreperson)	0	0	0	0	0	0	0	0	0
	Security Assistant Crew Chief (Foreperson)	0	0	0	0	0	0	0	0	0
	Security Officer, Communications/Dispatch	0	0	0	0	0	0	0	0	0
	Janitor	0	0	0	0	0	0	0	0	0

Part 1
Appendix A2.7
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Trade Type	Trade Classification	Number of LOA Person-Days	Travel KMs	Regular Time Person-Hours	Overtime (1.5x) Person-Hours	Overtime (2.0x) Person-Hours	Second Shift Person-Hours	Third Shift Person-Hours	Travel Time Hours	Total Person-Hours
Electrical Line Workers	General Foreperson	0	0	0	0	0	0	0	0	0
	Non-working Foreperson	0	0	0	0	0	0	0	0	0
	Lead Lineperson	0	0	0	0	0	0	0	0	0
	Utility Worker	0	0	0	0	0	0	0	0	0
	Journey (Lineperson and/or Cable Splicer)	0	0	0	0	0	0	0	0	0
	Apprentice - 1st year	0	0	0	0	0	0	0	0	0
	Apprentice - 2nd year	0	0	0	0	0	0	0	0	0
	Apprentice - 3rd year	0	0	0	0	0	0	0	0	0
	Apprentice - 4th year	0	0	0	0	0	0	0	0	0
Ironworkers - Structural	General Foreperson	0	0	0	0	0	0	0	0	0
	Foreperson	2232	28350	12754	3189	6377	0	0	0	22320
	Connectors	0	0	0	0	0	0	0	0	0
	Journeyperson	6775	84700	38716	9679	19358	0	0	0	67753
	Apprentice - 1st 1,000 hrs	3388	42350	19358	4840	9679	0	0	0	33877
	Apprentice - 2nd 1,000 hrs	0	0	0	0	0	0	0	0	0
	Apprentice - 3rd 1,000 hrs	0	0	0	0	0	0	0	0	0
	Apprentice - 4th 1,000 hrs	0	0	0	0	0	0	0	0	0
Ironworkers - Rodman (Rebar)	General Foreperson	0	0	0	0	0	0	0	0	0
	Foreperson	0	0	0	0	0	0	0	0	0
	Journeyperson	0	0	0	0	0	0	0	0	0
	Apprentice - 1st 1,000 hrs	0	0	0	0	0	0	0	0	0
	Apprentice - 2nd 1,000 hrs	0	0	0	0	0	0	0	0	0
	Apprentice - 3rd 1,000 hrs	0	0	0	0	0	0	0	0	0
	Apprentice - 4th 1,000 hrs	0	0	0	0	0	0	0	0	0

Part 1
Appendix A2.7
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Millwrights	General Foreperson	0	0	0	0	0	0	0	0	0
	Non-working Foreperson	1282	16450	7291	1823	3646	0	0	0	12760
	Working Foreperson	0	0	0	0	0	0	0	0	0
	Journeyperson Millwright – Welder Machinist	3574	45033	20400	5100	10200	0	0	0	35700
	Apprentice 1st Year	1787	25517	10200	2550	5100	0	0	0	17850
	Apprentice 2nd Year	0	0	0	0	0	0	0	0	0
	Apprentice 3rd Year	0	0	0	0	0	0	0	0	0
	Apprentice 4th Year	0	0	0	0	0	0	0	0	0
Operating Engineers	Operating Engineer – Group 1	6708	84000	38331	9583	19166	0	0	0	67080
	Operating Engineer – Group 2	0	0	0	0	0	0	0	0	0
	Operating Engineer – Group 3	0	0	0	0	0	0	0	0	0
	Operating Engineer – Group 4	0	0	0	0	0	0	0	0	0
	Operating Engineer – Group 5	0	0	0	0	0	0	0	0	0
	Apprentice – 1st Period	3354	42000	19166	4791	9583	0	0	0	33540
	Apprentice – 2nd Period	0	0	0	0	0	0	0	0	0
	Apprentice – 3rd Period	0	0	0	0	0	0	0	0	0
	Apprentice – 4th Period	0	0	0	0	0	0	0	0	0
	Apprentice – 5th Period	0	0	0	0	0	0	0	0	0
	Apprentice – 6th Period	0	0	0	0	0	0	0	0	0
	Clerical – Group 1	0	0	0	0	0	0	0	0	0
	Clerical – Group 2	0	0	0	0	0	0	0	0	0
	Clerical – Group 3	0	0	0	0	0	0	0	0	0
Painters and Allied Trades	Painter/Glazier	1370	17150	7829	1957	3914	0	0	0	13700
	Drywall Taper, Spray Painter, Sand Blaster, Vinyl Hangers, Fireproofers	0	0	0	0	0	0	0	0	0
	Foreperson	0	0	0	0	0	0	0	0	0
	General Foreperson	0	0	0	0	0	0	0	0	0
	Apprentice - 1st year	0	0	0	0	0	0	0	0	0
	Apprentice - 2nd year	0	0	0	0	0	0	0	0	0
	Apprentice - 3rd year	0	0	0	0	0	0	0	0	0

Part 1
Appendix A2.7
Estimated Trade Person-Hour Schedule
Package Number: CH0032

Trade Type	Trade Classification	Number of LOA Person-Days	Travel KMs	Regular Time Person-Hours	Overtime (1.5x) Person-Hours	Overtime (2.0x) Person-Hours	Second Shift Person-Hours	Third Shift Person-Hours	Travel Time Hours	Total Person-Hours
Plumbers and pipefitters	General Foreperson	0	0	0	0	0	0	0	0	0
	Foreperson	0	0	0	0	0	0	0	0	0
	Journeyperson	0	0	0	0	0	0	0	0	0
	Welding Inspector	0	0	0	0	0	0	0	0	0
	Apprentice – 1st year	0	0	0	0	0	0	0	0	0
	Apprentice - 2nd year	0	0	0	0	0	0	0	0	0
	Apprentice - 3rd year	0	0	0	0	0	0	0	0	0
	Apprentice - 4th year	0	0	0	0	0	0	0	0	0
Sheet Metal Workers	General Foreperson	0	0	0	0	0	0	0	0	0
	Working Foreperson	0	0	0	0	0	0	0	0	0
	Non-working Foreperson	0	0	0	0	0	0	0	0	0
	Journeyperson	0	0	0	0	0	0	0	0	0
	Apprentice - 2nd year	0	0	0	0	0	0	0	0	0
	Apprentice - 3rd year	0	0	0	0	0	0	0	0	0
	Apprentice - 4th year	0	0	0	0	0	0	0	0	0
Teamsters	Group 1 (Single Axle)	0	0	0	0	0	0	0	0	0
	Group 2 (Dual Axle/Tandem Axle)	0	0	0	0	0	0	0	0	0
	Group 3 (Heavy Trucks & Warehouse)	3780	47600	21600	5400	10800	0	0	0	37800
	Group 4 (Emergency, Medical Technicians & First Mates)	0	0	0	0	0	0	0	0	0
	Group 5 (Duty Nurse, Fire Prevention Officer, Captains & Engineers)	0	0	0	0	0	0	0	0	0
	Group 6 (Tandem Axle)	0	0	0	0	0	0	0	0	0
	Group 6 (Tandem Tandem Axle)	0	0	0	0	0	0	0	0	0

Part 1
Appendix A2.7
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Elevator Constructors	Mechanic	0	0	0	0	0	0	0	0	0
	Mechanic in-charge (4 or more)	0	0	0	0	0	0	0	0	0
	Mechanic in-charge (30 or more)	0	0	0	0	0	0	0	0	0
	Probationary Helper I	0	0	0	0	0	0	0	0	0
	Probationary Helper II	0	0	0	0	0	0	0	0	0
	Helper I	0	0	0	0	0	0	0	0	0
	Helper II	0	0	0	0	0	0	0	0	0
	Improver Helper	0	0	0	0	0	0	0	0	0

*LOA = Living Out Allowance.

Notes:

Apprentices: The hours under 1st year apprentices are for the total pool of apprentices. Actual amount of 1st year, 2nd year etc. will be according to worker availability.

Travel km: Based on a schedule of 21 work days/7 days off, and an average distance traveled to the provenance airport of 175km.

EXHIBIT 3

COORDINATION PROCEDURES

TABLE OF CONTENTS

1 INTRODUCTION

This Exhibit 3 – Coordination Procedures is intended to govern Contractor and Company in the administration and management of the Agreement.

Contractor shall use its own systems, methods and procedures in the administration of the Work. However, Company has certain requirements regarding Agreement administration, monitoring and coordination, consistency and project controls with which Contractor shall comply. These requirements are described in this Exhibit 3. Where necessary, Contractor shall adapt its own systems, methods and procedures to satisfy such Company requirements.

It is Company's intention that Company and Contractor work together to mutually agree on a set of methods and procedures for performing the Work. In this regard, Company will require a series of meetings in Company offices immediately following Effective Date. During the meetings, Contractor and Company will review Contractor's proposed methods and procedures for executing the Work. Following this review, the Parties will agree on any modifications to Contractor's methods and procedures required to satisfy the requirements of this Exhibit 3.

The following additional Exhibits have been provided to specify Company requirements and Contractor responsibilities with respect to Health and Safety Requirements (Exhibit 5), Environmental and Regulatory Compliance Requirements (Exhibit 6), Quality Requirements (Exhibit 7), Site Conditions (Exhibit 12) and Provincial Benefits (Exhibit 13).

2 EARLY ACTIVITIES AND GENERAL EXECUTION

2.1 SCOPE

This Section 2 sets forth minimum early activities associated with preparation for execution as well as general execution activities.

2.2 OBJECTIVES

Contractor shall employ a systematic management approach to the Work embracing sound management principles, including:

a) Finalization of an Execution Plan as it pertains to the Work (as described in Section 2.4 below); and
b) Understanding of and alignment with Company's objectives, priorities, and philosophies with the aim of Contractor developing appropriate plans and procedures.

2.3 CONTRACTOR DUTIES

Contractor shall:

a) Review Contractor's proposed Execution Plan with Company. Update the plan with all Accepted changes and enhancements and maintain on an ongoing basis;
b) Participate in meetings, as scheduled by Company, to mutually agree on methods and

procedures for performing the Work. Meetings shall be held in Company offices and may be scheduled to begin within fourteen (14) days of the Effective Date and shall be completed within forty-five (45) days of the Effective Date;

c) Provide all information requested by Company to support Company's appraisal of Contractor's performance of the Work, including performance of Subcontractors. Such information may include, without limitation, Contractor's systems, methods and procedures for performing the Work; copies of calculations, working drawings, specifications, purchase requisitions and recommendations (if applicable); estimates; labor productivity data; schedules; procedures; and alternative studies;

d) Contractor shall maintain close management alignment with Company during execution of the Work;

e) Actively support and participate in project reviews as required by Company and as they relate to the Work.

2.4 SPECIFIC REQUIREMENTS

Early Deliverables

A list of all early deliverables and the timing of their submission to Company is specified in Exhibit 4 - Supplier Document Requirements List.

Execution Plan

Contractor shall make all changes based on Company's comments and submit a final Execution Plan (based on the bid submission Execution Plan) to Company for Acceptance by the date specified in Exhibit 4 – Supplier Document Requirements List. The Execution Plan will serve as the basis for developing the detailed plans for the Work.

The Execution Plan shall:

a) Document the results of the overall planning process for the Work. The Execution Plan is a framework from which will evolve execution strategies and approaches, work plans, risk identification and mitigation plans, detailed procedures, organizational structures, logic networks, schedules and other material needed by Contractor's Personnel to develop execution details and Contractor's plans for the Work, including detailed fabrication and construction plans;

b) Document Contractor's objectives, priorities and philosophies that are based on and consistent with Company's objectives, priorities and philosophy for the Work; and

c) Outline formalized processes to be employed to identify broad strategic issues, evaluate impact, develop mitigation measures/action plans, and to follow-up on results of mitigation measures/action plans.

Contractor shall maintain the Execution Plan as a living, working document. Changes to such plan will be subject to the review and Approval of Company. As changes arise, Contractor shall identify and document critical issues and/or potential constraints that could adversely affect the accomplishment of Company's objectives for the Work and shall submit such changes to

Company for Approval.

Coordination Teams

As one of the early project activities, coordination teams will be established at various levels within Contractor's and Company's organizations. Contractor and Company will mutually agree on the composition of each team and agree on the frequency of meetings. If there is a failure to agree on such composition and/or frequency, Company Representative shall have the authority to determine these matters.

The initial meetings of the coordination teams will be to:

a) Develop positive working relationships between team members;
b) Develop plans to meet objectives, guidelines for individual and team behaviors, and teamwork, and determine Contractor / Company success criteria;
c) Identify and review, as appropriate by team, challenging areas or areas of opportunity which require special attention; and
d) Establish the initial framework for the specific plans for the Work as referenced in this Exhibit 3.

3 ORGANIZATION, ADMINISTRATION AND REPORTING

3.1 CONTRACTOR DUTIES

Contractor shall:

a) Submit proposed, and Accepted or Company Approved organization charts, identifying key positions required for executing the Work. These shall be included within the Execution Plan;
b) Provide information required by Company and seek Company's Approval on matters as required by the Agreement;
c) Participate in regular meetings with Company and Company's Other Contractors to discuss the status of the Work, methods for resolving problems encountered or anticipated, and other topics pertinent to the Work;
d) Produce timely, accurate and consistent progress reports for the Work that facilitate proactive management of the Work;
e) Provide to Company Group Personnel offices, logistical support and facilities at Contractor's offices and the Worksite(s), as outlined in the Agreement and as required by Company;

3.2 SPECIFIC REQUIREMENTS

3.2.1 CONTRACTOR ORGANIZATION

Within the time specified in Exhibit 4 - Supplier Document Requirements List, and to be included in the Execution Plan, Contractor shall submit a description of its project organization for the Work indicating clear lines of decision making, authority and responsibility addressing as

a minimum the following:

a) Project management organization;
b) Health and Safety management organization both at home office and for the Worksite(s);
c) Quality management organization, including Quality Manager, Worksite(s) quality organizations and vendor inspection organization;
d) Engineering management organization;
e) Technical Interface management;
f) Newfoundland and Labrador Benefits Management;
g) Regulatory and environment organization(s);
h) Procurement organization, including purchasing, subcontracting and material management for both Contractor's home office and for the Worksite(s);
i) Project controls including cost and schedule management for both Contractor's home office and for the Worksite(s);
j) Technical organization, including engineering, design, constructability and document control;
k) Construction Worksite(s) including engineering support, planning, cost and schedule control, material management, quality, safety and construction operations (including field supervision);
l) Completions organization; and
m) Start-up organization.

Each organization within the overall organization of the Work shall have key Personnel assigned and have designated authority and responsibility for the given portion of Work.
For each position designated as being key Personnel, the following information shall be provided:

a) Roles and responsibilities;
b) Job titles;
c) Approval authority assigned to each position;
d) Contact address(es) and telephone number(s); and
e) Candidate's most recent resume.

Contractor shall update the organization charts, contact addresses and phone numbers as changes occur to the Work, as Contractor's overall organization changes or as requested by Company.

The organization charts shall clearly indicate how and to whom Contractor's organization for the Work reports in its home and/or any affiliated offices and the relationship of Contractor's organization for the Work to its corporate and/or departmental organization.

Listed below are Contractor's key Personnel for the management, control and execution of the Work. Contractor shall maintain up-to-date organization charts, which shall be submitted to Company in the event of changes.

POSITION DESCRIPTION (TITLE)	
Contractor's Representative	Mathieu Bertrand
Project Engineer	Lucio D'Alessandro
System Engineer – Hydro-Mechanical Equipment	Gerhard Kohlberger
Commercial Manager	Nicole Hu
Documentation Control	Mary Grace Balenzano
Project Scheduler	Maryam Darvish
Quality Manager / Vendor Quality Planner	Antoine Prévault / Franz Hanger
H&S Manager	Antoine Prévault / Marcel Labelle
Environmental Manager	Antoine Prévault
Site Coordinator / Site Manager	Michele Castelli / Denis Côté
Equipment Manager	Michele Castelli / Denis Côté
HSE Site officer	Rosana Villa Vergara

Key Personnel shall be assigned on a full time basis and be committed to continue until Substantial Completion in order to maintain continuity. The appointment, transfer and replacement of key Personnel shall be subject to Company's prior Acceptance.

3.2.2 CORRESPONDENCE AND COMMUNICATION REQUIREMENTS

Correspondence and Notices

Company and Contractor shall jointly establish a correspondence plan and procedures which shall be periodically updated and kept current.

Aconex shall be utilized to manage all written communication between Company and Contractor. Aconex is an electronic document management system which is a secure, on-line platform for storing, managing and distributing project information that can be accessed via an internet connection and a web browser (www.aconex.com). The implementation of Aconex Mail will be coordinated during the kick-off meeting between Contractor and Company.

The Aconex module, "LCP Rev Controlled", will be utilized for all technical documentation (refer to the document entitled "LCP Supplier Document Requirements" provided in Exhibit 11 - Company Supplied Documents).

Administration:

A. All formal correspondence and notices relating to the Agreement shall be exchanged between Contractor's Representative and Company's Representative, using official letterhead and submitted c/o Company's Document Control via Aconex and shall carry the following: subject, date, and reference correspondence. Letters will be, to the degree possible, specific to one subject matter.

B. All deliverables, as defined in the Agreement, shall be exchanged between Contractor's Representative and Company's Representative to be defined per each deliverable.

C. All Agreement deliverables shall be submitted to Company's Representative, c/c Company Document Control via Aconex, using a uniquely numbered document transmittal.

D. All information exchanged shall be managed in accordance with Coordination Procedures, Section 14 – Information Management and all associated standards and procedures.

Company and Contractor Representatives

All formal correspondence, documents and Agreement deliverables required by the Agreement, including this Exhibit 3, from Contractor to Company shall be addressed to the Company Representative. Likewise all correspondence from Company to Contractor shall be sent to Contractor's Representative.

Company Representative

The Company Representative has the responsibility of managing the Agreement on behalf of Company, including Approval of Changes, amendments to the Agreement and issuance and receiving of Notices.

The Company Representative has the authority to stop the Work for the purposes of safety, quality and risk of damaging Company property under the care, custody and control of Contractor. Notification of stoppage can be addressed verbally, and then supported by writing. Contractor shall resume Work when appropriate actions are addressed to the satisfaction of Company. No compensation will be provided for Work stoppages of this nature.

The Company Representative may delegate any of his or her responsibilities to any nominated deputy. Notice of delegation shall be provided to Contractor's Representative in writing.

Contractor's Representative

Contractor shall appoint a Contractor's Representative for the Work, who shall have full authority to receive instructions and administer the Agreement for and on behalf of Contractor, in addition to those authorities stated in the Articles of the Agreement.

The Contractor's Representative shall have the responsibility for receiving, acknowledging, countersigning and returning any instructions, decisions, Notices, authorizations and acknowledgements to Contractor under the Agreement, in addition to those responsibilities stated in the Articles of the Agreement. Contractor's Representative shall also be responsible for administering, monitoring, reviewing and coordinating all aspects of the Work on behalf of Contractor.

Contractor's Representative may delegate any of his or her responsibilities to any nominated deputy upon prior Notice to the Company Representative. Notifications, information, authorizations, acknowledgements and decisions from any such nominated deputy shall be as if from Contractor's Representative.

3.2.3 REPORTS AND MEETINGS

Contractor shall submit reports to Company on the progress of engineering, procurement, construction and completions, and on the status of other activities for the Work as otherwise provided below and other provisions in this Exhibit 3 (See Section 7.7 for further details).

Weekly Report

Contractor shall submit a weekly report ("Weekly Report"), which shall reflect the current status of the Work, progress and issues. The timing, format and content shall be as agreed between Contractor and Company, but shall address the following as a minimum:

- Brief summary of status of the Work;
- Management and administration;
- Significant items planned for the following weeks;
- Health, safety and environment;
- Quality management;
- Highlights and concerns including any required and implemented corrective action in all of the following main areas:
  - engineering
  - procurement
  - manufacturing
  - fabrication
  - construction
  - installation
  - completions;
- Interface activities;
- Status of Change Requests; and
- Receipt of major components and/or materials at the Site.

Monthly Progress Report

Contractor shall submit a monthly progress report ("Monthly Progress Report") based on a cut-off date of the 25th of each month.. The timing of the submission of this report shall be by close of business no later than the 5th calendar day of the following month. The first Monthly Progress Report shall be issued not later than forty-five (45) calendar days after the Effective Date. The format and content of the Monthly Progress Report shall be as agreed between Contractor and Company, but shall address the following as a minimum:

a) Highlights, in bullet point style, of the significant accomplishments achieved and issues addressed during the reporting period;
b) A description of problems or delays encountered or anticipated, and corrective actions initiated or contemplated to counteract or minimize the effect of such problem, together with the results of any corrective actions already taken;

c) The Worksites' safety status including health and safety statistics for the past month and for the Work to date. The content and format for the safety statistics are provided in Exhibit 5 – Health and Safety Requirements. Major safety problems shall be highlighted and action plans to improve conditions outlined. Safety initiatives undertaken during the past month and/or planned for the forthcoming month shall be discussed;
d) Short narrative covering all significant events during the reporting period;
e) Management, including mobilization, systems implementation, procedures development and other administrative activities;
f) Current status of the Work. Progress data (progress curves, histograms, productivity information and Summary Schedules) shall be provided on graphs which show actual versus planned progress as further described in Section 7 of this Exhibit 3 for: (i) engineering, (ii) equipment and materials orders, (iii) equipment and materials deliveries at the Worksite(s), (iv) construction, (v) completions and (vi) overall Work progress. For activities that are behind schedule, an analysis of reasons for the slippage shall be included, together with a description of actions to be taken to recover;
g) All constructability issues;
h) The quality status including quality statistics for the past month and for the Work to date;
i) Interface management status;
j) Cost and financial reports as defined and/or specified in Sections 6 and 12 of this Exhibit 3;
k) The status of planning, scheduling and schedule control, including coverage of relevant activities called for within Section 7 of this Exhibit 3;
l) The status of Changes, if any, and the corresponding current value of the Contract Price including the effect of Change Orders and Change Requests;
m) The status of procurement and subcontracting, including placement of Subcontracts, status of spare parts orders, performance of Subcontractors (including Subcontractors' subcontractors of every tier), and Subcontract administration matters;
n) The status of items involving Authorities such as inspections, approvals, permits, clearances and licenses, as further described in Exhibit 6 - Environmental and Regulatory Compliance Requirements;
o) Provincial Benefits report as described in Exhibit 13 – Provincial Benefits;
p) Monthly risk report consisting of the following:
    - A structured narrative that describes major risk activities and events during the reporting period containing major changes in the Risk Register (as defined in Section 9.1(c) below) with a focus on medium and high level risks;
    - Highlights of five (5) to seven (7) most important package risk management activities and events; and
    - An updated Risk Register (as defined in Section 9.1(c) below); and
q) Status of planned tests and/or hold points.

Final Contract Report

A final report summarizing the Work shall be submitted by Contractor to Company Representative for Approval, the content and timing of which shall be specified by Company Representative.

Meetings

Meetings of key Contractor's Personnel, Company Representative and/or Company Personnel, shall be held regularly.

Monthly and weekly progress meetings will be held, details of format and content of which will be as agreed between Contractor and Company.

Company may hold other meetings with Contractor to discuss matters of technical, interface management, health, safety, environmental, design, quality, verification, certification, documentation, engineering data, cost, accounting, scheduling, construction, progress and the like, and as may be otherwise required for the Work and the Agreement. Contractor shall ensure sufficient and appropriate qualified Personnel are available to attend.

In general, meetings shall adhere to the following guidelines:

a) The agenda items for any meeting will be issued to the Parties no less than two Business Days prior to such meeting. Company and Contractor shall ensure, in accordance with their respective responsibilities, that reports, reproducible documentation and forward planning information relating to agenda items are issued in sufficient time to allow adequate preparatory study and evaluation;
b) The meeting will address only the items covered by the agenda and any other minor topics relevant to the Parties and subject concerned;
c) In those instances where matters of urgency need to be addressed, Company and Contractor will make every effort to address such items at the earliest opportunity; and
d) It shall be the responsibility of Contractor to record minutes of all meetings unless otherwise instructed by Company. Minutes should be brief, indicate with whom the responsibility for action lies, the date the action was assigned and the date required for completion of such action. Minutes should also state the results of assigned actions outlined in previous minutes, including the actual date of completion of the action.

Photographs

Contractor shall provide photographs as Company may request of sufficient quality for possible inclusion in Company's publications depicting significant activities and general progress of the Work.

3.2.4 INFORMATION SYSTEMS AND TECHNOLOGY (IS/IT)

Contractor shall:

a) establish and maintain an IS/IT infrastructure and associated computing environment to ensure overall reliability, performance and security control;
b) provide access, for Company and Company Personnel, to any software applications and supporting services required in order for Company to perform their work;
c) maintain an upgrade path for electronic formats that will keep data formats compatible with that of Company;

d) securely transfer data and information electronically to Company on a timely basis using industry recognized standards, processes, systems and methodologies;
e) ensure control practices and risk mitigation plans are in place to provide protection and safeguard for all data and information related to the Work including but not limited to access management, data corruption, data loss, backup and disaster recovery procedures; and
f) provide to Company a description of the IS/IT support organization and how it is structured to support the Work.

3.2.5 DATA

All documentation and information, including correspondence, notes reports, information identified and/or required by the Agreement, drawings, specifications, schedules, weekly, bi-weekly and/or monthly reports, databases, records, videos, photos and other documents (hereinafter collectively referred to as "Data") shall be made available to Company in electronic PDF format as well as hard copy. Contractor will provide only the system diagrams, interface and as-built drawings in native file format The transfer of Data will be by storage medium such as optical or magnetic discs. Contractor shall undertake all reasonable efforts to ensure Data is provided in a form fully useable to Company with well recognized industry standard applications.

3.2.6 FACILITIES AND SERVICES FOR COMPANY PERSONNEL

Facilities Provided for Company by Contractor

A. Where individual Company Personnel are assigned to Contractor office(s) for extended periods of time, office space and office equipment (no computer) shall be provided to the standard afforded to Personnel of equal organizational level within the Contractor's organization.
B. Where individual Company Personnel are required to visit other Contractor office(s), temporary space shall be provided, which shall include a fully equipped (no computer) office space with phone and internet connections.

4 INTERFACE MANAGEMENT

Contractor shall manage external interfaces with other organizations involved in the LCP, including Company Representative, Company's Other Contractors and their subcontractor(s) and vendor(s) of every tier, Authorities and other entities associated with the Work. Refer to Scope of Work Specification for further information on interfaces at each of the worksites.

4.1 OBJECTIVES

Contractor shall:
a) Have primary responsibility for managing technical and execution interfaces and thus coordinating its activities with other organizations as required to effectively accomplish

the Work;

b) Identify major interfaces early in the Work through a structured process;
c) Define the interface information needed for the Work. Contractor and other interfacing entities (including originating and responding organizations) shall then agree on roles, responsibilities and timing for providing agreed upon information or actions;
d) Ensure that all communications with other organizations shall be clear, accurate, timely and consistent to accomplish their intended purpose of transferring information between organizations or ensuring agreed action is taken to progress the Work;
e) Ensure that interface resolution issues with potential for impacts to cost or schedule shall be identified quickly and communicated to all interfacing entities, including Company, in order to minimize their impact; and
f) Cooperate with Company and comply with the requirements of Company's interface management system as it relates to the Work.

4.2 SPECIFIC REQUIREMENTS

Contractor shall:

a) Develop an interface management plan and shall implement systems and methodology for ensuring the identification of originators and responders, quality, accuracy and timeliness of interface information;
b) Incorporate the schedules for submittal of its deliverables (as determined by interface management activities) as Milestones in Contractor's schedule for the Work. Contractor shall manage compliance with such Milestones accordingly;
c) Schedule and participate in interface coordination meetings with Company, Company's Other Contractor(s), and their subcontractor(s) and vendor(s) of every tier, and other organizations, as required to properly manage interfaces; and
d) Regularly advise Company on the status of resolution of interface issues. Contractor shall promptly elevate unresolved interfaces and interface issues to Company for resolution.

5 PROCUREMENT AND MATERIAL MANAGEMENT

Contractor shall maintain records of materials procured for the Work. Company will have the right to carry out periodic inspection of all Contractor's storage and inventory control records for the Work as well as physical spot checks of all material held in storage.

A logistics and transportation plan shall be produced by Contractor and submitted to Company by the date specified in Exhibit 4 – Supplier Document Requirements.

5.1 COMPANY SUPPLIED ITEMS

Contractor shall:

a) Receive from Company any Company supplied items associated with the Work and as applicable unload, unpack, inspect, and confirm receipt and condition of receipt by issuing a material receiving report to Company confirming Contractor acceptance of items and the condition of items at the time of acceptance;

b) Ensure that all materials are used correctly and no materials are substituted without prior Company Approval;
c) Be responsible for the security and safe keeping, in accordance with good industry practice and Company's and the manufacturers guidelines/instructions for preservation and storage, any Company supplied items associated with the Work and ensure all items are visually marked as being provided for the Work;
d) Maintain index records and account for any Company supplied items received and installed, and the remaining surplus and scrap. The index shall, at a minimum, include description, part number, serial number, storage location, status and receipt date;
~~e)~~ Be responsible for any costs incurred as a result of Contractor's failure to properly store, preserve and protect Company supplied items.

Company shall:
a) If applicable, supply Company supplied items complete with available documentation to demonstrate traceability and quality assurance to Contractor; and
b) Have the right to inspect Company supplied items at Contractor's and Subcontractor's storage location(s) and storage records at any time without prior Notice. Such inspection shall not relieve the Contractor of any responsibility for the accountability and safe keeping of Company supplied items.

6 COST MANAGEMENT

Cost Control of Accounts

Company will provide cost control accounts to Contractor within thirty (30) days of the Effective Date. The cost control accounts will be cross referenced to the compensation amounts outlined in Exhibit 2 – Compensation.

Cost Report

Contractor shall submit an estimated incurred cost flow report, consistent with the control accounts and payment elements contained in Exhibit 2 – Compensation based upon a cut-off date of the 25th of the month. This report shall be by month for the duration of the agreement (monthly forecast of incurred cost) and shall be submitted by the 20th of each month. Accordingly, the final five day period of the month shall be estimated. It is understood the Contractor will not disclose any of its actual costs. The report will provide approximate dollar amounts In a format similar to the reports generated under contract CH0030.

Contractor shall prepare a finance report to be included as a section of the Monthly Progress Report. Reporting will be consistent with the control accounts and payment elements contained in Exhibit 2 – Compensation. Contractor shall submit to Company a sample cost report for Company's Approval. In general, the finance report shall address the following as a minimum:
a) Contract Price and all changes thereto;
b) Forecast final Contract Price (previous period, current period and monthly variance);

c) Reimbursable cost status, if applicable;
d) Change Order status;
e) Contract incurred cost flow described above (actual/forecast); and
f) Invoice and payment status, including cash flow forecast by currency.

7 SCHEDULE MANAGEMENT

This Section 7 sets forth the minimum requirements for Contractor's planning, scheduling, measurement and reporting of physical progress, and schedule control activities for the Work.

7.1 DEFINITIONS

a. **Earned Value Management**: A method to measure the value of Work performed. Earned value uses current budgets and progress-to-date to show whether the incurred values are on budget and/or whether the tasks are ahead or behind the Approved Control Schedule. A method for measuring Work productivity and performance; it compares the effort of Work that was actually expended with what was physically completed.

b. **Control Schedule (CS):** The Control Schedule forms the basis to measure progress in which cost, schedule, scope and other performance criteria are formally compared against the Approved Control Schedule Baseline Document for assessment of progress and performance. The Control Schedule forms the benchmark for comparison and identification of cost and schedule deviations. The Control Schedule shall represent the total Work execution and interfaces with others (Milestones, key dates, design, procurement, regulatory, fabrication and manufacturing, transportation, installation, construction and completion – both static, dynamic and support to operations) covering the entire duration of the Work, and includes roll-up details of all Contractor's schedules. The Control Schedule is to be a schedule network, which is calculated using the critical path method. Contractor will ensure that the Control Schedule aligns with Exhibit 9 – Interface and Milestone Schedule. The Control Schedule shall be developed using Primavera (P6 or later version) or equivalent. If software other than Primavera is used, the native file shall have the capability to be easily converted to Primavera P6 and shall be subject to the Acceptance of Company.

c. **Milestone:** The start or completion of an activity in the performance of the Work and which is identified as such in Exhibit 9 – Interface and Milestone Schedule.

d. **Control Schedule Baseline Document (CSBD):** A series of schedules, s-curves, histograms, tables and narrative which together form the basis of the plan to complete the Work. The Control Schedule Baseline Document is updated and re-issued following re-baselining of the Control Schedule. The CSBD includes the Control Schedule, as well as critical and near-critical path(s). The Control Schedule Baseline Document shall provide supporting documentation to the Control Schedule. It shall include all baseline assumptions regarding schedule durations, logic, installation rates, progress weighting and relevant material as deemed necessary by Company.

e. **Summary Schedule (SS):** The Summary Schedule incorporates all Milestones and is a roll-up of schedule information from the detailed Control Schedule such as engineering, procurement, construction, fabrication, installation and completions (static and dynamic to be shown separately) and any subject deemed necessary by the Company to adequately convey a rollup or the CS.

f. **Schedule Development and Control Plan (SDCP):** A formal document providing the approach to planning and schedule control including schedule development, analysis, forecasting, reporting, corrective action and the method for incorporation of Changes. The SDCP addresses the scheduling interfaces between Contractor and Subcontractors, as well as Contractor and Company. In particular, the plan shall provide a detailed description of Contractor's progress measurement system including how Contractor measures, verifies and reports physical progress of each major activity of the Work (such as engineering, procurement, fabrication, manufacturing, permitting, transportation, construction/installation and completion).

g. **Monthly Cut-Off Date**: The month end date that Contractor uses as a basis to compile its progress during the month. The Monthly Cut-off Date will be agreed between Contractor and Company based on the nature of the Work. If there is a failure to agree on such date, Company shall have the authority to determine the date.

h. **Monthly Risk Statement**: Indicates the major risks identified during the month that could represent a threat to the success of the Work, the contemplated mitigation measures for newly identified risks and the actions status pertaining to mitigation measures proposed for previously identified risks.

i. **Monthly Progress Report:** The monthly report which is described in Section 3.2.3 of this Exhibit 3.

j. **Weekly Report:** The weekly report which is described in Sections 3.2.3 and 7.7 of this Exhibit 3.

7.2 CONTRACTOR DUTIES

With respect to planning, scheduling and schedule control of the Work, Contractor shall:

a) Prepare, implement and maintain a Schedule Development and Control Plan (SDCP) in accordance with the date specified in Exhibit 4 – Supplier Document Requirements List for the Work using methods and procedures that are in accordance with Good Utility Practice;

b) Analyze and calculate earned quantities, man-hours and costs, and forecast and report the progress of the Work using industry recognized Earned Value Management practices as compared to current Work plans and overall schedule, summarizing the results of the schedule analysis in the Monthly Progress Report, which shall include a Milestone listing with target dates and current forecast dates;

c) Develop recovery plans and associated schedules if slippage is apparent, or as required by

Company. Recovery plans will be reviewed with Company and implemented upon Company's Acceptance. Recovery plans will be monitored and adjustments made as needed to keep the Work on schedule;

d) Incorporate the results of progress measurement and related status information into schedule forecasts, Weekly Reports and Monthly Progress Reports, as required under the Agreement;
e) Provide access to all details of schedule preparation, progress measurement and schedule updates when requested by Company;
f) Make changes in the schedule preparation, progress measurement and schedule control procedures at Company's request;
g) Utilize agreed Company's progress measurement definition strategy. Actual progress shall be based on physical Work completed measured against the current Work;
h) Provide Company with the Control Schedule (CS) with the baseline estimate that will hold the mechanism of measuring progress in hard copy and electronic form, in accordance with the date specified in Exhibit 4 – Supplier Document Requirements List. The native electronic file shall include all information necessary to duplicate Contractor's schedule, progress measurement analysis and resource requirements. In addition to the electronic file, the schedule software settings, calendar definitions and application generated scheduling report shall be included;
i) Take the initiative to propose potential corrective actions whenever there is an identified trend which indicates that a Milestone will not be achieved or indicates an opportunity to shorten the overall schedule, or counteract potential schedule slippages; and implement the action(s) as Accepted by the Company; and
~~j)~~ Provide a Control Schedule Baseline Document (CSBD) in accordance with the date specified in Exhibit 4 – Supplier Document Requirements List, with all supporting documentation. The (CSBD) shall be re-issued each time the (CS) is re-baselined.

7.3 SCHEDULE DEVELOPMENT AND CONTROL PLAN (SDCP)

Contractor's Schedule Development and Control Plan shall cover all areas of schedule development and control, including development, analysis, forecasting, reporting and corrective action. In particular, the plan shall provide a detailed description of Contractor's progress measurement system.

Contractor's Schedule Development and Control Plan will, at a minimum, include:

a) How Contractor's detailed schedule and current Work plans will be developed, reviewed and updated;
b) Methodology that Contractor will use to analyze and forecast the progress of the Work relative to current schedules;
c) How interface management will be addressed. Interface management includes all key internal interfaces within the Work as well as all key interfaces between the Contractor, Subcontractors and Company's Other Contractors. The plan will define how interfaces are identified, stewarded and their status reported;
d) How interfaces, outside of Contractor's control, could impact the Control Schedule;
e) The number, types, uses, frequency of updates (and responsibility for updates) and level of

detail for each of the various schedules the Contractor intends to use to control the Work;

f) Methods for analyzing critical path and conducting float analysis;
g) Procedure for re-baselining the Control Schedule (subject to Company's Acceptance);
h) Coding system for schedules;
i) The methods that will be used to measure physical progress of each of the various activities or groups of activities in engineering, procurement logistics, fabrication, manufacturing, installation, construction and completions. Methods for engineering shall specifically address use of computer aided design and drafting (CADD), both 2D and 3D;
j) Procedures within Contractor's organization for review and verification of progress measurement information prepared at each Worksite;
k) The methods to control over progressing of activities; and verification methods confirming that all activities reported as 100% complete are actually complete;
l) The method for recognizing the impact of rework on apparent progress, during engineering, procurement, fabrication, construction and completions and the method for specifically progressing and tracking the Work;
m) The methods and procedures for incorporating the effects of Changes on the assessment of progress;
n) The method for weighting and combining individual and overall progress measurements to arrive at the discipline and overall progress assessments for engineering, procurement, fabrication, installation, completions and other major activities related to the Work. Progress weightings shall be subject to Company's review and Acceptance, and once Accepted shall not be changed without Company's prior Acceptance; and
o) Contractor plans to manage and report receipt of materials and/or components at the Worksites.

7.4 CONTROL SCHEDULE BASELINE DOCUMENT (CSBD)

Contractor shall prepare and submit to Company for its review and Acceptance the Control Schedule Baseline Document in hard copy, portable document format (PDF) and native electronic format. All information required to reproduce the Control Schedule Baseline Document including scheduling software settings, working calendars, application time conversion factors, and precedence and scheduling output reports from the scheduling software, will be included with the submission.

The Control Schedule Baseline Document shall be organized into an overall summary section and a detailed section for each component of the Work (such as engineering, procurement, manufacturing, fabrication, testing and handover). Each section shall be organized as follows:

a) Assumptions underpinning the execution methodology and Control Schedule, as well as any issues that may impact the Work. This section will also include the basis for any planned changes to the Control Schedule;
b) Summary Schedule;
c) Progress curve and table;
d) Critical and sub-critical path(s); and
e) Detail schedule.

7.5 CONTROL SCHEDULE (CS)

A detailed Control Schedule for the Work will be prepared by the Contractor and submitted to Company for Approval. Contractor shall develop the Control schedule in accordance with Company's work breakdown structure and code of accounts for the Work. The detailed schedule will contain sufficient detail to demonstrate how all activities affect the, Work and Exhibit 9 – Interface and Milestone Schedule.

The Control Schedule will show activities that provide sufficient detail in all areas of Work execution (such as Milestones, key dates, design, procurement, fabrication, manufacturing, transportation, installation, construction, completions and all relevant interfaces) to enable monitoring and control of the Work. Schedule forecasts will give a complete and accurate representation of the current status of the Work, including impacts from delays and advancements, Change Orders and the consequences of productivity.

7.6 GENERAL SCHEDULING AND PROGRESS REQUIREMENTS

Contractor's planning, scheduling and schedule control activities for the Work will, at a minimum, include the following:

a) A time-scaled critical path method (CPM) logic network that shall set forth the order and estimated times by which planned activities are to be completed. This network shall identify the critical and subcritical paths (a subcritical path is defined as any series of activities whose completion is within one (1) week of the critical path completion). The logic network shall clearly indicate all restraints and interrelationships and shall incorporate Exhibit 9 – Interface and Milestone Schedule;
b) A description of those activities associated with material sources, Subcontractors and fabrication. All interfaces will be incorporated into the Control Schedule;
c) All schedule and progress information (CS, SS, tables, histograms, s-curves, document register, procurement plan, manufacturing schedule and support documentation) shall be issued on a monthly basis;
d) Progress measurements such that the physical progress of the Work can be related easily to the Control Schedule activities. Progress shall be evaluated on discrete, identifiable deliverables for each Work activity weighted by budgeted person hours or other methods to determine a total percent for each activity. Physical progress measurement relates to the assessment of the proportion of actual Work accomplished towards completion of given components of the Work;
e) The ability to assess progress for all progress earning activities required for each component of Work, regardless of source. As additional progress earning components are identified, they will be added to the base level of Work through the change management process, to be accomplished and progress measured and reported;
f) Indicate the schedule calendars used to develop the schedule including, daily work hours, work week, shift schedule, scheduled facility shutdowns (if any) and holidays. Any planned non-work periods shall be clearly indicated and a narrative shall be supplied indicating the period of non-work and the rationale for the non-work period;

g) Show status of all interfaces within the components of the Work (such as engineering, procurement, manufacturing, fabrication, construction and completions);
h) Exclude home office and field support functions, such as project management, coordination, engineering office follow-up during construction, construction and fabrication management and supervision, warehousing, material handling and clean-up, from physical progress measurements;
i) Produce and maintain a schedule network that is logically linked, with a minimal number of constraints utilized. Where constraints are required, the fewest possible constraints necessary to meet the required objective will be used. The reason for the constraint shall be noted in the notebook file for that activity. Constraints that affect the backward pass calculation of the network ("Mandatory Finish", "Mandatory Start", "Finish On Or Before", "Start On Or Before", "Finish On", "Start On") are to be strictly avoided, unless Accepted by Company;
j) Use of activity lags is discouraged. Where the use of lags is considered, Contractor shall consider if the use of an activity to represent the lag is a reasonable representation of the condition being modeled. If a lag is used, the reason and rationale for the lag shall be noted in the notebook file for that activity;
k) Scheduling option that retains the current logic ("retained logic") of activities started out of sequence will be used. Where necessary, the logic for those activities for which the relationship is no longer applicable will be manually changed;
l) Schedule time forecasting shall not be based upon the percentage of schedule completed. The scheduling control software function for linking remaining duration and such percentage shall be disabled;
m) Control Schedule will be structured to provide five (5) activity code fields, for summarization and reporting purposes, for exclusive use by Company. Each code field will be ten (10) characters in length and will be titled LCP1, LCP2, LCP3, LCP4 and LCP5. Company will provide the applicable coding to Contractor for inclusion within these code fields. Contractor will populate and maintain these code fields for all schedule activities;
n) Schedule calendars and activity codes will be prefixed with the six character package identifier and a dash (for example, "CD0502-"). This is to prevent potential data errors in the Company's planning system;
o) Schedule activity descriptions shall clearly identify the work associated with the activity, and shall be consistently applied throughout the schedule;
p) Activity durations shall not, in general, exceed twice the update frequency;
q) Start to Finish (SF) relationship types shall be avoided;
r) Open ends within the schedule network shall be avoided;
s) Network logic shall be consistently applied throughout the schedule;
t) The "Work Breakdown Structure" (WBS) shall not be the only coding system used within the schedule network. Activity codes are required to enable effective schedule development, review and analysis;
u) Gantt or bar chart displays shall have the current schedule bar assigned to position 1, with the baseline schedule bar assigned to position 2; and
v) Company will have access to all supporting documentation.

7.7 PROGRESS REPORTING

Contractor shall provide Weekly Reports and Monthly Progress Reports as described in Section 3 of this Exhibit 3 and, with respect to progress reporting, as more fully detailed below:

a) Weekly Reports shall include the following:
   - An updated resourcing plan showing the resources assigned to the project in accordance with the Contractor's Organization Chart Progress table including quantities/statistics for current engineering, procurement, and fabrication/construction/installation/completions activities;

b) Monthly Progress Reports shall include the following:
   - Planning and schedule control reports will be updated and issued monthly. Reports shall include the Control Schedule, Summary Schedule, tables, resource histograms, progress s-curves, document register, procurement plan, manufacturing schedule and support documentation. Contractor shall supply a copy of the schedule using Primavera (P6 or later version) or equivalent, as well as hard copy format. If software other than Primavera is used, the native file shall have the capability to be easily converted to Primavera P6 and shall be subject to the Acceptance of Company;
   - Deviations from schedule in time or progress, reasons for delays and deviations with recommended actions for recovery;
   - Status of planned tests and/or hold points;
   - Tabulation of project man-hours addressing planned, actual and forecast at completion;
   - Progress table including quantities/statistics for current engineering, procurement, and fabrication/construction/installation/completions activities; and
   - Identification of critical and sub-critical path(s).

8 CHANGES TO THE WORK

8.1 INTRODUCTION

This Section 8 sets forth minimum requirements for identifying and processing Changes in support of Article 26 of the Agreement and Exhibit 2 - Compensation.

Changes will be initiated in one of two ways:

a) by completing a Change Request, in the form as attached to this Exhibit 3 as Appendix A – Change Request; or
b) by the issuance of a Change Order.

Contractor shall specify its assessment of cost and schedule impacts in each Change Request or proposal presented in accordance with this Section 8.

If Company issues a Change Order to proceed with a Change on a reimbursable basis, Contractor shall prepare daily time sheets for Company's signature covering such Change and submit them to the Company within twenty four (24) hours where the Change is performed on

Site, or within one (1) week where the Change was performed elsewhere, after such Change has been performed. Company's signature of Contractor presented time sheets shall not commit Company to any particular payment in respect of the Change, but shall serve as a record of events in the eventual resolution of any difference of opinion between Company and Contractor regarding the cost or schedule impacts of the Change. Contractor shall also present details of its assessment of any effect of the Change on the Control Schedule. Neither Company's issuance of such a Change Order or Contractor's performance of Change Work pursuant to such Change Order shall prejudice the Party's respective position regarding the appropriate compensation and/or schedule impact of such Change Work. Changes performed on a reimbursable basis will be priced and paid for as per Sections 3, 4, 5, 6 and 7 of Exhibit 2 - Compensation.

Company will be entitled to an equitable reduction in the Contract Price and/or an equitable adjustment of the Control Schedule in respect of any reduction in the Work pursuant to a Change Order and in accordance with the provisions of Article 26 of the Agreement, Exhibit 2 - Compensation and this Exhibit 3.

Contractor is not entitled to recover any costs related to preparation and administration of Change Orders, responses to Change Requests or preparation of Change Requests.

Each Change Order shall be deemed to take full account of the cumulative effects on the Contract Price and of all prior Change Orders.

8.2 COMPANY REQUESTED CHANGES

Company may issue a Change Order directly to Contractor or may request a proposal from Contractor for a contemplated Change through Company by issuance of a Change Request.

Upon receipt of a Change Request from Company, Contractor shall prepare a proposal for the Change Request and submit it within five (5) Business Days to Company for further processing. Contractor's proposal shall include:

a) A detailed execution methodology for the proposed Change;
b) A detailed schedule for the execution of the Change and the impact on the Control Schedule;
c) a lump sum price for the Change (if Contractor proposes any other method of compensation it shall provide its rationale for that method); and
d) Details of the impact on the Execution Plan, the Quality Plan, the health and safety plan referenced in Article 15.2 of the Agreement and the environmental protection plan referenced in Article 15.3 of this Agreement.

If Contractor cannot present the proposal for the Change Request to Company within five (5) Business Days of the receipt of the relevant Change Request from Company, Contractor shall promptly notify Company and provide reasons for the delay and the date the proposal will be ready. Contractor shall not unduly delay submission of the proposal to Company. Company, at its sole discretion, can reject any proposal not submitted in accordance with the requirements outlined herein.

Company will review Contractor's proposal within ten (10) Business Days and either Accept and return a Change Order (in the form as attached to this Exhibit 3 as Appendix B - Change Order) for Contractor execution or reject the proposal for resubmission or cancellation.

8.3 CONTRACTOR IDENTIFIED CHANGES

Contractor may request a Change by submitting a Change Request to Company. The Change Request will include:

a) A detailed explanation of why Contractor considers that a Change has occurred along with detailed support to enable Company to easily evaluate and assess the merits of the Change Request. Contractor shall specify the relevant provision(s) of the Agreement which it interprets as the basis for the Change Request;
b) A detailed schedule for the execution of the Change and the impact on the Control Schedule;
c) a lump sum price for the Change (if Contractor proposes any other method of compensation it shall provide its rationale for that method); and
d) Details of the impact on the Execution Plan, the Quality Plan, the health and safety plan referenced in Article 15.2 of the Agreement and the environmental protection plan referenced in Article 15.3 of the Agreement.

Contractor has the responsibility to identify, by the issuance of a Change Request, any change to the Work that it believes to be necessary for environmental integrity, or that will benefit Company in terms of capital or operating cost, or improved performance flexibility, safety or operation of the Work.

8.4 CHANGE ORDER PRICE

Contractor's proposed price for any Change will generally be stated as a lump sum price. Contractor shall provide substantiation, as Company may reasonably request, regarding such proposed price. Each lump sum price for a Change shall be determined using the rates and prices outlined in Exhibit 2 - Compensation or on a basis to be agreed between Company and Contractor if there are no applicable rates in Exhibit 2 – Compensation.

For any Change proposed to be compensated on a reimbursable basis, Contractor shall include an estimated total price for the Change in the Change Request or in its proposal in response to a Change Request. Changes performed on a reimbursable basis will be priced in accordance with Exhibit 2 – Compensation.

Each Change Order shall fully define the terms of payment and invoicing provisions. Contractor shall not be entitled to additional compensation in respect of:

a) Personnel already assigned full time to the Work, except when such Personnel are paid overtime, shift premiums or their assignment to the Work is extended, specifically in relation to the Change; and
b) Contractor's Items already assigned full time to the Work, except when the hire period of rented items is extended specifically in relation to the Change.

8.5 CHANGE IMPACT ON CONTROL SCHEDULE

Contractor will submit to Company, all necessary information to support any proposed impact of a Change on the Control Schedule, in both hard copy and electronic format. The information shall include detailed critical path analysis, identification and full accounting for the use of float and the current Control Schedule.

Each Change Order shall be deemed to take full account of the cumulative effects on the Control Schedule and all prior Change Orders. Due consideration will be given to cumulative effects that may not have manifested themselves in previous Change Orders, such as a Change that is accommodated by reducing available float. Any cumulative schedule effects assessed by Contractor shall be supported by detailed analysis to account for the use of float. This analysis shall include an electronic version of the current Control Schedule that clearly highlights the schedule effects to enable Company to verify Contractor's analysis prior to the issuance of the relevant Change Order.

Contractor shall update the Control Schedule for Company's Approval within five (5) Business Days after Company's issuance of any Change Order affecting the Control Schedule.

8.6 CHANGE REGISTER

Contractor shall maintain, fully updated at all times, a register of all Change Requests and Change Orders. The register will include:

a) Change Request number and date;
b) Change Order number and date and reference to a Change Request;
c) Brief description of the Change;
d) Status of Change Request and Change Order;
e) Value;
f) Effects on Control Schedule; and
g) Brief description of the basis for the Change Request.

Each Change Request will be identified by means of a unique sequential reference number beginning with 1000 for any Change Request issued by Company, and 2000 for any Change Request issued by Contractor. Each Change Order will be identified by means of a unique reference number, which will be assigned by Company.

All Change Orders that affect the Control Schedule shall be individually detailed, by reference number and summary description, in the successive Control Schedule updates issued by Contractor for Company's Approval.

Contractor shall submit the Change register in the Monthly Progress Report or more frequently as required by Company.

9 RISK MANAGEMENT

Contractor's Risk Management activities will be a continuation of the risk assessment process initiated during the bidding process. Requirements for ongoing risk management and reporting will be agreed between Contractor and Company at the kick-off meeting. Depending on the nature of the Work, Company shall have the authority to specify the type of risks (such as schedule, quality, cost, safety and environmental) which shall be reported by Contractor subject to Article 26. Some risks will be identified as "internal" risks, not subject to reporting.

9.1 RISK MANAGEMENT REQUIREMENTS

a) Contractor shall establish and implement a risk management system to identify, address and manage safety, health and environment, cost, schedule, quality and other execution risks, for the duration of the Work.

b) Contractor's risk management system shall be based on the following principals:
   - All risks shall be identified and captured in the Risk Register (as defined in Section 9.1(c) below);
   - All risk scenarios shall be evaluated for elimination or mitigation through appropriate measures; and
   - All higher and medium risk scenarios and associated risk management strategies shall be communicated and accepted by the appropriate level of Contractor's management.

c) Contractor's risk management system shall include the following features:
   - Contractor shall develop a risk management plan indicating the formal risk process to be followed during Work execution, with risk assessment approach and frequency. The plan shall also include assessments required for safety, health and environment and execution risks referenced elsewhere in this Exhibit 3;
   - Contractor shall develop and maintain a risk register ("Risk Register") to capture all details required to monitor identified risks. The format and content shall be subject agreed to by Contractor and Company. It shall be submitted as part of the Monthly Progress Report, along with other reporting requirements specified within this Exhibit 3;
   - Contractor shall perform risk assessments using qualified and knowledgeable Personnel. Contractor shall consult with Company regarding meeting target levels of safety. Contractor shall also include active involvement of Company's Personnel and external expertise, as appropriate;

- Risk assessments and recommended prevention and/or mitigation measures shall be formally documented in the Risk Register;
- Risk mitigation and prevention strategies for assessed risks in the higher and medium categories are required to be reviewed for acceptability by specified levels of Contractor's and Company's management. These strategies shall be supported by formal actions captured in an action log and be appropriate to the nature and magnitude of the risk, with decisions and updates clearly documented;
- Results of formal risk assessments shall be considered in the preparation or review of emergency response plans and procedures; and
- Follow-up processes to ensure that decisions have been implemented shall be formally documented and maintained in an action log. At a predetermined frequency, compliance reviews shall be undertaken to verify that formal risk assessments and follow-up actions are implemented.

d) Where appropriate, Company shall be invited to observe and/or participate in risk assessments performed by Contractor. Results of risk assessments related to the Work shall be distributed to Company upon completion of any of the assessments included within Contractor's risk management plan.

e) Contractor shall also participate in risk assessments conducted by Company or Company's Other Contractors when these risk assessments relate to activities for which interfaces exist with the Work or where Contractor is involved.

10 ENGINEERING AND TECHNICAL DOCUMENTATION

10.1 INTRODUCTION

This Section sets forth minimum requirements for engineering coordination in support of the Agreement, including Article 3 – Contractor's Work Obligations, and Document No. 505573-0000-37AG-I-0015 -– Directions to Contractors / Supplier Document Requirements for Contractor.

10.2 GENERAL REQUIREMENTS

a) As part of the requirement in Section 2.4 to submit its execution plan for the Work, Contractor shall include a detailed engineering management plan for the first 90 days following the Effective date. This plan will address planning activities, staff, offices and other resource mobilization, software acquisition and schedule development.

b) It is the responsibility of Contractor to maintain an electronic system for monitoring, recording and tracking all revisions and changes to drawings and documentation.

c) Any Documents (as defined in section 10.4 below) which require Approval of any Authority, will be submitted to such Authority by Contractor for Approval, unless otherwise agreed.

d) All applicable Documents shall be marked "Issued for Construction" or similar status, prior to commencement of fabrication, manufacture, construction or installation of the Work.

e) Contractor shall not commence any Work involving permanent installation of any equipment, materials or products until Contractor has submitted to Company and Company has accepted the Health, Safety and Environmental plans required by Article 15 of the Agreement.

10.3 DESIGN CONTROL

Contractor shall establish and implement a system to control Engineering activities in order to ensure achievement of a satisfactory level of quality and compliance with requirements including those of all Authorities and the Agreement.

Contractor's Engineering control activities shall include the following:

a) Implement a system for (internal) discipline checking, including the use of check lists where appropriate, to substantiate compliance with the requirements of Authorities, Agreement requirements and Supplier and Subcontractor requirements. Discipline checks shall be documented and traceable

b) Ensure that all aspects of the design (including Supplier information) are systematically verified

c) Ensure that there is no conflict between documents, and

d) Systematically record, for each revision of all documents, originator, checker, Contractor and approval signatures, and, where required, Company Acceptance or Approval, and to incorporate comments as required during the checking and approval processes.

10.4 COMPANY REVIEW AND APPROVAL OF CONTRACTOR DOCUMENTS

Throughout this Section and elsewhere in the Agreement, wherever there is a stated requirement for Approval or Acceptance by Company of a Contractor drawing, procedure, specification or other documentation **(Document)**, this shall mean:

(a) Contractor shall carry out its internal inter-discipline checking (IDC) to verify the quality of the Document. Contractor will verify product requirements, catalogue numbers and similar data and that Contractor has checked and coordinated each Document with the requirements of the Work and of the Agreement

(b) After Contractor’s IDC, and subject to the Document being free of significant “holds”, Contractor shall issue the Document for Company’s Approval.

(c) Related engineering required to allow Company to review each Document must be made available by Contractor, if not already in Company’s possession.

(d) Contractor shall revise the Document to take account of Company’s comments as part of the Work.

(e) Contractor must get Company’s Approval of the Document before it is issued for implementation.

(f) Company will review and return Documents in accordance with the schedule agreed upon.

(g) Company's review is for conformity to the requirements of the Agreement design concept and for general arrangement only.

(h) Company's review will not relieve Contractor of responsibility for errors or omissions in any Document submitted by Contractor or for meeting all requirements of the Agreement unless Company expressly notes the Acceptance of a deviation on the Document.

(i) Upon Company's request, Contractor will revise and resubmit Documents which Company reasonably rejects as inconsistent with the Agreement unless otherwise directed by Company. Contractor will notify Company in writing of any revisions to the resubmission other than those requested by Company.

(j) Company shall have the right to raise additional comments at any time to address Contractor's errors and omissions and Contractor shall incorporate such comments into the Work.

10.5 TECHNICAL QUERY PROCEDURE

Requests for clarification or guidance related to technical details contained within Company Supplied Data, shall be formally presented by Contractor to Company as a Site Query (SQ). Refer to Section 11 below for details on the use of an SQ.

11 CONSTRUCTION MANAGEMENT

11.1 OBJECTIVES

In executing the Work, Contractor shall assign experienced and qualified project management Personnel and craft workers with demonstrated skills during the field work / construction phase of the Work and provide continuity of such Personnel throughout the execution of the Work;

a) Maintain adequate controls and oversight during the field work / construction phase of the Work to ensure conformance with all requirements of the Agreement;
b) Minimize Work execution risks and risks to Company's assets;
c) Develop adequate contingency and recovery plans to mitigate impacts on schedule of unforeseen events (e.g. weather events); and
d) Provide Worksite(s) that are safe, secure and free of industrial health hazards.

11.2 CONTRACTOR'S DUTIES

With respect to the Work, Contractor shall:

a) Plan and co-ordinate the design, fabrication, transportation, installation, construction and completions of the Work with Company to ensure all interfaces are identified and managed;
b) Identify execution risks and develop mitigation plans and procedures covering all reasonable events during the field work / construction phases;

c) Conduct all engineering for field work, fabrication, transportation, construction and completions as stipulated in the Agreement;
d) Prepare, maintain and implement:
   - emergency preparedness and response procedures;
   - detailed fabrication, construction, transportation and material management plans for major Worksites;
   - security measures at the Worksite; and
   - a health and safety program;
e) Provide all construction and installation equipment, tools and temporary facilities required to perform the Work;
f) Provide Personnel and facilities for all field testing, inspection, supervision and coordination activities associated with the Work;
g) Support Company's construction management activities related to the Work; and

11.3 SITE QUERY (SQ)

The Site Query (SQ) process, as described in this Exhibit 3, shall be used by Contractor to facilitate the timely resolution of minor engineering and construction problems encountered at the Worksites. The SQ is used to formally transmit and co-ordinate technical queries with Company and to document the resolution to the query. Company shall not be involved in answering Site Queries which are entirely within Contractor's own responsibility.
Contractor may raise an SQ (in the form attached as Appendix E - Site query (SQ)) to clarify Technical Requirements which require a formal response. The SQ will include separate sections for Contractor's query and for Company's response. Any relevant documents that might assist those assigned to respond to the query in understanding the issue should be included or referenced with mark-ups as required. Contractor's SQ shall be approved by an appropriate level of authority within Contractor's organization and submitted formally to Company (distribution list to be provided). Contractor shall assign an SQ number based upon the Accepted numbering system which will be provided to the Contractor.

Company shall review the SQ and provide a response within the appropriate section of the SQ. It will be Contractor's responsibility to implement any actions associated with the response. Responses may simply be explanatory in nature and require no additional action. Where appropriate, an SQ response may be accompanied by a Site Instruction (in the form attached as Appendix F - Site Instruction) or an Engineering Change Notice (in the form attached as Appendix G - Engineering Change Notice (ECN)). An SQ will remain open until any associated actions have been completed, to the satisfaction of Company.

Open SQs shall be reviewed at weekly Site meetings in order to resolve all matters relating to their resolution.

11.4 SITE INSTRUCTION (SI)

The Site Instruction (SI) process, as described in this Exhibit 3, shall be used to provide a formal record of an instruction or verbal agreement originated directly at Site from Company to the Contractor.

SIs (in the form attached as Appendix F - Site Instruction) will be provided to address the following items (examples only):

a) Instructions to Contractor related to safety or quality;
b) Confirmation of verbal instructions/notifications;
c) Site administration;
d) Reporting requirements;
e) Work clarification; and
f) Instruction subsequent to a Site Query response.

Open SIs shall be reviewed at weekly meetings in order to resolve all matters relating to their implementation.

11.5 ENGINEERING CHANGE NOTICE (ECN)

The Engineering Change Notice (ECN) process, as described in this Exhibit 3, will be followed by Company to highlight the issuance of any engineering design change to the Contractor whenever:

a) Issued for Construction (IFC) drawings or specifications are revised after their issue to Contractor;
b) New IFC drawings or specifications are issued that are not listed in Exhibit 1 - Scope of Work; and
c) IFC, sketches, documents or any such typical instructions are issued.

Company will generate an ECN, using the form found in Appendix G - Engineering Change Notice (ECN) of this Exhibit 3, to describe and communicate Issued for Construction (IFC) document changes to the Contractor. These changes will be described on the ECN form and accompanied by the associated drawings, specifications, sketches and related documents for implementation by Contractor. Where an ECN is the result of an SQ or a SI, it will reference the relevant document. The ECN will be assigned a unique number by Company for future reference and reporting.

12 INVOICING AND PAYMENT

12.1 OBJECTIVES

Contractor shall submit accurate, complete and detailed invoices that reflect the Work completed by Contractor, in a format that will be established by the Company and with the necessary supporting/verification documentation to enable Company to efficiently attest the invoices and recommend Approval and payment of Contractor's invoices by Company, and all in

accordance with the Articles of the Agreement.

12.2 CONTRACTOR'S DUTIES

a) Contractor shall submit invoices in accordance with the Agreement complete with Company Approved Payment Certificates and all supporting/verification documentation Acceptable to Company.
b) Contractor shall submit to Company, a monthly report that summarizes invoices submitted and payments made, along with applicable dates of both the invoices and the payments and other pertinent information that Company may require.
c) Contractor shall submit to the Company, each month, a cash forecast report by currency for the following three (3) months. This report shall be submitted by the 25th day of every month.

12.3 PROCEDURAL REQUIREMENTS

a) Contractor shall submit to Company one original invoice, along with one (1) PDF copy of the invoice and all required Billing Information.
b) Each invoice is to be organized such that it is easily understood and:
   - contains a clear description of the completed Work being invoiced;
   - the charges can be easily and efficiently verified against the Agreement and the Billing Information; and
   - all charges are clearly cross referenced to the Billing Information.
c) All invoice amounts shall be detailed based on Company's code of accounts.
d) The invoice shall include the following information:
   - Contractor's name, address and tax identification number (HST registration number);
   - Invoice date and invoice number;
   - Agreement number and name;
   - Charges detailed by code of accounts along with cumulative value of all invoices for the Agreement detailed by Company's code of accounts;
   - Adjustments, if any, from prior invoices;
   - Subtotal, tax (HST applicable to the invoice) and total;
   - All invoices shall be in the currencies detailed in Exhibit 2 - Compensation;
   - Complete and accurate supporting documentation, including without limitation Billing Information and any other pertinent information that Company may require to verify completion of the Work, the accuracy of the fees, charges and third party charges; complete with a summary sheet cross referencing all supporting documentation to the charges covered on the invoice;
   - Approved Payment Certificate (in the form as stated in Appendix D - Payment Certificate;
   - If Contractor is a non-resident, in accordance with Exhibit 10 – Declaration of Residency, Contractor shall note on each invoice whether any portion of the Work covered by such invoice was performed inside or outside of Canada for the purposes of Canadian income tax legislation, or such other information requested or required

by Company to properly assess withholding requirements; and

- Where appropriate, Change Order amounts may be shown separately and the invoice will itemize charges associated with each Change Order, including without limitation, a detailed description of each item being invoiced. A copy of the Change Order shall accompany the invoice.

e) Before Company pays an invoice, Company may request clarification or substantiation in relation to any charges on the invoice and Contractor shall promptly comply with any such request. Invoice review meetings (or pre-payment meetings) may be held to agree on charges to be included on an invoice.

f) If an invoice is deemed incorrect by Company, Company is entitled to reject such invoice and shall provide reasons for the rejection.

g) A Final Completion Certificate will be required before final payment will be made. When Contractor believes the requirements of Final Completion have been satisfied, as described in Article 25 of the Agreement, Contractor shall request by Notice a Final Completion Certificate. Such request shall be in the form as contained in Appendix C - Request and Final Completion Certificate.

Invoicing for Change Work

Contractor shall submit separate invoices for Changes, unless Company Accepts otherwise, with the Change Order number and date mentioned on the invoice. Invoicing provisions shall be specified on each Change Order. All Changes shall be subject to the compensation provisions and payment terms set out in Article 12 of the Agreement, Exhibit 2 – Compensation and Exhibit 3.

Contractor will not invoice Company for any amounts which result in the cumulative amount invoiced being greater than the lump sum price indicated on a Change Order.

Under no circumstances will Contractor present invoices for a Change, nor will Company compensate Contractor for any Change, in the absence of a Change Order.

Banking Information

a) Payments of invoices shall, where possible, be made by electronic funds transfer to Contractor's bank account, as specified in writing by Contractor to the Company.

b) Any changes in Contractor's banking information or payment instructions shall be submitted in writing to the Company Representative. The Company shall not be held responsible for errors or delays resulting from incorrect or delayed submission of changes in banking instructions by Contractor.

APPENDIX A

CHANGE REQUEST

Agreement No:		CHR No. (Reference)	
Agreement Title:		Rev. No:	
Company:		CHO No.	
Contractor/Supplier:		Date:	
		Aconex No.	

Description of Change Request and Reason (attach all supporting information):

Supporting information that forms part of this Change Request:

Description of impact on Control Schedule:

Revised Finish Date:

Lump sum price (or estimated cost) and adjustment to the Contract Price:

Item	Description	UOM	QTY	Unit Price	Extended Price
				Value of this Change Request:	$

ORIGINATOR ☐ COMPANY ☐ CONTRACTOR/SUPPLIER

Title	Name	Signature	Date

OTHERS REVIEW

Title	Name	Signature	Date

APPENDIX B

CHANGE ORDER

Agreement No:		CHO No.	
Agreement Title:		Rev. No:	
Company:		CHR No.	
Contractor/Supplier:		Date:	

Description of Change:

Supporting information that forms part of this Change Order:

Change Includes: Adjustment Type:	☐ Price	☐ Schedule	Original Contract Price	
	☐ Lump Sum	☐ Unit Rate	Previous Change Orders Price	
	☐ Fixed Amount	☐ Estimate	This Change Order Price	
	☐ Reimbursable		Total Contract Price to Date	$

Impact on Control Schedule:

Revised Finished Date:

This Change Order shall form and be read and construed as an integral part of the above-noted Agreement. The above adjustment to the Contract Price constitutes full compensation (including all impact costs) to the Contractor/Supplier for the above Change.

Issued by Company:	Acknowledgement of Contractor/Supplier Receipt:
Supply Chain Manager or Delegate Name:	Signature:
Signature: / Date:	Name:
Company Representative Name:	Date:

APPENDIX C

REQUEST FOR FINAL COMPLETION CERTIFICATE

REQUEST FOR FINAL COMPLETION CERTIFICATE

Agreement No.: _____

Agreement Title: _____

Contractor: _____

To Engineer:

In accordance with Article 25 of the Agreement, Contractor hereby confirms that it has completed the Work and all the requirements of Final Completion (as described in the Agreement) have been met, all in accordance with the Agreement, excluding its Warranty obligations.

Contractor agrees that, as of the date of its confirmation below, the Contractor waives, remises, releases and discharges the Company of any and all Claims that are known, ought to have been known or discoverable by reasonable means by the Contractor, which Contractor has or may have relating to or arising out of this Agreement and the subject matter of this Agreement, and all facts and circumstances related to the Work, save and except:

a) Only those Claims previously submitted by Contractor in writing and remaining unresolved prior to the date of Contractor's below confirmation, as listed below:

_____

_____;

and

b) The balance of the Contract Price payable, if any, upon the issuance of this Final Completion Certificate.

Contractor Confirmation:

Contractor confirms it has completed the Work in accordance with the above-noted Agreement.

By: _____
Contractor Representative

Acknowledgement of Engineer Receipt:

By: _____
Engineer

Date:

FINAL COMPLETION CERTIFICATE

Agreement No.: _____

Agreement Title: _____

To Contractor:

Company hereby confirms that the Date of Final Completion of the Work is **[date].**

By: _____
Company Representative

Date:

APPENDIX D

PAYMENT CERTIFICATE

PAYMENT CERTIFICATE

Date: _____
Agreement #: _____
Agreement Title: _____
Contractor: _____

Milestone / Monthly Progress
Payment Description: _____

Milestone / Monthly Progress
Payment Amount: _____

Work Executed for Monthly Progress / Milestone Completion criteria and status (list below):

_____
_____
_____
_____
_____

Contractor:

Contractor hereby notifies Company that it considers that it has executed the associated Work or met the criteria for achieving the above-noted Milestone(s) and requests Company Approval.

By: _____
Contractor Representative

Date:

Company Approval:

Company hereby Approves this Payment Certificate. Company Approval of this Payment Certificate does not relieve Contractor of any of its obligations under the Agreement.

By: _____
Company Representative

Date:

APPENDIX E

SITE QUERY (SQ)

Lower Churchill Project	SITE QUERY (SQ)

Company:		Project No.	Date	Page of	Rev.
Project Name:		Site Query No.			
Contractor:		Distribution ☐ QC ☐ Package Engineer ☐ Contractor ☐ Document Control ☐ Contract Administrator ☐ Resident Engineer ☐ Construction Manager ☐ Chief Inspector			
Agreement No.:					
Agreement Title:					

1. QUERY DETAILS

DOCUMENT NO.	REV.	TITLE

	TITLE	NAME/COMPANY	SIGNATURE	DATE
Prepared by:				

2. QUERY ADMISSIBILITY (If Contractor Request)

	TITLE	NAME	SIGNATURE	DATE
Approved by:				

3. RESPONSE / PROPOSED SOLUTION (If Applicable)

Comments:

	TITLE	NAME	SIGNATURE	DATE
Prepared by:				
Approved by Site:				
Approved by Home Office:				

4. INSPECTION (CLOSE OUT)

Inspection: Work executed as per proposed solution ☐ Yes ☐ No

Explain:

	NAME	SIGNATURE	DATE
Inspector:			
Chief Inspector:			

APPENDIX F

SITE INSTRUCTION (SI)

LOWER CHURCHILL PROJECT	SITE INSTRUCTION (SI)

Company:	Date	Rev.	Page of
Project Name & Location:	Site Instruction No.		
Contractor:	*DISTRIBUTION (NAME PLUS DISCIPLINE OR COMPANY)*		
Agreement No.:	From:		
Agreement Title:	To:		
Plant Area / Bldg No.:	Copies to:		
Reference Specification:			
Reference Drawing No.:			

The Contractor agrees that by signing acceptance of this Site Instruction, the contents hereof do not contain or imply any additional money or schedule effect in the above-noted Agreement whatsoever.

Instruction:

Reason:

	TITLE	NAME	SIGNATURE	DATE
Prepared by:				
Accepted by:				

DISTRIBUTION

- ☐ File
- ☐ Contractor
- ☒ Area Construction Manager
- ☐ Environment
- ☐ QA Coordinator
- ☐ Planner
- ☐ Estimator
- ☐ Chief Inspector
- ☐ Cost Controller
- ☐ Document Control (site)
- ☐ Resident Engineer
- ☐ Contracts Administrator
- ☐ Commissioning
- ☐ Other _____
- ☐ Other _____

APPENDIX G

ENGINEERING CHANGE NOTICE (ECN)

Lower Churchill Project	Engineering Change Notice (ECN)	Page 1 of 2	
		Revision	
		No.	Date
		00	

Company: Project:	ECN No.:

Agreement No.	Contractor
Agreement Title	

Distribution		
From	To	Copy to

Summary Description of Changes

Instruction to Contractor	
☐ Submit impact on contractual terms prior to proceeding with the work	☐ Lump Sum ☐ Unit Price ☐ Cost Plus
☐ No impact on the contractual terms, proceed with the work	☐ ☐ ☐
☐	

Received by Contractor		
Name	Signature	Date

	Title	Name	Signature	Date
Prepared by:				
Reviewed by:				
Approved by:				

APPENDIX H

NOT USED

APPENDIX I

SUBSTANTIAL COMPLETION CERTIFICATE

Substantial Completion Certificate

Agreement No: _____
Agreement Title: _____
Contractor: _____

To Company:
In accordance with Article 25.2 of the Agreement, Contractor hereby confirms that it has completed all requirements in the Agreement to achieve Substantial Completion as of _____("Substantial Completion Date"). Substantial Completion shall be effective as of the Substantial Completion Date upon the execution and issuance of this Substantial Completion Certificate.

Delivered by Contractor:

By: _____
Contractor Representative

Date:

Company Confirmation:

Company confirms Contractor has achieved Substantial Completion in accordance with the Agreement as of the Substantial Completion Date. This certificate does not relieve the Contractor of its contractual responsibilities for repairing all minor deficiencies as a part of the Work.

By: _____
Company Representative

Date:

APPENDIX J

MILESTONE COMPLETION CERTIFICATE

MILESTONE COMPLETION CERTIFICATE

Date: _____

Agreement #: _____

Agreement Title: _____

Contractor: _____

Milestone Description: _____

Milestone Amount: _____

Milestone Completion criteria and status (list below):

_____

_____

_____

_____

Contractor:

Contractor hereby notifies Company that it considers that it has met the criteria for achieving this Milestone(s) and requests Company Approval

By: _____
Contractor Representative

Date:

Company Approval:

Company hereby Approves this Milestone Completion Certificate.

Company Approval of this Milestone Completion Certificate does not relieve Contractor of any of its obligations under the Agreement.

By: _____
Company Representative

Date:

APPENDIX K

NOT USED

APPENDIX L

STATUTORY DECLARATION

STATUTORY DECLARATION – ACCOMPANYING INVOICE FOR PAYMENT

C A N A D A	)	IN THE MATTER OF THE AGREEMENT
	)	BETWEEN COMPANY AND
PROVINCE OF NEWFOUNDLAND	)	**[CONTRACTOR]** DATED AS OF **[DATE]** FOR
AND LABRADOR	)	THE **[DESCRIPTION OF WORK]** BEING
	)	AGREEMENT NO. **[INSERT NO.]** (the
	)	"Agreement")

I, **[●]**, of the City of **[●]**, in the **[Province]/[State]** of **[●]**,**[Country]**, do solemnly declare that:

1. I am the **[title]** of **[full legal name of Contractor]** and as such have personal knowledge of the facts set out in this Declaration.

2. Defined terms used in this Statutory Declaration but not defined in this Declaration have the meanings given to those terms in the Agreement.

3. All (a) payments due to Subcontractors, (b) wages and benefit payments due to any of the Contractor's Personnel, and (c) Taxes, contributions, premiums, allowances and remittances due to any Authority, pension fund, benefit plan or union fund in accordance with a collective agreement or Applicable Laws, have been paid in a timely manner on or before the date of the Invoice and associated Payment Certificate to which this Declaration relates, subject to any withholdings or holdbacks required by Applicable Laws.

4. Title to the applicable part of the Work will pass to Company in accordance with Article 27 of the Agreement.

   (a) There are no known outstanding Claims under the Agreement, including Claims by Contractor against Company, except for those Claims which have already been communicated to Company in a timely manner in the form of Notice required by the Agreement and which are described and listed in the Appendix to this Declaration, including an estimate of the value of each such Claim; or

   (b) There are outstanding Claims, including Claims by Contractor against Company, which have not been communicated to Company and each of these Claims is described and listed in the Appendix to this Declaration and is delivered to Company in a timely manner, and there are no other known outstanding Claims under the Agreement, except for those Claims which have already been communicated to Company in a timely manner in the form of Notice required by the Agreement and which are described and listed in the Appendix to this Declaration, including an estimate of the value of each such Claim.

6. The last application for payment for which we have received payment is No. _____ dated the _____ day of _____, 20__.

I make this Declaration conscientiously believing it to be true and knowing it is of the same force as if made under oath.

DECLARED before me at the City of)
[●],)
in the **[Province]/[State]** of)
[●],)
[Country])
on **[Month]**, **[Date]**, 20**[●]**)
)
_____)

Name:
A Commissioner, etc.

_____
Declarant

APPENDIX M

FORM OF CONFIRMATION OF FINANCING

Form of Confirmation of Financing

[●], 2013

[●]

Dear Sirs and Mesdames,

Re: A [●] agreement entered into between Muskrat Falls Corportation ("**MF**") and [●] (the "**Contractor**") on [●] and subsequently assigned by MF to <*> ("**SPV**") and assumed by SPV on <*> (such agreement as the same may have been supplemented, amended or restated, the "**Agreement**"),

We are the <*> [agent or security trustee or collateral agent] of the lenders to SPV and we hereby confirm to you in such capacity that [credit facilities/financing] in the amount of <*> has been made available to SPV for the purposes of financing the costs of the <*> project which includes the price of the work covered by the Agreement.

Yours truly,

<*>

By: _____
[●]

APPENDIX N

FORM OF CONFIRMATION OF FINANCING FROM MUSKRAT FALLS CORPORATION

Form of Confirmation of Financing from Muskrat Falls Corporation

[●], 2013

[●]

Dear Sirs and Mesdames,

Re: A [●] agreement entered into between Muskrat Falls Corporation ("**MF**") and [●] (the "**Contractor**") on [●] and subsequently assigned by MF to <*> ("**SPV**") and assumed by SPV on <*> (such agreement as the same may have been supplemented, amended or restated, the "**Agreement**"),

MF hereby confirms that [credit facilities/financing] has been made available to SPV for the purposes of financing the costs of the <*> project in the amount of <*> (which includes the price of the work covered by the Agreement) and is ready for disbursement in accordance with the terms of the [credit facilities/financing] agreement.

Yours truly,

SPV **Muskrat Falls Corporation**

_____ _____

[●]

EXHIBIT 4

SUPPLIER DOCUMENT REQUIREMENTS LIST

CH0032

Powerhouse and Spillway Hydro-Mechanical Equipment

Prepared by: Bruce Drover (Package Lead)

Reviewed by: Randy Koob (Lead Discpline Engineer)

Approved by: Ned Carter (Quality Assurance)

Approved by: Greg Snyder (Engineering Manager)

Table of Contents

REVISION LIST

Revision						Remarks
N°	By	Chec	Appr.	Appr.	Date	
01	BD	RDK	GC	GS	22-JUL-2013	Approved for Design
00	EC	RDK	GC	GS	7-NOV-2012	Issued for Review

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision	
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013

SUPPLIER DOCUMENT REQUIREMENTS TABLE

1	2	3	4	5	6	7	8	9	10	11	12	13
SDRL Code	Type of Document	Provide with Proposal	Submit Prior to Start of Fabrication / Construction	After Shipment	With Shipment	Minimum Documents approved Code 1 prior to Inspection Release	As Built	Final Documentation Location (R01 / R02)	Final File Format	First Submission (Weeks)	Submit Monthly	Notes
A.	GENERAL											
A01	Supplier Document Register (SDR)							R02	PDF	AR0+2	X	Preliminary prior to award. Update Monthly.
A02	Control Schedule	X						R02	P6/ XER	AR0+2	X	Level II with proposal including native file
A03	Monthly Risk Reports								PDF	ARO+8	X	
A04	Risk Management Plan	X							PDF	ARO+8		Sample with proposal
A05	Unpriced Copies of Major Sub-Supplier Orders							R02	PDF	Note		Upon issue of PO to major sub suppliers
A06	Monthly Progress Reports								PDF	Note	X	As per Exhibit 3
A07	Project Execution Plan	X						R02	PDF	Note		As per Exhibit 3
A08	Permits		X		X				PDF	Note		As per Exhibit 6
A11	Logistics and Transportation Strategy	X							PDF	ARO+20		Preliminary with Proposal. Final before first major shipment
A13	Expediting Release Authorization				X				PDF	Note		Before Shipment from suppliers works
A28	Health and Safety Plan	X							PDF	ARO+6		As per Exhibit 5
A35	Contract Specific Environmental Protection Plan (C-SEPP)	X							PDF	Note		As per Exhibit 6
A39	Survey Report							R02	PDF	Note		Upon completion of required surveys
A40	Monthly Environmental Performance Report								PDF	Note	At Site	As per Exhibit 6, including fuel consumption report
A41	Health and Safety Training Records and Certificates	X							PDF	Note		Company Certificate with bid as per Appendix 5. Copies of individual certificates as requested by Engineer ARO.
A42	Schedule Development and Control Plan								PDF	Note		As per Exhibit 3 Coordination Procedure
A43	Provisional Packing List				X				PDF	SHIP-2		
A44	Control Schedule Baseline Document								PDF/ P6	ARO+0		
B.	ARRANGEMENT DRAWINGS											
B01	General Arrangements and Layouts	X	X				X	R01	PDF/ STP	ARO+8		
B02	Elevation/Profile Drawings	X	X				X	R01	PDF/ STP	ARO+8		
B03	Cross Section Drawings	X	X				X	R01	PDF/ STP	ARO+8		
B04	Arrangement and Sub Assembly Drawings		X				X	R01	PDF	ARO+8		
B05	Loading Drawings		X					R01	PDF	ARO+8		
B06	Cable and Tray Routing Drawings, Layout and Design		X					R01	PDF	ARO+20		
C.	DESIGN & OPERATIONAL DRAWINGS											
C03	HVAC Schematic and Flow Diagrams						X	R01	PDF	ARO+20		
C04	Logic Diagrams						X	R01	PDF	ARO+20		
C05	System Schematic Diagrams						X	R01	PDF	ARO+20		
C06	Sequential and Control Function Charts						X	R01	PDF	ARO+20		
C07	Functional Description or Process Control Narratives						X	R01	PDF	ARO+20		
D.	DETAIL DRAWINGS											

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision	
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013

SUPPLIER DOCUMENT REQUIREMENTS TABLE

1	2	3	4	5	6	7	8	9	10	11	12	13
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D03	Equipment Details	X	X					R01				
D04	Fabrication, Installation and Shop Drawings		X					R01/R02				Installation Drawings R1, Shop & Fab Drawings R02
D07	Equipment Drawings		X				X	R01				
D08	Shipping Drawings				X			R02		SHIP-2		
E.	ELECTRICAL/INSTRUMENTATION & INTERCONNECTIONS											
E01	Interconnection Block Diagrams		X					R01	PDF	ARO+20		
E02	Wiring Diagrams/Schematics		X					R01	PDF	ARO+20		
E03	Single Line Diagrams		X					R01	PDF	ARO+20		
E04	Control System Network Diagram		X					R01	PDF	ARO+20		
E05	Panel and Annunciator Layout Drawings		X					R01	PDF	ARO+20		
E06	Panel Details Diagrams		X					R01	PDF	ARO+20		
E07	Instrument Hook-up Details		X					R01	PDF	ARO+20		
E08	Block Diagrams		X					R01	PDF	ARO+20		
E09	Cable Specifications		X					R01	PDF	ARO+20		
F.	DATASHEETS											
F01	Equipment Data Sheet		X				X	R01	PDF			
F02	Motor Data Sheet		X				X	R01	PDF			
F03	Instrument Data Sheet		X					R01	PDF			
F04	WHMIS Material Safety Data Sheet (MSDS)				X			R01	PDF	SHIP-8		
F05	Mechanical Properties of Materials		X					R01	PDF			
F07	Shipping Bills of Material				X			R01	PDF			
G.	SCHEDULES/LISTS											
G01	Bill of Materials/Equipment List							R01	PDF	ARO+26		
G03	Cable Schedule							R01	PDF	ARO+26		
G05	Preventative Maintenance Schedule							R01	PDF	DEL-16		
G06	Instrument Index							R01	PDF	ARO+26		
G07	Alarms and Trip Set Point List							R01	PDF	ARO+26		
G08	Computer Systems Documentation							R01	PDF	ARO+26		
G09	Input/Output List							R01	PDF	ARO+26		
G10	Equipment Identification and Tagging							R01	PDF	ARO+26		
H.	CALCULATIONS											
H02	Foundation Support Calculations		X					R02	PDF	ARO+16		
H03	Structural Calculations		X				X	R02	PDF	ARO+16		
H07	Lifting Lug Calculations		X					R02	PDF	ARO+16		

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision	
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013

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H10	Fire Protection Calculations		X					R02	PDF	ARO+16		
H12	Mechanical Calculation - Misc.		X					R02	PDF	ARO+16		
H13	Electrical Calculation - Misc.		X					R02	PDF	ARO+16		
H14	Civil Calculation - Misc.		X					R02	PDF	ARO+16		
H35	Grouting Calculations		X					R02	PDF	ARO+16		
H36	Concrete Mix Calculation		X					R02	PDF	ARO+16		
H38	Essential Service Load Calculation		X					R02	PDF	ARO+16		
H39	Unit Service Load Calculation		X					R02	PDF	ARO+16		
H40	AC Station Service Load Calculation		X					R02	PDF	ARO+16		
H60	Acceptable Stress Calculations - Extreme Loads		X					R02	PDF	ARO+16		
J.	PERFORMANCE DATA											
J01	General Performance Data		X				X	R01	PDF	ARO+26		
J02	Current and Potential (CT/VT) Transformer Curves		X				X	R01	PDF	ARO+26		
K.	PROCEDURES											
K01	Welding and Weld Repair Procedure		X					R02	PDF			
K03	Non-Destructive Test Procedure		X					R02	PDF			
K04	Performance / Acceptance Test Procedure							R02	PDF	TEST-8		
K05	Heat Treatment Procedure		X					R02	PDF			
K07	Factory and Site Test Procedures (FAT/SAT)							R02	PDF	FAT/SAT-12		
K08	Load Test Procedure							R02	PDF	TEST-12		
K12	Commissioning Procedures							R02	PDF	TEST-20		
K15	Surface Preparation and Coating Procedure		X					R02	PDF			
K16	Instruction for Transportation, Storage, Warehousing and Long Term Storage				X			R02	PDF			
K24	Construction Method Statements and Procedures		X					R02	PDF			
L.	MAINTENANCE & SPARES											
L01	Lubricant and Operating Fluids Schedule							R01	PDF	ARO+52		
L02	Recommended Commissioning and Start-up Spares							R01	PDF	ARO+52		
L03	Recommended 12 and 24 Months Operation Spares							R01	PDF	ARO+52		
L04	Recommended Critical Spares (Insurance)							R01	PDF	ARO+52		
L05	Special Tools List							R01	PDF	ARO+52		
M.	TEST & INSPECTION REPORTS											
M01	Material Test Certificates		X					R02	PDF			
M02	Instrument/Electrical Test Report							R02	PDF			
M05	NDE Test Reports							R02	PDF			

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision	
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013

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M06	Welder Performance Qualifications and Certifications		X					R02	PDF			
M07	Heat Treatment Records							R02	PDF			
M08	Calibration Certificates							R02	PDF			
M10	Inspection Release Certificate				X			R02	PDF			
M12	Lifting Equipment Test Certificate				X			R02	PDF			
M15	Performance Test Certificate							R02	PDF			
M16	Painting/Coating Test Report							R02	PDF			
M17	Steel Manufacturing Reports							R02	PDF			
M19	Factory and Site Test Report (FAT/SAT)							R02	PDF	FAT/SAT+2		
M20	Commissioning Report							R02	PDF	Note		Upon Commissioning completion
M27	Mechanical Completion Report							R02	PDF	Note		Upon MC completion
M28	Certificate of Origin				X			R02	PDF			
M29	Preservation Records							R02	PDF			
Q	QUALITY ASSURANCE / QUALITY CONTROL											
Q01	Quality Assurance System Registration Certificate	X						R02	PDF			
Q02	Quality Assurance System Manual	X						R02	PDF			
Q03	Quality Plan	X	X					R02	PDF			
Q04	Inspection and Test Plan(s) (Factory and Site Works)		X					R02	PDF			
Q05	Certificates of Conformity (Factory and Site Works)				X			R02	PDF			
Q07	Internal/External Audit Schedule	X						R02	PDF			
Q10	NCR Register and associated close out reports							R02	PDF	Note		Submit as generated
Q11	Quality Management Certificate for Manufacturer							R02	PDF			
Q12	Declaration of Installation and Inspection Completion							R02	PDF			
Q13	Authorized Deviations							R02	PDF			Submit as generated
R.	MANUALS											
R01	Installation, Commissioning, Operating and Maintenance Manual				X				PDF	Note		Preliminary Delivery -16 weeks
R02	Manufacturing Record Book (MRB)			X					PDF	Note		Completion + 8 weeks
R03	Installation, Commissioning, Operating and Maintenance Manual Table of Contents (TOC)							R01	PDF	DEL-20		
R04	Manufacturing Record Book (MRB) Table of Contents (TOC)							R02	PDF	DEL-20		
R05	Dispatch Dossier				X							

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision		
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date	
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013	

	SDRL Definitions	
A	**A - General**	
A01	Supplier Document Register (SDR)	Supplier Document Register (SDR) – documents list identifying individual document deliverables by purchase order. This register will capture deliverable requirements as agreed by Contractor/Supplier and Company. Contractor/Supplier is responsible to create and approve this document as a revision controlled document.
A02	Control Schedule	As per Exhibit 3 Coordination Procedure
A03	Monthly Risk Reports	Provides a summary of activities carried out by a Contractor/Supplier aimed at addressing selected Risks; The monthly Risk Reports, inclusive of the Risk Register, are part of the subject matter of the Monthly Risk Reviews. The requirements for the Monthly Risk Report and Risk Register are set forth in sections 2.3 and 2.4 of the LCP Risk Management Requirements for Contractors and Suppliers (SLI document # 505573-0000-39RA-I-0002).
A04	Risk Management Plan	Provides a description of the Risk Management Process, organizational context and tools adopted by a Contractor/Supplier. The contractor shall prepare the Risk Management Plan using as guidance section 2.2 of the *LCP Risk Management Requirements for Contractors and Suppliers* (SLI document # 505573-0000-39RA-I-0002).
A05	Unpriced Copies of Major Sub-Supplier Orders	n/a
A06	Monthly Progress Reports	As per Exhibit 3 Coordination Procedure.
A07	Project Execution Plan	As per Exhibit 3 Coordination Procedure.
A08	Permits	Provide copies of all permit documentation, as described in Exhibit 6 (Environmental and Regulatory Compliance Requirements)
A11	Logistics and Transportation Strategy	Provide a logistics and transportation strategy for the Work which shall include proposed transportation modes and preferred carriers or freight forwarders. The following documents shall be taken into consideration when developing the strategy: (SLI document # GP-5500-F-01-E) Documentation, Packaging, Marking, Shipping and Instructions and /or (SLI document # 505573-361C-4ZEG-0001) Documentation, Packaging, Marking, Shipping and Instructions Specific to Transmission Line Components.
A13	Shipping Release Authorization	Include Shipping Bill of Materials, Quality Surveillance Release, and Shipping Release Notice.
A28	Health and Safety Plan	As per Exhibit 5 Health and Safety Requirements.
A34	List of Existing Transmission Lines under similar loading conditions	Supplier shall submit the list of Transmission Lines equipped with the proposed product cable under similar environmental conditions.
A35	Contract Specific Environmental Protection Plan (C-SEPP)	The Contractor shall prepare its C-SEPP using as guidance the *Contract-Specific Environmental Protection Plan* ***template*** (SLI document # 505573-0000-68RA-I-0011, provided in Exhibit 11). The Contractor's C-SEPP shall be based on the following: relevant provisions of the *Project-Wide Environmental Protection Plan* (P-WEPP, SLI Document # 505573-0000-68RA-I-0005, provided in Exhibit 11); the *General Environmental Requirements - Technical Specifications* (included in Exhibit 1); *Environmental and Regulatory Compliance Requirements* (Exhibit 6); the *Waste Management Plan* (SLI document # 505573-0000-68RA-I-0008, included in Exhibit 11); and the *Master Spill Response Plan (Nalcor document # MFA-PT-MD-0000-EV-PL-0001-01, included in Exhibit 11).*
A39	Survey Report	Field Survey Reports. Example: roads, transmission lines, etc.
A40	Monthly Environmental Performance Report	A Monthly Environmental Performance Report shall be submitted by the Contractor, in accordance with provisions of Exhibit 6 (Environmental and Regulatory Compliance Requirements). This report shall include a Monthly Fuel Consumption Report in the format prescribed in Exhibit 6, Appendix C.
A41	Health and Safety Training Records and Certificates	Training records and certificates for employees including, but not limited, to Confined Spaces, Fall Protection, Operator Competencies, Trade Certifications, etc.
A42	Schedule Development and Control Plan	As per Exhibit 3 Coordination Procedure.
A43	Provisional Packing List	A preliminary Packing List listing the items planned to be shipped against the Purchase Order. In addition to the item numbers; tag numbers; planned quantities to be shipped the P/L should also indicate the approximate weights and dimensions.
A44	Control Schedule Baseline Document	As per Exhibit 3 Coordination Procedure.
A99	Miscellaneous General Documents	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.
B	**B - ARRANGEMENT DRAWINGS**	
B01	General Arrangements and Layouts	Drawings showing the general arrangement or relative locations of components or construction elements, including overall horizontal dimensions and/or scale bars, noted relative elevations and/or topographic contours, geographic orientations, flow directions, etc. Drawings are normally in horizontal (planar) view, with the location and orientation of elevation views and/or cross-section views shown.

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision		
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date	
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013	

B02	Elevation/Profile Drawings	Drawings showing views of components or construction elements in a vertical plane, i.e. in elevation, for the purpose of showing the vertical arrangement of the components or construction elements, usually with horizontal and vertical dimensions and/or scale bars.
B03	Cross Section Drawings	Drawings showing views of components or construction elements in horizontal or vertical planes which are cut through the assembly of components or construction elements.
B04	Arrangement and Sub Assembly Drawings	Plans and Sections with nomenclature.
B05	Loading Drawings	Foundation drawings, loading requirements and anchor bolts.
B06	Cable Tray Routing Drawings, Layout and Design	Plans , elevations and sections.
B99	Miscellaneous Arrangement Drawings	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.
C	**C - DESIGN & OPERATIONAL DRAWINGS**	
C01	Piping and Instrumentation (P&IDs)	P&IDs are a graphical representation of all the process equipment, all the major sections of pipe, motors, all instruments (including control logic depiction) and their interconnection. Each item shown on the P&ID shall be given a unique Tag No. as per the Project approved naming conventions in coordination with the Owner representative. ISA Standards symbology shall be used.
C02	Process Flow Diagrams (PFD)	Diagrams shall be provided for all gas, oil, water, air systems etc. Diagrams shall be drawn using standard symbols and tagging systems adopted for the project as advised by the purchaser and shall include all indication and controls required for safe operation of the equipment, line sizes, line ratings and design pressures and temperatures, all customer connections identified in accordance with “Customer Terminal Point Schedule” - plus part numbers in accordance with “Bill of Materials.
C03	HVac Schematic and Flow Diagrams	Schematics and flow diagrams shall be provided for all heating, ventilating and air conditioning systems. Diagrams shall be drawn using standard symbols and tagging systems adopted for the project as advised by the purchaser and shall include direction of flow and location of system components.
C04	Logic Diagrams	Process Logic shall be detailed. A comprehensive set of SAMA logic diagrams must be produced.
C05	System Schematic Diagrams	Supplier to provide schematics for any systems not covered by P&ID, e.g. hydraulic, pneumatic, cooling.
C06	Sequential and Control Function Charts	A sequential function chart (SFC) provides an overview of system behavior. IT shall describe the start-up, shutdown and other sequential operations. A Continuous Function Chart (CFC) shall address the functions that run regardless of the active sequence. It complements the SFC and both shall be provided.
C07	Functional Description or Process Control Narratives	This document should include a text-based detailed description of the process control. It shall include but not be limited to: descriptives, flags, requests and commands, permissives, modes of operation, description of sequences, loop narratives, start conditions, start actions, run conditions, alarms, interlocks conditions and actions, pause conditions and actions, resume conditions and actions.
C99	Miscellaneous Design & Operational Drawings	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.
D	**D – DETAIL DRAWINGS**	
D01	Isometrics-Field Erected H/U Spools Only	Isometric drawings of plant and systems.
D03	Equipment Details	Details of equipment construction, capacity, etc. to meet the Purchaser’s specification.
D04	Fabrication, Installation and Shop Drawings	Drawings to show fully dimensioned component parts of items being supplied. To include Plating Drawings and dimensional drawings for lateral tees.
D06	Foundation Drawings	Provide all drawings associated with foundation details.
D07	Equipment Drawings	To include Rigging / Lifting Plans / Details and or Elevations complete with all necessary dimensions. All relevant notes regarding lifting and installation requirements.
D08	Shipping Drawings	Provide all drawings associated with shipping activities.
D99	Miscellaneous Detail Drawings	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.
E	**E – ELECTRICAL/INSTRUMENTATION & INTERCONNECTIONS**	
E01	Interconnection Block Diagrams	An Interconnection Block Diagram shall be provided when Equipment Supplier requires the field contractor to do the field installation or interconnection of devices or panels. The panels/junction boxes/devices Tag number shall be identified as well as any cable included by the supplier.

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision		
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date	
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013	

E02	Wiring Diagrams/Schematics	Wiring Diagrams shall be produced for each panel, cabinet, rack, console and item of equipment designed and constructed by the Supplier or Sub-Supplier specifically for this order. Diagrams shall indicate in an acceptable "ladder" format and shall be of a "Block" format showing all interconnections within the unit including those to all termination's and external interfaces. The diagram shall be fully detailed showing the details for each cable core and wire and the connections down to the level of interfaces to proprietary items within the unit. All units and connections shall be uniquely identified. All voltage levels, ratings, sizes, manufacturer, type numbers, cable and wire types, sizes, colour and ID number shall be included. All internal cables and wires shall be identified at both ends to a numbering schema agreed between the Purchaser and the Seller. Functional descriptions for each connection or signal path shall be included to enable users to fully comprehend the operation and configuration of the unit. Schematic drawings shall include cable types, cable numbers, tag numbers, termination point (plug/socket etc.), power supply sources, earthing arrangements and location of each item of equipment. The diagram shall also include any notes that may be necessary to enhance the understanding of the system's configuration and operation as well as indicating which components and connections are subject to emergency shutdown arrangements. Equipment and Cables not in the Supplier's scope shall be clearly identified. Schematic diagrams for instrument relay control and trip systems, etc., shall show the electrical arrangement of all component parts. Relays shall be shown with contacts in coil de-energized position.
E03	Single Line Diagrams	An interconnectivity representation of all electrical elements of a system.
E04	Control System Network Diagram	A single line diagram of the data communications system shall be provided. The drawing(s) shall show all the major control system components and how they are interconnected. Addressing information shall be provided at each drop.
E05	Panel and Annunciator Layout Drawings	General arrangement of Panel components complete with identification tags. Include BOM unless being issued as a separate document.
E06	Panel Detail Diagram	Provide details of equipment layout, terminal blocks and wiring schedule.
E07	Instrument Hook-up Details	Provide installation detail drawings for any instrument that requires installation by the field contractor.
E08	Block Diagram	Provide Control System Block diagram showing major system components (complete with tag No. and description) and their interconnection.
E09	Cable Specifications	Provide Technical data and specifications for cables connected to equipment not supplied as part of the scope of the turbine and generator package: cables connecting the line protection panels: control cables between the powerhouse and switchyard used for interlock purposes.
E99	Miscellaneous Electrical/Instrumentation & Interconnections Documents	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.
F	**F - DATASHEETS**	
F01	Equipment Data Sheet	Equipment data sheets will be issued by the Purchaser as part of enquiry or purchase order. Supplier to complete.
F02	Motor Data Sheet	Electrical data sheets will be issued as part of the enquiry and purchase requisition, part of the data sheet is completed by the purchaser, the remainder is to be fully completed by the Supplier.
F03	Instrument Data Sheet	An instrument datasheet shall be completed with process information, instrument specification information, materials of construction, process connections, power requirements, instrument and calibrated ranges, signal output, cable entry size, mounting type and any other key information. An instrument supplier datasheet can be provided as long as all other specific information such as manufacturer and model number (complete), calibration ranges and setpoints are included in the instrument index.
F04	WHMIS Material Safety Data Sheet (MSDS)	Supplier must provide suitable and sufficient health and safety information to ensure compliance with the Hazardous Products Act of Canada and any other relevant Provincial or Local legislation.
F05	Mechanical Properties of Materials	When requested Supplier to provide the following mechanical properties: Tensile strength, Yield Strength, Elongation at Ambient Temperature and any other information as requested.
F07	Shipping Bills of Material	Weights and dimensions data for all materials to be shipped.
F99	Miscellaneous Datasheets	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.
G	**G - SCHEDULES/LISTS**	
G01	Bill of Materials / Equipment List	Bill of Materials shall list all items in the system by part number, and indicate the major features of each item, e.g. make, model, type, supply voltages, output characteristics, materials, set pressure, design pressure, range, etc. It shall show the total quantity of each item supplied.
G02	Line Lists	Blank line lists will be supplied by the Purchaser for Supplier to indicate all salient features for piping included in his supply.
G03	Cable Schedule	The following information must be included in the cable schedule as a minimum: Cable Tag, a brief technical description of all cables, source, destination. Also a field showing scope of supply (i.e. by supplier, or by others) and scope of installation and termination for each cable (i.e. by supplier or by field contractor). The schedule shall be updated monthly or when significant changes occur. This document will not be approved to final status until the dispatch of all equipment to site after which any changes will be made directly onto the purchasers Master Cable Schedule. The schedule shall be submitted in hard copy and MS Excel format. Samples can be provided upon request.

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision		
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date	
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013	

G05	Preventative Maintenance Schedule	Section shall include schedule of preventative maintenance tasks/maintenance frequencies, where relevant routine test procedures and inspection instructions are to be provided.
G06	Instrument Index	An instrument list in Excel and hard copy format shall be provided. Each instrument tag number must be listed. The following fields are to be included and completed: Tag number, instrument type description, service, associated equipment, instrument range and calibration range (include calibration range if not provided in datasheets), reference P&ID or schematic if applicable, manufacturer and complete model number.
G07	Alarms and Trip Set Point List	Provide list in excel format and hard copy. Sample can be provided upon request.
G08	Computer Systems Documentation	1. System Description a. Hardware Components b. Operating System c. Driver d. Utilities e. Application Software f. Type of Interface g. Operator's Manual ***2. Hardware*** a. Schematic b. Interconnection diagram, especially special interfaces signal level, type of signal (how one sees it on an oscilloscope) and meaning, especially in relation to diagnostic programs c. Point list, if applicable d. Equipment drawing as provided by Original Equipment Manufacturer (OEM) e. Card drawing as provided by OEM f. Document on any customer modification g. Maintenance manual, with schedule of preventative maintenance h. Material list, with identification of original source of supplier, where practical ***3. Software*** a. Memory map b. Disk map c. Description of all key routines and sub-routines specifically, its function; how parameters are passed to it, where it returns parameters, how routine is activated, priority level constraints on usage, etc. d. source code, laddered diagrams, set points, etc.
G09	Input/Output List	I/O list shall include the corresponding device tag, I/O type and complete hardware and software addresses of each I/O point in the system. Required in Excel format and hard copy. Project sample can be provided upon request.
G99	Miscellaneous Schedule/List Documents	As described in the procurement documents and on SDRL or considered necessary by Supplier.
H	**H - CALCULATIONS**	
H01	Architectural Calculations	Calculations shall be provided for the following, as a minimum : **1**. Noise Design Calculations shall be provided for wall, partition and liner to ensure that noise transfer between areas is below purchasers stated requirements. Noise design calculations shall also be provided for proprietary equipment for areas such as Galleys and Laboratories (any equipment with any moving or mechanical parts). **2**. Thermal Calculations shall determine heat emitted to the atmosphere for project loading and ambient temperatures specified by the purchaser. **3**. Calculations shall also be provided for Structural elements such as Mini modules, blast walls, Firewalls etc. Please refer to Structural calculations for requirements.
H02	Foundation Support Calculations	Calculations shall be provided for the following, as a minimum: • Identification of all applicable loading conditions • Bearing capacity requirements • Beating capacity of the foundation for the applicable loading condition • Anchorage requirements with loads and anchor details.
H03	Structural Calculations	Calculations shall be provided for the following, as a minimum: • Identification of all applicable loading conditions • Loading, bending moment and shear force diagrams for all members, bracings and connections • Member selection details • Weld load and size requirements • Bolt load, size and number requirements
H04	Pressure Vessel / Tank Calculations	Calculation of wall thickness and volume verification for each vessel/tank in accordance with applicable ASME requirements.
H05	Pressure Piping System	Calculation of wall thickness, welds, flanges and instrument connections; dynamic analysis for each pressure line and system of design and extreme operation conditions in accordance with applicable ASME and CSA B51 requirements, including permit requirements.

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision		
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date	
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013	

H06	Thrust Bearing Loads and Capabilities	Calculations shall be provided for the following, as a minimum: • Hydraulic thrust loads • Structural support and stiffness requirements • Oil film thickness • Friction coefficients and losses • Cooling oil and water flow requirements • Hydrostatic lift system requirements.
H07	Lifting Lug Calculations	As a minimum calculation for lifting lug tension, bearing and shear failure loads; weld loads and size requirements; and specified safety factor to be provided.
H09	Instrument Air or Hydraulic Requirement Calculations	Calculation listing the air or hydraulic consumption requirements for each instrument air or hydraulic user and total air or hydraulic requirements.
H10	Fire Protection System Calculations	Calculations to detail pipe friction losses, nozzle sizes, and discharge rates in accordance with NFPA requirements. i.e.: sprinklers as primary protection.
H12	Mechanical Calculations - Misc.	All other mechanical calculation requirements specified in the contract documents and technical specifications, not already outlined in Attached 5a and 5b of this document, shall be provided.
H13	Electrical Calculation - Misc.	Purchaser will detail these as specifics are prepared. Calculation listing of various equipment rating.
H14	Civil Calculation - Misc.	Civil Calculations shall be provided.
H15	Transmission Line Calculation - Misc.	Any calculations not covered in H52-H58.
H23	Compressed Air Calculation	Calculations listing the compressed air consumption requirements for each instrument air user and total air requirements for both high and low pressure compressed air. In addition to system schematics and flow diagrams, calculations for piping sizes and rating, compressor rating, storage tanks, and expected volumes compensation/leakage air are to be provided for both high and low pressure compressed air systems.
H24	Gate Operating Ring Calculation	Gate operating ring materials and mechanical properties are to be provided. Calculations for the radial and axial displacement as well as maximum and allowable stress under applied load conditions are to be provided.
H25	Turbine Shaft Calculation	As per technical specification
H26	Runner Calculation	As per technical specification
H27	Stay Ring Calculation	As per technical specification
H28	Wicket Gate Calculation	As per technical specification
H29	Shaft Seal Calculation	As per technical specification
H30	Head Cover Calculation	As per technical specification
H31	Penstock Calculation	Not Applicable for Muskrat Falls
H32	Survey Calculation	Calculations shall be provided for the following, as a minimum: • Identification and 3D coordinates of the original site survey control points. • Identification and 3D coordinates of all major control points on the site. • Details layout drawings showing all major control points.
H33	Reinforced and Prestressed Concrete Calculation	Calculations shall be provided for the following, as a minimum: • Identification of all applicable loading conditions • Finite element analyses • Loading, bending moment and shear force diagrams for all components • Locations and jacking loads for pre-stressing tendons
H34	Structure Stability Calculation	Calculations shall be provided for the following, as a minimum: • Identification of all applicable loading conditions • Stability, including overturning and sliding • Location of resultant with respect to mid third of base • Location and size of drainage system components • Stability of excavated surfaces (soil and rock) • Stability of constructed fill slopes • Stability of natural in-situ materials and/or slopes affected by construction or reservoir impoundment, during construction or operation.
H35	Grouting Calculation	Calculations shall be provided for the following, as a minimum: • Definition of grout curtain (Primary, secondary, tertiary), including hole depths • Volume of grout take per hole
H36	Concrete Mix Calculation	Calculations shall be provided for the following, as a minimum: • Mix designs for slush grout and dental concrete for foundation preparation • Mix designs for conventional concrete for each structure, including primary and secondary concrete • Mix design for roller compacted concrete for each structure

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision		
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date	
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013	

H37	Blasting Calculation	Calculations shall be provided for the following, as a minimum: • Drilling pattern and powder factor for each structure or operation, including: - Size and spacing of holes, and Size and placement of charges, for pre-shearing. - Size and spacing of holes, and Size and placement of charges, for pre-shearing. - Size and spacing of holes, and size and placement of charges, for mass excavation. • Vibration limitations for each structure or operation.
H38	Essential Service Load Calculation	Full report and calculation
H39	Unit Service Load Calculation	Full report and calculation
H40	AC Station Service Load Calculation	Full report and calculation
H41	DC Station Service Load Calculation	Full report and calculation
H42	Primary Grounding Calculation	Full report. Calculations and drawings.
H43	EMTP Study	Full Report
H44	Insulation Coordination Study	Full Report
H45	Exciter Performance & Parameter Study	Full Report
H46	Governor Performance & Parameter Study	Full Report
H47	HVdc Scheme RAM Study	Full Report
H48	Reactive Power Study	Full Report
H49	Resonance Study	Full Report
H50	Sub-Synchronous Resonance Study	Full Report
H51	Relay Setting Calculation	Full Report
H52	Sag and Tension Calculation	All wires. All load cases. Stringing sag charts. Calculations for all load cases.
H53	Electrical Clearance Calculation	All codes as per CSA 22.3
H54	Design Load Cases	All calculations shall include zoning. Including 3 zones for dc, and 1 zone for ac.
H55	Coordination of Strength Calculation	Take into account conductor, tower (suspension, angle, dead-end) foundation, and hardware/insulators.
H56	Aeolian Vibration Calculation	Done by supplier using proprietary software.
H57	Insulation Requirement Calculation	As per CSA 22.3
H58	PLS-CADD Model Input Parameter Calculation	All details including *.bak file.
H59	Critical Speed of Rotating System	As per technical specification
H60	Acceptable Stress Calculations - Extreme Loads	As per technical specification
H61	Extreme Loads - Breaking point of shear pins	As per technical specification
H62	Natural Frequency Analysis	As per technical specification
H63	Fatigue Analysis	As per technical specification
H64	Step-up Calculation Prototype Efficiency	As per technical specification
H65	Current Transformer Design Calculations	As per technical specification including knee point calculations
H66	Creep Correction Chart	Provide Creep Correction Chart for the material.
H99	Miscellaneous Calculations Documents	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.
J	**J - PERFORMANCE DATA**	
J01	General Performance Data	This heading to cover any Performance Data required, but not previously covered by Code and Description.
J02	Current and Potential (CT/VT) Transformer Curves	Graph showing current transformer magnetization characteristics.
J04	Compressor Performance Curves	Curves to indicate the discharge pressure, shaft input power, polytropic head and efficiency versus inlet capacity for specified inlet pressure, temperature and molecular weight for each section (casing) and overall unit. Curves shall indicate performance from surge through to 120% rated capacity. Units driven by variable speed drivers shall be provided with curves for 80, 90, 100 and 105% rated speed.
J05	Pump Performance Curves	Curves to indicate differential head developed, efficiency, input power required and NPSHR versus flow for rated impeller. Units driven by variable speed drivers shall indicate four performance curves to indicate performance from minimum to maximum operating speeds. Curves shall indicate performance from zero to 120% rated flow, with minimum continuous flow clearly indicated.

J06	Performance Guarantee	As per technical specification and as follows: Performance guarantees shall be provided for all supplied equipment, ensuring environmental sustainability and safety, with specified performance requirements. Guarantee information to be provided shall include, but is not limited to, the following: • Expected life of equipment/components • Terms of warranty • Rated capacity and efficiency • Minimum hours of operation without failure/defects (e.g. oil leakage, surface cracking, insulation failure, wear rate, etc.) • Acceptable Operation limits (e.g. Operating temperature range, coolant and/or lubricant requirements, vibration limits, operating voltage, etc.)
J07	Miscellaneous Performance Data	As per technical specification
J08	Turbine Efficiency Curves	As per technical specification
J09	Generator Performance Curves	As per technical specification. Diagram showing generator real and reactive power capability.
J10	Soil Graduation Analyses	Standard particle size distribution in table and graph formats.
J11	Optimization Analyses (Civil)	Depending on the type of optimization, one or more of the following are to be provided: • Comparative layouts with tabulated associated relative benefits and costs. • Tables and/or graphs to illustrate the relative benefits and costs to provide the next level or size of installation.
J12	List of Environmental Emission and Effluent	As per Environmental Requirements.
J99	Miscellaneous Performance Data Documents	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.
K	**K – PROCEDURES**	
K01	Welding and Weld Repair Procedure	Specification defining all shop and field welding techniques and test results, and in accordance with the requirements of the Purchase Order.
K02	Vibration/Noise Level Test Procedure	Procedures defining extent, method and data to be recorded.
K03	Non-Destructive Test Procedure	Procedures defining extent, method and acceptance levels of all NDT in compliance with Purchaser's requirements, for materials and formed or welded fabrications by visual, radiographic, ultrasonic, magnetic particle, dye penetrant, eddy current or other techniques.
K04	Performance/Acceptance Test Procedure	• Suppliers' procedures for testing to demonstrate compliance with Purchaser's requirements and process guarantees. • Procedures shall indicate test bed arrangements, procedures to be adopted, readings to be taken, instruments to be used, and method of interpreting readings taken to determine basis for acceptance of results.
K05	Heat Treatment Procedure	Suppliers' procedures in accordance with the applicable code/standard and Purchaser's purchase order requirements.
K06	Pressure Test Procedure	Procedures shall indicate test bed arrangement, procedures to be adopted, readings to be taken, instruments to be used, and method of interpreting readings taken to determine basis for acceptance of results.
K07	Factory and Site Test Procedures (FAT/SAT)	• Description of system test procedures for control systems, safety, trip/shutdown systems, electrical and telecommunication systems with typical test record documents. • Factory test procedures are to be produced for use in tests to be conducted at the Supplier's or Sub-Supplier's works for each system. There shall also be an integrated test procedure to test all interfaces and connectivity, i.e. an overall test with all systems fully assembled and interconnected in the factory (including central equipment and a representative number of field equipment's). These tests shall demonstrate complete compliance to the Project Specification within the Purchase Order or Sub-Contract.
K08	Load Test Procedure	Procedure describing the method and extent of testing Cranes, Davits, Lifting Lugs in accordance with specified codes, standards and statutory and mandatory requirements.
K09	Dimensional Inspection Procedure	Dimensional Control Procedure, Visual Inspection Procedure.
K10	Manufacturing/Fabrication Procedure	Procedure explaining methods used to produce the required item(s) stated in the purchase order as detailed by the specification and/or data sheets.
K11	Cable Wiring Procedure	Supplier to supply his standard for approval.
K12	Commissioning Procedures	Commissioning Procedures shall comprise a Mechanical Completion Procedure to verify the integrity of installation works completed by others and Commissioning Procedures, all conducted by the Supplier. Mechanical Completion Procedures shall be produced which verify the mechanical completion for cables, cable termination's and equipment and systems physically installed by others. The procedure shall also certify the integrity of Supplier installed cables and termination's prior to the application of power. Commissioning Procedures shall be produced in accordance with the Project Specification within the Purchase Order or Sub-Contract.

K15	Surface Preparation and Coating Procedure	Painting and/or coating procedures shall be provided for all equipment/components requiring a protective covering. Procedures shall be in compliance with purchaser specifications and industry standards and provided for both factory and site applied paint and coatings. Procedures shall include but not limited to, the following information: • Description of material/components to be covered. • Surface preparation details • MSDS information from paint and/or coating manufacturer • Primer requirements, if applicable • Required number and thickness of painting/coating layers
K16	Instructions for Transportation, Storage, Warehousing and Long term Storage	Provide Full Instructions for transportation, storage, presentation, warehousing and long term storage.
K17	Shaft Inspection Procedure	As per Technical Specification.
K18	Flushing Procedure	As per Technical Specification.
K21	Certified Fusion Splicing Procedure	Fusion splicing shall be carried out by trained personnel.
K22	Routine Test Procedure	Provide a full list of routine tests, which will be carried out during manufacture, as well as the actual procedures and the test equipment that will be used.
K23	Sample Test Procedure	Provide a full list of sample tests, which will be carried out during manufacture, as well as the actual procedures and the test equipment that will be used.
K24	Construction Method Statements and Procedures	Includes all necessary construction method statements and procedures. Site installation and erection procedures shall also be included.
K99	Miscellaneous Procedures Documents	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.
L	**L -MAINTENANCE & SPARES**	
L01	Lubricant and Operating Fluids Schedule	Schedule to indicate type and grade of lubricants required for all equipment supplied. For each entry, first-fill capacities, rate of consumption plus frequency of change shall be indicated.
L02	Recommended Commissioning and Start-up Spares	List shall indicate parts recommended by Supplier, and be defined by reference to cross-sectional drawings and relevant parts list. Against each entry, Manufacturer, Manufacturers part no, price and delivery shall be indicated.
L03	Recommended 12 and 24 Months Operation Spares	List shall indicate parts recommended by Supplier and be defined by reference to cross-sectional drawings and relevant parts list. Recommendation shall assume that recommended commissioning spares will be purchased with main equipment. Against each entry, Manufacturer, Manufacturers part no, number of parts in operation, price and delivery shall be indicated.
L04	Recommended Critical Spares (Insurance)	Essential Spares that have a long delivery time and/or require testing with the main equipment. Against each entry, Manufacturer, Manufacturers part no, number of parts in operation, price and delivery shall be indicated.
L05	Special Tools List	List shall indicate those tools necessary for removing equipment from transport at site, plus those necessary for installation and maintenance equipment. Against each entry, a brief description shall be indicated plus, where necessary for clarity, a drawing provided.
L99	Miscellaneous Maintenance & Spares Documents	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.
M	**M - TEST & INSPECTION REPORTS**	
M01	Material Test Certificates	Material Test Certification. The level of certification, traceability and marking of materials will be defined within the Purchase order referenced specifications, drawings and data sheets.
M02	Instrument/Electrical Test Report	Heat run, short circuit, etc. test reports
M03	Component/Assembly Balance Certificate	Static and dynamic test results.
M04	Hydrostatic/Pneumatic Test Certificate	Tested to a recognized code or standard. Including marked-up isometrics for pipework defining extent of test.
M05	NDE Test Reports	Detailed NDT reports detailing procedure used, acceptance levels, results obtained and action for radiographic, ultrasonic, magnetic particle dye penetrant and eddy current examinations. Reports shall identify code/standard, components tested, location, operator, date, heat treated condition and weld repairs (as applicable).
M06	Welder Performance Qualifications and Certifications	Qualification of all welder/welding operators using approved weld procedures and by weld position in compliance with the Purchaser's requirements. Code forms or Supplier standard forms to be used as appropriate.
M07	Heat Treatment Records	Fully endorsed certificates of any heat treatment conducted during forming or fabrication such as normalizing, quenching, post weld heat treatment etc. Certificates must be fully traceable for each part by means of serial or unique numbering systems.
M08	Calibration Certificates	Suitably endorsed valid certification to verify that instrumentation has been calibrated by a recognized authority. Where required by the equipment specification, suitably endorsed valid certification shall be supplied for
M09	Fire Testing Certificates	Certification issued by an approved testing establishment or recognized authority for hydrocarbon fires, jet or pool, for the durations stated in the Purchase Order.
M10	Inspection Release Certificate	Fully endorsed certificate issued by Purchaser's inspector.

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision		
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date	
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013	

M11	Code Compliance Certificate	The Certificate should be issued by the IIA, and document that all Pressure Vessels have been designed in accordance with the nominated code or standard, and that the review considered the specified design conditions, nozzle and environmental loadings.
M12	Lifting Equipment Test Certificate	Required for all items, hoists, cranes wire ropes/shackles, padeyes, etc.
M13	Noise Test Certificate/Reports	In compliance with the Project Specification within the Purchase Order.
M14	Vibration Test Certificate/Reports	In compliance with the Project Specification within the Purchase Order.
M15	Performance Test Certificate	Suppliers report on performance testing of equipment, including overspeed tests with the copies of data, indicating that equipment complies with Purchaser's specification.
M16	Painting/Coating Test Report	As required by the Project Painting and Coating Standards.
M17	Steel Manufacturing Reports	Residual magnetism report, heat treatment report, mechanical test reports, full traceability cross-reference control sheet.
M18	Mechanical Run Test Report	The mechanical run test report shall include details and result of the successfully completed FAT of equipment and systems as well as the details and results of the successfully completed commissioning static checks and dynamic commissioning/system commissioning tests completed after equipment and systems are assembled and installed at site.
M19	Factory and Site Test Report (FAT/SAT)	Full test report for each test as per K07.
M20	Commissioning Report	Full test report for each test as per K12.
M21	Efficiency Test Reports	• Full test report and calculations. • Full test report shall be provided detailing the measured actual efficiency of equipment and systems including turbine, generator, governor, auxiliary equipment, etc., after assembly, installation and commissioning at site and Turnover to Operations.
M24	Manufacturer's Type Test List and Report	Proof of design and type tests previously performed on the material shall be submitted for approval.
M25	Reports and Certificates for Routine Tests	Provide Routine test reports with certificates before and after stranding.
M26	Reports for Sample Tests	Provide sample test reports
M27	Mechanical Completion Report	Provide as per K12.
M28	Certificate of Origin	A document required from the Exporter (or its agent) and certified by an issuing body, that the goods in a particular export shipment have been wholly produced, manufactured or processed in a particular country. The Certificate of Origin must be signed by the Exporter and, in many countries, validated by a Chamber of Commerce.
M29	Preservation Records	Preservation records that shows compliance to storage requirements
M99	Miscellaneous Test & Inspection Reports	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.
Q	**Q – QUALITY**	
Q01	Quality Assurance System Registration Certificate	Certificate provided by an authorized registrar confirming conformance to a quality management system.
Q02	Quality Assurance System Manual	Document specifying the quality management system of an organization.
Q03	Quality Plan	Document specifying which procedures and associated resources shall be applied by whom and when to a specific project, product, process or contract.
Q04	Inspection and Test Plan(s) (Factory and Site works)	Document defining the inspection and test activities to be carried out during the realization of a product.
Q05	Certificates of Conformity (Factory and Site Works)	Certificates authorized by the supplied or third party verification body attesting that the product meets requirements.
Q06	List of Generator Tests	Provide list of all generator tests to be performed during manufacturing, installation and commissioning.
Q07	Internal/External Audit Schedule	Documented audit schedule for both internal and external (supplier and third party) audits.
Q08	Management Review of Meeting Minutes	Minutes of meeting of the most recent management review of the quality management system.
Q09	Third Party Surveillance Report	Report by an authorized third party on the audit of the ISO 9001:2008 quality management system.
Q10	NCR Register and associated close out reports	Register of Nonconformities reported and associated close out reports.
Q11	Quality Management Certificate for Manufacturer	Supplier shall submit their manufacturer's ISO 9001:2008 or internationally recognized Quality Management Certificate or quality manual.
Q12	Declaration of Installation and Inspection Completion	As per Quality requirements.
Q13	Authorized Deviations	Site queries, concession requests etc. as approved by Purchaser.
Q99	Miscellaneous Quality Documents	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision		
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date	
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013	

R	R – MANUALS	
R01	Installation, Commissioning, Operating and Maintenance Manual	**1. Installation** Section shall include all erection/assembly drawings, instructions as to the use of special tools provided, tolerances allowed on setting dimensions, handling and unpacking instructions. Also includes quantities of preservatives and fluids required for shipment. **2. Commissioning** Sectional shall include list of spare parts, special tools and utilities required, pre-commissioning checks to be performed, sequenced procedure for dynamic commissioning and start-up and fault finding guidelines. Copies of all relevant drawings shall be included. **3. Operating** Section shall include description of equipment, operating procedures for start-up, steady state, shutdown, emergency and fault conditions, operating parameters, function of protective devices and controls, copies of all relevant cause and effect charts and block diagrams, and fault finding guidelines. **4. Maintenance** Section shall include instructions for maintenance disassembly, repair/overhaul and reassemble, schedule of preventative maintenance/maintenance frequencies.
R02	Manufacturing Records Book (MRB)	Construction, manufacturing, installation, testing, reporting and certification documentation required to demonstrate that constructions, equipment, materials and fabricated systems and units are in compliance with he statutory regulations and specified requirements.
R03	Installation, Commissioning, Operating and Maintenance Manual Table of Contents (TOC)	Table of Contents template for the Installation, Commissioning and Operation Manuals
R04	Manufacturing Records Book (MRB) Table of Contents (TOC)	Table of Contents template for the Manufacturing Record Book
R05	Dispatch Dossier	Dispatch Dossier shall mean all those documents required, as a minimum to accompany goods released to site from Contractors/Suppliers and Fabricators. Procured goods shall not be dispatched without Dispatch Dossier.
R99	Miscellaneous Manuals	As described in the procurement documents and on SDRL or considered necessary by Vender/Supplier.

Lower Churchill Project	Powerhouse and Spillway Hydro-Mechanical Equipment Supplier Document Requirements List (SDRL)	Revision		
	Nalcor Doc. No.: MFA-SN-CD-2000-ME-LS-0001-01	B2	Date	
	SLI Doc. No.: 505573-3321-45EL-0002	01	22-Jul-2013	

Legend

Column	Title	Description
1	SDRL Code	Document code identifying a type of document required. Supplier may have multiple documents with the same SDRL code, if so these will be identified by unique sequential number on the Supplier Document Register.
2	Type of Document	Short description of SDRL code. Refer to SDR descriptions for detail.
3	Provide With Proposal	Document is required with the proposal.
4	Submit Prior to start of Fabrication / Construction	Document is required to be submitted prior to start of fabrication or construction
5	After Shipment	Not used
6	With Shipment	Hardcopy of document must accompany the shipment (Typically unpacking and erection procedures etc.)
7	Minimum Documents Approved Code 1 Prior to Inspection Release	Document must be approved code one (1) prior to inspection release. Defines a minimum requirement. Additional requirements may be identified through Inspection and Test Plans.
8	As Built	"As Built" revision of the document must be submitted
9	Final Documentation Location (R01/R02)	The final version of all technical documents must be compiled in a manual and submitted. This column identifies which Manual the document will be located in: "R01" Installation , Commissioning , Operating and Maintenance Manual or "R02" Manufacturing Record Book
10	Final File Format	An electronic copy of all files must be submitted. This column defines the file type by its standard 3 letter extension (PDF. DWG, etc.) Further description will be provided in the notes if required.
11	First Submission	The required first submission date for the document after the order has been received. This is defined by a number of weeks relative to an event. Typical events are: ARO = After Receipt of Order FAT = Factory Acceptance Test SHIP = Shipment from Supplie
12	Submit Monthly	Identifies periodic reports and schedule to be submitted monthly after first submission.
13	Notes	Additional explanation or instructions as required.

Supplier Name

Contact Person - Phone and Email address

Supplier Document Register (SDR) - A01

Project No.	Project Name	Equipment/Material	Package Number:	Rev. No.
	Lower Churchill Project	**Package / Requisition Title**	**CH0032**	**xx**

Package Engineering Approval:

Approval:

Date:

																Nalcor Energy Document Number													
SDRL Code	Supplier Doc. #	Supplier Revision	Document Title	Submit Prior to Start of Fabrication / Construction	After Shipment	With Shipment	Minimum Documents Approved Code 1 Prior to Inspection Release	As-Built	Final Document Location (R01 / R02 / R99)	Final File Format	Submission Requirements Date Required - Weeks After Receipt of Order (ARO)	Submission Requirements Monthly	Date Required	Supplier Forecast Submittal Date	Supplier Actual Submittal Date	Project Code	Originator Code	Doc. Type Code	Physical Component	Discpline	SDRL Code	Sequential #	Sheet #	Rev. No.	Sub-Supplier Name (if applicable)	Final Delivery Date	Review Class	Y/N Engineer Stamp	Remarks
													dd-mmm-yyyy	dd-mmm-yyyy	dd-mmm-yyyy														

To be completed by Nalcor

EXHIBIT 5

HEALTH AND SAFETY REQUIREMENTS

1.0 Introduction

Without limiting the generality and application of the Agreement, Contractor will abide by and ensure Contractor Group Personnel abides by, at a minimum, the health and safety requirements set forth herein and as described in the most recent version of the following documents located in Exhibit 11 – Company Supplied Documents:

- LCP Health and Safety Management Plan (LCP-SN-CD-0000-HS-PL-0001-01)
- LCP Security Management Plan (LCP-PT-MD-0000-HS-PL-0005-01)
- Standard for Drug and Alcohol (LCP-PT-MD-0000-LR-SD-0001-01)
- Global Power Health and Safety Management System (LCP-PT-MD-0000-HS-PL-0006-01)
- Global Power Health and Safety Standards Manual (LCP-PT-MD-0000-HS-SD-0002-01)
- Critical Risk Control Protocols (LCP-PT-MD-0000-RI-SD-0001-01)

2.0 Health and Safety Commitment

Contractor will demonstrate a strong commitment to health and safety management and must operate and ensure that Contractor Group operates a health and safety management system that is compliant with OSHAS 18001:2007, corresponding Canadian standards and fulfills all Applicable Laws pertaining to the Work and Worksites.

Contractor will place the highest priority on safety and health while performing the Work. Contractor is responsible for maintaining a safe working environment at all time at the Worksite whether of a temporary or permanent nature. The system in place will cater to specific requirements for instruction, supervision and resources pertaining to Contractor's Personnel, and Engineer's and Company's Personnel.

Contractor will not permit nor tolerate any unsafe or unhealthy condition or activity over which it has control. Contractor will immediately inform Engineer of any unsafe or unhealthy condition or work practice of which it becomes aware but over which it has no authority to correct.

3.0 Compliance with Health and Safety Regulations and Standards

Contractor will be responsible for complying with all Applicable Laws relating to health and safety, and for taking all necessary safety precautions related to or arising out of the performance of the Agreement in order to protect the Work, Contractor's Personnel, and Engineer's and Company's Personnel, the general public, all other persons, the property of Company, and the property of third parties.

Without prejudice to Contractor's general and legal responsibility for the safety of its operations and of the Personnel and property involved, where Engineer has notified

Contractor of any specific health, safety or environmental requirements, which are applicable to any part of the Work being performed, Contractor will comply therewith.

4.0 General Requirements

Without limitation to the full implementation of Contractor's health and safety management system for the Work, Contractor will:

a) Be responsible for maintaining and enhancing the health and safety awareness of Contractor's Personnel. Contractor will arrange and participate in regular meetings with Contractor's Personnel and Engineer to review implementation of the systems and processes required for Contractor to meet its health and safety obligations in the execution of the Work;

b) Identify all high risk activities and cease work in any identified areas until adequate and effective controls are implemented;

c) Require all Contractor's Personnel to wear personal protective equipment (PPE) and clothing suitable for existing Work in compliance with the Applicable Laws in the locations the Work is being performed. Canadian Safety Association (CSA) standards for PPE will apply to Work performed in Canada;

d) Provide specific instruction to Contractor Group on their responsibilities for safe work during normal and emergency operations, including explanation of recognized hazards and associated protective measures, procedures and emergency response measures;

e) Ensure that each of Contractor's Personnel, regardless of prior experience, demonstrates competency to Engineer in his/her job. The Contractor Group's supervisory Personnel will observe new Personnel's work performance until Engineer is satisfied that such Personnel are competent to fill the position in a safe and effective manner;

f) Ensure that all Contractor's equipment, facilities, materials and Contractor's Items are maintained in safe, sound and proper condition, meet all applicable industry standards and Applicable Laws and are capable of performing the function intended;

g) Conduct thorough drills, desktop exercises and tests of Contractor's Items, Personnel and procedures. The Contractor will ensure the effectiveness, suitability and adequacy of the emergency response and preparedness program;

h) Document and instruct Personnel on work procedures, safe practices, Contractor's safety rules and standards, emergency plans and duties, and Applicable Laws;

i) Conduct scheduled and impromptu safety meetings of all Personnel performing the Work, including any Contractor's Personnel, in which the possible hazards, problems of the job, and related safe practices are emphasized and discussed;

j) Practice good housekeeping standards;

k) Provide general safety education through training, safety meetings, Company and Engineer publications and other educational media;

l) Establish and support a health and safety committee in accordance with Applicable Laws;

m) Provide all reasonable means to control and prevent fires and explosions, injury to Personnel and damage to equipment and property;

n) Institute a permit to work system for hot and cold work, for all Work involving welding, energized equipment, cutting and burning, open flame, electric tools, grinding and soldering which is conducted outside a designated safe area. Contractor will ensure that gas bottles for cutting and burning are stored, separated and capped in accordance with Applicable Laws;

o) Institute a confined space entry procedure and provide training for Personnel involved in confined space entry;

p) Institute a lock out - tag out procedure for all work on equipment, which may inadvertently operate during installation, repair or maintenance, all in accordance with Contractor's permit to work system;

q) Institute a pre-work inspection program prior to commencement of Work. Contractor will inspect and perform task analysis to ascertain whether any health or safety hazards exist. Contractor will correct identified hazards before commencement of Work or will take steps to prevent exposure of Personnel to the hazard. Contractor will document this inspection and hazard analysis process and maintain a copy of the document on file;

r) Institute a program to ensure Contractor's Personnel are fully trained and currently qualified for their jobs in accordance with regulatory and industry standards and all Applicable Laws, and as otherwise specified in this Agreement. Records of certification and training will be maintained for each of Contractor's Personnel;

s) Maintain a register of all lifting equipment. All lifting and rigging equipment will be load tested as per manufacturer's recommendations and be fully certified with suitable inspection procedures in place. All Personnel involved in lifting and rigging activities will be suitably trained and certified. All lifting and rigging equipment must be inspected annually by a certified inspection company and certificate issued and maintained on site.

t) Operate and use all pressure vessels in accordance with local safety requirements and Applicable Laws;

u) Maintain a current inventory of hazardous materials and ensure compliance with Applicable Laws pertaining to their transportation, storage, use, handling and disposal;

v) Ensure compliance with current occupational exposure limits for physical, chemical, or biological agents or materials, in accordance with Applicable Laws;

w) Implement and maintain a planned maintenance system for its tools, equipment, machinery and electrical systems for Contractor's Personnel;

x) Provide Engineer with the results of any health and safety visits, audits, inspections, investigations, surveys, tests or measurements, associated with the Work, conducted by an Authority;

y) Provide signage, as appropriate, to warn Personnel of hazards and indicate areas where the use of additional personal protective equipment is required;

z) Provide and maintain proper barriers, safe access and egress, guards, rails and safety devices to minimize hazards during the performance of Work;

aa) Ensure all inboard and over-the-side scaffolding and work platforms are installed, tested and certified by competent Personnel, prior to use;

bb) Perform planned health and safety audits and inspections of the Worksites, work practices and HS management system in accordance with the audit and inspection schedule outlined in the Contractor's Health and Safety Plan (as described in Section 5 of this Exhibit 5);

cc) Conduct a risk assessment of its operations and provide Engineer with a copy of the assessment, outlining measures to be taken and schedule for implementation of those measures required to address identified hazards. The risk assessment will include consideration of health and safety risks;

dd) Ensure that all Personnel engaged in the Work are medically fit and maintain high standards of hygiene;

ee) Ensure that all firefighting equipment is maintained and operational in accordance with CSA standards and firefighting Personnel are well trained and competent in firefighting;

ff) Set out a communications scheme identifying lines of reporting and method of reporting, both within the Contractor's own organization and to Engineer;

gg) Not cause, permit, or tolerate a hazardous, unsafe, unhealthy condition or activity over which it has control, to exist or be conducted in a Worksite; and

hh) Prior to providing access to a Worksite, provide all Personnel with a Worksite orientation which will include:

i. Worker's rights;
ii. Contractor health and safety policy;
iii. Contractor environmental policy;
iv. Safe work practices and procedures;
v. Reporting of incidents and accidents;
vi. Emergency response;
vii. Personal protective equipment;
viii. Risk assessment; and
ix. Hazard identification.

5.0 Contractor's Health and Safety Plan

Within fourteen (14) days of the Effective Date, Contractor shall submit to Engineer for Approval, a Health and Safety Plan for the Work. Contractor's Health and Safety Plan will be based upon the Contractor's health and safety management system and will address all requirements stated in this Exhibit 5.

Engineer will review Contractor's Health and Safety Plan and may provide written comments to Contractor. Contractor will review Engineer's comments, make the necessary changes and reissue it for Engineer's Approval. Contractor will present all changes to its Health and Safety Plan to Engineer for Approval.

As a minimum, the following information will be included in the Contractor's Health and Safety Plan:

a) Communication of safety expectations to Contractor Group;
b) Identification of the strategic initiatives that Contractor will utilize during the Work to achieve an injury and illness free workplace;
c) A verification/audit program to verify that the Health and Safety Plan has been implemented for the Work;
d) An LCP level safety organization chart;
e) Line functions with specific safety responsibilities;
f) High level, Work specific roles and responsibilities for Contractor's Personnel, including accountabilities and qualifications;
g) Interface roles and responsibilities between Contractor and all other members of Contractor Group by use of responsibility-assignment matrices;
h) Description of how Contractor's management team will actively participate in health and safety management activities;
i) Subcontractor selection and management;
j) Be structured in accordance with the various elements associated with the Work such as fabrication, transportation, installation and commissioning;
k) Identification of Contractor's resources (Personnel, Contractor's Items, facilities, equipment, consumables, or other requirements) required to support health and safety management;
l) A description of the system in place to ensure that the safety integrity of equipment and systems involved is maintained throughout the Work;
m) Identification of procedures applicable to individual activities comprising the Work, including chemical handling procedures and permits to work;
n) Identification of training and qualification requirements pertaining to Personnel involved in the Work, including all location specific training;
o) Outline of a process for maintaining a hazard register, which identifies significant hazards to the safety and health of all Personnel, the safety of the environment and the safety of the technical assets. The register will include a cross reference to the operating procedures in place to control the risk arising from individual hazards;
p) Identification of interfaces to Company's and Engineer's health and safety management systems in line with the Work;
q) An emergency response preparedness plan in line with Contractor's scope of the Work and which interfaces with Company's and Engineer's emergency response plan;
r) Processes that will be utilized by Contractor during the Work to eliminate or control identified hazards;
s) Any other elements as identified in Company's and Engineer's health and safety standards;
t) Identification of how Contractor will capture learning and best practice during the Work execution;
u) Inclusion of a measureable health and safety targets for both leading and lagging indicators that are in line with Company's targets. Performance measuring will include lost time injury frequency rate, all-injury frequency rate, and severity rate; and

v) Identification of how Contractor will measure, assimilate, and report health and safety performance to Engineer.

Contractor's Health and Safety Plan shall:

- take into consideration the hazards and risks that all of Contractor's Personnel are exposed to while working at the Site;
- be communicated to Contractor's Personnel prior to the commencement of Work at the Site; and
- meet all Applicable Laws.

Contractor shall comply with its Health and Safety Plan.

Contractor is responsible for implementing, resourcing, and periodically verifying its Health and Safety Plan. Contractor will provide Engineer with an implementation schedule for its Health and Safety Plan, along with an update to the Health and Safety Plan on a quarterly basis.

Contractor will participate in a health and safety management system interface process and will be in a position to demonstrate through a gap analysis that Contractor's Health and Safety Plan complies with the requirement outlined herein and the most recent version of the following documents as amended from time to time:

- LCP Health and Safety Management Plan (LCP-SN-CD-0000-HS-PL-0001-01)
- LCP Security Management Plan (LCP-PT-MD-0000-HS-PL-0005-01)
- Standard for Drug and Alcohol (LCP-PT-MD-0000-LR-SD-0001-01)
- Global Power Health and Safety Management System (LCP-PT-MD-0000-HS-PL-0006-01)
- Global Power Health and Safety Standards Manual (LCP-PT-MD-0000-HS-SD-0002-01)
- Critical Risk Control Protocols (LCP-PT-MD-0000-RI-SD-0001-01)

Any deficiencies identified as a result of the gap analysis will be corrected by Contractor unless otherwise agreed in writing with Engineer. Contractor acknowledges that it fully understands all interfaces between Contractor's Health and Safety Plan and Company's and Engineer's health and safety standards.

6.0 Engineer's Review of Contractor's Health and Safety Plan

Without relieving Contractor of its responsibilities under the Agreement, Contractor will allow Engineer access to facilities, Personnel and records, when requested, to enable Company to:

a) ensure that Contractor is carrying out its health and safety responsibilities under this Agreement;

b) ensure that Contractor is carrying out its responsibilities outlined in its Health and Safety Plan; and

c) conduct, if required, independent investigation into any health, safety or environmental incident arising in the performance of the Agreement.

The forgoing will also be applicable to all other members of Contractor Group.

If Engineer is made aware of a failure of Contractor to comply with its responsibilities under this Agreement, which does not create an imminently unsafe condition, Engineer will have the right to notify Contractor of such failure and to direct Contractor to abate such condition as soon as possible. If Contractor fails to comply within a reasonable period, then Engineer will have the right to stop all Work being performed by Contractor and the Work will not be restarted until Contractor has abated the failure to comply. Contractor shall not be entitled to compensation for any costs it incurs as a result of such Work stoppage.

7.0 Contractor's Health and Safety Personnel

Contractor shall provide full time, designated health and safety advisor(s) who will be responsible for attending safety meetings, conducting incident investigations, providing health and safety support to all Personnel engaged in the Work and the implementation, maintenance and monitoring safety guidelines and procedures. Contractor will ensure that the safety advisor is a Certified Registered Safety Professional or has equivalent training and experience.

Contractor will require Engineer's Approval of all health and safety Personnel that are proposed to be based at the Worksites.

8.0 Drug and Alcohol Policy

The use, possession, distribution or sale of alcohol, illegal drugs or drug-related paraphernalia, firearms, explosives, weapons or other dangerous substances or articles is not permitted at the Site.

Contractor will submit to Engineer, for Engineer's Approval, Contractor's drug and alcohol policy, which will be in accordance with Applicable Laws. Contractor will ensure that Contractor's Personnel, engaged in the Work at the Site, comply with Company's drug and alcohol policy, Standard for Drug and Alcohol (LCP-PT-MD-0000-LR-SD-0001-01).

Engineer may, if it has reasonable cause to believe that any of Contractor's Personnel is under the influence of alcohol or drugs, require such Personnel be tested in accordance with Company's Standard for Drug and Alcohol (LCP-PT-MD-0000-LR-SD-0001-01) or require Personnel to be removed from the Site and denied further access.

9.0 Reporting

Contractor will provide immediate notification in writing to Engineer of all incidents, including lost time injuries, restricted work cases, medical aids, property damages and near misses. Contractor will immediately complete an investigation into the incident. Incident investigation reports will be submitted to Engineer within seven (7) Business Days after the incident. Contractor's incident investigation report will verify that the incident has been fully investigated and that the root cause and contributing factors have been identified and communicated to the appropriate Personnel. Contractor will also provide Engineer with copies of all reports or other documents filed or provided by Contractor's insurers and Authorities in connection with such incidents.

Contractor will provide Engineer with a monthly safety performance report, which at a minimum, will include all of the following:

a) Lost time Injuries
b) Restricted work cases
c) Medical aids
d) First aids
e) Occupational illness
f) Property damage
g) Recordable injuries
h) Near miss incidents

Contractor will classify all incidents in accordance with the Canadian Electrical Association (CEA) Standard A-2-2007. In general terms, the following is the classification scheme for all injury types:

a) Lost time injury is defined as a work related injury for which an employee requires medical attention and is unable to return to work for his/her next scheduled shift.
b) Medical treatment injury is defined as a work related injury for which an employee requires medical attention; however, s/he is able to return to work for the next scheduled shift.
c) First aid injury is defined as a work related injury, which is minor in nature and can be treated at the Worksite.

The general decision-making process for injury classification typically consists of the following five (5) steps:

a) Determine whether a case occurred; that is, whether there was a death, illness, or an injury;
b) Establish that the case was work related or resulted from an event or exposure in the work environment;
c) Decide whether the case is an injury or an illness;
d) If the case is an illness, record it;
e) If the case is an injury, decide if it is recordable based on a finding of medical treatment, loss of consciousness, restriction of work or motion or transfer to another job.

Injury and illness will be classified in accordance to CEA Standard A-2-2007. Generally, a recordable injury is any occupational injury or illness that results in an individual experiencing:

a) fatality;
b) lost time injury;
c) medical treatment injury; or
d) Other injury/illness (not captured above), which has restricted work; or significant occupational injury/illness; or loss of consciousness.

Each injury or illness should be recorded only once and categorized using the above hierarchy. To illustrate, a lost time injury that involves medical treatment injury and subsequent restricted work will be categorized as a lost time injury.

For work-related injury/illness where the signs and symptoms recur or continue in the absence of an exposure to the workplace, the incident is recurred and does not precipitate a new incident.

EXHIBIT 6

ENVIRONMENTAL AND REGULATORY COMPLIANCE REQUIREMENTS

1 INTRODUCTION

This Exhibit 6 - Environmental and Regulatory Compliance Requirements specifies the Contractor's responsibilities with respect to compliance with Applicable Laws during construction activities at the LCP.

1. The Contractor shall demonstrate a strong commitment to environmental management and must operate, and ensure that all members of the Contractor Group operate in accordance with Canadian standards and fulfill all Applicable Laws, including regulatory requirements, pertaining to the Work and Worksites.

2. The Contractor shall place high priority on environmental protection while performing Work and is responsible for maintaining an environmentally compliant Worksite at all times whether the Work is temporary or permanent.

3. The Contractor shall not cause, permit nor tolerate an environmentally non-compliant condition or activity over which it has control. The Contractor shall immediately inform the Engineer of any environmentally non-compliant condition or work practice of which it becomes aware but over which it has no authority to correct.

2 CONTRACTOR'S RESPONSIBILITIES - REGULATORY AGENCIES

2.1 General

1. The Contractor shall ensure Work areas are available for inspection by the Authorities. All inspections, other than by the Engineer or Company Representative, will be arranged in advance through the Engineer.

2. Any violations of environmental permits or authorizations, or any environmental related incidents observed by inspectors representing Authorities, are to be reported to the Engineer prior to leaving the Site. Except in emergencies, environmental protection measures required by Authorities shall be subject to the Acceptance of Engineer prior to implementation.

3. The Contractor shall ensure that Contractor's Personnel, including machinery and equipment operators and truckers, comply with (a) the terms and conditions of the Agreement, (b) all environmental Applicable Laws and applicable permits, (c) requirements of Authorities, and (d) such other rules and regulations as the Engineer may establish and notify the Contractor.

4. Contractor shall ensure that all members of the Contractor Group shall not harass wildlife or waterfowl or unduly disturb fish. Hunting and fishing are not permitted on the Site. Any contravention of environmental requirements, including employee actions accidental or otherwise, resulting in environmental damage shall be reported to the Engineer without delay.

5. In accordance with the Agreement, the Contractor shall be responsible for customs clearance, import permits, Work validations, Work permits and operating licenses in the port of mobilization / demobilization of the Work, and other requirements that are essential to the Work during all phases of the Work.

2.2 Permits

1. The Contractor shall review the Work to identify all permits, authorizations and certificates that are required for all the Contractor's facilities and the Work. Within the time specified in Section 3.1 below, Contractor shall provide to the Engineer a permit list (containing all such identified permits, authorizations, and certificates), to be entered into a permit registry on Aconex. Once entered, the Engineer shall have the authority to assign to either the Contractor or the Engineer the responsibility for preparing the permit applications.

2. Appendix A - List of Permits, Acceptances and Authorizations provides a list of permits that may be required to undertake the Work and responsibility for completing permit applications. This is a preliminary list and the Contractor shall complete its own list and submit it to the Engineer for Acceptance. In addition, the responsibility outlined on this list may be changed by written intructions from the Engineer to the Contractor due to changes in the Work or schedule constraints.

3. For those permits identified as the responsibility of the Contractor, the Contractor shall identify and prepare applications for all authorizations, permits, dispensations, consents and licenses required by Applicable Laws to enable it to perform the Work. All permit applications identified as the responsibility of the Contractor shall be submitted to the Engineer for internal review a minimum of 3 weeks prior to the date that such authorization, permit, dispensation, consent or license is submitted to the Authority. The Engineer will then submit the permit to the applicable Authority, on behalf of the Contractor. The Engineer will obtain the permit, and forward a copy to the Contractor immediately upon receipt and before the Contractor's facilities are used or the Work is undertaken. The Contractor shall ensure that it receives a copy of the permit and complies with the permit conditions.

   For Service NL building permits, the Contractor shall submit electronically one application package for each building on Site. Such package will include:

   - The fire and life safety review application and the Building Accessibility/Exemption application together as one PDF;
   - All electrical and mechanical permits associated with each building;
   - Any other required approval for buildings/utilities; and
   - The related drawings for the building in a separate PDF document. This PDF shall be created from the full size auto cad drawings.

4. For those permits identified as the responsibility of the Engineer, the Contractor shall

provide information as required in a timely manner to complete the relevant applications. The Contractor shall ensure that permits designated as the responsibility of the Engineer that are required for the Work are in place prior to starting the Work.

5. It should be noted that some authorizations associated with the LCP are subject to an aboriginal consultation process. This process requires that permit applications are provided to relevant aboriginal organizations by the associated Authority for a period of at least 30 days.

6. The Contractor shall take into consideration all these additional reviews and approvals, and the associated timelines, and ensure applications are prepared with the incorporation of these timelines.

7. For permits already in place for existing facilities and permits that the Contractor holds to carry out its business and daily activities, the Contractor must provide a copy of these permits to the Engineer prior to the start of the Work.

8. The *Storage and Handling of Gasoline and Associated Products Regulations, 2003* (referred to as the "GAP Regulations") under the *Environmental Protection Act* of Newfoundland and Labrador applies to the construction, operation and registration of "storage tank systems"[1] in the Province of Newfoundland and Labrador. While Section 3 of the GAP Regulations explicitly exempts storage tank systems of capacity of 2500 litres or less that are connected to a heating appliance (e.g. tanks controlled by the *Heating Oil Storage Tank System Regulations, 2003* of Newfoundland and Labrador), all other "stationary" tanks (i.e. tanks installed in a fixed location) may be interpreted as falling under the control of these regulations. Following this strict interpretation, even very small tanks (e.g. less than 5 litre tanks connected to small generators, water pumps, etc. installed in temporary locations) may fall under control of the GAP Regulations.

   Contractor shall provide Notice to Engineer of any and all storage tanks, storage tank systems and equipment storage tanks proposed by Contractor for use on the Site at least one (1) week prior to such use, along with all information pertaining to such tanks and systems as required by Engineer. If requested by Engineer, Contractor shall obtain written dispensation from the application of the GAP Regulations from the applicable Authority prior to such use of tanks or systems that are not already registered under GAP Regulations. Any required tank or system registration must be accompanied by any necessary regulatory variances.

   In general, the GAP Regulations apply to all stationary storage tanks and storage tank systems except in the following cases:

[1] The GAP Regulations defines "storage tank system" as an "… atmospheric or low pressure closed tank container and all vents, fill and withdrawal piping associated with it installed in a fixed location and includes temporary arrangement on cradles and skids".

- Tanks with capacities of 2,500 liters or less that are connected to a heating appliance;
- Tanks that are designed, constructed and utilized in the inherent operation of a piece of equipment. In this case, the tanks must be physically secured and dedicated to the equipment requiring the fuel for its operation; and
- "Mobile" tanks (e.g. tank trucks and tank truck trailers) used for temporary, stationary storage. In this case, storage period must not exceed 14 days and no additional fuel can be added to the tank. There must also be a minimum of 14 days of downtime between separate storage periods and there can be no more than two 14-day storage periods within a 12 month time frame.

Note that all provisions of the GAP Regulations, including registration, apply for all tanks associated with mobile generators.

Notwithstanding the above provisions of this Section 2.2.8, Contractor shall be solely responsible to comply with all Applicable Laws relating to the Work, and nothing in this Section 2.2.8 shall be construed so as to restrict, limit, waive or otherwise diminish Contractor's responsibility and liability to comply with all such Applicable Laws.

3 CONTRACT-SPECIFIC ENVIRONMENTAL PROTECTION PLAN (C-SEPP)

1. Within two (2) weeks after the Effective Date, the Contractor shall submit to the Engineer for Acceptance, a Contract Specific Environmental Protection Plan (C-SEPP) for the Work using the C-SEPP template provided in the Agreement. No Site Work shall take place until the Engineer has Accepted the C-SEPP.

2. The Contractor’s C-SEPP shall be based upon the *General Environmental Requirements* of the Technical Specification of this Agreement (if applicable), the Project Wide Environmental Protection Plan (in Exhibit 11 - Company Supplied Documents), and the Contractor’s own corporate environmental management system.

3. The C-SEPP is prepared by the Contractor and is specific to the Work. The C-SEPP provides a practical way for the Contractor to demonstrate its understanding of environmental regulations, practices and procedures required to reduce, or eliminate, potential negative environmental effects.

4. The Contractor’s C-SEPP shall include the following, at a minimum (refer to the C-SEPP template for all requirements):

   - a description of the construction sequence (e.g. GANTT Chart);
   - roles and responsibilities;
   - mitigation procedures for all areas of environmental concern;
   - procedures for environmental monitoring;
   - maintenance requirements for environmental control structures;
   - procedures for post-activity clean-up and demolition; and

- contingency planning for environmental concerns.

5. The Contractor's C-SEPP shall also include any permits, registrations or notifications, required by Federal, Provincial, or aboriginal stakeholders for the proposed activities. The Contractor may be required to prepare additional environmental documentation prior to any fieldwork for non-time critical activities.

6. The Contractor is responsible for implementing, resourcing, and periodically verifying the C-SEPP. Contractor shall provide Engineer with an implementation schedule for the plan and with an update provided on a quarterly basis.

4 REPORTING

1. The Contractor shall conduct daily inspections of the Work to confirm environmental compliance. The inspections shall be documented by the Contractor in daily reports which shall be kept on file. Any non-compliance and corrective actions shall be documented by the Contractor.

2. The Contractor shall immediately notify the Engineer of all environmental incidents, including any loss of hazardous or controlled products. **Any spill meeting the following criteria shall be reported immediately to the Canadian Coast Guard at 709-772-2083 or 1-800-563-9089**:

    a. Any spill on a natural water body (marine or freshwater); or
    b. Any land-based spill:
        i. that is over 70 litres; or
        ii. of any quantity that has the potential (e.g. by migrating through subsurface soils/bedrock/substructures[2], etc) to enter a natural water body; or
        iii. of any quantity that has the potential to impact a privately owned property.

3. Once the spill is reported to the Canadian Coast Guard, the Engineer will liaise with other Authorities to provide additional information, as required.

4. The Contractor shall provide the Engineer with a monthly environmental performance report for the Work. The monthly cut-off for each report shall be the close of business day up to and including the final day of each calendar month. The Contractor's environmental performance report shall include, without limitation, the following:
    i. Hazardous and other waste generated during the period;
    ii. Environmental incidents, including loss of fuel or other hazardous products; and
    iii. Reported non-compliance and associated corrective actions.

[2] sewer systems, conduits, tunnels, etc

5. The Contractor shall complete and submit to the Engineer a Monthly Fuel Consumption Report, in the form as set out in Appendix C - Monthly Fuel Consumption Report, no later than 7 days after the end of each calendar month.

APPENDIX A

LIST OF PERMITS, ACCEPTANCES AND AUTHORIZATIONS

	Permit	Regulatory Body	Act	Responsibility for Completing Permit Applications
1	Application for Crown Lands - LCP related Infrastructure	DOEC	*Lands Act* of Newfoundland and Labrador	Engineer
2	Application for Crown Lands - Contractor Facilities	DOEC	*Lands Act* of Newfoundland and Labrador	Contractor
3	Notice of Intent for Reservation of Shoreline	DOEC	*Lands Act* of Newfoundland and Labrador	Engineer
4	Application for Water and Sewerage Works Permit	DOEC	*Water Resources Act* of Newfoundland and Labrador, Sections 36, 37 and 48	Contractor
5	Permit to Alter a Body of Water and Schedule A (Culverts)	DOEC	*Water Resources Act* of Newfoundland and Labrador, Section 48	Engineer
6	Permit to Alter a Body of Water and Schedule B (Bridges)	DOEC	*Water Resources Act* of Newfoundland and Labrador, Section 48	Engineer
7	Permit to Alter a Body of Water and Schedule C (Dams)	DOEC	*Water Resources Act* of Newfoundland and Labrador, Section 48	Engineer
8	Permit to Alter a Body of Water and Schedule D (Fording)	DOEC	*Water Resources Act* of Newfoundland and Labrador, Section 48	Engineer
9	Permit to Alter a Body of Water and Schedule E (Pipe Crossing - Water Intake)	DOEC	*Water Resources Act* of Newfoundland and Labrador, Section 48	Engineer

	Permit	Regulatory Body	Act	Responsibility for Completing Permit Applications
10	Permit to Alter a Body of Water and Schedule F (Stream Modifications)	DOEC	*Water Resources Act* of Newfoundland and Labrador, Section 48	Engineer
11	Permit to Alter a Body of Water and Schedule G (Small Bridges)	DOEC	*Water Resources Act* of Newfoundland and Labrador, Section 48	Engineer
12	Permit to Alter a Body of Water and Schedule H (Other Alterations)	DOEC	*Water Resources Act* of Newfoundland and Labrador, Section 48	Engineer
13	Application for Permit for Drilling a Non-Domestic Well - LCP related Infrastructure	DOEC	*Water Resources Act* of Newfoundland and Labrador, Section 58	Engineer
14	Application for Permit for Drilling a Non-Domestic Well - Contractor Facilities	DOEC	*Water Resources Act* of Newfoundland and Labrador, Section 58	Contractor
15	Application for Water use License - LCP related Infrastructure	DOEC	*Water Resources Act* of Newfoundland and Labrador, Section 48	Engineer
16	Application for Water use License - Contractor Facilities	DOEC	*Water Resources Act* of Newfoundland and Labrador, Section 48	Contractor
17	GAP Registration	Service NL and DOEC	*Environmental Protection Act* of Newfoundland and Labrador	Contractor
18	Diesel Generator Registration Form	Service NL	*Environmental Protection Act* of Newfoundland and Labrador	Contractor

	Permit	Regulatory Body	Act	Responsibility for Completing Permit Applications
19	Permit for Access of any Highway	Service NL	*Urban and Rural Planning Act, 2000* of Newfoundland and Labrador *Works, Services and Transportation Act* of Newfoundland and Labrador	Engineer
20	Highway Services Signs Application	DTW	*Urban and Rural Planning Act, 2000* of Newfoundland and Labrador, subsections 36(2) and 39(2)	Contractor
21	Asphalt Plant Construction and Operation Form	Service NL	*Environmental Protection Act* of Newfoundland and Labrador	Contractor
22	Building Accessibility Design Registration / Exemption Registration - LCP related Infrastructure	Service NL	*Buildings Accessibility Act* of Newfoundland and Labrador	Engineer
23	Building Accessibility Design Registration / Exemption Registration - Contractor Facilities	Service NL	*Buildings Accessibility Act* of Newfoundland and Labrador	Contractor
24	Fire and Life Safety Review Plan (National Building Code) - LCP related Infrastructure	Service NL	*Buildings Accessibility Act* of Newfoundland and Labrador	Engineer

	Permit	Regulatory Body	Act	Responsibility for Completing Permit Applications
25	Fire and Life Safety Review Plan (National Building Code) - Contractor Facilities	Service NL	*Buildings Accessibility Act* of Newfoundland and Labrador	Contractor
26	Used Oil Storage Tank System Application	DOEC	*Environmental Protection Act* of Newfoundland and Labrador	Contractor
27	Mobile Fuel Storage Tank Relocation	Service NL	*Environmental Protection Act* of Newfoundland and Labrador	Contractor
28	Design Registration of Pressure Piping System	Service NL	*Public Safety Act* of Newfoundland and Labrador	Contractor
29	Elevating Devices	Service NL	*Public Safety Act* of Newfoundland and Labrador	Contractor
30	Food Establishment License Temporary Facility	Service NL	*Food and Drug Act* of Newfoundland and Labrador	Contractor
31	Septic Systems less than 4,546 L/day flow	Service NL	*Water Resources Act* of Newfoundland and Labrador	Contractor
32	Commercial Cutting/Operating Permit - LCP related Infrastructure	DNR	*Forestry Act* of Newfoundland and Labrador	Engineer
33	Commercial Cutting/Operating Permit - Contractor Facilities	DNR	*Forestry Act* of Newfoundland and Labrador	Contractor
34	Application for a Quarry Permit - LCP related Infrastructure	DNR	*Quarry Materials Act, 1998* of Newfoundland and Labrador	Engineer

	Permit	Regulatory Body	Act	Responsibility for Completing Permit Applications
35	Application for a Quarry Permit - Contractor Facilities	DNR	*Quarry Materials Act, 1998* of Newfoundland and Labrador	Contractor
36	Permit to Destroy Problem Animals	DNR	*Wildlife Act* of Newfoundland and Labrador	Engineer
37	Archaeological Investigation Permit	DTCR	*Historic Resources Act* of Newfoundland and Labrador	Engineer
38	Application for Authorization for Works or Undertakings Affecting Fish Habitat - Assessment of Freshwater HADD	DFO	*Fisheries Act* of Canada, Section 35(1)	Engineer
39	DFO Referral for any in-water works	DFO	*Fisheries Act* of Canada, Section 35(2)	Engineer
40	Request for Project Review	DFO	*Fisheries Act* of Canada, Section 35(1)	Engineer
41	Application for License to Install and Operate a Radio Station in Canada - LCP related Infrastructure	IC	*Radiocommunication Act* of Canada	Engineer
42	Application for License to Install and Operate a Radio Station in Canada - Contractor Facilities	IC	*Radiocommunication Act* of Canada	Contractor

	Permit	Regulatory Body	Act	Responsibility for Completing Permit Applications
43	Acceptance to Dispose Waste in Municipal Landfill	Service NL and Municipality (Town of Happy Valley Goose Bay)	*Municipalities Act, 1999* of Newfoundland and Labrador	Contractor
44	Municipal Development Plan	DMA	*Municipalities Act, 1999* of Newfoundland and Labrador	Engineer
45	Explosives User Magazine Licence (Type U)	NRCAN	*Explosives Act* of Canada	Contractor
46	Type A (Annual) Import Permit (to transport explosives)	NRCAN	*Explosives Act* of Canada	Contractor
47	Nav Canada Land Use Division Review	Nav Canada	*Aeronautics Act* of Canada	Contractor
48	Aeronautical Obstruction Clearance Form	TC	*Aeronautics Act* of Canada	Contractor
49	Navigable Waters Protection Act (NWPA)	TC	*Navigable Waters Protection Act* of Canada, Section 4	Engineer
50	Permit to Transport Dangerous Goods	TC	*Transportation of Dangerous Goods Act, 1992* of Canada, Section 3	Contractor

APPENDIX B

ABBREVIATIONS AND ACRONYMS

Abbreviations	Description
C-SEPP	Contract-Specific Environmental Protection Plan
DFO	Department of Fisheries and Oceans (Canada)
DOEC	Department of Environment and Conservation (Newfoundland and Labrador)
DNR	Department of Natural Resources (Newfoundland and Labrador)
DMA	Department of Municipal Affairs (Newfoundland and Labrador)
DTCR	Department of Tourism, Culture and Recreation (Newfoundland and Labrador)
DTW	Department of Transportation and Works (Newfoundland and Labrador)
GAP Regulations	*Storage and Handling of Gasoline and Associated Products Regulations, 2003* of Newfoundland and Labrador.
IC	Industry Canada
NRCAN	Natural Resources Canada
NWPA	*Navigable Waters Protection Act* of Canada
P-WEPP	Project-Wide Environmental Protection Plan
TC	Transport Canada

APPENDIX C

MONTHLY FUEL CONSUMPTION REPORT

MONTHLY FUEL CONSUMPTION REPORT[1]

Contractor's Name: _____

Report completed by (please print): _____

Signature: _____

Reporting month/year (mm/yyyy): _____

Report date (dd/mm/yyyy): _____

Agreement Number: _____

Agreement Name: _____

Consumed Fuel			
Fuel Type		**unit**	**quantity**
Diesel		litres	
Gasoline		litres	
Heating oil		litres	
Propane		litres	
aviation turbo fuel		litres	
kerosene		litres	
Other (specify type)			
1		litres	
2		litres	
3		litres	
4		litres	
5		litres	
6		litres	
Total			

Notes:

1 To be completed by Contractor and submitted to the Engineer for each calendar month, no later than 7 days after end of each month.

2 Consumed fuel to be reported is defined as:

a) quantity of fuel transferred during the reporting month to tanks of all LCP-dedicated vehicles, equipment, and facilities, or

b) quantity of fuel used in the reporting month as part of a process (such as ANFO used for explosives); or

c) quantity of fuel delivered to bulk storage tanks at Company's Laydown Area within the reporting month by the Fuel Delivery Services Contractor.

3 Contractor shall provide as part of the Monthly Fuel Consumption Report a general listing of all types of equipment, facilities, and processes that have burned fuel during the reporting month. The types of equipment, facilities, and processes include, but are not limited to, the following: heavy equipment (e.g. excavators, bull dozers, concrete trucks, etc); light equipment and vehicles (e.g. pick-up trucks, chain saws, pumps); faciliites (e.g. diesel generators, concrete production, etc); processes (e.g. explosives in ANFO, etc); etc.

MONTHLY FUEL CONSUMPTION REPORT

General Listing of Fuel Burning Equipment, Facilities, and Processes

Equipment	Facilities	Processes

EXHIBIT 7

QUALITY REQUIREMENTS

1.0 INTRODUCTION

Without limiting the generality and application of the Agreement, Contractor will abide by and ensure Contractor Group abides with the quality requirements set forth in this Agreement.

2.0 QUALITY OBJECTIVES

The following quality objectives are required of Contractor:

a) Work will comply with the quality requirements of the Agreement;
b) Quality management systems of Contractor Group will ensure early and proactive identification of process or product failure so as to prevent problems before they occur or minimize rework, cost and schedule impacts, and to identify potential failures, opportunities for improvement and best practices;
c) Equipment and materials procured and/or installed by Contractor Group will be consistent with Exhibit 1 – Scope of Work;
d) Construction Work will be carried out in accordance with established construction standards and methods;
e) Completion activities will be executed in accordance with the procedures and manuals covering those activities; and
f) Documentation of objective evidence of conformance to the requirements will be maintained and recorded during the execution of the Work.

3.0 DEFINITIONS, TERMS AND ABBREVIATIONS

ISO 9001:2008	Quality Management Systems – Requirements
ISO 9000:2005	Quality Management Systems – Fundamentals and Vocabulary
ISO 10006: 2003	Quality Management Systems – Guidelines for Quality Management in Projects
ITP	Inspection and Test Plan
NCR	Nonconformity Report
PMI	Positive Material Identification
QA/QC	Quality Assurance/Quality Control
QMS	Quality Management System
QP	Quality Plan
SDRL	Exhibit 4 - Supplier Document Requirements List

4.0 CONTRACTOR'S RESPONSIBILITIES

a) Contractor shall comply with and ensure that Contractor Group complies with requirements outlined in this Exhibit 7.
b) The Contractor shall ensure that Contractor Group implements the quality activities described in this Exhibit 7.
c) Contractor shall demonstrate the implementation of its quality program and the compliance of its Work with the requirements of the Agreement.

d) In accordance with the Articles of the Agreement, Contractor shall provide the right of access to Company Group Personnel, to the Worksites to monitor the progress of the Work.
e) Contractor shall provide acceptable office accommodation, including internet connections for the Engineer's inspectors and expeditors. The level of involvement of inspectors and expeditors shall be determined by Engineer.
f) Contractor shall ensure that documents requiring a registered professional engineer's seal and signature shall be in accordance with the *Engineers and Geoscientists Act, 2008* of Newfoundland and Labrador and the by-laws of the Professional Engineers and Geoscientists – Newfoundland and Labrador (refer to www.pegnl.ca).

5.0 QUALITY MANAGEMENT SYSTEM

Contractor shall have an effectively implemented and maintained QMS for the execution of the Work. The QMS shall, at a minimum, be formally documented and compliant with the requirements of ISO 9001:2008. The QMS shall emphasize building quality into the Work through the use of documented control processes that incorporate activities necessary to assure quality.

The QMS shall be supported by an established quality organization with qualified resources, and formally documented control procedures to effectively administer and implement the requirements.

Prior to subcontracting any Work, Contractor shall demonstrate to Engineer that the selected Person has a quality management system that complies with the provisions of ISO 9001:2008. Contractor shall not Subcontract any part of the Work to a Person that does not meet the standards established by the ISO 9001:2008. These requirements also apply to Work to be performed by Subcontractors' subcontractors of every tier.

6.0 QUALITY ORGANIZATION

Contractor shall appoint a quality representative, empowered by management with freedom and authority to:
a) oversee the management of quality for the Work:
b) manage quality issues and their resolution; and
c) ensure compliance with the Agreement.

Contractor shall provide details of the QA/QC organization it intends to employ at the Worksites. Contractor shall appoint sufficient qualified Personnel to ensure that the quality management system, specifically the quality control and inspection activities, including those pertaining to any part of the Work, are achieved.

7.0 QUALITY DOCUMENTS

The SDRL identifies specific quality documentation required from Contractor and defines the required submission dates and form of submission. The SDRL and instructions for Contractor document requirements are contained in document 505573-0000-37AG-I-0015 (Document Number LCP-SN-CD-0000-IM-PR-0002-01), Lower Churchill Project Supplier Document Requirements located in Exhibit 11 – Company Supplied Documents. Contractor shall ensure that it meets all quality documentation requirements outlined in the Agreement.

8.0 QUALITY PLAN

8.1 GENERAL REQUIREMENTS

Contractor shall submit a QP, prepared in accordance with this Exhibit 7, to the Engineer for review and Acceptance. The QP shall include all aspects of the Work. All QP revisions are subject to review and Acceptance by Engineer prior to being implemented. Contractor shall:

a) Develop and maintain a QP stating the procedures, processes, resources and sequence of quality activities related to the Work;
b) Mandate one person to be responsible for development, approval and follow up of the QP;
c) Ensure QP review and revisions by Contractor's Personnel comprising representatives of all affected disciplines; and
d) Upon request, provide Engineer with the procedures and instructions to which the QP refers.

8.2 QUALITY PLAN CONTENT

The QP shall:

a) Accurately reflect the planning implemented by Contractor to comply with the Agreement;
b) Apply the guidelines of ISO 10006:2003 - Quality Management Systems – Guidelines for Quality Management in Projects;
c) Document any non-applicable requirement or any provision in the QP that does not comply with quality system requirements;
d) Identify each of the main stages of execution for each of the deliverable elements of the Work;
e) At a minimum, contain the following:
    i. Scope;
    ii. Quality objectives;
    iii. Definitions, terms and abbreviations;
    iv. Organization chart and quality related roles and responsibilities associated with all phases of the Work;
    v. Management review of Subcontracts;

vi. Documentation and records management; and
vii. Listing of all control procedures required to perform the Work (current and to be developed); and

f) Provide detailed descriptions of:

i. Responsibilities of Contractor's management related to QA/QC activities;
ii. The systems and procedures Contractor will use to ensure that quality is an intrinsic part of all aspects of the Work;
iii. Reviews, approvals required and checks and inspections to be conducted, including responsibilities and the timing of the required checks and inspections in the Work sequence;
iv. How procurement documents will be prepared to properly establish quality requirements with Subcontractors (and Subcontractors' subcontractors of every tier). Contractor shall require that Contractor Group prepare a product specific or service specific quality plan for of the Work of such Subcontractors and subcontractors;
v. How Persons, to whom Contractor proposes to Subcontract any part of the Work, will be evaluated and selected to ensure they have the requisite resources, tools, procedures, and quality capabilities to meet established requirements (this requirement also applies to proposed subcontractors of Subcontractors of every tier;
vi. How ITPs will be prepared. Each ITP shall include a list of the specifications that must be met, describe the tests that will be performed to ensure compliance, and identify who will perform the tests. Each plan shall identify inspections and QA/QC steps that will be taken by Contractor Group;
vii. How records will be maintained to demonstrate that all design, materials, equipment and construction conforms to established requirements and how and in what form the records will be submitted to the Engineer;
viii. How nonconformities, concessions and waivers shall be controlled and resolved including the process that will be used, the Personnel responsible for administering the process and the information flow through Contractor's organization for resolution;
ix. How all instruments used for testing and inspection will be properly certified, including PMI devices, equipment for calibrating instrumentation and hydrostatic test gauges;
x. The auditing, appraising, sampling techniques, reviews and reporting Contractor intends to carry out for the Work to confirm the effectiveness of the QA/QC activities, and that the QMSs are indeed delivering the quality required;
xi. How Contractor plans to meet requirements for PMI, source inspection and field quality control, including the frequency of testing, the locations where the testing will be conducted (e.g., Worksites, upon receipt at Worksites, following installation), and the type(s) of testing equipment to be used;
xii. Control procedures that adequately address the controls required for quality activities; and
xiii. Acceptance and rejection criteria applicable to the activity and approval requirements.

8.3 QUALITY AUDITS AND MANAGEMENT REVIEWS

Contractor shall provide a schedule of quality audits (both internal and external) and quality management system reviews to be performed during execution of the Work. The schedule of quality audits shall identify those planned audits of Contractor Group.

The schedule of audits shall be provided to Engineer on the later of four (4) weeks before start of the Work or two (2) weeks after the Effective Date.

Contractor shall report progress, on a monthly basis, on implementing any actions that arise from the audits or management system reviews.

8.4 SURVEILLANCE OF SUBSUPPLIERS AND SUBCONTRACTORS

Contractor shall perform surveillance and inspection of Contractor Group as well as review and approve dossiers provided by the Contractor Group to ensure that the requirements of the Agreement have been met.

Contractor shall identify planned verification activities used to assess and manage Contractor Group to ensure compliance with requirements of this Agreement.

The verification activities shall be documented in the QP and reported monthly together with the progress on audits and management reviews.

9.0 INSPECTION AND TEST PLANS

9.1 GENERAL REQUIREMENTS

Contractor shall develop and submit its inspection and test plan (ITP), which shall include those of its Subcontractors (and Subcontractors' subcontractors of every tier), for review and Acceptance by the Engineer on the later of four (4) weeks before start of the Work or two (2) weeks after the Effective Date.

The ITPs shall cover all aspects of the Work to be executed by Contractor Group and shall implement and maintain all quality activities described therein.

Contractor will notify Engineer of all hold and witness points ten (10) Business Days prior to the scheduled date of such activity. Contractor will reconfirm the scheduled date of such activity seventy-two (72) hours prior to commencement. The Contractor shall identify upcoming hold and witness points for the next six (6) months in the Monthly Progress Report (as referenced in Exhibit 3 - Coordination Procedures).

9.2 INSPECTION AND TEST PLAN CONTENT

Contractor is required to follow all of the instructions below in preparing the ITPs, and acknowledges that the Engineer review will be based on these instructions.

a) Identification
   - Code the ITP, identify the revision and date;
   - Identify the Company, project and sector;
   - Identify the Agreement, as well as the component, discipline or system to which the ITP applies; and
   - Identify the Personnel responsible for quality, at all Worksites.

b) Work Items and Steps
   - These are normally copied from the elements of the Contractor' Group's detailed Work schedule. Complimentary or specific details may be required; and
   - Contractor shall ensure ITPs, as far as practical, follow the normal sequencing of the Work. ITPs shall identify the stages requiring approval, inspection and testing hold and witness points.

c) Control Activities
   - The control points, including their summary description (inspection, verification, tests) shall be inserted in the detailed Work schedule.

d) Responsibilities
   - Identify Contractor's Personnel responsible for control activities.

e) Frequency
   - Specify the percentage, frequency or sampling rate applicable to the control points.

f) Reference to Specifications
   - Control activities shall refer to applicable drawings, specification sections and/or specifications/codes;
   - Identify parameters and characteristics that will be mainly considered in the controls; and
   - For each control, identify and note down the criteria and/or tolerances for approval.

g) Procedures Used
   - Identify the procedures or instructions developed by Contractor or Subcontractors (or Subcontractors' subcontractors of every tier) to perform control and testing.

h) Control Equipment
   - Describe and identify the equipment to be used for quality control. Users shall provide evidence of the calibration status.

i) Checklists
   - The information identified above can be recorded in a checklist prepared by Contractor. The checklists shall be appended.

j) Forms
   - Identify the forms to be used to record the control point results and append them to the ITP. The recorded results will constitute an inspection or testing report.

k) Engineer's Control Points

- The type of control points, namely: witness, hold or documentation review will be identified during ITP review by the Engineer.

l) Quality Records
- Identify the types of records to be included in the quality records, to be submitted to the Engineer, and include the applicable standard table of contents.

m) Remarks
- Include all other relevant information that may be useful in carrying out the ITP.

9.3 FINAL INSPECTION AND DECLARATION OF COMPLETION

Appendix A - Declaration of Installation and Inspection Completion ("Declaration") of this Exhibit 7 will be completed by Contractor upon completion of aspects of the Work. Contractor shall confirm that these aspects of Work are complete and comply with the requirements outlined in the Agreement, that all related quality records have been submitted to Engineer and confirm that Engineer carry out its final inspection on that aspect of Work.

Upon receipt of a Declaration, Engineer will conduct a final inspection of the aspect of Work described therein and, if necessary, issue a deficiency list if it is determined that the aspect of Work is not complete or includes elements that do not comply with the requirements of the Agreement.

When Contractor has corrected all deficiencies and the quality records are Accepted by Engineer, the Declaration will be Accepted by Engineer and an Accepted copy will be returned to Contractor.

10.0 NONCONFORMITY REPORTING

Contractor shall submit, to Engineer for review and Acceptance, its nonconformity, corrective action, preventive action procedure(s) and resolution reporting form.

Contractor will ensure that all nonconformities, which shall take on the definition of noncompliance with a requirement of ISO 9000:2005 Quality Management Systems – Fundamentals and Vocabulary, are recorded, investigated and resolved to Engineer's satisfaction.

All of Contractor's Personnel shall have a responsibility to identify apparent nonconformities arising from the execution of the Work.

Contractor shall maintain a register of all applicable and open nonconformity reports. The status of all NCRs shall be reported in the Monthly Progress Report (as referenced in Exhibit 3 - Coordination Procedures).

Contractor's NCR form may be used but, at a minimum, it shall contain the following:

a) Project number;
b) NCR number;
c) Contractor;
d) Project name/location;
e) Purchase order/contract number;
f) Product description (including part #, serial # and tag #);
g) Date opened;
h) Date closed;
i) NCR description;
j) Action by;
k) Status;
l) Root cause analysis;
m) Resolution proposed; and
n) Resolution Implemented.

Contractor shall identify Personnel responsible for verifying and resolving NCRs.

11.0 QUALITY RECORDS

Contractor's quality records shall include, as a minimum, the following documents:
a) Inspector qualifications (quality control);
b) Welder's qualifications ;
c) Checklists;
d) Relevant inspection and testing reports;
e) Materials analysis certificates, when required;
f) Steel works certificates;
g) Paint specification sheet, when required;
h) Identification and traceability documentation;
i) Engineer Approved deviations;
j) Closed out nonconformity reports, corrective and preventive actions;
k) Completed test packages;
l) Preservation records;
m) Declarations to Authorities, when required;
n) As-built drawings;
o) As-built specifications;
p) As-built bills of material;
q) Various required manuals;
r) All Accepted Declaration of Installation and Inspection Completion forms (Appendix A); and
s) Shipping authorization.

Quality records shall be retained until the later of (a) seven (7) years after the satisfaction of all of the obligations of Contractor pursuant to this Agreement, (b) seven (7) years after expiration or any termination of this Agreement, or (c) such longer period as may be required under Applicable Laws. During this period, the quality records shall

be available to Engineer and Company for inspection and audit.

12.0 ENGINEER'S ACTIVITIES

12.1 Engineer shall be entitled, at its sole discretion, to perform certain QA/QC activities, the performance of which shall not relieve Contractor of its responsibilities under this Agreement or its overall responsibility for quality of the Work. These QA/QC activities may include:

a) Audit of Contractor's QA/QC program and include any or all of the following:
   - Review of Contractor's documented QA/QC plans and procedures;
   - Random review of Contractor's procurement documents for inspection and specification content;
   - Review of Contractor's specific equipment inspection and test plans in relation to specification requirements;
   - Review of inspector's surveillance and non-conformance reports, Contractor's deviation log, procedure approval logs;
   - Receipt of inspection discrepancy reports and field inspection reports;
   - Review of activities undertaken by Contractor Group;

b) Independent source inspections. Results of Engineer source inspections will be made available to Contractor and Contractor shall address and resolve any issues arising from these inspections;

c) Review and assessment of Contractor Group quality plans and ITPs;

d) Review and assessment of Contractor's control procedures and audit schedule, monitoring compliance and monitoring resolution of any issues raised;

e) Participation in selected pre-inspection and pre-production meetings;

f) Conducting oversight of Contractor's quality activities including Contractor Group inspection activities, field inspection and surveillance activities, along with participation in inspection and test stages outlined in Accepted ITPs;

g) Review and Acceptance of NCRs where proposed dispositions do not result in meeting specifications; and

h) Other activities as deemed appropriate by Engineer.

12.2 Engineer shall, at its sole discretion, perform pre-planned shop expediting activities at Contractor's premises to ensure that critical scheduled milestones are being maintained. Pursuant to Article 14 of the Agreement, Engineer's nominated Shop Expeditor shall be allowed free access to perform the following activities:

a) Review and reconciliation of supplier data/engineering issues complete with committed submittal dates from the Contractor Group to the Engineer;

b) Review of the Contractor's sub-order status report to confirm that delivery dates for major buy-out components fully support the Contractor's schedule;

c) Review of the Contractor's current fabrication schedule, and those of its SubContractors and SubContractors' subContractors and subContractors of every tier;

d) Visually verify by means of a shop tour that Contractor's forecasted procurement, fabrication, testing and shipping milestones are proceeding on schedule; and
e) Other activities as deemed appropriate by Engineer.

Engineer's Shop Expeditor shall have the right to give Contractor instructions on the timely preparation of and adherence to the Contractor's schedule covering activities in engineering, issuance of drawings and data, procurement, fabrication, assembly, inspections, testing and shipping.

Contractor shall provide its full cooperation to facilitate such expediting access during all phases of the Agreement.

13.0 QUALITY SURVEILLANCE & EXPEDITING RELEASE

In all cases a Quality Surveillance Release (in the form set out in Appendix B - Quality Surveillance Release) and Expediting Release Notice (in the form set out in Appendix C - Expediting Release Notice) is required for all fabricated equipment and materials supplied by Contractor Group prior to Delivery. Bulk materials and off the shelf items will require an Expediting Release Notice. The Quality Surveillance Release and Expediting Release Notice shall be a hold point on all Contractor ITP's.

It is the Contractor's responsibility to contact the Engineer to notify when the equipment/material is ready for final inspection/release.

A Quality Surveillance Release shall not be issued until Engineer is satisfied that:

- All NCRs and Corrective Action Requests have been closed out;
- All inspection and test points shown on the Contractor's Accepted ITP have been completed and signed off by all Parties; and
- All required documentation is fully completed and reviewed for compliance.

The final Quality Surveillance Release is issued to the Contractor to Accept the Goods as presented by the Contractor. The release does not relieve the Contractor of any responsibility for the quality of Work or any obligations related to the specification, codes/standards or Agreement requirements.

The final Expediting Release Notice will be issued by the Engineer once all requirements of the Agreement are met.

A copy of the Company/Engineer Approved Quality Surveillance Release and Expediting Release Notice shall be issued to the Contractor for attachment to the packing list.

APPENDIX A

DECLARATION OF INSTALLATION AND INSPECTION COMPLETION

SNC·LAVALIN	**DECLARATION OF INSTALLATION AND INSPECTION COMPLETION**	nalcor energy LOWER CHURCHILL PROJECT

Declaration No.:	**Date:**

Prepared by
Contractor: _____

Agreement No.: _____
Agreement Title: _____

WORK DESCRIPTION:

UNRESOLVED DEFICIENCIES:

This document certifies that the Work described above has been completed, inspected and tested in accordance with the above-noted Agreement's requirements, and that all quality records have been finalized and sent to the Engineer.

Notes:

Contractor:	**Engineer**:
Signature: _____	**Signature**: _____
Date: _____	**Date:** _____

APPENDIX B

QUALITY SURVEILLANCE RELEASE

SNC·LAVALIN	QUALITY SURVEILLANCE RELEASE	nalcor energy LOWER CHURCHILL PROJECT

Client:	Project:	Date:
Project N°:	QS RELEASE N°:	Page 1 of
Agreement N°:	QS Assignment N°:	

CONTRACTOR		SUB-CONTRACTOR	
Company Name:		Company Name:	
Address:		Address:	

PURCHASE ORDER ITEMS RELEASED

Item N°	Tag N°/ Material Code	Description	Quantity

REMARKS / CONDITIONS OF RELEASE:

NOTES:
THIS RELEASE DOES NOT CONSTITUTE A SHIPPING AUTHORISATION. THIS RELEASE DOES NOT RELIEVE THE CONTRACTOR OF RESPONSIBILITY TO COMPLY WITH THE TECHNICAL SPECIFICATIONS OF THE AGREEMENT NOR FOR ERRORS OR OMISSIONS ON ITS PART. A COPY OF THIS RELEASE SHALL BE SENT WITH THE SHIPMENT.

PARTIAL SHIPMENT ☐	COMPLETE SHIPMENT ☐	LAST PARTIAL SHIPMENT ☐
Packing inspected ☐ No ☐ Yes	Packaging inspected ☐ No ☐ Yes	Marking inspected ☐ No ☐ Yes

Name of the Quality Surveillance Representative:	Signature:	Date:	Attachments: ☐ No ☐ Yes

APPENDIX C

EXPEDITING RELEASE NOTICE

SNC·LAVALIN

Client:		*Date:*	*Page:* **of**
Project Name: Lower Churchill Project, Muskrat Falls Newfoundland & Labrador		***ERN No.:***	
Agreement No.:		**Shipping Terms:**	
Prime Contractor:		**Shipping From:**	
Sub Contractor:			
Qty	**Type:** ☐ Crate ☐ Pallet ☐ Skid ☐ Container ☐ Other _____	**Shipping To:**	**Hydro Happy Valley Line Depot 31 Hunt St. Happy Valley Goose Bay NL, Canada A0P 1E0**
		Material Control- Primary Contact: Pearcy Benoit 709-693-8851 Secondary Contact: Craig Roberts 709-778-6638	

1. PURCHASE ORDER ITEMS RELEASED

ITEM NO.	QUANTITY	TAG / PART NO. AND DESCRIPTION

Contractor is required to provide 24hr notice, to the receiving warehouse, prior to the date of delivery for all shipments arriving at Site. The point of contact for delivery is identified above; see attached shipping instructions for further details.

☐ **Partial shipment** ☐ **Complete shipment** **Last partial shipment** _____

Packaging inspected in accordance with requirements ☐ **Yes** ☐ **No**

This release does not relieve the Contractor of responsibility to comply with the technical specifications of the Agreement nor for errors or omissions on its part. A copy of this release shall be sent with the shipment.

Has a Quality Surveillance Release been issued? ☐ **Yes** ☐ **No** **If not the Inspection Coordinators signature is required below.**

	LCP Inspection Coordinator	LCP Package Responsible Expeditor	LCP Expediting Manager
Name:			
Signature:			
Date:			

SNC·LAVALIN

Project Name:	Lower Churchill Project, Muskrat Falls Newfoundland & Labrador	*ERN No.:*
ITEM NO.	TAG / PART NO. AND DESCRIPTION	

SNC·LAVALIN

SHIPPING DATA

Proposed method of land, sea or air shipment to point of delivery : _____

Origin point (city/country of manufacture): _____

Supplier's Logistic Representative : Name and contact telephone number _____

Number of containers : [ITEMIZE OR REFER TO PACKING LIST]

Number of crates : _____

Number of skids : _____

Other : _____

Weight of heaviest piece (kg) : _____

Total shipping weight (kg) : _____

Volume of largest piece (m^3) : _____

Total shipping volume (m^3) : _____

Storage at job site is recommended to be : _____

_____ Outdoors

_____ Indoors

_____ Other (please specify) :

_____ Attach a copy of Supplier Storage / Preservation Procedure for outdoor and or indoor storage.

Cost of temporary storage by Supplier (if required) : _____ **Per month**

Packaging	Description	Packaged Dimension m x m x m	Packaged Weight

SNC·LAVALIN

SHIPPING INSTRUCTIONS

1. **DO NOT SHIP WITHOUT AN AUTHORIZED EXPIDITING RELEASE NOTICE**

2. **DRIVERS ARE REQUIRED TO GIVE 24 HOURS NOTICE PRIOR TO DELIVERY - NO EXCEPTIONS**

ADDRESS:
Lower Churchill Project
C/O Hydro Happy Valley Line Depot
31 Hunt St.
Happy Valley Goose Bay
NL, Canada A0P 1E0

Note: *If for some reason equipment/materials are to be delivered to a different location, the Material Control group needs to be notified ASAP, the contact names and numbers are listed below.*

RECEIVING HOURS:
Monday-Friday, 09:00-15:00 (9:00AM to 3:00PM)

PRIMARY CONTACT
Pearcy Benoit
Material Control, SNC-Lavalin Inc.
Cell: (709) 693-8851

SECONDARY CONTACT
Craig Roberts
Material Control Manager
(709) 778-6638

TERTIARY CONTACT
Mark Dykeman, Site Manager
Cell: (709) 896-1332
Office: (709) 570-5930

SPECIAL INSTRUCTIONS:

- Drivers are required to contact the material manager 24hours prior to delivery.
- Drivers are required to wear hard hats, safety glass, gloves, reflective vests, and steel toed boots when outside of the cab.
- Drivers are required to check in at the gate prior to entering the lay down yard.

EXHIBIT 8

SUBCONTRACTORS, MANUFACTURERS AND MATERIAL SOURCES

Muskrat Falls Package CH0032

Proposed Manufacturers

	Item	Name of Manufacturer(s)	Location [a]	ISO 9001	Relative Value [b]
1	Gates, Trash Racks, Stop Logs	AH China / Tianbao	China	YES	11%
2	Main Rollers	AH Precision Machining	USA	YES	4%
3	Control System	AH Hemi Controls	Canada	YES	2%
			Total % for Proposed Manufacturers		**17%**

Proposed Subcontractors

	Item	Name of Subcontractor(s)	Location [a]	ISO 9001	Relative Value [b]
1	Primary Anchors	Mecanitec, Trans-Roll, Atelier Ferland	Canada	YES	1%
2	Guides	PEMEL, Metalica Gallegha, CIMOLAI, Stakotra	Portugal, Spain, Italy, Slovakia	YES	20%
3	Gates, Trash Racks, Stop Logs	JHMW	China	YES	18%
4	Towers	Qingdao Wuxiao, Shandong Luneng	China	YES	5%
5	Cladding	HOESCH Bausysteme Type Isowand, Arcelor Mittal/Pflaum, Kingspan Insulated Panels	Germany, India, Ireland	YES	1%
6	Hoists	Gantner, Rialex, HMI Construction	Austria, Poland, Canada	YES	10%
7	Gantry Crane	GH Cranes, Rialex	Poland, Spain	YES	4%
8	Trash Rack Cleaning Machine	Muhr, Kunz	Germany, Austria	YES	6%
9	Spillway Electrical Building	Sunny Corner Entreprises, Construction Grimard, G.J. Cahill, Construction Binet	Canada	YES	2%
10	Diesel Generator	Cummins, Hewitt (Caterpillar)	Canada	YES	0.5%
11	MV Transformers	Rex, Trasfor, Delta, VA Transformers	Canada, Switzerland, USA	YES	0.5%
11	LV Distribution Transformers	Rex, Trasfor, Delta, VA Transformers	Canada, Switzerland, USA	YES	0.5%
12	On-load tap changer	Rex, Reinhausen	Canada, Germany	YES	0.5%
13	600 V MCC	Allen-Bradley, Eaton, Square-D	Canada	YES	0.5%
14	LV AC/DC distribution	Eaton	Canada	YES	0.5%
15	LV Bus	Eaton	Canada	YES	0.5%
16	25 KV Switchgear	Eaton, Dual-ADE	Canada	YES	0.5%
17	UPS/Onvertors/Batteries	Primax	Canada	YES	0.5%
18	Fire Alarm System	Mircom, Simplex Grinnell, Edwards, Notifier	Canada	YES	0.5%
19	Cables	Anixter, Sonepar	Canada	YES	0.5%
			Total % for Proposed Subcontractors		**73%**

Proposed Material Sources

	Item	Name of Supplier(s)	Location [a]	ISO 9001	Relative Value [b]
1	Sealings	Rubberart	Brazil, Sweden	YES	1%
2	Bearings	Ina, SKF	Germany	YES	2%
			Total % for Proposed Material Sources		**3%**

Total % for Proposed Manufacturers, Subcontractors, and Material Sources [c] 93%

General Note:

(a) Same as location of testing and inspection
(b) Based on the total value of the Work related to the Equipment supply only
(c) The remaining components will come from various vendors to be identified during the contract execution

The above list includes major components only. Other vendor names for miscellaneous items will be provided during contract execution.

All the manufacturers, subcontractors and suppliers included in the above plan are selected from the Andritz Hydro qualified supplier list. For major components, Andritz Hydro relies only on companies that have a long and satisfactory track record from previous projects executed for Andritz Hydro.

As the Muskrat Falls project will be executed between 2013 & 2018, the forecasted workload information is not currently available. For now, all proposed companies have the capacity available for a project like Muskrat Falls. Production slots are booked for a specific project at the time of purchase order placement. At that time, the workload of each company will be assessed and purchase orders will be placed only with companies that can execute per the project's required schedule.

EXHIBIT 9

INTERFACE AND MILESTONE SCHEDULE

Contractor shall comply with the requirements outlined in Part 2, Exhibit 9 - Work and Milestone Schedule. Contractor's schedule shall clearly indicate bidder's work plans and methods, as well as interfaces with other parties. Contractors Control Schedule Baseline Document shall align with this Exhibit 9.

The schedule shall be provided in portable document format (PDF) and native electronic format. Unless otherwise approved by company, the native file shall be generated from the Primavera planning software.

	Interface and Milestone Schedule		
Milestone No.	**Interface No.**		**Date**
	General		
M1		Contract Award	18 Dec 2013
M2		Substantial Completion of the Work	14 May 2018
	Spillway		
M3a		Hydro-Mechanical primary embedded parts required for the Spillway slab delivered to Site (figure 1)	14 Mar 2014
M3b		Hydro-Mechanical primary embedded parts for the South Pier delivered to Site (figure 1)	21 Mar 2014
M3c		Hydro-Mechanical primary embedded parts for the Pier 1 delivered to Site (figure 1)	25 Apr 2014
M3d		Hydro-Mechanical primary embedded parts for the Pier 2 delivered to Site (figure 1)	16 May 2014
M3e		All remaining Hydro-Mechanical primary embedded parts required for all Piers as shown in figure 1 delivered to site. Includes Pier 3, Pier 4 and North Pier.	30 May 2014
M3f		All Hydro-Mechanical primary embedded parts required for downstream stoplogs delivered to site. (figure 2)	28 Nov 2014
M3g		All Rollway Hydro-Mechanical primary embedded parts delivered to site	29 Jan 2016
	I1A	Upstream of Spillway ready for start of Hydromechanical Works	16 Feb 2015
	I1B	Downstream of Spillway ready for start of Hydromechanical Works	1 Aug 2015
M4		Spillway all hydro-mechanical and electrical systems (including Trash Cleaner hoist) commissioned and ready for river diversion	13 Feb 2016

	Interface and Milestone Schedule		
Milestone No.	**Interface No.**		**Date**
M5		Bay No. 1 Installation of Upstream and Downstream Stoplogs Complete	3 Oct 2016
M6		Bay No. 1 Rollway Ready for Installation of Sill Beams and Modification of the Gates	14 Mar 2017
M7		Bay No. 1 Stoplogs Removed and Ready for Operation	25 Apr 2017
M8		Bay No. 2 & 4 Installation of Upstream and Downstream Stoplogs Complete	5 Nov 2017
M9		Bay No. 2 & 4 Rollway Ready for Installation of Sill Beams and Modification of the Gates	18 Mar 2018
M10		Bay No. 2 & 4 Stoplogs Removed and Ready for Operation	29 Apr 2018
M11		Bay No. 3 & 5 Installation of Upstream and Downstream Stoplogs Complete	30 May 2017
M12		Bay No. 3 & 5 Rollway Ready for Installation of Sill Beams and Modification of the Gates	20 Sep 2017
M13		Bay No. 3 & 5 Stoplogs Removed and Ready for Operation	1 Nov 2017
	Powerhouse		
M20a		Draft Tube Units 1& 2 Hydro-Mechanical, primary embedded parts, Delivered to Site	04 Jul 2014
M20b		Draft Tube Units 3 & 4 Hydro-Mechanical, primary embedded parts, Delivered to Site	05 Aug 2014
M21a		All Intake Unit 1 – Hydro-Mechanical primary embedded parts, delivered to Site	14 Apr 2014
M21b		All Intake Unit 2 – Hydro-Mechanical Primary embedded parts, delivered to Site	30 May 2014
M21c		All Intake Unit 3 – Hydro-Mechanical primary embedded parts, delivered to Site	16 Jun 2014
M21d		All Intake Unit 4 – Hydro-Mechanical Primary embedded parts, delivered to Site	25 Jul 2014
	I7	Service Bay Draft Tube Gallery Ready for start of Hydromechanical Installation	1 Aug 2015
	I8	Unit 1 – Draft Tube Structure Ready for start of Hydromechanical Installation	1 Oct 2015
	I9	Unit 2 – Draft Tube Structure Ready for start of Hydromechanical Installation	12 Nov 2015

	Interface and Milestone Schedule		
Milestone No.	**Interface No.**		**Date**
	I10	Unit 3 - Draft Tube Ready for start of installation of Hydromechanical Installation	21 Jan 2016
	I11	Unit 4 – Draft Tube Ready for start of installation of Hydromechanical Installation	3 Mar 2016
M22		All Draft Tube hydro-mechanical work complete, stoplogs installed in units 1 & 2, Bulkheads installed in units 3 & 4, and ready for water up of tailrace channel	9 Jul 2016

Milestone No.	Interface No.		Date
	Intake		
	I12	Unit 1 – Intake Structure Ready for start of Hydromechanical Intallation	1 Apr 2016
	I13	Unit 2 – Intake Structure Ready for start of Hydromechanical Installation	30 Jun 2016
	I14	Unit 3 – Intake Structure Ready for start of Hydromechanical Installation	28 Sep 2016
	I15	Unit 4 – Intake Structure Ready for start of Hydromechanical Installation	3 Jan 2017
M23		All Intake hydro-mechanical work (including trash cleaner) commissioned and ready for reservoir impoundment	22 Jul 2017

Interface I1A, 16 Feb 2015

Spillway and Related Works required for upstream guides installation and concreting, including:

- Completion of Spillway Invert;
- Completion of Spillway piers and walls (upstream 2/3 portion only), including upstream bridge;
- Spillway Upstream Channel free for Hydro-Mechanical Contractor CH0032 occupation.

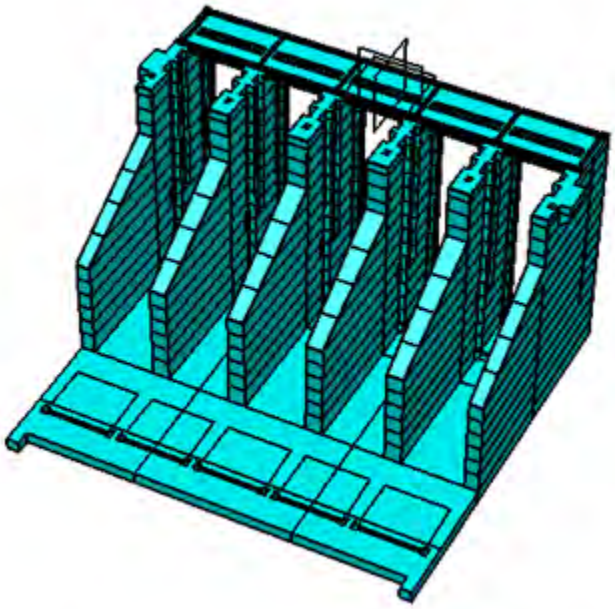


Figure 1 Spillway – Upstream Construction

Interface I1B, 1 Aug 2015

Spillway and related works required for downstream stoplog guides, gates and hoists installation, including:

- Completion of Spillway piers and walls (downstream 1/3) including both Downstream Bridges and Access Ramp Retaining Wall;
- Completion of North Transition Dam;
- Completion of Northern 2 Monoliths of Center Transition Dam including the Electrical Building Platform;
- Completion of Spillway concrete Discharge Channel Phase 1;
- Completion of Separation Wall;
- Spillway Discharge Channel free for CH0032 occupation.

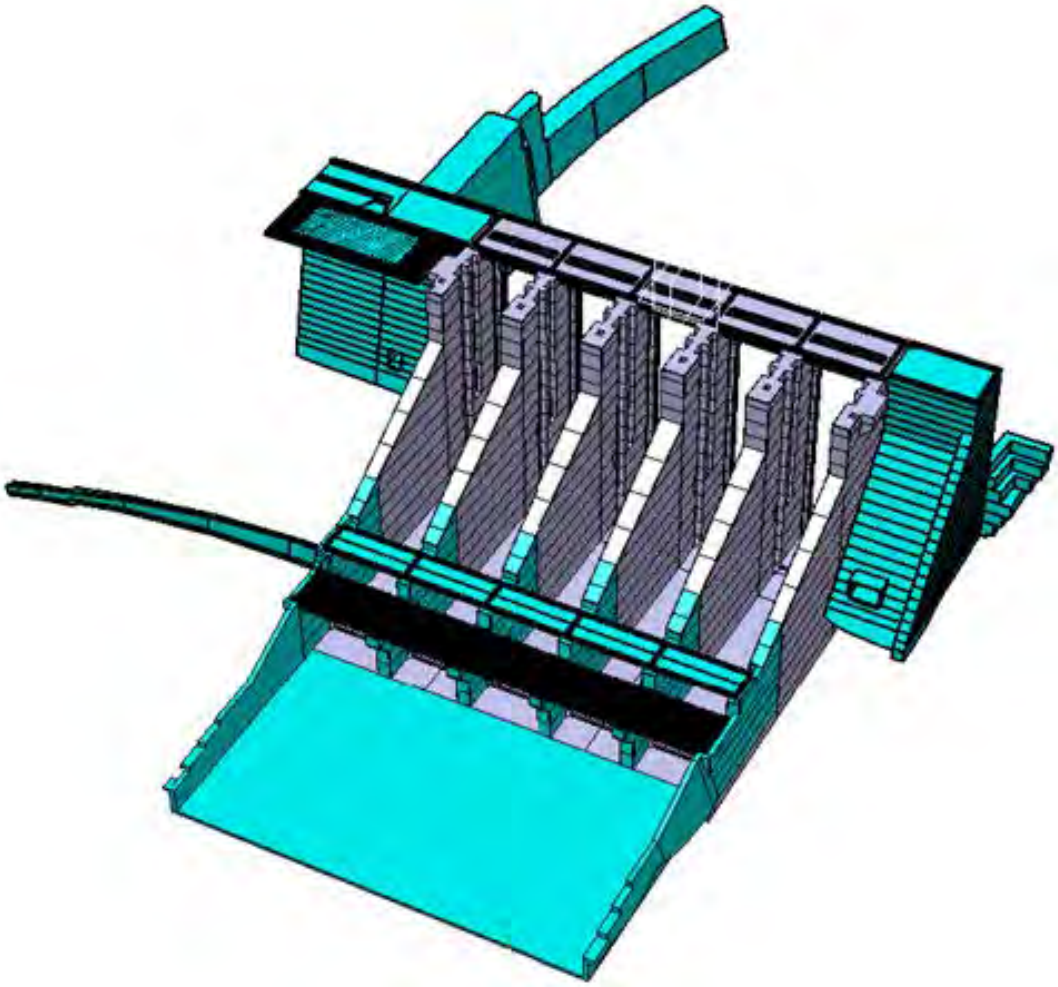


Figure 2 Spillway – Downstream Construction

EXHIBIT 10

DECLARATION OF RESIDENCY

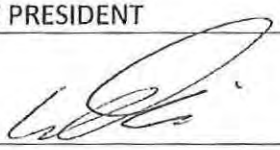
ANDRITZ Hydro

DECLARATION OF RESIDENCY

We represent that, for Canadian income tax purposes, ANDRITZ HYDRO CANADA INC. (the "Corporation") is a corporation registered in Canada. We attach a certified copy of the Corporation's Certificate of Incorporation. If at any time the Corporation's residency status changes, we shall inform Company immediately by issuance of a revised "Declaration of Residency".

Name: DANIEL CARRIER

Title: VICE PRESIDENT

Signature: 

Date: March 18th 2013

Bidder shall attach the following documents:

1. Certificate of Incorporation.
2. Current Certificate of Compliance from Industry Canada and/or a letter of good standing from the province in which Bidder is registered.

This document will form Exhibit 10 of the Agreement.

New Nouveau Brunswick

CANADA
PROVINCE OF NEW BRUNSWICK
BUSINESS CORPORATIONS ACT

CANADA
PROVINCE DU NOUVEAU-BRUNSWICK
LOI SUR LES CORPORATIONS COMMERCIALES

CERTIFICATE OF AMENDMENT

CERTIFICAT DE MODIFICATION

Andritz Hydro Canada Inc.

Name of Corporation / Raison sociale de la corporation

CERTIFIED COPY TRUE AND CORRECT
COPIE CERTIFIÉE EXACTE ET CONFORME
13 - 01 - 2012
Day/Jour - Month/Mois - Year/Année

638753

Corporation Number / Numéro de la corporation

Director Business Corporations Act
Directeur - Loi sur les corporations commerciales
New Brunswick Corporation Number

I HEREBY CERTIFY that the Articles of the above-mentioned corporation are amended under the relevant section(s) of the Act, as applicable:

JE CERTIFIE que les statuts de la corporation mentionnée ci-dessus ont été modifiés en vertu des articles pertinents de la Loi, selon le cas :

(a) Section 11 of the Business Corporations Act in accordance with the attached notice;
Article 11 de la Loi sur les corporations commerciales conformément à l'avis ci-joint;

(b) Section 26 of the Business Corporations Act as set out in the attached Articles of Amendment designating a series of shares;
Article 26 de la Loi sur les corporations commerciales de la façon indiquée dans les statuts de modification ci-joints décrivant les actions d'une série;

(c) Section 117 of the Business Corporations Act as set out in the attached Articles of Amendment;
Article 117 de la Loi sur les corporations commerciales de la façon indiquée dans les statuts de modification ci-joints;

(d) Section 132 of the Business Corporations Act as set out in the attached Articles of Reorganization.
Article 132 de la Loi sur les corporations commerciales de la façon indiquée dans les statuts de réorganisation ci-joints.

Director - Directeur

December 31, 2008 - le 31 décembre 2008
Date of Amendment - Date de modification

NEW BRUNSWICK
BUSINESS CORPORATIONS ACT
FORM 3
ARTICLES OF AMENDMENT
(SECTION 26, 116)

NOUVEAU-BRUNSWICK
LOI SUR LES CORPORATIONS COMMERCIALES
FORMULE 3
STATUTS DE MODIFICATION
(ARTICLE 26, 116)

1 - Name of Corporation - Raison sociale de la corporation
Andritz VA Tech Hydro Canada Inc.

2 - Corporation No. - Numéro de la corporation
638753

3 - The articles of the above - mentioned corporation are amended as follows:

Les statuts de la corporation mentionnée ici sont modifiés comme suit :

The new name of the coporation is: - La nouvelle raison sociale de la corporation est :

Andritz Hydro Canada Inc.

Date	Signature	Description of Office - Description du bureau
2008-12-22	Deborah B. Zink	Assistant Secretary

FOR DEPARTMENT USE ONLY
RÉSERVÉ À L'USAGE DU MINISTRÈRE
Corporation No. - No. de Corporation 638753

TN# 1663532

Filed - Déposé
2008-12-31

SN0250/45-5031 (6/01)
SN0307

New Nouveau Brunswick

CANADA
PROVINCE OF NEW BRUNSWICK
BUSINESS CORPORATIONS ACT

CANADA
PROVINCE DU NOUVEAU-BRUNSWICK
LOI SUR LES CORPORATIONS COMMERCIALES

CERTIFICATE OF AMENDMENT

CERTIFICAT DE MODIFICATION

Andritz VA Tech Hydro Canada Inc.

CERTIFIED COPY TRUE AND CORRECT
COPIE CERTIFIÉE EXACTE ET CONFORME

Name of Corporation / Raison sociale de la corporation

13 06 2012
Day/Jour - Month/Mois - Year/Année

638753

Corporation Number / Numéro de la corporation

Director Business Corporations Act
Directeur - Loi sur les corporations commerciales
New Brunswick / Nouveau-Brunswick

I HEREBY CERTIFY that the Articles of the above-mentioned corporation were amended under the relevant section(s) of the Act, as applicable:

JE CERTIFIE que les statuts de la corporation mentionnée ci-dessus ont été modifiés en vertu des articles pertinents de la Loi, selon le cas :

(a) Section 11 of the Business Corporations Act in accordance with the attached notice;
Article 11 de la Loi sur les corporations commerciales conformément à l'avis ci-joint;

(b) Section 26 of the Business Corporations Act as set out in the attached Articles of Amendment designating a series of shares;
Article 26 de la Loi sur les corporations commerciales de la façon indiquée dans les statuts de modification ci-joints décrivant les actions d'une série;

(c) Section 117 of the Business Corporations Act as set out in the attached Articles of Amendment;
Article 117 de la Loi sur les corporations commerciales de la façon indiquée dans les statuts de modification ci-joints;

(d) Section 132 of the Business Corporations Act as set out in the attached Articles of Reorganization.
Article 132 de la Loi sur les corporations commerciales de la façon indiquée dans les statuts de réorganisation ci-joints.

June 23, 2008 - le 23 juin 2008

Director - Directeur | **Date of Amendment - Date de modification**

NEW BRUNSWICK
BUSINESS CORPORATIONS ACT
FORM 3
ARTICLES OF AMENDMENT
(SECTION 26, 116)

NOUVEAU-BRUNSWICK
LOI SUR LES CORPORATIONS COMMERCIALES
FORMULE 3
STATUTS DE MODIFICATION
(ARTICLE 26, 116)

1 - Name of Corporation - Raison sociale de la corporation
638753 N.B. INC.

2 - Corporation No. - Numéro de la corporation
638753

3 - The articles of the above - mentioned corporation are amended as follows:

Les statuts de la corporation mentionnée ici sont modifiés comme suit :

The new name of the coporation is: - La nouvelle raison sociale de la corporation est :

Andritz VA Tech Hydro Canada Inc.

Date	Signature	Description of Office - Description du bureau
2008-06-23	David Bumsted	Director

FOR DEPARTMENT USE ONLY
RÉSERVÉ À L'USAGE DU MINISTRÈRE
Corporation No. - No. de Corporation 638753
TN# 1448581

Filed - Déposé
2008-06-23

SN0250/45-5031 (6/01)
SN0307

New Nouveau Brunswick

CANADA
PROVINCE OF NEW BRUNSWICK
BUSINESS CORPORATIONS ACT

CERTIFICATE OF INCORPORATION
(SECTION 6)

CANADA
PROVINCE DU NOUVEAU-BRUNSWICK
LOI SUR LES CORPORATIONS COMMERCIALES

CERTIFICAT DE CONSTITUTION EN CORPORATION
(ARTICLE 6)

CERTIFIED COPY TRUE AND CORRECT
COPIE CERTIFIÉE EXACTE ET CONFORME
13-01-2012
Day/Jour - Month/Mois - Year/Année

638753 N.B. INC.

Name of Corporation / Raison sociale de la corporation

Director Business Corporations Act
Directeur - Loi sur les corporations commerciales
New Brunswick / Nouveau-Brunswick

638753

Corporation Number / Numéro de la corporation

I HEREBY CERTIFY that the above-mentioned corporation, the Articles of Incorporation of which are attached, was incorporated under the Business Corporations Act of the Province of New Brunswick.

JE CERTIFIE que la corporation mentionnée ci-dessus, dont les statuts constitutifs sont joints à ce certificat, a été constituée en corporation en vertu de la Loi sur les corporations commerciales de la province du Nouveau-Brunswick

Director - Directeur

June 6, 2008 - le 6 juin 2008
Date of Incorporation - Date de constitution

New Nouveau Brunswick

BUSINESS CORPORATIONS ACT
FORM 1
ARTICLES OF INCORPORATION
(SECTION 4)

LOI SUR LES CORPORATIONS COMMERCIALES
FORMULE 1
STATUTS CONSTITUTIFS
(ARTICLE 4)

1 - Name of Corporation:
638753 N.B. INC.

Raison sociale de la corporation:

2 - The classes and any maximum number of shares that the corporation is authorized to issue and any maximum aggregate amount for which shares may be issued including shares without par value and/or with par value and the amount of the par value:

See Schedule - Share Structure

Les catégories et le nombre maximal d'actions que la coporation peut émettre ainsi que le montant maximal global pour lequel les actions peuvent être émises y compris les actions sans valeur au pair ou avec valeur au pair ou les deux et le montant de la valeur au pair:

3 - Restrictions, if any, on share transfers:

No securities, other than non-convertible debt securities, shall be transferred without the consent of the directors or shareholders of the corporation expressed by resolution passed at a meeting of the board of directors or shareholders or by an instrument or instruments in writing signed by all such directors or shareholders.

Restrictions, s'il y en a, au transfert d'actions:

4 - Number (or minimum and maximum number) of directors:
Minimum 1 Maximum 10

Nombre (ou nombre minimum et maximum) des administrateurs:

5 - Restrictions, if any, on business the corporation may carry on:
None

Restrictions, s'il y en a, à l'activité que peut exercer la coporation:

6 - Other provisions, if any:
See Schedule - Other Provisions

D'autres dispositions, le cas échéant:

7 - Incorporators:

Fondateurs:

Date	Names - Noms	Address (include postal code) Adresses (y compris le code postal)	Signature
2008-06-06	C. Paul W. Smith	44 Chipman Hill Suite 1000 Saint John NB E2L 2A9	C. Paul W. Smith

FOR DEPARTMENT USE ONLY

RÉSERVÉ À L'USAGE DU MINISTRÈRE

Corporation No. - No. de Corporation 638753
TN# 1427350

Filed - Déposé
June 6, 2008 - le 6 juin 2008

45-4104 (6/01)

638753 N.B. INC.

Schedule - Share Structure

The Corporation is authorized to issue:

(a) an unlimited number of Common shares, without nominal or par value;

(b) an unlimited number of Class A Preferred shares, without nominal or par value; and

(d) an unlimited number of Class B Preferred shares, without nominal or par value.

I. The Common shares shall have attached thereto the following rights, privileges, restrictions and conditions:

(a) Voting. Each Common share shall entitle the holder thereof to one (1) vote at all meetings of the shareholders of the Corporation (except meetings at which only holders of another specified class of shares are entitled to vote pursuant to the provisions hereof or pursuant to the provisions of the Act).

(b) Dividends. The holders of the Common shares shall be entitled to receive, as and when declared by the board of directors, subject to the rights, privileges, restrictions and conditions attaching to the Class A Preferred shares and Class B Preferred shares, in equal amounts per Common share, dividends payable in money, property or by the issue of fully paid shares of the capital of the Corporation.

(c) Liquidation, etc. In the event of the liquidation, dissolution or winding-up of the Corporation, whether voluntary or involuntary, or other distribution of assets of the Corporation among shareholders for the purpose of winding-up its affairs, subject to the rights, privileges, restrictions and conditions attaching to the Class A Preferred shares and the Class B Preferred shares, the holders of the Common shares shall be entitled to receive, in equal amounts per Common share, the remaining property of the Corporation.

II. The Class A Preferred shares shall have attached thereto the following rights, privileges, restrictions and conditions:

(a) Non-Voting. Subject to the provisions of the Act or as otherwise expressly provided herein, the holders of the Class A Preferred shares shall not be entitled to receive notice of, nor to attend or vote at meetings of the shareholders of the Corporation.

(b) Dividends. The holders of the Class A Preferred shares shall be entitled to receive during each month, as and when declared by the board of directors, but always in preference and priority to any payment of dividends on the Class B Preferred shares and the Common shares or any other shares ranking junior to the Class A Preferred shares non-cumulative dividends at a fixed rate of one half of one percent (0.50%) per month calculated on the Class A Preferred Redemption Price (as hereinafter in paragraph II. (h) defined) of each such share payable in money, property or by the issue of fully paid shares of any class of the Corporation. The holders of the Class A Preferred shares shall not be entitled to any dividend in excess of the dividend hereinbefore provided for.

(c) Liquidation, etc. In the event of the liquidation, dissolution or winding-up of the Corporation, whether voluntary or involuntary, or other distribution of assets of the Corporation among shareholders for the purpose of winding-up its affairs, the holders of the Class A Preferred shares shall be entitled to receive for each Class A Preferred share, in preference and priority to any distribution of the property or assets of the Corporation to the holders of the Class B Preferred shares, the Common shares or to any other shares ranking junior to the Class A Preferred shares, an amount equal to the Class A Preferred Redemption Price plus all declared and unpaid dividends thereon, but shall not be entitled to share any further in the distribution of the property or assets of the Corporation.

(d) Redemption by Corporation. The Corporation may, in the manner hereinafter provided, redeem at any time all, or from time to time any part, of the outstanding Class A Preferred shares on payment for each Class A Preferred share to be redeemed of the Class A Preferred Redemption Price plus all declared and unpaid dividends thereon (in paragraphs II. (e), (f) and (g) called the "Redemption Price").

(e) Procedure on Redemption. Before redeeming any Class A Preferred shares, the Corporation shall mail or deliver to each person who, at the date of such mailing or delivery, shall be a registered holder of Class A Preferred shares to be redeemed, notice of the intention of the Corporation to redeem such shares held by such registered holder; such notice shall be delivered to, or mailed by ordinary prepaid post addressed to, the last address of such holder as it appears on the records of the Corporation, or in the event of the address of any such holder not appearing on the records of the Corporation, then to the last address of such holder known to the Corporation, at least five (5) days before the date specified for redemption; such notice shall set out the Redemption Price, the date on which the redemption is to take place and, if part only of the Class A Preferred shares held by the person to whom it is addressed is to be redeemed, the number thereof so to be redeemed; on or after the date so specified for redemption the Corporation shall pay or cause to be paid the Redemption Price to the registered holders of the Class A Preferred shares to be redeemed on presentation and surrender of the certificates for the Class A Preferred shares so called for redemption at the registered office of the Corporation or at such other place or places as may be specified in such notice, and the certificates for such Class A Preferred shares shall thereupon be cancelled, and the Class A Preferred shares represented thereby shall thereupon be redeemed; from and after the date specified for redemption in such notice, the holders of the Class A Preferred shares called for redemption shall cease to be entitled to dividends in respect of such shares and shall not be entitled to exercise any of the rights of the holders thereof, except the right to receive the Redemption Price, unless payment of the Redemption Price shall not be made by the Corporation in accordance with the foregoing provisions, in which case the rights of the holders of such shares shall remain unaffected; on or before the date specified for redemption, the Corporation shall have the right to deposit the Redemption Price of the Class A Preferred shares called for redemption in a special account with any chartered bank or trust company in Canada named in the notice of redemption, to be paid, without interest, to or to the order of the respective holders of such Class A Preferred shares called for redemption, upon presentation and surrender of the certificates representing the same and, upon such deposit being made or upon the date specified for redemption, whichever is later, the Class A Preferred shares in respect whereof such deposit shall have been made, shall be deemed to be redeemed and the rights of the respective holders thereof, after such deposit or after such redemption date, as the case may be, shall be limited to receiving, out of the moneys so deposited, without interest, the Redemption Price applicable to their respective Class A Preferred shares against presentation and surrender of the certificates representing such Class A Preferred shares. If less than all of the Class A Preferred shares are to be redeemed the shares to be redeemed shall be redeemed pro rata, disregarding fractions, unless the holders of the Class A Preferred shares unanimously agree to the adoption of another method of selection of the Class A Preferred shares to be redeemed. If less than all of the Class A Preferred shares represented by any certificate be redeemed, a new certificate for the balance shall be issued.

(f) Redemption by Holder. A holder of Class A Preferred shares shall be entitled to require the Corporation to redeem at any time all, or from time to time any part, of the Class A Preferred shares registered in the name of such holder by tendering to the Corporation at its registered office the share certificate(s) representing the Class A Preferred shares which the registered holder desires to have the Corporation redeem together with a request in writing specifying (i)the number of Class A Preferred shares which the registered holder desires to have redeemed by the Corporation and (ii) the business day (in this paragraph referred to as the "Redemption Date") on which the holder desires to have the Corporation redeem such Class A Preferred shares, which Redemption Date shall not be less than five (5) days after the day on which the request in writing is given to the Corporation. Upon receipt of the share certificate(s) representing the Class A Preferred shares which the registered holder desires to have the Corporation redeem together with such a request, the Corporation shall on, or at its option, before, the Redemption Date redeem such Class A Preferred shares by paying to the registered holder thereof, for each share to be redeemed, an amount equal to the Redemption Price in respect thereof; such payment shall be made by cheque payable at par at any branch of the Corporation's bankers for the time being in Canada. The said Class A Preferred shares shall be deemed to be redeemed on the date of payment of the Redemption Price and from and after such date such Class A Preferred shares shall cease to be entitled to dividends and the holders thereof shall not be entitled to exercise any of the rights of the holders of Class A Preferred shares in respect thereof. Notwithstanding the foregoing, the Corporation shall only be obliged to redeem Class A Preferred shares so tendered for redemption to the extent that such redemption would not be contrary to any applicable law, and if such redemption of any such Class A Preferred shares would be contrary to any applicable law, the Corporation shall only be obliged to redeem such Class A Preferred shares to the extent that the moneys applied thereto shall be such amount (rounded to the next lower multiple of one hundred dollars ($100.00)) as would not be contrary to such law, in which case the Corporation shall pay to each holder his pro rata share of the purchase moneys allocable. If less than all of the Class A Preferred shares represented by any certificate be redeemed, a new certificate for the balance shall be issued.

(g) Purchase for Cancellation. The Corporation may purchase for cancellation at any time all, or from time to time any part, of the Class A Preferred shares outstanding, by private contract at any price, with the unanimous consent of the holders of the Class A Preferred shares then outstanding, or by invitation for tenders addressed to all the holders of the Class A Preferred shares at the lowest price at which, in the opinion of the directors, such shares are obtainable but not exceeding the Redemption Price thereof. If less than all of the Class A Preferred shares represented by any certificate be purchased for cancellation, a new certificate for the balance shall be issued.

(h) Class A Preferred Redemption Price. For the purposes of the foregoing paragraphs II. (b), (c) and (d), the "Class A Preferred Redemption Price" of each Class A Preferred share shall be an amount equal to the aggregate of (i) the monetary consideration received by the Corporation upon the issuance of such share, if such share has been issued for money and (ii) the fair market value of the consideration received by the Corporation (including, without limitation, shares of another class of the Corporation) upon the issuance of such share, if such share has been issued in whole or in part for consideration other than money, less (iii) the aggregate of all amounts by which the stated capital per Class A Preferred share has been reduced from the date of issuance until immediately before the time of redemption. Subject to the provisions of the following sub-paragraph, such fair market value is to be determined by the directors on the basis of generally accepted accounting and valuation principles.

The fair market value determined as hereinabove provided for shall be subject to revision in accordance with any binding agreement with, or decision by, the appropriate taxation authorities, or any judgment of a court of competent jurisdiction. In the event that any such agreement, decision or judgment shall result in a final determination under the provisions of the appropriate taxation legislation and the amount thereby determined is an amount other than the amount for which such share was originally issued as determined by the directors in accordance with the preceding subparagraph, such finally determined amount for the purpose of the appropriate taxation legislation shall then be deemed to have been the fair market value of the consideration received by the Corporation upon the issuance of such Class A Preferred share. Such final determination shall reflect any assessment by the Minister of National Revenue or other taxing authority to which no appeal is taken or any agreement reached by the Corporation or any holder of a Class A Preferred share and a said taxing authority in settlement of a dispute regarding such assessment or proposed assessment, or any decision by a court or tribunal of competent jurisdiction regarding the fair market value of the Class A Preferred share or the consideration received by the Corporation upon the issuance of such Class A Preferred share to which no appeal may be taken or the period during which an appeal may be taken has expired.

In the event that, subsequent to any redemption of Class A Preferred shares, the Class A Preferred Redemption Price of each Class A Preferred share is adjusted pursuant to a revision of fair market value as aforementioned, either the Corporation shall pay out to the former holders of such redeemed Class A Preferred shares or the said former holders of the redeemed Class A Preferred shares will reimburse the Corporation as the case may be, the difference between the Class A Preferred Redemption Price of the said Class A Preferred shares as adjusted and the amount paid by the Corporation upon redemption, within sixty (60) days from the date of adjustment of the Class A Preferred Redemption Price.

(i) Stated Capital. In the event that only part of the amount of the consideration received by the Corporation for any Class A Preferred share issued by the Corporation is added to the stated capital account of the Class A Preferred shares, such Class A Preferred share shall be deemed to have been issued for the full amount of the consideration received, for all purposes of these articles (except only with respect to the stated capital of such Class A Preferred shares) including, but without limiting the generality of the foregoing, dividend rights, redemption rights and rights upon liquidation and dissolution.

(j) No Change. No change to any of the provisions of paragraphs II. (a) to (i) or of this paragraph (j) shall have any force or effect until it has been approved by a majority of not less than two-thirds (2/3) of the votes cast by the holders of the Class A Preferred shares, voting separately as a class at a meeting of such holders specially called for that purpose, or by a resolution in writing signed by all the holders of the Class A Preferred shares, in addition to any other approval required by the Act.

III. The Class B Preferred shares shall have attached thereto the following rights, privileges, restrictions and conditions:

(a) Non-Voting. Subject to the provisions of the Act or as otherwise expressly provided herein, the holders of the Class B Preferred shares shall not be entitled to receive notice of, nor to attend or vote at meetings of the shareholders of the Corporation.

(b) Dividends. The holders of the Class B Preferred shares shall be entitled to receive during each month, as and when declared by the board of directors, but always in preference and priority to any payment of dividends on the Common shares or any other shares ranking junior to the Class B Preferred shares, but after payment of dividends to the holders of the Class A Preferred shares, non-cumulative dividends at a fixed rate of fifty-four one hundredths of one percent (0.54%) per month calculated on the Class B Preferred Redemption Price (as hereinafter in paragraph III. (h) defined) of each such share payable in money, property or by the issue of fully paid shares of any class of the Corporation. The holders of the Class B Preferred shares shall not be entitled to any dividend in excess of the dividend hereinbefore provided for.

(c) Liquidation, etc. In the event of the liquidation, dissolution or winding-up of the Corporation, whether voluntary or involuntary, or other distribution of assets of the Corporation among shareholders for the purpose of winding-up its affairs, the holders of the Class B Preferred shares shall be entitled to receive for each Class B Preferred share, in preference and priority to any distribution of the property or assets of the Corporation to the holders of the Common shares or any other shares ranking junior to the Class B Preferred shares, but after distribution to the holders of the Class A Preferred shares, an amount equal to the Class B Preferred Redemption Price plus all declared and unpaid dividends thereon, but shall not be entitled to share any further in the distribution of the property or assets of the Corporation.

(d) Redemption by Corporation. The Corporation may, in the manner hereinafter provided, redeem at any time all, or from time to time any part, of the outstanding Class B Preferred shares on payment for each Class B Preferred share to be redeemed of the Class B Preferred Redemption Price plus all declared and unpaid dividends thereon (in paragraphs III. (e), (f) and (g) called the "Redemption Price").

(e) Procedure on Redemption. Before redeeming any Class B Preferred shares, the Corporation shall mail or deliver to each person who, at the date of such mailing or delivery, shall be a registered holder of Class B Preferred shares to be redeemed, notice of the intention of the Corporation to redeem such shares held by such registered holder; such notice shall be delivered to, or mailed by ordinary prepaid post addressed to, the last address of such holder as it appears on the records of the Corporation, or in the event of the address of any such holder not appearing on the records of the Corporation, then to the last address of such holder known to the Corporation, at least five (5) days before the date specified for redemption; such notice shall set out the Redemption Price, the date on which the redemption is to take place and, if part only of the Class B Preferred shares held by the person to whom it is addressed is to be redeemed, the number thereof so to be redeemed; on or after the date so specified for redemption the Corporation shall pay or cause to be paid the Redemption Price to the registered holders of the Class B Preferred shares to be redeemed on presentation and surrender of the certificates for the Class B Preferred shares so called for redemption at the registered office of the Corporation or at such other place or places as may be specified in such notice, and the certificates for such Class B Preferred shares shall thereupon be cancelled, and the Class B Preferred shares represented thereby shall thereupon be redeemed; from and after the date specified for redemption in such notice, the holders of the Class B Preferred shares called for redemption shall cease to be entitled to dividends in respect of such shares and shall not be entitled to exercise any of the rights of the holders thereof, except the right to receive the Redemption Price, unless payment of the Redemption Price shall not be made by the Corporation in accordance with the foregoing provisions, in which case the rights of the holders of such shares shall remain unaffected; on or before the date specified for redemption, the Corporation shall have the right to deposit the Redemption Price of the Class B Preferred shares called for redemption in a special account with any chartered bank or trust company in Canada named in the notice of redemption, to be paid, without interest, to or to the order of the respective holders of such Class B Preferred shares called for redemption, upon presentation and surrender of the certificates representing the same and, upon such deposit being made or upon the date specified for redemption, whichever is later, the Class B Preferred shares in respect whereof such deposit shall have been made, shall be deemed to be redeemed and the rights of the respective holders thereof, after such deposit or after such redemption date, as the case may be, shall be limited to receiving, out of the moneys so deposited, without interest, the Redemption Price applicable to their respective Class B Preferred shares against presentation and surrender of the certificates representing such Class B Preferred shares. If less than all of the Class B Preferred shares are to be redeemed, the shares to be redeemed shall be redeemed pro rata, disregarding fractions, unless the holders of the Class B Preferred shares unanimously agree to the adoption of another method of selection of the Class B Preferred shares to be redeemed. If less than all of the Class B Preferred shares represented by any certificate be redeemed, a new certificate for the balance shall be issued.

(f) Redemption by Holder. A holder of Class B Preferred shares shall be entitled to require the Corporation to redeem at any time all, or from time to time any part, of the Class B Preferred shares registered in the name of such holder by tendering to the Corporation at its registered office the share certificate(s) representing the Class B Preferred shares which the registered holder desires to have the Corporation redeem together with a request in writing specifying (i)the number of Class B Preferred shares which the registered holder desires to have redeemed by the Corporation and (ii) the business day (in this paragraph referred to as the "Redemption Date") on which the holder desires to have the Corporation redeem such Class B Preferred shares, which Redemption Date shall not be less than five (5) days after the day on which the request in writing is given to the Corporation. Upon receipt of the share certificate(s) representing the Class B Preferred shares which the registered holder desires to have the Corporation redeem together with such a request, the Corporation shall on, or at its option, before, the Redemption Date redeem such Class B Preferred shares by paying to the registered holder thereof, for each share to be redeemed, an amount equal to the Redemption Price in respect thereof; such payment shall be made by cheque payable at par at any branch of the Corporation's bankers for the time being in Canada. The said Class B Preferred shares shall be deemed to be redeemed on the date of payment of the Redemption Price and from and after such date such Class B Preferred shares shall cease to be entitled to dividends and the holders thereof shall not be entitled to exercise any of the rights of the holders of Class B Preferred shares in respect thereof. Notwithstanding the foregoing, the Corporation shall only be obliged to redeem Class B Preferred shares so tendered for redemption to the extent that such redemption would not be contrary to any applicable law, and if such redemption of any such Class B Preferred shares would be contrary to any applicable law, the Corporation shall only be obliged to redeem such Class B Preferred shares to the extent that the moneys applied thereto shall be such amount (rounded to the next lower multiple of one hundred dollars ($100.00)) as would not be contrary to such law, in which case the Corporation shall pay to each holder his pro rata share of the purchase moneys allocable. If less than all of the Class B Preferred shares represented by any certificate be redeemed, a new certificate for the balance shall be issued.

(g) Purchase for Cancellation. The Corporation may purchase for cancellation at any time all, or from time to time any part, of the Class B Preferred shares outstanding, by private contract at any price, with the unanimous consent of the holders of the Class B Preferred shares then outstanding, or by invitation for tenders addressed to all the holders of the Class B Preferred shares at the lowest price at which, in the opinion of the directors, such shares are obtainable but not exceeding the Redemption Price thereof. If less than all of the Class B Preferred shares represented by any certificate be purchased for cancellation, a new certificate for the balance shall be issued.

(h) Class B Preferred Redemption Price. For the purposes of the foregoing paragraphs III. (b), (c) and (d), the "Class B Preferred Redemption Price" of each Class B Preferred share shall be an amount equal to the aggregate of (i) the monetary consideration received by the Corporation upon the issuance of such share, if such share has been issued for money and (ii) the fair market value of the consideration received by the Corporation (including, without limitation, shares of another class of the Corporation) upon the issuance of such share, if such share has been issued in whole or in part for consideration other than money, less (iii) the aggregate of all amounts by which the stated capital per Class B Preferred share has been reduced from the date of issuance until immediately before the time of redemption. Subject to the provisions of the following sub-paragraph, such fair market value is to be determined by the directors on the basis of generally accepted accounting and valuation principles.

The fair market value determined as hereinabove provided for shall be subject to revision in accordance with any binding agreement with, or decision by, the appropriate taxation authorities, or any judgment of a court of competent jurisdiction. In the event that any such agreement, decision or judgment shall result in a final determination under the provisions of the appropriate taxation legislation and the amount thereby determined is an amount other than the amount for which such share was originally issued as determined by the directors in accordance with the preceding subparagraph, such finally determined amount for the purpose of the appropriate taxation legislation shall then be deemed to have been the fair market value of the consideration received by the Corporation upon the issuance of such Class B Preferred share. Such final determination shall reflect any assessment by the Minister of National Revenue or other taxing authority to which no appeal is taken or any agreement reached by the Corporation or any holder of a Class B Preferred share and a said taxing authority in settlement of a dispute regarding such assessment or proposed assessment, or any decision by a court or tribunal of competent jurisdiction regarding the fair market value of the Class B Preferred share or the consideration received by the Corporation upon the issuance of such Class B Preferred share to which no appeal may be taken or the period during which an appeal may be taken has expired.

In the event that, subsequent to any redemption of Class B Preferred shares, the Class B Preferred Redemption Price of each Class B Preferred share is adjusted pursuant to a revision of fair market value as aforementioned, either the Corporation shall pay out to the former holders of such redeemed Class B Preferred shares or the said former holders of the redeemed Class B Preferred shares will reimburse the Corporation as the case may be, the difference between the Class B Preferred Redemption Price of the said Class B Preferred shares as adjusted and the amount paid by the Corporation upon redemption, within sixty (60) days from the date of adjustment of the Class B Preferred Redemption Price.

(i) Stated Capital. In the event that only part of the amount of the consideration received by the Corporation for any Class B Preferred share issued by the Corporation is added to the stated capital account of the Class B Preferred shares, such Class B Preferred share shall be deemed to have been issued for the full amount of the consideration received, for all purposes of these articles (except only with respect to the stated capital of such Class B Preferred shares) including, but without limiting the generality of the foregoing, dividend rights, redemption rights and rights upon liquidation and dissolution.

(j) No Change. No change to any of the provisions of paragraphs III. (a) to (i) or of this paragraph (j) shall have any force or effect until it has been approved by a majority of not less than two-thirds (2/3) of the votes cast by the holders of the Class B Preferred shares, voting separately as a class at a meeting of such holders specially called for that purpose, or by a resolution in writing signed by all the holders of the Class B Preferred shares, in addition to any other approval required by the Act.

638753 N.B. INC.

Schedule - Other Provisions

1. PLACE OF SHAREHOLDER MEETINGS

Notwithstanding subsections (1) and (2) of Section 84 of the Business Corporations Act, as from time to time in force, meetings of shareholders of the Corporation may be held at any place outside New Brunswick.

2. NOTICE OF SHAREHOLDER MEETINGS

Notwithstanding subsection (1) of Section 87 of the Business Corporations Act, as from time to time in force, notice of time and place of a meeting of shareholders of the Corporation shall be deemed to be properly given if sent not less than Five (5) days before such meeting:

(a) to each shareholder entitled to vote at the meeting;

(b) to each director; and

(c) to the auditor, if any.

3. PRE-EMPTIVE RIGHTS

(A) Notwithstanding subsection (2) of Section 27 of the Business Corporations Act, as from time to time in force, but subject however to any rights arising under any unanimous shareholders agreements, the holders of equity shares of any class, in the case of the proposed issuance by the Corporation of, or the proposed granting by the Corporation of rights or options to purchase, its equity shares of any class of any shares or other securities convertible into or carrying rights or options to purchase its equity shares of any class, shall not as such, even if the issuance of the equity shares proposed to be issued or issuable upon exercise of such rights or options or upon conversion of such other securities would adversely affect the unlimited dividend rights of such holders, have the pre-emptive right as provided by Section 27 of the Business Corporations Act to purchase such shares or other securities.

(B) Notwithstanding subsection (3) of Section 27 of the Business Corporations Act, as from time to time in force, but subject however to any rights arising under any unanimous shareholders agreements, the holders of voting shares of any class, in case of the proposed issuance by the Corporation of, or the proposed granting by the Corporation of rights or options to purchase, its voting shares of any class or any shares or options to purchase its voting shares of any class, shall not as such, even if the issuance of the voting shares proposed to be issued or issuable upon exercise of such rights or options or upon conversion of such other securities would adversely affect the voting rights of such holders, have the pre-emptive right as provided by Section 27 of the Business Corporations Act to purchase such shares or other securities.

4. PRIVATE CORPORATION RESTRICTIONS

(A) The number of shareholders, exclusive of persons who are in the employment of the Corporation and are shareholders of the Corporation and persons who, having been formerly in the employment of the Corporation, have continued to be shareholders of the Corporation after termination of that employment, is limited to not more than Fifty (50) persons, two or more persons who are joint registered holders of one or more shares being counted as one shareholder.

(B) Any invitation to the public to subscribe for any shares, debentures or other securities of the Corporation shall be prohibited.

5. FINANCIAL ASSISTANCE

The Corporation may, directly or indirectly, give financial assistance by means of a loan, guarantee or otherwise:

(a) to any shareholder, director, officer or employee of the Corporation or of an affiliated corporation, or

(b) to any associate of a shareholder, director, officer or employee of the Corporation or of an affiliated corporation;

whether or not:

(c) the Corporation is, or after giving the financial assistance would be, unable to pay its liabilities as they become due; or

(d) the realizable value of the Corporation's assets, excluding the amount of any financial assistance in the form of a loan or in the form of assets pledged or encumbered to secure a guarantee, after giving the financial assistance, would be less than the aggregate of the Corporation's liabilities and stated capital of all classes.

6. NUMBER OF DIRECTORS

The number of directors within the minimum and maximum numbers provided for in these articles shall be as determined by resolution of the board of directors.

CANADA
PROVINCE OF NEW BRUNSWICK
BUSINESS CORPORATIONS ACT
CERTIFICATE

New Nouveau Brunswick

CANADA
PROVINCE DU NOUVEAU-BRUNSWICK
LOI SUR LES CORPORATIONS COMMERCIALES
CERTIFICAT

I HEREBY CERTIFY that according to the records under the Business Corporations Act,

JE CERTIFIE par la présente que d'après les livres en vertu de la Loi sur les corporations commerciales,

Andritz Hydro Canada Inc.
(#638753)

was incorporated by Articles of Incorporation filed the **6th day of June, 2008.**

a été constitué par les statuts de constitution déposés le **6ième jour de juin 2008.**

I CERTIFY FURTHER that according to the said records the Articles above referred to have not been dissolved.

JE CERTIFIE de plus que, d'après lesdits livres, les statuts mentionnés ci-dessus n'ont pas été dissous.

I CERTIFY FURTHER that according to the said records the above corporation has filed Annual Returns and paid filing fees up to the end of **July 2013.** ☒

JE CERTIFIE de plus que, d'après lesdits livres, la corporation ci-dessus a déposé des rapports annuels et payé les droits de dépôt jusqu'à la fin de **juillet 2013.**

OR

OU

I CERTIFY FURTHER that no Annual Return or filing fee therefore is required by the said corporation until the end of

JE CERTIFIE de plus qu'aucun rapport annuel ou droit de dépôt n'est par conséquent requis à l'égard de ladite corporation jusqu'à la fin de

CERTIFIED under my hand at Fredericton, New Brunswick

CERTIFIÉ par le soussigné à Fredericton, Nouveau-Brunswick

2013 03 12

Year/Année – Month/Mois – Day/Jour

Director
Directeur

Newfoundland Labrador

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
Service NL

CORPORATIONS ACT

CERTIFICATE OF GOOD STANDING

Corporation Name: **ANDRITZ HYDRO CANADA INC.**
Corporation Number: **61430**
Date of Registration: **December 10, 2009**

I certify that this Corporation has filed all documents required under the Corporations Act of Newfoundland and Labrador and is in Good Standing.

REGISTRAR OF COMPANIES
For Province of Newfoundland and Labrador
March 12, 2013

EXHIBIT 11

COMPANY SUPPLIED DOCUMENTS

This Exhibit contains a listing of documents that forms an integral part of this Agreement see Volume 3. Contractor shall be knowledgeable with all documentation and data listed herein.

Document No.	Title	Rev
LCP-SN-CD-0000-EV-PL-0006-01	Contract Specific Environmental Protection Plan (C-SEPP)	B2
LCP-PT-MD-0000-RI-SD-0001-01	Critical Risk Control Protocols	B1
LCP-PT-MD-0000-MM-SD-0001-01	Documentation, Packaging, Marking and Shipping Instructions	B1
LCP-PT-MD-0000-HS-PL-0001-01	LCP Health and Safety Management Plan	B3
LCP-SN-CD-0000-RI-PR-0001-01	LCP Risk Management Requirements for Contractors and Suppliers	B1
LCP-SN-CD-0000-EV-PL-0002-01	Project-Wide Environmental Protection Plan – Component 1 and 4B	B11
LCP-SN-CD-0000-IM-PR-0002-01	LCP Supplier Document Requirements	C3
LCP-SN-CD-0000-EV-PL-0005-01	Waste Management Plan - Component 1 and 4B	B3
LCP-PT-MD-0000-HS-PL-0005-01	LCP Security Management Plan	B1
LCP-PT-MD-0000-LR-SD-0001-01	Standard for Drug and Alcohol	B1
LCP-PT-MD-0000-IM-SD-0001-01	Coding Standard	B3
N/A	Code of Business Conduct and Ethics	N/A
LCP-PT-MD-0000-LR-CT-0002-01	Collective Agreement between the Muskrat Falls Employers' Association Inc. and the Resource Development Trades Council of Newfoundland and Labrador.	B1

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nalcor energy

Lower Churchill Project

Contract-Specific Environmental Protection Plan Template

SLI Document No. 505573-0000-68RA-I-0011-01

Nalcor Reference No. LCP-SN-CD-0000-EV-PL-0006-01-B2

Date: 27-Sep-2012

Prepared by: _____
Lesley Reid
Environmental Coordinator Transmission Lines and DC Specialties

Verified by: _____
David Haley
Environmental Manager

Approved by: _____
Normand Bechard
Project Manager

Revision					
N°	By	Appr.	Date	Revised pages	Remarks
01	LR	DH	27-Sep-12	ALL	Issued for Final
00	LR	KD	01-Nov-11	ALL	Issued for Final

TABLE OF CONTENTS

1 SCOPE

This Contract Specific Environmental Protection Plan (C-SEPP) template shall be used to complete a C-SEPP by the Contractor and shall describe the Contractor's procedures and methods to be implemented during site activities to minimize pollution, protect and conserve natural resources, restore damage, and control noise and dust within reasonable limits. The C-SEPP must be accepted by both SLI and Nalcor, as part of the Work Plan, prior to the start of any on-site activities or mobilization to the site.

A Project Wide Environmental Protection Plan (P-WEPP) has been prepared and is part of the Contract Documents. The P-WEPP will serve as a resource to Contractors as they prepare their own C-SEPP. Select contract packages will include this C-SEPP template/outline and specific instructions on how the C-SEPP is to be properly completed. Contractors are responsible for developing, implementing, and maintaining their own C-SEPP.

The C-SEPP shall include the following information:

a) Description of construction sequence and work methods.

b) Roles and responsibilities.

c) Mitigation procedures for all areas of environmental concerns.

d) Procedures for environmental monitoring.

e) Maintenance requirements for environmental control structures.

f) Procedures for post-activity clean-up and demolition.

g) Contingency planning for environmental concerns.

The C-SEPP shall also include any permits, registrations or notifications required by Federal, Provincial or aboriginal stakeholders for the proposed activities. The Contractor may be required to prepare additional environmental documentation prior to any fieldwork for non-time critical removals. The Contracting Officer will determine the type of environmental documentation required at each site.

2 C-SEPP OUTLINE/PROPOSED TABLE OF CONTENTS

2.1 Contractor's Name

Provide name of company

2.2 Brief Description/Scope of Work of Contract

Include scope of work, methods of construction, etc.

2.3 Schedule of Work

Include a detailed schedule of work including sequence of activities (GANTT type chart).

2.4 Responsibilities

List all responsible personnel (i.e. Project Manager, Environmental Coordinator, Health and Safety Manager, Field Supervisor, Regulators, etc.) including work specific roles and responsibilities including accountabilities and qualifications and interface roles and responsibilities between Contractor and Subcontractors. A table similar to that shown below would be acceptable.

Name	Title/Responsibility	Contact Information

2.5 Emergency Contacts

List emergency contacts required for the protection of environmental and human health. A table similar to that shown below would be acceptable.

Name	Governing Agency	Title/Responsibility	Contact Information

2.6 Description of Resources

Identify resources required (personnel, facilities, equipment, consumables or other requirements) required to complete contract.

2.7 Installations Required

List any temporary or permanent installations such as bridges, culverts, cofferdams, settling ponds, etc.

2.8 Applicable Policies and Training

List any environmental policies, compliance procedures and rules for contractors and subcontractors to follow. Also list any environmental training, including site specific training available to employees, or managers, as well as subcontractors. Attach any applicable documentation regarding policies or training.

2.9 Site Specific Environmental Concerns:

List any potential environmental concerns and sensitive issues associated with specific construction activities. The items listed below must be identified and located, on a site plan or sketch that shall be submitted with the C-SEPP. In the case of linear developments, this shall be located on a plan and profile by kilometer markings (or structures in the case of transmission lines). The plan shall identify the following:

a) Endangered/threatened species or identified critical habitat within the project site.

b) Wetlands within the project site.

c) Cultural and archaeological resources within the project site.

d) Water resources (all water bodies or watercourses such as ponds, lakes, streams) within the project site.

e) Coastal zones within the project site.

f) Trees and shrubs that will be removed within the project site.

g) Existing waste disposal sites within the project site.

h) Timing restrictions regarding construction of various construction sites.

2.10 Plans

The following full plans are to be prepared:

a) Sedimentation and Erosion Control Plan

b) Rehabilitation Plan

c) Compliance Monitoring Plan

d) Dewatering Plan

e) Blasting Plan

2.11 General Environmental Protection Procedures

A complete list of activities requiring mitigation measures, as outlined in the P-WEPP is provided below (1 – 35). List or reference specific procedures and methods for environmental protection and mitigation as they apply to the specific contract. Note: all activities will not apply to all contracts.

1) Scheduling and timing of Construction Activities

2) Construction Entrance

3) Linear Developments

4) Winter Construction

5) Equipment Operations and Movement

6) Vessel Operations (Barge/Boats)

7) Helicopter Traffic

8) Clearing of Vegetation

9) Pumps and Generators

10) Surveying

11) Drilling

12) Surface Water and Groundwater Use

13) Storage, Handling and Disposal of Fuel and other Hazardous Materials

14) Sewage Disposal

15) Solid Waste Disposal

16) Working within 15 meters of a Body of Water

17) Watercourse Crossings – Fording, Culverts and Bridges

18) Buffer Zones

19) Alterations to a Body of Water/Instream Works

20) Working In/Around Marine Environmental

21) Grubbing and Disposal of Related Debris

22) Quarrying and Aggregate Removal from Borrow Areas

23) Trenching

24) Excavation, Backfilling and Grading

25) Erosion Prevention and Sediment Control

26) Site Water Management

27) Dewater Work Areas

28) Blasting and Waste Rock Disposal

29) Concrete Production

30) Dust Control

31) Noise Control

32) Resource Specific Mitigations

33) Commissioning

34) Reservoir Impoundment

35) Site Rehabilitation

The activities listed above coincide with Section 5.0 of the P-WEPP, and if applicable to the specific contract, they should be reviewed and included in the C-SEPP. The Contractor should confirm that they agree with the specific measure noted in P-WEPP Section 5 or propose an alternative for consideration.

2.12 Monitoring/Auditing

Describe any monitoring activities required. Monitoring may include surveillance monitoring, compliance monitoring, wildlife monitoring, etc. The following details should be included:

a) Analytical parameters and laboratory to be used for samples.

b) Sampling locations.

c) Frequency of sampling.

d) Reporting (frequency of reports and what to include).

e) Corrective Actions (how to identify, document and execute).

2.13 Environmental Contingency Measures

List specific environmental contingency measures to be implemented should the environmental protection procedures be unsuccessful in protecting the environment. Contingency measures should be included for the following:

a) Fuel and hazardous materials spills (including details on spill response equipment).

b) Forest fires (including details on spill response equipment).

c) Wildlife encounters and nuisance presence.

d) Discovery of historic resources.

a) Alternative protection procedures for erosion and sediment control and site water management (measures to be implemented in the event initial mitigations are not successful).

2.14 Permits, Registrations, Notifications, Approvals and Authorizations

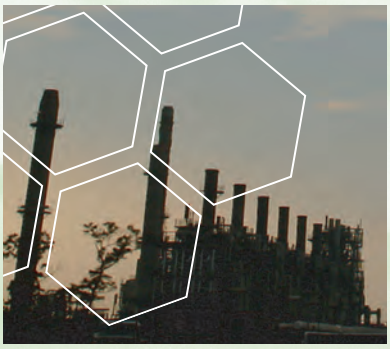
List all permits, registrations, notifications, approvals and authorizations that are required. A table similar to that shown below would be acceptable.

Required Registrations/Approvals/Permits/ Authorizations/Notifications	Issuing Department	Individual Obtaining Permit

2.15 Document Control

Provide details on document control methods.

Critical Risk Control Protocols



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about the health and safety of our employees, of those who work under our care, and of the people our projects serve.

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Winning the hearts and minds

of our people for safety requires each person to become a safety leader. These are leaders who inspire, motivate and transform others to excel in safety.

Emphasis on safety and quality on projects

which involves the integration of safety into all core business activities, the distribution of responsibility and accountability for safety to all employees at all levels and the adoption of peer-driven safety review processes.

Competence of the organization and people

in indentifying and managing risk requires a systematic focus on behaviours, risk perceptions and skills. Risk is inseparable from opportunity and reward and is to be managed competently at all levels of the organization.

Analysis of performance

while respecting lessons learned from previous experience, our focus is on sustaining a proactive safety culture. This includes processes like root cause analysis, positive incentive programs, safety leadership training, etc…

Risk transformation

ensures that the overall management of safety is risk-based, systematic and responsive to the dynamic nature of hazards and risks. We must stay vigilant and support processes which effectively assess all of our projects, business activities, and operations.

Engineering innovation for safety

reduces risks in project design, infrastructure, construction, and operations. It includes processes of quality management, lessons learned, e-technology, innovation, and benchmarking against best practices.

REVISION HISTORY

Revision	Date	Description	Prepared by	Approved by
0	January 2006	Draft	Global Health & Safety	T. Horton
1	June 2006	Initial release	Global Health & Safety	T. Horton
2	November 2009	Checklists added	Global Health & Safety	C. Price
3	December 2010	Excavations added - Protocol 7	Global Health & Safety	C. Price
4	March 2011	Checklists updated	Global Health & Safety	T. Van Wieren
5	January 2012	Full Document Review	Global Health & Safety	T. Van Wieren

Caution: Un-Controlled Copy

Valid only at time of retrieval from network source directory.
User should verify that the revision number is the most current.

TABLE OF CONTENTS

INTRODUCTION

The Critical Risk Protocols are designed to provide those controls deemed necessary to prevent fatalities, serious incidents and injuries arising from the most common hazards associated with our business.

The existence of these Protocols does not provide coverage of all risk areas. Other risk areas are addressed through our risk management process , a key element of the SNC-Lavalin Risk Register Procedure.

CONTEXT

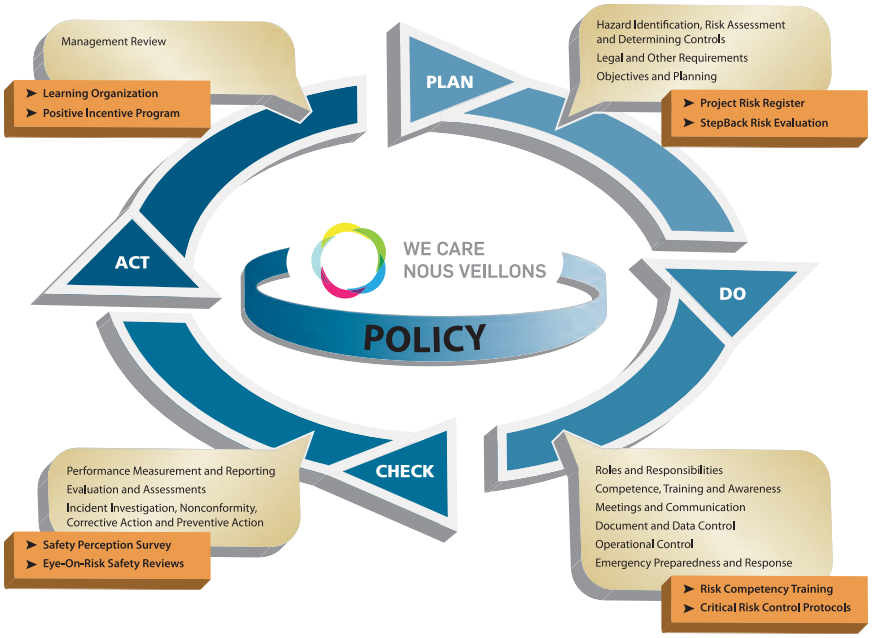
These Protocols should be read and used in conjunction with SNC-Lavalin Global Health and Safety Management System, Standards and Procedures. The SNC-Lavalin Global Health and Safety Management System as shown below is hierarchical, where documents and systems must meet and support the requirements of those at a higher level.

DEPLOYMENT

The mandatory requirements of these protocols are signified by the use of the word “shall”. The word “should” indicates that the primary intent is to comply with the full requirements as if they were mandatory. However, there will be circumstances where local conditions may demonstrate that the requirement is either not applicable or an alternative approach is necessary. Variation can only be considered as compliance if the most senior manager of the project approves it based on an evaluation of the risk. The risk management approach adopted must be consistent with the SNC-Lavalin risk management process and follow the hierarchy of controls.

APPLICATION

These protocols apply at all SNC-Lavalin controlled sites for controlled activities, and to all SNC-Lavalin employees, contractors and visitors when involved in these controlled activities.



HIERARCHY OF CONTROLS

The hierarchy of controls is the preferred order to mitigate hazards and control risk levels:

1. **Elimination:** Complete removal of a hazard.
2. **Substitution:** Replacing the material or process with a less hazardous one.
3. **Separation:** Isolate the hazard (e.g. guarding or enclosing it).
4. **Engineering:** Designs or modifications to reduce the exposure to the hazard.
5. **Administrative:** Limit exposure to hazardous conditions or energies by procedural means (e.g. timing of work, policies, signage and work practices).
6. **Personal Protective Equipment (PPE):** Last line of defence; hazards are still present and PPE is used to reduce the potential for harm.

A number of these options may be considered and applied individually, or in combination.

It is recognized that sound (and formalized) risk management principles are still required (e.g. beyond simple compliance with a mandatory Protocol) to identify, quantify, control and reduce the likelihood of incidents through the investigation, assessment and understanding of hazards associated with the activities covered by these Protocols.

SNC-Lavalin operates a diverse range of businesses in different countries and cultures around the world, all with varying legal frameworks. When applying procedures and practices to meet the needs of these Protocols, the relevant legislation must be complied with.

The nature of hazards and extent of risk may be significantly influenced by changes implemented to operations, processes, equipment, systems, services and people. This requires procedures to assess the effect of these changes and the associated risks. As with any formal risk management process, appropriate change management processes shall be in place.

APPROVAL FOR ALTERNATIVE CONTROLS

In unique circumstances where the specific requirements of a Critical Risk Control Protocol cannot be fully achieved, approval for alternative control measures shall be obtained by providing a comprehensive and documented risk-based management control plan, containing the following:

- Details of the Critical Risk Control Protocol conformance gaps;
- Alternative controls to be implemented;
- Timeframe and associated conditions towards achieving compliance;
- Assigned single point accountability; and
- Sign off by the “one up manager” to the most senior manager of the project.

MAINTENANCE OF CONTROLS

All controls require maintenance and monitoring. The monitoring and measuring of control effectiveness shall be instituted as part of the risk management process for all SNC-Lavalin controlled sites.

PROTOCOL 1 – VEHICLES AND MOBILE EQUIPMENT

1.1 INTENT

To eliminate or minimize the risk of fatalities, injuries and incidents arising from the use of vehicles and mobile equipment.

1.2 APPROACH

This protocol applies to all self-propelled vehicles and mobile equipment.

This protocol applies to all SNC-Lavalin controlled sites and activities, and to all SNC-Lavalin employees, contractors and visitors when involved in controlled activities. This protocol does not apply to employees personal vehicles. (Note: if client or local legislation requires more stringent controls, then those controls shall be implemented).

1.2.1 REASON FOR INCLUSION

Vehicles have been involved in a significant proportion of fatal and high potential incidents in the construction and mining industries. Identified causes and contributing factors include:

1. Inappropriate speed for conditions.
2. Driver fatigue.
3. Vehicle stability.
4. Driver distraction.
5. Vehicle condition (tires, brakes, etc.).
6. Alcohol and drugs;.
7. Poor visibility.
8. Lack of vehicle separation from other mobile equipment, objects and pedestrians.
9. Risk taking behaviour.
10. Driver experience/competency.

1.3 DEFINITIONS

- **Mobile equipment** includes vehicles such as bobcats, front end loaders, forklifts, dump trucks, tractor trailers, packers, etc.

- **Light vehicles** includes vehicles such as passenger cars, four wheel drives (including all wheel drives), sports utility vehicles (SUVs), cargo vans, pick-ups (utilities), mini buses, etc.
- **Heavy equipment** includes vehicles such as bull dozers, rock trucks, excavators, graders, etc.

1.4 DEPLOYMENT

Please refer to the deployment section on page 3 for definition and explanation, and approval for alternative controls.

The requirements of this protocol are as follows.

1.4.1 GENERAL REQUIREMENTS

1. Maintain and operate all vehicles in accordance with manufacturer's specifications.

2. Safe work plans shall be in place to ensure that risks associated with servicing vehicles are managed and controlled. The systems shall include, but are not limited to, primary and secondary stands specifically manufactured for the support of vehicles or mobile equipment when support for mobile equipment is required.

3. Vehicle selection shall be based on a documented risk assessment process, taking account of tasks, suitability for job application, environment and roll over and crash worthiness ratings.

4. Tires specifically designed for the hazardous road conditions, including tires designated for winter driving during the season when snow or ice can be expected.

5. In instances where SNC-Lavalin staff must use short-term rental vehicles, all efforts should be made to comply with these protocols. Where it is not possible to comply (e.g. winter tires), alternate controls should be utilized (e.g. rental of four-wheel-drive vehicle).

6. Prior to allowing vehicles not specifically designed to dump their loads from uneven surfaces to dump, supervision must ensure that the vehicle is on firm/level ground.

7. All installed and required safety equipment such as seat belts, air bags, emergency stopping system, parking brake and audible back-up alarms shall be used at all times when the vehicle/equipment is in use.

8. Before the operator exits a vehicle the parking brake must be set and the ignition turned off.

9. Circle checks must be completed to ensure safe movement of vehicles prior to use.

10. When the vehicle is parked on an incline and as applicable to the type of equipment, the wheels must be blocked, the blade/forks/bucket lowered or the wheels turned into a berm or other obstruction.

11. Light vehicle running lights (low beam headlamps) shall be on at all times when the vehicle is in operation.

12. Mobile phones, whether hands-free or hand-held, shall not be used by the driver of a vehicle unless the vehicle is stationary and in a safe location.

13. Controls shall be in place to ensure the safety of people working in traffic areas, including working on unexpected vehicle breakdowns.

14. To allow forward egress into traffic areas and improve safe movement of traffic, in our parking lots at our office and project sites, all vehicles should back into parking spaces where appropriate.

15. A fit-for-work policy shall be in place, incorporating defined action levels for drugs (including prescribed medication) and alcohol and procedures for managing driver fatigue

1.4.2 PROJECT EQUIPMENT REQUIREMENTS

All road going vehicles shall have the following minimum safety features:

1. Vehicles carrying passengers shall have suitable seats with seatbelts (no seat, no ride) and shall not have seating that is side mounted. Passengers may be permitted without appropriate seats if it has been authorized for training or for inspecting the equipment, but only if adequate provision has been made for the safety of the passenger.

2. Roll-over protection is required for all vehicles where the risk of roll over is high.

3. Cargo barriers and load restraints for all vehicles designed for carrying loads (other than passengers), or that are unable to have cargo separated from the vehicle's occupant carrying space.

4. A first aid kit suitable for road emergencies.

5. Emergency roadside triangles or beacons (three of either).

6. Driver frontal airbag and passenger airbag (for light vehicles).

1.4.2.1 INTERACTION WITH HEAVY EQUIPMENT

All vehicles that interact with heavy mobile equipment shall:

1. Have means that enable communication to be made with that equipment.

2. Have a flashing, revolving or strobe light or for light vehicles reflective taping and a high-visibility flag (e.g. a whip flag or buggy whip).

3. Ensure vehicles with poor visibility, oversized loads, operating in tight quarters or other high risk situations are moved with the assistance of a signal person (spotter).

1.4.3 MOBILE EQUIPMENT

Mobile equipment shall have:

1. Seatbelts for all occupant seats.
2. Roll over protection where there is risk of roll over.
3. Falling object protection unless the risk of falling objects is low.
4. A suitably mounted portable fire extinguisher.
5. Lights for safe operation.
6. Horn or other audible warning device.
7. Reverse alarm (except for bi-directional vehicles such as shuttle cars).
8. Isolation point (see Protocol 4 – De-Energization, Isolation, Lock-Out and Tagging) that can accept a personal lock.
9. Wheel chocks for rubber tired mobile equipment.

1.4.4 EQUIPMENT INSPECTION

1. Inspect vehicles at the start of each shift and complete a pre-shift vehicle/equipment checklist and keep the checklist on the vehicle for that shift.
2. Prior to acceptance and use of heavy and mobile equipment on site, a mechanical inspection must be carried out and a copy of the inspection forwarded to the appropriate SNC-Lavalin personnel.
3. Ensure that a formal, effective and auditable preventive maintenance program is established for all vehicles and mobile equipment.
4. Immediately tag and lock vehicles out of service that have been found to have defects that pose a hazard to safe operation.

1.4.5 MODIFICATION OF EQUIPMENT

Stamped engineering documents shall accompany all vehicle/mobile equipment modifications, including the attachment of any equipment. Examples of changes or modifications may include, but are not be limited to:

1. Any change or modification made to the overall vehicle body structure or design.
2. Any change or modification made to the original manufacturer's required or suggested type of tires or wheels.

3. Any change or modification made to the vehicle suspension system, mechanical system, or lifting capacity.

4. Any change or modification that may adversely alter the vehicle's centre of gravity.

5. Any change or modification that may affect the vehicle's load carrying capacity.

6. Any change that may affect the vehicle's crash-worthiness or the effective operation of any vehicle feature.

1.4.6 JOURNEY MANAGEMENT PLANS

Journey management plans are required anytime employees are required to travel:

1. More than 400 km or 4 hours.

2. In areas that pose safety and security risks due to political or social instability.

3. In unpopulated areas with limited communication ability.

4. In areas where conditions make the travel more hazardous:
   a) extensive travel on unpaved or unmaintained roadways.
   b) high levels of wildlife interactions.
   c) mountainous areas.
   d) dangerous seasonal or extreme weather conditions.

Systems shall be in place to ensure that risks associated with vehicle journeys are managed and controlled. The systems should include, but not be limited, to:

1. Journey management plans in place prior to commencement of new or changed travel activities.

2. Identification and monitoring of the risks associated with the number of journeys, routes, intersections, etc. To ensure that the overall exposure is reduced to as low as reasonably practicable.

3. The need for survival or emergency equipment suitable for the operating environment.

4. Assessment and communication of changed environmental and road conditions at the time of travel.

5. Outline of actions required in the event of an emergency (e.g. collision or break down).

6. Provisions to manage driver fatigue.

7. When traveling long distances or in remote areas alone, a check-in schedule is established with a contact person who knows how to respond if a problem develops.

1.4.7 TRAFFIC MANAGEMENT PLANS

An assessment needs to be completed to see if there are any traffic hazards at a given project, and if so a site-based traffic management plan shall be in place including, but not limited to the following:

1. A traffic control person (spotter) is required any time a large vehicle is backing up on a construction site, any vehicle that is backing up into a congested area, and any time project equipment interacts with the public to ensure a clear and safe path of travel. This person shall have sufficient documented training to complete this task.

2. Setting of appropriate speed limits for vehicle types, road surfaces and environmental conditions.

3. Overtaking protocol.

4. Procedures for light vehicles entering hazardous or restricted areas.

5. Clear communication protocols.

6. Standards for safe following distances based on operational circumstances, environmental conditions and near sight (blind spot) limitations of other mobile equipment.

7. Installation and maintenance of road traffic control signs as appropriate to the work site.

8. Parking procedures (e.g. safe parking distances/locations) and required barriers from heavy mobile equipment and pedestrians.

9. A site-based review of pedestrian interaction, road design and layouts (including entrance and exit points, intersections and other potential points of interaction between vehicles and other mobile equipment), shall be conducted and updated when changes to layouts are required. Where possible, traffic segregation should be used to separate pedestrians, light vehicles and other mobile equipment.

10. Any changes to the site traffic management plan shall go through a change management review.

1.4.8 PEOPLE REQUIREMENTS

1. All employees, contractors and visitors shall be inducted in appropriate site road safety and vehicle hazards.

2. A system shall be in place to verify that drivers of heavy and mobile equipment have a valid and appropriate level of public road driver's license prior to being allowed to operate vehicles/ equipment off site. Where applicable, vehicle operators shall have their license on their person at all times.

3. A permit or certification system shall be in place to ensure drivers/operators are competent to operate vehicles in their intended environment, whether that be internal or external to a

SNC-Lavalin site. Only qualified personnel or personnel in training under direct supervision are permitted to operate equipment.

4. As a minimum training should include:
   a) hazards assessed for a particular vehicle and the task for which it is to be used.
   b) specific road/project site rules.
   c) vehicle familiarization, taking into account the vehicles handling dynamics, blind spots and various features.
   d) loading and restraining principles where the vehicle intended to be operated is designed for carrying cargo loads.
   e) education and awareness of driving and travel risks that may be encountered within the environment where the vehicle may be operated or driven.
   f) emergency crash and breakdown procedures, basic mechanical principles including tire changing and how to adequately perform a pre-operation check.
5. Where suitable, the SNC-Lavalin Positive Incentive Program should be used to reinforce safe driving practices.

PROTOCOL 2 – HAZARDOUS MATERIALS MANAGEMENT

2.1 INTENT

To eliminate or minimize the risk of fatalities, illnesses, injuries and incidents arising from the storage, handling, production, transport, recycling and disposal of hazardous materials.

2.2 APPROACH

This protocol applies to hazardous materials that, in one or more of their forms (solid, liquid or gas), have the potential to harm our people, the environment, or our communities (all stakeholders), either in an accident involving loss of control/containment, or in normal, controlled activities (e.g. storage, handling, production, transport, recycling and disposal). This protocol does not cover handling of explosives or radioactive materials.

This protocol applies to all SNC-Lavalin controlled sites and controlled activities, and to all SNC-Lavalin employees, contractors and visitors when involved in hazardous materials operations. (Note: if client or local legislation requires more stringent controls, then those controls shall be implemented.)

2.2.1 REASON FOR INCLUSION

Hazardous materials have contributed to the number of incidents in the construction and maintenance industries. They are generally associated with uncontrolled releases and have the potential to affect a wide area around the incident (e.g. gases can travel significant distances). It is therefore necessary to ensure that equipment, processes, and behaviours are developed and adopted that will manage the risk associated with these materials. The causes and contributing factors to these incidents have been:

1. At-risk maintenance activities.
2. Lack of understanding of chemical properties and reactions.
3. At-risk manual handling activities.
4. Insufficient management of risk.
5. Equipment failure.
6. Insufficient primary and secondary containment systems.

2.3 DEFINITIONS

- **HAZOP** stands for **HAZ**ard and **OP**erability study.
- **HAZID** stands for **HAZ**ard **Id**entification.
- **MSDS** stands for **M**aterial **S**afety **D**ata **S**heet.
- **HAZCHEM** stands for **HAZ**ardous **CHEM**ical.

- **ALARP** stands for **A**s **L**ow **A**s **R**easonably **P**racticable.
- **HAZMAT** stands for **HAZ**ardous **MAT**aterials

2.4 DEPLOYMENT

Please refer to the deployment section on page 3 for definition and explanation, and approval for alternative controls.

The requirements of this protocol are as follows.

2.4.1 FACILITIES, PROCESS AND EQUIPMENT REQUIREMENTS

1. Provisions shall be made for the safe venting, drainage and containment of hazardous materials, where required by normal operations, maintenance and repair activities, and emergency situations. These provisions should be based on a formal risk assessment process, such as HAZOP or HAZID studies, and take into consideration any applicable environmental legislation.

2. For toxic gas release, an adequate model of dispersion shall be available for credible scenarios, in order to determine the zone of exclusion and adequate containment area for impacted personnel.

3. Labelling shall be in place on all storage vessels, containers and tanks, as per appropriate local or applicable CSA standards. This labelling shall clearly identify the carried or stored material. Supporting information (e.g. material safety data sheets [MSDS]) shall also be readily available at the point of use and storage locations.

4. Piping containing hazardous substances shall be marked such that the contents and direction of flow of the piping can be identified.

5. Security and access control systems and hardware shall be in place, appropriate to the risk, to manage access to areas where hazardous materials are stored and used. These areas must also be designed for easy access for firefighting and emergency response efforts. Storage facilities must protect hazardous materials containers from physical damage due to factors such as, but not limited to, extreme temperatures, moisture, corrosive mist and vapours, and vehicles.

6. Fixed and personal detection devices shall be considered as options in the selection of potential risk reduction measures. These are the redesign and separation controls, and personal protective equipment as described in the Hierarchy of Controls.

2.4.2 PROCEDURAL REQUIREMENTS

1. The requirements of relevant OH&S legislation, regulations, standards and industry codes of practice shall be applied.

2. A program must be in place to assess safer alternatives to current hazardous materials based on risk assessment and also consider product and process reformulation/redesign actions where technically feasible.

3. Optimization practices must be designed to minimize the inventory of hazardous materials to necessary amounts for justifiable use.

4. A risk management process shall be in place for all hazardous materials to identify:
   a) the selection criteria and lifecycle analysis for all hazardous materials, including the means of disposal.
   b) the level of risk associated with the hazardous materials.
   c) controls required to manage the risk to levels that are ALARP.
   d) the performance requirements (reliabilities and capacities) of specific equipment and systems included in these controls.

5. All facilities which have high levels of risk from hazardous substances shall provide an emergency response plan which includes:
   a) means of escape in an emergency situation.
   b) emergency response teams appropriate to the risk.
   c) appropriate number and location of safe refuge and assembly areas for people.
   d) emergency response equipment for spillage containment, fires, explosions, burns, etc.
   e) appropriate response arrangements with external medical providers (e.g. ambulance, hospitals, fire brigade etc).
   f) emergency response procedures appropriate to the risk; and theoretical and practical training of involved personnel.
   g) recovery procedure and disposal of the hazardous material.

6. A system shall be in place whereby the introduction and disposal of hazardous materials, including empty containers, shall be approved by the site Hazardous Materials Co-coordinator (refer to requirement number 2.4.3.1 of this protocol) prior to introduction or disposal.

7. A site register shall be in place for all hazardous materials, and includes:
   a) name;
   b) HAZCHEM/United Nations code;
   c) MSDS;
   d) summary of maximum inventory;
   e) storage requirements and precautions;
   f) location, physical properties of the materials, where they are used; and
   g) approved disposal methods.

8. A system shall be in place to ensure that MSDS are readily available to all personnel (employees, contractors and other affected parties such as first aiders and medical personnel) involved in

the transportation, storage, handling, use and disposal of hazardous materials and be in the language commonly used at the site.

9. A system shall be in place to ensure that all relevant design documents and drawings associated with this protocol are up-to-date, controlled and available.

10. Critical activities involving hazardous material, which have the potential for immediate or long-term harm, shall be identified and safe operating procedures and training documented, including selection, transportation, storage, handling, and use and disposal of incompatible hazardous substances.

11. Monitoring systems for hazardous materials shall be in place to ensure that the status of process operations is understood and shown clearly at all times. These systems shall include the procedure for a documented hand-over between shifts that records any relevant information/ changes in operating status.

12. A permit to work system shall be in place to ensure proper decontamination of land, facilities, and equipment, isolation, use of the correct personal protective equipment, and any special requirements or precautions (e.g. requirements for venting, clearing of piping or when using open flames) where the occupational exposure limit of a hazardous substance could be exceeded.

13. Documented emergency response plans for incidents involving hazardous materials shall be in place, reviewed, revised (if necessary) tested annually. This shall include external support services such as local ambulance and hospitals as appropriate to the risk.

14. A system shall be in place to authorize and control the training of appropriate personnel in normal transportation, storage handling, use and disposal of, and emergency response procedures for hazardous materials.

15. A system shall be in place to monitor short and long-term exposure of personnel to hazardous materials, whenever there is the potential for immediate or long-term harm. This system shall ensure that fatality potential is also addressed.

16. Procedures shall be in place for transporting hazardous materials. Where required, a hazardous material manifest and supporting documentation shall be completed and shipped with the hazardous material. This documentation shall comply with local legislation and be readily available to be audited by SNC-Lavalin.

2.4.3 PEOPLE REQUIREMENTS

1. The role of a site Hazardous Materials Coordinator shall be required at sites where hazardous materials are processed, stored and handled. This person shall be competent to understand and evaluate the risks associated with hazardous materials. The individual shall be responsible for assessing the hazardous properties and authorizing the use of hazardous materials on site, as well as dictating any required controls to be implemented prior to use.

2. A competency based training program shall be in place for operations, maintenance and emergency response roles involving hazardous materials.

3. Behaviour based observations shall include the operation of equipment and systems handling hazardous materials.

2.4.4 SAFETY IN DESIGN

1. The design of a facility or process, permanent or temporary, which transports, produces, stores, uses or disposes of hazardous materials shall be reviewed, amended as necessary and documented utilising adequate risk analysis methods and tool. As-built design drawings (e.g. process and instrumentation diagrams, process flow diagrams, layout drawings, isometrics, etc.) shall be updated as a result of these reviews.

2. All specifications for the design and/or modification of hazardous materials facilities shall be subject to a risk analysis that includes hazardous materials selection, transport, production, storage, handling, use and disposal. Previous incidents should be reviewed to ensure risk is as low as reasonably practicable (ALARP). Identified hazardous situations and associated risks will be recorded in the Project HSE Risk Register using Risk Management Tool.

3. Process control systems shall ensure that the potential for personnel to be exposed to hazardous materials is eliminated wherever possible or reduced to ALARP.

4. Automatic project control systems should be in place in hazardous material facilities to eliminate the need for operator intervention and maintain operation within the required parameters. Such systems shall incorporate fail to safe systems in the event of emergencies. Where automatic control is not practicable, risk assessment shall be used to identify and implement operational options that reduce health, safety and environment risks to ALARP.

5. A system shall be in place to identify and document the selection, use, maintenance, inspection, testing schedules and procedures for critical equipment associated with hazardous materials.

6. A system shall be in place for the management of change of equipment and/or processes for selection, transportation, storage, handling use and disposal and shall include specific steps to assess the impact of changes on the risk associated with hazardous materials.

7. Safe operating limits for equipment handling hazardous materials, which have the potential for immediate or long-term harm, shall be clearly defined, documented and available to operations and maintenance personnel.

8. A system shall be in place to control simultaneous operations involving hazardous materials to avoid mixing of incompatible materials.

PROTOCOL 3 – EQUIPMENT SAFEGUARDING

3.1 INTENT

To eliminate the risk of fatalities, and injuries when there is potential for human interaction with moving parts of potential energy releases of machines and equipment.

3.2 APPROACH

This protocol applies to the safeguarding of people from moving parts, mobile machines, equipment and power tools, including moving equipment, high pressure equipment and applications, electrical, other energy sources with the potential to move, and objects falling or projected from moving parts.

This protocol applies to all SNC-Lavalin controlled sites and activities, and to all SNC-Lavalin employees, contractors and visitors when interfacing with equipment. (Note: if client or local legislation requires more stringent controls, then those controls shall be implemented).

3.2.1 REASON FOR INCLUSION

A number of high potential incidents have been associated with the inadequate and inappropriate safeguarding of equipment. The causes and contributing factors to these incidents have been:

1. Absent, inadequate or ineffective guarding in place.
2. Working alongside unguarded moving parts.
3. No process assessment to identify guarding needs.
4. Struck by objects projected from moving parts.
5. Struck by equipment mobilized by high pressure equipment (e.g. hydraulics, compressed air).
6. Working on moving parts with guarding removed.
7. Lack of guarding interlocks on potential/high equipment.

3.3 DEFINITIONS

N/A

3.4 DEPLOYMENT

Please refer to the deployment section on page 3 for definition and explanation, and approval for alternative controls.

The requirements of this protocol are as follows.

3.4.1 PROJECT AND EQUIPMENT REQUIREMENTS

1. Designers and purchasers of new equipment shall consider all energy sources and ensure that they are designed to eliminate the need for guarding where practicable. Safeguarding shall be selected where other potential mitigation measures do not adequately protect personnel.

2. Equipment safeguards shall be designed and constructed to comply with applicable legislation, CSA standards, codes of practice and relevant recognized leading industry practices and considering maintainability and operability.

3. Prior to allowing personnel into an operational or construction environment, a formal evaluation shall be made to ensure the integrity of equipment safeguarding.

4. Where safeguarding and interlock systems are insufficient to protect people, access to equipment shall be controlled and monitored.

5. Fail-to-safe/deadman switches or devices shall be installed on all manually operated rotating equipment and power hand tools (e.g. saws, lathes, drill presses, etc.).

6. Guards shall only be removed for maintenance and repair after equipment has been isolated, locked out and tested in line with Protocol 4 – De-Energization, Isolation, Lock-Out and Tagging. Where the temporary removal of safeguards is necessary on operating equipment, for the purposes of fault finding, testing and commissioning, a risk-based procedure shall be in place. Guards shall be replaced prior to equipment being put back into operation.

3.4.2 PROCEDURAL REQUIREMENTS

1. The requirements of relevant OH&S legislation, regulations, standards and industry codes of practice shall be met.

2. A documented assessment process shall be used to identify where safeguarding is required on equipment and to identify safeguarding hazards that require interlock systems as an additional control where required.

3. No guarding shall be modified or altered except through the application of a risk-based change management process and if applicable, sign-off by a professional engineer.

3.4.3 PEOPLE REQUIREMENTS

1. People likely to come into contact with high-energy moving and rotating parts, shall be required to have competency based training including what the risks are, what the controls are, emergency management and incident response procedures and where to get further information, if required.

2. A training system that includes the requirements of this protocol shall be in place for relevant personnel involved in the design, purchase, construction, operation and maintenance of equipment.

3. Only appropriately competent people are allowed to work with high-energy moving and rotating parts and they must be instructed and supervised by appropriately competent people.

PROTOCOL 4 – DE-ENERGIZATION, ISOLATION, LOCK-OUT AND TAGGING

4.1 INTENT

To eliminate or minimize the risk of fatalities, injuries and incidents arising from the uncontrolled and unexpected release of energy or hazardous materials.

4.2 APPROACH

This protocol applies to the isolation of all sources of energy (electrical, mechanical, hydraulic, chemical, gravitational, pneumatic, kinetic, stored energy, etc.).

This protocol applies to all SNC-Lavalin controlled sites and activities, and to all SNC-Lavalin employees, contractors and visitors when working with all potential sources of energy. (Note: if client or local legislation requires more stringent controls, then those controls shall be implemented).

4.2.1 REASON FOR INCLUSION

Failing to lock out an energy source can create an immediately dangerous to life and health situation. A high portion of energy related incidents are caused by inadequate or improper isolation of the energy sources. The causes and contributing factors to these incidents have been:

1. Failure to identify or recognize a source of potential or stored energy.
2. Inadequate training or competence.
3. Inadequate lock-out/tag-out systems.
4. Complacency.
5. Working on, or isolation of the wrong equipment.
6. Inadequate design/maintenance of isolators.

4.3 DEFINITIONS

- A system or isolation tag is a **tag** applied to an isolation point by the person who is responsible to ensure isolation requirements for the task have been met and is a tag that when applied prohibits all use, operation or start-up of equipment.
- **Routine** work is work that does not require a permit and is covered by a procedure, work instruction or checklist.
- **Non-routine** work is any activity that is outside regular operation of the construction site or a site which we may be operating. Non-routine work can involve an activity where more than one energy source has to be isolated.

- A **group isolation** is achieved when there is a single common isolation point that isolates more than one unit of equipment.
- A **multiple isolation** is a single isolation point that is locked and / or tagged by more than one person.
- A **short-term isolation** is an isolation in place for one shift period or less.
- A **long-term isolation** is an isolation in place for more than one shift period.
- **Software overrides** are those that either electronically set and hold a device or electronically defeat an output action for emergency and safety shutdown systems. Their functions are electronically initiated and applied to control rather than power circuits.
- **Personal locking device** is one that is provided to an individual for the purpose of their own protection. It is not to be used by others, and can only be removed by the owner. The only exception is the site master key that can be used by the construction manager or his/her designate, or the manager in charge of the facility we are operating.
- **Personal danger tag** is a tag personally applied by the individual prior to commencing work on isolated equipment. The individual who placed the personal danger tag on the isolated piece of equipment is the only person who can remove the tag. The only exception for removal of the tag by others is when the construction manager or his/her designate, who after ensuring the individual has left the site or facility we are operating, has given approval.

4.4 DEPLOYMENT

Please refer to the deployment section on page 3 for definition and explanation, and approval for alternative controls.

The requirements of this protocol are as follows.

4.4.1 PROJECT AND EQUIPMENT REQUIREMENTS

1. Purchase and design of equipment (including hired and contracted equipment) shall be given due consideration to meeting the requirements of this protocol.

2. Isolation shall provide positive protection and be achieved by the use of locking devices or the establishment of a physical barrier or separation. All separations or physical barriers shall be provided with either a permanent or temporarily fitted locking device.

3. Personal locking devices shall:
   a) be uniquely keyed.
   b) not be combination locks.
   c) not have an unauthorized second-party master override key.
   d) be kept under the exclusive control of the owning individual, and key(s) shall not be transferred to another person for lock removal.

4. Designated isolation points shall be clearly labelled at all times to identify the circuit or system

over which they have direct control. These labels shall be applied following a process of preisolation identification using isolation lists, load verification, marked drawings etc. (where permanently applied, these labels shall be physically verified prior to the isolation).

5. Lockout boxes, stations or equivalent shall be provided where required.

6. All designated isolation points fitted with personal locking devices shall be tagged. The isolation tagging system shall ensure that:
   a) isolation points are positively identified, including the name of the person locking out.
   b) the reason for the isolation is clearly identified.
   c) the date and time the tag was applied.
   d) isolation tags are highly visible to prevent inadvertent operation.

4.4.2 PROCEDURAL REQUIREMENTS

1. The requirements of relevant OH&S legislation, regulations, standards and industry codes of practice shall be followed.

2. All sites shall have a documented isolation lock-out and tag-out system. An overall site specific isolation and lock-out procedure shall be in place, and include:
   a) definitions of appropriate treatment for routine isolations (e.g. maintenance activities for construction equipment).
   b) non-routine isolations (construction activities).
   c) group, master and/or multiple isolations.
   d) short-term isolations and long-term isolations (“mothballing” procedures are only required prior to such activity).

3. No work can be done on any equipment or system until it has been established that it is in a zero energy state (ZES), unless involved in commissioning or troubleshooting. If it is not possible to establish a ZES on electrical systems, then the working live requirements of CSA Z462 must be followed.

4. The isolation system shall be applied to all activities on site, including contractor activities (e.g. construction, commissioning, operation of fixed/permanent equipment where applicable, operation, maintenance, return to service, emergency, modification or demolition of equipment).

5. The isolation procedure should determine the appropriate isolation method for any activity, either by way of a full description for specific cases, or by demonstrating the process that shall be followed to achieve the appropriate level of isolation in new activities. This shall include, but not limited to:
   a) the role of work instructions, checklists, tagging requirements and the permit to work system.

b) a positive registration process for people working on isolated equipment (personal tag, log sheet etc.).

c) changed requirements associated with the duration of the isolation and tasks, or when tasks take longer than planned to complete.

d) energy sources to be isolated (hazardous materials, mechanical, electrical, etc.).

e) the physical state of the energy sources such as their phase (liquid, solid, vapour, etc.) and other characteristics (e.g. pressure, temperature, voltage, etc.).

f) controls required for the duration of the activity (temporary changes, emergency procedures, personal protective equipment, etc.).

g) the requirements for formal contact with representatives in charge of each facility area affected, and the process for granting written authorization to proceed.

h) special precautions when isolations cover one or more shift changeovers.

6. Prior to relying on an isolation to supply a safe working environment documented test procedures shall be provided to verify isolation integrity including, but not limited to, the following principles:

   a) identification of all energy sources or hazardous materials directly and indirectly associated with the work to be performed.

   b) confirmation of those systems requiring isolation.

   c) notification of affected employees.

   d) isolating the confirmed energy or hazardous material sources.

   e) application of lock/tag.

   f) application of isolation tag.

   g) trying/testing of all systems and non-redundant isolations when reasonably or feasibly possible (to verify the integrity of the isolation and ensure a zero energy state exists), and restart procedures.

7. A formal procedure shall be in place for controlling clearances to work for the:

   a) isolation and de-isolation of equipment.

   b) handover and hand back of equipment between operation, and maintenance.

   c) transfer of isolations between shifts or different workgroups.

8. Specific procedures shall be developed to address software overrides.

9. A procedure for testing and positioning during maintenance and set-up.

10. A procedure shall be in place to mitigate hazards in special cases where any one of the following is not achievable:

a) a zero energy state.

b) a test/try of isolation is not possible.

c) use of a locking device is not feasible.

11. Formal isolation procedures shall include requirements for investigation, reporting and removal of personal locks/tags by an authorized person other than the originator.

12. The isolation system shall be regularly reviewed and audited to capture any previously unidentified changes and revised when necessary.

4.4.3 PEOPLE REQUIREMENTS

1. Roles and responsibilities for electrical, mechanical, or process isolation management shall be defined.

2. A competency based training system and field assessment shall be in place to approve personnel before they conduct isolation processes.

PROTOCOL 5 – WORKING AT HEIGHTS

5.1 INTENT

To eliminate or minimize the risk of fatalities, injuries and incidents arising from working at heights.

5.2 APPROACH

This protocol applies wherever there is potential for any person to fall 1.8 metres or more, or to gain access to within 1.8 meters of an open edge from where there is the potential to fall 1.8 metres or more, including working from various forms of portable and moveable elevated work platforms, cages, ladders, scaffolding and where objects could fall and cause injuries. Risk assessment may identify high potential fall hazards when working at heights of less than 1.8 metres in which case this protocol shall be applied. (Note: if client or local legislation requires more stringent controls, then those controls shall be implemented). This protocol does not apply to rope rescue situations and rappelling that are regarded as specialist functions.

This protocol applies to all SNC-Lavalin controlled sites and activities, and to all SNC-Lavalin employees, contractors and visitors when involved in work at heights.

5.2.1 REASON FOR INCLUSION

Falls from heights have contributed to a significant proportion of our fatal and high potential incidents. The causes and contributing factors to these incidents have been:

1. Failing to wear a harness.
2. Lack of job planning and job assessment.
3. Wearing the wrong type of harness.
4. Unstable set-up of elevated work platforms.
5. Wearing the harness incorrectly.
6. Unguarded or unbarricaded hole, edges, voids, excavations or walkways.
7. Absent or insufficient training.

5.3 DEFINITIONS

- **Fall prevention** means the design and use of a fall prevention system such that no exposure to an elevated fall hazard occurs. This may require more than one fall prevention system or a combination of prevention or protection measures.
- **Fall restraint** means an approved device and any necessary components that function together to restrain a person in such a manner as to prevent that person from falling to a lower level.

- **Fall arrest system** means the use of multiple, approved safety equipment components such as body harnesses, lanyards, deceleration devices, drop lines, horizontal and/or vertical lifelines and anchorages, interconnected and rigged, as to arrest a free fall.
- **Fixed lanyard** is a line used as part of a lanyard assembly to connect a harness to an anchorage point or a static line in situations where there is risk of a fall.
- **Inertia reel** (also known as a self-retracting lanyard or fall-arrest block) is a mechanical device that arrests a fall by locking onto a drop line and at the same time allows freedom of movement.
- **Suspension trauma** is the effect that can occur when a person's legs are immobile in an upright posture for a prolonged period, after an arrested fall with a fall-arrest system. The person is suspended and caught in an upright, vertical position and the harness straps cause pressure on the leg veins. The blood flow to the heart is reduced, resulting in fainting, restriction of movement or loss of consciousness. This may lead to renal failure and eventually death, depending on a person's susceptibility. The condition may be worsened by heat and dehydration.
- **Barricading** is defined as a physical barrier that prevents inadvertent access to an area (e.g. handrails, access doors and gates or similar installations, temporary or permanent). Barrier tape does not qualify as barricading.
- **Demarcation** is defined as any method that indicates that an area is used for a specific purpose or that access is restricted. Examples are barrier tape, painted lines on floor surfaces, portable signs denoting drop zones or no access past a specific point.

5.4 DEPLOYMENT

Please refer to the deployment section on page 3 for definition and explanation, and approval for alternative controls.

The requirements of this protocol are as follows.

5.4.1 GENERAL REQUIREMENTS

1. The requirements of relevant OH&S legislation, regulations, standards and industry codes of practice shall be followed.

2. The risk of fall shall be eliminated where reasonably practicable utilizing the Hierarchy of Controls.

3. Fall restraint and arrest systems shall be the consideration when it is not practicable to install fall prevention systems.

4. Standard work procedures shall be in place for the correct wearing and use of personal fall arrest and fall restraint equipment.

5. All personnel who are at risk of falling over 1.8 metres or have an unusual risk of injury at a lower height shall wear a safety harness with a shock-absorbing lanyard, unless the shock absorber will allow the worker to hit the ground or equipment below. The lanyard must be attached to a secure anchorage at all times while the person is in an exposed position. This may necessitate

the use of two lanyards so that one can be attached while the second is being moved to the next anchorage (facilitating 100% tie-off).

6. A self-retracting life-line (SRL) may be used in place of a shock-absorbing lanyard if used in accordance with manufacturer specifications.

7. Due to the detrimental effect on their safe working capacity, lanyards must not be hooked back onto themselves, unless specifically designed to do so.

8. All safety harnesses, lanyards, attachment slings and devices shall be inspected monthly in accordance with the manufacturer's recommendations and a record maintained of such inspections. Any harness found to be defective shall be tagged "do not use" and/or destroyed immediately.

9. Personnel using fall protection equipment shall visually inspect their safety harnesses and lanyards prior to use.

10. Personally owed fall protection equipment is not preferred for use on any project; however, under special circumstances it will be considered on a case-by-case basis, at the discretion of SNC-LAVALIN Safety Management. All personally owed fall protection equipment, if approved for usage on the project, must follow the same inspection requirements as defined for the project equipment.

11. All floor openings shall be protected by secure covers capable of supporting a point load in any part of the cover, or shall be fully barricaded is any fall hazard exists. Covers must be labelled accordingly.

12. A documented risk assessment shall be conducted before the commencement of work at height and at any time the scope of work changes or the risk of a fall increases. The risk assessments shall include:

    a) consideration for the potential of objects, as well as personnel, to fall.

    b) selection of appropriate control measures using the Hierarchy of Controls.

    c) the possibility for weather and other environmental conditions to influence the working conditions (e.g. wind, rain, snow, dust, gases, poor lighting, temperature, etc.).

    d) selection of appropriate equipment.

    e) selection of anchor and tie off points.

    f) condition of supporting structures such as roofs.

    g) selection of appropriate barricading and / or demarcation.

    h) fall clearances (e.g. length of lanyard + tear-out distance + height of user + safety margin).

    i) selection of first-man-up systems.

13. All fall protection and rescue equipment shall be fit-for-purpose and undergo pre-use checks. A documented inspection shall be completed by a competent authorized person once every six months (biannually) at a minimum. An equipment register and tagging system shall be in place

to indicate compliance with this inspection. Testing shall be done in accordance with the intent and requirements of the applicable CSA standards.

14. Where the work method requires persons to detach and re-attach at height, a dual lanyard system (100% tie-off) shall be utilized to ensure that at least one connection point is maintained at all times.

15. Where the use of personal fall arrest equipment is required, a person shall not work alone and there shall be other personnel in the vicinity that can raise the alarm immediately should emergency assistance be required.

16. The written site emergency response plan(s) shall include plans for the rapid retrieval of personnel in the event of a fall from height (e.g. response time is critical if a person is to avoid suspension trauma).

17. A system should be in place to prevent tools, materials and other objects from falling from height.

18. An assessment of the possibility of falling objects must be completed and appropriate controls be put into place. Controls may include, but are not limited to barricading, warning signs, tethering tools, snow fence.

19. There shall be processes implemented to ensure that:
    a) anchors are designed, installed and maintained for appropriate load capacities and certified by a professional engineer.
    b) inspection and maintenance of fall protection equipment occurs on a regularly scheduled basis.
    c) removal from and return to service if fall arrest equipment has been subjected to any loads.
    d) a written JSA is completed when working more than 7.5 m above ground.
    e) appropriate permission is granted from the relevant authority in high risk situations.
    f) cranes and hoists used to suspend work platforms operate at appropriate load capacities and in a safe manner.

5.4.2 PROJECT AND EQUIPMENT REQUIREMENTS

1. All working at heights equipment shall comply and be used in accordance with the intent and requirements of the relevant approved CSA design standards and manufacturers specifications.

2. Where there is potential to fall more than 1.8 metres, personnel shall use appropriate personal fall protection equipment. The use of body belts for fall arrest is prohibited, except for specialized tasks such as pole-climbing belts worn by specially trained linesmen.

3. Where there is potential to fall into dangerous or unprotected areas, access shall be restricted and assessed with appropriate controls put into place.

4. Single person anchor points shall be capable of withstanding 18kN (approximately 4000 lbf). Where it is not practical to install dedicated anchor points (e.g. ad hoc work), anchor points capable of withstanding the required loads shall be identified through a risk assessment process and shall be approved by a competent person prior to commencement of work. Lifelines shall be tagged to indicate that they have been designed and approved by a competent person. Stamped engineered drawings and inspection schedule are required for all horizontal lifelines prior to use.

5. Where personnel are required to work within 1.8 metres (6 feet) of an opening or leading edge where they could fall to another level, they shall use personal fall restraint equipment, such as a fixed lanyard and harness as a minimum, which will prevent them from falling over the edge.

6. Where operators need to gain access to places at height on large mobile machinery regularly (e.g. to clean windscreens or filters), then access ways should be provided. These access ways shall have handrails. Where handrails cannot be installed, then fall restraint, fall arrest equipment, or other solution shall be implemented dependant on the outcome of a risk assessment of each situation.

7. If work is to be done on a surface not designed for normal/regular access, an assessment should be completed to ensure that the surface can support the employees and work equipment, considering such factors as stability and load rating (e.g. ductwork, roof).

5.4.2.1 ELEVATING WORK PLATFORMS (EWP)

8. Personnel operating elevated work platforms and cages shall be trained and certified for the specific equipment they are using.

9. All forms of portable and movable elevated work platforms and suspended work cages shall conform to the intent and requirements of the relevant approved CSA design standards. People in the work platform basket shall wear a correctly fitted harness attached by a lanyard to a suitable anchor point in the basket.

10. The following controls are required for the use of EWPs:
    a) EWP to have appropriate warning devices.
    b) all warning labels and stickers must be clearly visible.
    c) there must be a documented inspection prior to use. The EWP should not be used if any deficiencies are identified that adversely affect the safe operation of the equipment.
    d) a signaller must be utilized while travelling in congested areas.
    e) an exclusion zone must be set up around the machine while in use.
    f) a harness and lanyard attached to the manufacturer's installed anchor point at all times, when inside the basket.
    g) no working alone. A ground person must be in within proximity, enabling visible and audible contact with the employee in EWP. The ground person must be trained to lower the EWP in the event of an emergency situation.

h) the EWP has been selected for the job so that workers are not required to stand on the mid or top rails of the platform.

5.4.2.2 LADDERS

1. Ladders and associated components must meet the intent and requirements of the applicable CSA standard.

2. The following controls are required for the use of ladders:
   a) ladders must be inspected each time before use and apply appropriate corrective/preventive action, as required.
   b) inspections and tagging of portable ladders must be conducted quarterly, at a minimum.
   c) the stability of any portable ladder must be ensured prior to use. All ladders shall be placed on firm and level surfaces.
   d) all extension ladders shall extend a minimum of 1 metre above the landing/step-off area.
   e) only short-duration and limited-complexity tasks are allowed to be performed off ladders. Ladders are not work platforms and should not be used as such.
   f) step-ladders must be fully opened and hinges locked into place, prior to use.
   g) extension-ladders should be tied at the top and bottom and maintained at a 1-to-4 ratio, when in use.
   h) the centre of gravity (belt buckle) of the person using the ladder must remain between the side-rails at all times.
   i) no side-loading or exerting or sideways forces while utilizing a portable ladder (e.g. cable pulling, drilling).
   j) if work is performed while standing on a ladder and the possible fall distance is more than 1.8 meters and 3-point contact cannot be maintained, a fall-arrest system should be used. The employee must not work alone.
   k) additional controls must be applied when using ladders near hand-rails or stairwells.

5.4.2.3 SCAFFOLDING

The following controls are required for the use of scaffolds:

1. All scaffolding shall be erected on firm and level surfaces.

2. Wherever practical, scaffold stairs should be used to provide access to the various areas. Exterior vertical ladders shall not be used on scaffolding over 15 metres in height.

3. Only qualified persons are to erect, dismantle, or modify scaffolds.

4. A 3-tag scaffold access/inspection system must be utilized (green, yellow, red).

5. To ensure a 3-point contact is maintained, and to reduce the possibility of falling objects, lifting/ nose bags must be used to transport materials between elevations whenever possible.

6. To minimize falling material and debris, scaffolds must be thoroughly cleaned prior to dismantling.

7. Stamped engineered drawings must be available at the worksite during installation, disassembly and use of a work platform, where required.

8. Safe working load limits for platforms shall be clearly marked at the work platform.

9. All scaffolds, which are more than twice the height of the base width, shall be secured to a fixed structure or employ outriggers to prevent tipping.

10. All scaffold sections shall be pinned together to prevent separation. Pinning shall comply with manufacturer's instructions.

11. Lumber used in scaffolding is of appropriate grade and marked.

12. Limits of approach are maintained when scaffolding is required near electrical lines, bus bars, or exposed electrical services.

13. Scaffolding is effectively grounded when there is a possibility of electrical contact.

14. Where there is a possibility of contact with vehicles or equipment, scaffolding must be sufficiently protected (e.g. jersey barriers).

15. A work platform must be removed from service if subjected to a sudden drop, electrically energized, or showing signs of structural or mechanical damage or wear, and not returned to service until certified as safe by a professional engineer.

5.4.3 PEOPLE REQUIREMENTS

1. All persons engaged in the erection, dismantling or inspection of scaffolds shall complete a competency-based exam, to confirm their knowledge and understanding of these activities. All persons who work on scaffolds shall receive training to ensure the recognition of scaffolding hazards that may affect them.

2. A competency based training program for employees and supervisors shall be in place, which includes provisions for maintaining competence. All persons engaged in work covered by this protocol shall be adequately trained and assessed for competency.

PROTOCOL 6 – LIFTING OPERATIONS

6.1 INTENT

To eliminate or minimize the risk of fatalities, injuries and incidents arising from the performance of lifting operations.

6.2 APPROACH

This protocol applies wherever lifting operations are undertaken. It includes lifts involving SNC-Lavalin owned, hired or contracted cranes such as mobile, crawler, tower, derrick, portal and pedestal-type, vehicle loading cranes, electric overhead traveling cranes, and monorail cranes. The protocol also applies to lifting accessories including slings, chains, wire ropes, shackles, padeyes, containers, baskets, tuggers, winches, man-riding winches, work and personnel transfer baskets.

In addition to the manufacturer's standard safety features, the intent and requirements of the applicable CSA standards and local statutory requirements, the following minimum safety features shall be included as indicated.

This protocol applies to all SNC-Lavalin controlled sites and activities, and to all SNC-Lavalin employees, contractors and visitors when involved in lifting operations. (Note: if client or local legislation requires more stringent controls, then those controls shall be implemented).

6.2.1 REASON FOR INCLUSION

A significant proportion of workplace fatal and high potential incidents have occurred in the course of lifting and crane operations. Identified causes and contributing factors include:

1. Lack of job planning and hazard assessment.
2. Incorrect selection of cranes and lifting equipment for the task.
3. Inadequate knowledge of lifting operations by personnel involved.
4. Inadequate inspection, maintenance, tagging and storage of lifting equipment and accessories.
5. Lack of training in correct use of lifting equipment and accessories.
6. Lack of competence in lifting operations.
7. Incorrect use of cranes and lifting equipment, including poor practices such as side loading, over loading and over reaching.
8. Poor recognition of unsafe conditions, including environmental conditions.
9. Operation of cranes and lifting equipment with safety and warning devices overridden, inoperable or illegible.
10. Incorrect design of cranes and lifting equipment.

6.3 DEFINITIONS

- **Crane** refers to a mechanical structure used for lifting weight
- Critical lift refers to any:
  a) tandem lifts by cranes/lifting equipment.
  b) lift over operating facilities/equipment.
  c) lift where the lifting equipment is within 80% of its rated capacity.
  d) lift involving special equipment or rigging (e.g. multi-level rigging, the use of more than 3 spreader bars, cargo nets etc.).
- **Lifting equipment** refers to tools, tuggers, and pieces of equipment used for lifting weight.
- **Lifting operation** means any operation using a crane and lifting equipment that involves the raising and lowering of a load, including the suspension of a load.
- **Lifting accessories** refers to any device which is used or designed to be used directly or indirectly to connect a load to a crane and which does not form part of a load, (e.g. wire rope slings, chain slings, synthetic fibre slings, hooks and fittings, swivels, shackles, eye bolts, rigging screws, wedge sockets, plate clamps and lifting beams).
- **Engineered Lift Study** refers to a document which sets out lift calculations, and which is stamped by a registered professional engineer.
- **External rated capacity lighting** refers to clearly visible green, amber and red lights mounted externally.

6.4 DEPLOYMENT

Please refer to the deployment section on page 3 for definition and explanation, and approval for alternative controls.

The requirements of this protocol are as follows.

6.4.1 PROJECT AND EQUIPMENT REQUIREMENTS

1. All electrical cranes shall have power supply isolation points capable of being positively locked.

2. Cranes shall be ergonomically acceptable to the site and have fall protection systems provided for their operation, maintenance and inspection.

3. Cranes without a physical locking system that disables and isolates its free-fall capability, shall not be used.

4. Electric overhead traveling and portal cranes shall have overload protection.

5. Crane cabins should be air-conditioned or heated in accordance with environmental conditions.

6. All crane hooks shall be fitted with a positive locking safety catch.

7. The safe working load (SWL) or working load limit (WLL) shall be clearly identified and marked on all cranes, lifting accessories and relevant lifting equipment and shall not be exceeded.

8. Load cells, load moment indicators and external rated capacity lighting shall be available in accordance with the table below.

Crane Type	Load Moment Indicator	Load Cell	External Rated Capacity Lighting
Mobile Rough Terrain	Shall	Shall	Shall
Mobile Rough Terrain	Shall	Shall	Shall
Mobile Truck Mounted	Shall	Shall	Shall
Crawler	Shall	Shall	Shall
Pedestal and Tower	Shall	Shall	Should
Electric Overhead Travelling	Not Applicable	Should	Should
Mobile Pick and Carry >10Tonne	Should	Should	Should
Vehicle Loading Crane	Should	Should	Should
Portal	Not Applicable	Should	Should

9. All cranes and lifting equipment, and lifting accessories shall comply with the intent and requirements of the relevant approved CSA design standard. In countries where the requirements of the relevant national standard exceed the requirements of the CSA standard, the national standard shall apply.

10. All cranes lifting equipment and accessories that are subject to periodic inspection shall be identifiable with a unique identity code or number.

11. A competent person shall determine the maximum environmental conditions under which cranes and lifting equipment can be safely used. Except in the event of an emergency, cranes and lifting equipment shall not be put into service if the maximum environmental conditions are exceeded. Risks shall be assessed and appropriately controlled in emergency situations.

12. Items of lifting equipment that are subject to wear and frequent replacement (e.g. slings, shackles, padeyes, shipping and handling baskets) or used to transport equipment to and from sites, shall be colour coded to confirm compliance with certification and inspection requirements.

6.4.2 PROCEDURAL REQUIREMENTS

1. The requirements of relevant OH&S legislation, regulations, standards and industry codes of practice must be followed.

2. A formal documented selection and acceptance process shall be in place for all new (to site) and modified lifting equipment, taking into account the crane's various safety features and cabin ergonomics, prior to commencement of work.

3. Manufacturer's crane and lifting equipment operating manuals and load charts shall be available to the crane and lifting equipment operators. These should be in the language of the country in which the lifting equipment is being used.

4. Where the crane and lifting equipment operator is not conversant with the language of the country, provisions shall be made to ensure that the operators can understand the operating manuals and load charts.

5. A procedure shall be in place to address:
   a) critical lifting operations.
   b) lifting operations when the arcs of operation of two or more cranes can overlap*.
   c) multiple crane lifting operations*.
   d) the danger to lifting operations when adverse weather conditions are present or imminent (e.g. electrical storm, high winds and sea state).
   e) people safety when cranes and lifting equipment are operating in the proximity of live electrical conductors*.
   f) lifting operations when lifting near or over unprotected, equipment or services.
   g) the effective hand-over from one operator to another for cranes with complex boom, jib or tower configurations.
   h) availability and use of check-lists for pre and post-operational inspections.

Detailed lifting plans are required for points above marked "*" and shall be approved by a competent supervisor. Pre-lift meetings shall be held prior to such lifts to ensure all personnel understand how it is to be executed.

6. Cranes shall not be used for lifting operations until crane operators have been given sufficient time to familiarize themselves with relevant aspects of the crane.

7. Risks associated with all lifting, crane maintenance, assembly activities and environmental conditions shall be assessed as part of the planning process. Barricading, warning signs or other means of ensuring personnel protection shall be in place during lifting operations and for those cranes left unattended in wind vane mode.

8. There shall be no side loading of crane booms.

9. With the exception of pick and carry operations, all lifting shall be carried out with outriggers deployed and locked.

10. Controls shall be in place to prevent objects from falling from above.

11. The lifting of personnel with cranes shall only be carried out using approved workbaskets or cages. Cranes used for this purpose shall be approved as suitable for man-riding operations. A recovery plan should be in place before personnel are lifted. Prior to lifting, any personnel in an approved basket with a crane, a load test shall be completed and observed with sign-off by designated health and safety personnel and a competent crane/lifting specialist.

12. The elimination of the need to work under suspended loads shall be pursued. Where working under suspended loads is unavoidable, controls shall be in place to eliminate or minimize the risks to personnel.

13. Any modification to cranes and lifting equipment shall be subject to the original equipment manufacturers approval and to a rigorous change management process.

14. A preventive maintenance system should be in place to ensure that all cranes and lifting equipment and accessories are maintained and in a serviceable condition.

15. All cranes and lifting equipment shall be inspected and tested (including non-destructive testing as required by the intent and requirements of the applicable CSA standard) prior to being operated or put into service. After any repair and/or modification, cranes and lifting equipment shall be inspected (and non-destructively tested as required by the relevant standard) prior to being returned to service.

16. Certificate of conformity to be readily available at all times in the crane unit.

17. A system of periodic inspection shall be in place for all cranes, lifting equipment and accessories. Lifting equipment shall be visually inspected and confirmed fit for purpose prior to being put into service. Visual inspection of equipment and accessories by approved competent person should be performed on a regular basis (e.g. six monthly) unless regulations in the local area require examination more frequently.

18. A register of all lifting equipment and applicable accessories should be maintained and readily available at all times in the lifting unit. This should include:

    a) the equipment's unique identification number.

    b) documentary evidence of all inspections.

    c) certifications.

    d) maintenance.

    e) modifications and tests.

19. There shall be processes implemented to ensure that:

    a) cranes and hoists are designed, constructed, erected, disassembled, inspected, maintained and operated in accordance with the manufacturer's specifications or professional engineer's specifications and the intent and requirements of the appropriate CSA standards.

b) daily inspections are carried out on cranes, hoisting and rigging equipment by appropriately competent people and these are documented.

c) the crane or hoist and interchangeable rigging equipment have appropriate identification details.

d) the rated capacity is not exceeded and rating capacity indicated on superstructure.

e) the load charts are located on equipment where required.

f) the crane and hoist equipment conforms to the relevant OH&S legislation.

g) the manufacturer's manual is always available.

h) the inspection and maintenance records are kept current and are available.

i) any modifications carried out on crane, hoist equipment and/or rigging are certified by a professional engineer.

j) safe means of ingress and egress.

k) appropriate calibrations of load weighing devices and moment indicators by manufacturer are conducted.

l) multiple crane lifts are conducted as appropriate.

m) workers are warned of lifts and suspended loads are not passed over workers wherever possible.

n) yellow or red barrier tape is used to barricade lift zone.

o) loads are never left suspended when unattended by operator.

p) nobody ever rides a load, slinging, hook or other rigging device.

q) emergency shut-off for electrically powered cranes is installed, tested and operational.

r) the crane operator receives direction of rigger/lift supervisor.

s) correct storage of hardware, slings and hooks is implemented to prevent inadvertent damage and exposure to the elements.

t) mobile cranes or boom trucks have appropriate load weight indicators and trim indicators.

u) appropriate safe modification and operation is considered for cranes on floating supports.

v) mobile crane/boom truck tire type, condition and inflation is in accordance with manufacture's specifications.

w) appropriate load-bearing surfaces are used for mobile cranes and boom trucks.

x) safe travel is considered with loads.

y) the rigger undertakes required physical and load rating inspections of hardware, Slings, wire rope slings, hooks, alloy chain slings, synthetic webbing Slings, metal mesh Slings and below the hook lifting devices prior to lifting loads and process for removal from service if required and a log of such to be maintained.

z) the rigging or rigging assembly loads are not exceeded.

aa) the safe detachment of loads is considered.

bb) the rigging design factors for rigging components are met.

cc) the appropriate use of hook safety latches and securing pins.

dd) the rigging and slinging devices as specified in of relevant OH&S legislation are installed.

ee) taglines are used wherever possible.

ff) slings are protected from sharp edges with softeners while in use.

gg) allowance is made for load rating reduction due to Slings operating at angles.

hh) an engineering lift study shall be completed prior to any critical lift.

6.4.3 PEOPLE REQUIREMENTS

1. Suitably qualified, certified and competent person(s) shall be involved in the planning, supervision and implementation of the lifting operations.

2. The roles and responsibilities for lifting operations shall be clearly defined.

3. A competency based training program for contractors, employees and supervisors shall be in place.

4. A competent inspector shall perform lifting equipment inspections. An approved examiner should assess the competency of the lifting and handling equipment inspector.

5. Appropriate crane, hoists and rigging awareness training for people likely to come into contact with loads being lifted, including what the risks are, what the controls are, emergency management and incident response procedures and where to get further information if required.

6. Crane operators and crew shall be able to communicate in a common language and to use the agreed to crane signals.

7. Sole crane operators shall also be trained in slinging practices.

8. A fit-for-work policy shall be in place, incorporating defined action levels for drugs and alcohol and a fatigue management plan.

9. Behaviour based observations shall be performed and any need for additional specific training shall incorporate the results of these observations.

PROTOCOL 7 – CONFINED SPACE

7.1 INTENT

To eliminate the risk of fatalities and minimize the potential for injuries or incidents arising from entering or working in confined spaces.

7.2 APPROACH

This protocol applies to all spaces/areas which meet the SNC-Lavalin or prevailing legislated definitions for a confined or restricted space. Furthermore, these protocols apply to any space/area which may become a confined or restricted space as a result of work activities, conditions and/or location. As soon as it becomes apparent that a space or area is becoming a confined or restricted space, this protocol shall be applied completely. See section 7.3 in this protocol for the SNC-Lavalin confined and restricted space definitions. Refer to local Occupational Health and Safety legislation for definitions from prevailing legislation.

This protocol applies to all SNC-Lavalin controlled projects, worksites, activities, employees, contractors, consultants and visitors. (Note: if client or local legislation requires more stringent controls, then those controls shall be implemented.).

7.2.1 REASON FOR INCLUSION

Confined or restricted spaces can lead to Immediately Dangerous to Life and Health (IDLH) situations. The most frequent reasons for confined or restricted space incidents include:

1. Failure to identify the confined or restricted space.
2. Lack of job planning and risk assessment.
3. Inadequate training or competence.
4. Failure to prevent unauthorized entry.
5. Failure to carry out appropriate and sufficient air monitoring.
6. Failure to wear appropriate respiratory protection.
7. Failure to properly wear and/or maintain breathing apparatus.
8. Failure to have/use/wear appropriate emergency rescue gear (lifeline, harness, emergency extraction equipment, etc.).
9. Failure to appoint a qualified watch person.
10. Failure to have a qualified rescue team prepared and capable to respond.

7.3 DEFINITIONS

The definitions provided herein should not be considered a full and complete description of the subject topics. Persons must check the prevailing legislation to confirm whether additional definitions exist and are applicable in the place of work.

- **Confined space** means an enclosed or partially enclosed space that:
  - ♦ Is not intended or designed for continuous human occupancy.
  - ♦ Has a limited or restricted means of access or egress.
  - ♦ Is large enough to be entered by a person to work.
  - ♦ At any time, contains, or is could contain, any of the following:
    a) an atmosphere that has potentially harmful levels of a contaminant.
    b) an atmosphere that does not have a safe oxygen level.
    c) contains a material that could cause engulfment.
  - ♦ Examples of a confined space:
    a) storage tanks, tank cars, process vessels, pressure vessels, boilers, silos and other tank-like compartments.
    b) caissons, coffer dams, pylons, pits and shafts.
    c) pipes, sewers, sewer pump stations including wet or dry wells, shafts and ducts.
    d) shipboard spaces entered through small hatchways or access points, cargo tanks, cellular double bottom tanks, duct keels, ballast or oil tanks and void spaces.
- **Inerted space** is one:
  - ♦ Where oxygen or fuel vapours are purged using an inert gas (e.g. nitrogen, carbon dioxide or argon) to remove the hazard of fire or explosion.
  - ♦ Where oxygen is displaced to ensure the concentration is too low to support combustion.
- **Restricted space** is one:
  - ♦ Which is fully or partially enclosed.
  - ♦ That is not both designed and constructed for continuous human occupancy, but in which atmospheric hazards are not present nor likely to occur.
  - ♦ Examples of a restricted space:
    a) electrical equipment rooms, utility tunnels, air plenums.
- **Purged space** is one where contaminants inside a confined space are displaced with air to achieve acceptable atmospheric levels.
- **Permits** are an administrative tool used to document the completion of a hazard assessment for each confined space entry. Minimum permit requirements include the:

- the length of time the permit is valid for.
- the name(s) of the worker(s) that will enter the confined space.
- the name(s) of the attendant(s) (safety watch) and/or supervisor.
- the location of the confined space.
- the work that is to be done in the confined space.
- the date and time of entry into the confined space and the anticipated time of exit.
- the details of any atmospheric testing done on the confined space - type of instrument used with serial number, when, where, results, date monitoring equipment was last calibrated. Ideally, calibration would be done just before each use. If this is not possible, follow the equipment manufacturer's guidelines for frequency of calibration.
- the use of mechanical ventilation and other protective equipment needed and any other precautions that will be followed by every worker who is going to enter the confined space.
- the process required for clear communication between the entrants and the watch person.
- the protective equipment and emergency equipment to be used by any person who takes part in a rescue or responds to other emergency situations in the confined space.
- a signature of the worker who did the confined space testing. The signature on the permit indicates that adequate precautions are being taken to control the anticipated hazards.

Please note, permit requirements are mandatory for confined space entry only, and may not be required for entry into a restricted space.

- **Ventilated** space is one:
  - Where there is continuous provision of fresh air into the confined space by mechanical means to maintain acceptable atmospheric levels.
  - where contaminants are removed continually for the entire duration that work is being performed in the confined space.

7.4 DEPLOYMENT

SNC-Lavalin Project Management carries the obligation to ensure the requirements established in this protocol are uniformly and consistently applied on SNC-Lavalin controlled projects. In cases where an area, equipment or condition is under the direction and control of a project contractor or subcontractor, SNC-Lavalin project management will require the contractor or subcontractor to uphold and maintain the requirements established herein.

The requirements of this protocol are as follows.

7.4.1 PROJECT AND EQUIPMENT REQUIREMENTS

7.4.1.1 CONFINED SPACE SIGNAGE

Confined spaces should be identified and fixed signage erected at the entry points denoting that a permit is required prior to entry. Where signage is impractical, other means of highlighting the dangers need to be used.

7.4.1.2 CONFINED SPACE PROCEDURE

All employees, contractors, consultants and visitors who will or may be required to enter a confined/restricted space shall be trained in the Confined Space Procedure. The procedure must:

1. Meet prevailing legislated requirements and be compliant with these protocols.

2. Detail what rescue equipment, systems, and personnel must be in place before entries are performed.

3. Ensure that effective communications systems are available for persons entering/working in the confined/restricted space.

4. These procedures shall be reviewed at least annually by a qualified person. The procedures shall include directions for:
   a) qualifications of the persons developing and/or approving confined/restricted space entry procedures/permits.
   b) qualifications of persons performing confined/restricted space risk assessments.
   c) clearly defined worker and supervisor responsibilities and duties.
   d) requirement to conduct confined/restricted space pre-entry meetings.

7.4.1.3 CONFINED SPACE PPE

1. All required personal protective equipment (PPE) including Respiratory Protection Equipment (If required) shall comply with NIOSH requirements, the intent and requirements of the applicable CSA design standard, manufacturer's specifications and prevailing legislated requirements.

2. Respiratory protection equipment selection and fit test procedures including functional tests and training, as applicable shall be carried out.

7.4.1.4 CONFINED SPACE AIR TESTING AND MONITORING

1. Air quality testing equipment shall be task appropriate and calibrated and maintained in accordance with manufacturer and legislative requirements.
2. The types and frequency of the air quality testing is identified, scheduled and conducted pre-entry and ongoing while persons are in the confined/restricted space. The air quality testing shall include, but is not necessarily limited to, confirming that:
   a) the percentage of oxygen content is within legislated safe ranges.
   b) lower explosive limits for flammable vapours is below legislated permissible exposure limits.

c) levels of other harmful naturally occurring or man-made compounds are maintained below legislated permissible exposure limits (H2S, CO, Methane, VOC's etc.).

Note: Air quality testing must be appropriate to the hazards, chemicals and conditions identified in the confined/restricted space risk assessment. See control 7.3.2.1 Risk Assessment for more details.

7.4.1.5 ISOLATION AND LOCK OUT (CRCP 04)

All energy sources within the confined/restricted space that could result in undue risk from an existing energized state, start-up or unexpected energy release shall be controlled in accordance with Protocol 4 – De-Energization, Isolation, Lock-Out and Tagging and prevailing legislation.

7.4.1.6 CONFINED SPACE DESIGN

A competent and qualified engineer shall inspect and certify:

1. All false works, supports or aids used to establish and/or maintain the confined space.
2. Any temporary mechanical ventilation systems which requires certification.

7.4.1.7 CONFINED SPACE EQUIPMENT REGISTER

All confined/restricted space equipment shall be fit-for-purpose and undergo pre-use checks and a minimum of six–monthly (bi-annual) documented inspections by a competent authorized person. An equipment register and tagging system shall be in place to indicate compliance with the inspection. Testing shall be done in accordance with recognized standards.

7.4.2 PROCEDURAL REQUIREMENTS

1. Confirm the applicable requirements of the prevailing OH&S legislation, regulations, codes and standards are understood and followed by persons assessing, controlling and entering a confined/restricted space.

2. SNC-Lavalin or the contractor responsible for the confined/restricted space must implement site specific confined/restricted space entry procedures. These procedures shall be reviewed at least annually by a qualified person. The procedures shall include directions for:

   a) qualifications of the persons developing and/or approving confined/restricted space entry procedures/permits.

   b) qualifications of persons performing confined/restricted space risk assessments.

   c) clearly defined worker and supervisor responsibilities and duties.

   d) respiratory protection equipment selection and fit test procedures including functional tests and training, as applicable.

   e) requirement to conduct confined/restricted space pre-entry meetings.

f) implementation of a confined space entry permit system including the requirement to physically inspect and monitor the space by the Entry Supervisor prior to permit approval and signature.

g) ensuring that any energy sources within, or brought into, the confined/restricted space are treated in accordance with Protocol 4 – De-Energization, Isolation, Lock-Out and Tagging and prevailing legislation.

h) ensuring the proper selection and use of PPE.

i) requirement to have immediately implementable rescue plans.

j) how communication will be maintained with attendants, and entrants.

k) ensuring clear access and egress are established and maintained.

l) ensure appropriate signage is in place to identify all confined spaces.

3. Procedures to evacuate the confined/restricted space if the air quality values reach or exceed the permissible exposure action levels. Re-entry procedures must also be documented, including the means of determining the source(s) of exposure, the measures to return air quality to acceptable limits and the means of preventing future occurrences.

4. Ensure effective cleaning, purging and venting processes are used as appropriate.

5. The process for confirming that a confined/restricted space has been properly inerted prior to entry, including notification to the relevant authorities as applicable.

7.4.2.1 Confined Space Risk Assessments

A documented risk assessment shall be conducted prior to entry into any confined/restricted space. Re-assessment will be required during the course of the work if and/or when:

1. The scope of work or conditions within the confined/restricted space changes.

2. The air quality readings unexpectedly change during the work and approach actionable levels.

3. There are/will be changes to the configuration or the confined/restricted space which alter the access and egress routes.

4. The documented risk assessments shall include:

   a) description of the confined/restricted space.

   b) description of the work activities to be performed within the confined/restricted space.

   c) identification of equipment, materials and processes to be brought into the confined or restricted space which may affect the air quality of the space.

   d) evaluation of all air quality hazards and their corresponding risk levels before the controls are implemented.

e) evaluation of all other hazards and their corresponding risk levels before the controls are implements, [e.g. noise, illumination, temperature, biological, vermin, engulfment etc].

f) evaluation and selection of appropriate control measures to reduce the hazards/risks to acceptable levels, using the SNC-Lavalin Hierarchy of Controls.

g) identification of the PPE and respiratory protection equipment to be used/worn within the confined/restricted space.

h) identification of the equipment to be used to ventilate the space, including as necessary the calculations - performed by a qualified person - to determine the appropriate air exchange rates and equipment capabilities.

i) identification of the type and quantity of gas detection equipment, and, identification of the calibration schedules and frequency of testing within the confined/restricted space.

j) identification of the emergency response procedures, equipment and personnel to affect rescue based on the risk levels and work activities.

k) evaluation of other factors which might alter the risk levels within the confined space, (e.g. wind, dust, gases, distances, etc.).

l) identification of any limitations on entrants due to the configuration of the space, (e.g. maximum allowable distance from the entry location based on rescue requirements.

7.4.2.2 Emergency Response

Emergency response plans and procedures shall be in place prior to commencement of confined or restricted space operations and shall include:

1. The types of emergencies which may arise based on the risk assessments.
2. The means of notification and communication of an emergency, including the personnel to be contacted in case of an emergency.
3. The means of initiating a rapid evacuation of all entrants within the confined/restricted space.
4. Written plans for the rapid retrieval of personnel in the event of an emergency. At minimum this will include specific information on the methods of rescue and equipment requirements (e.g. hauling equipment, overhead anchors, tripod system, reserve equipment, medical equipment, additional PPE, etc.).
5. The names and contact information for the Emergency Response Crews, First Aid Attendants and other first responders.

   a) the numbers and positioning of the emergency response personnel must be appropriate based on the hazards/risks inside the confined/restricted space. The risk assessment must be used to evaluate and identify these emergency response requirements.

   b) the training and competency requirements for the emergency response personnel.

   c) where the local emergency response agency personnel (Fire, Ambulance, Police) are expected to be part of the emergency rescue plans, these agencies must be contacted and confirm

their participation in the rescue efforts. local emergency response agencies must be brought to site and shown the locations of the confined spaces and any barriers to rescue.

6. An emergency management and incident response drill schedule must be implemented and tested at intervals which ensure emergency response personnel are capable and competent to affect rescue from the confined/restricted spaces.

7.4.3 PEOPLE REQUIREMENTS

1. All persons who will or may enter or work in confined/restricted spaces shall be appropriately trained. Training shall include at minimum:
   a) the roles and responsibilities of the Entry Supervisor, Entrants, Watch Person and the Emergency Rescue personnel.
   b) the requirement to be identified and granted permission to enter the space (no one shall enter a space without the knowledge and consent of the Entry Supervisor).
   c) The hazards, risks and controls measures for the confined/restricted space.
   d) the requirements for pre-entry testing and confirmation of air quality prior to entry.
   e) the means of ventilation for the space and the actions which must be taken in the event of a failure of the ventilation systems.
   f) the proper use of the air quality test equipment and the permissible exposure limits.
   g) the actions which must be taken in the event the permissible exposure action limits are reached or exceeded (e.g. shut down equipment, vacate the space, etc.).
   h) the scheduled check-in procedures with the watch person.
   i) what to do in case of an emergency, including first aid, emergency extraction and rescue procedures.
   j) the limitations on the work activities (e.g. no unplanned work may be performed if it has not been identified, assessed and approved by the Entry Supervisor).
   k) the general and specific PPE requirements, including respirator fit testing requirements and restrictions (e.g. must be clean shaven).
   l) general prohibitions and safeguards (no smoking, where first aid equipment is located, etc.).
   m) a competency based test to confirm the understanding of the entrants and watch persons.
   n) competency based tests shall be kept on file by SNC-Lavalin or the contractor who is responsible for the confined/restricted space for the duration of the project.
   o) recurrence competency testing must be performed for long duration projects and/or where conditions within the confined/restricted spaces changes to increased risk.

2. Process to verify that only appropriately competent people enter and conduct emergency rescue activities in a confined/restricted space.
   a) all project personnel who perform emergency response must receive specific training which

includes identification of the confined/restricted spaces and the specific response actions for affecting rescue.

b) a curriculum must be developed and delivered to all emergency response personnel.

c) emergency response training should include practice exercises as part of the training program.

3. Projects shall utilize a process to ensure that selected personnel are fit to work in confined spaces.

PROTOCOL 8 – EXCAVATIONS, TRENCHES AND CORING

8.1 INTENT

To eliminate the risk of fatalities and reduce the potential for injuries and incidents when working in and around excavations and trenches.

8.2 APPROACH

This protocol applies when creating and/or working in and around excavations and trenches. See section 8.3 in this protocol for the SNC-Lavalin excavation and trench definitions. Refer to local Occupational Health and Safety legislation for definitions from prevailing legislation.

This protocol applies to all SNC-Lavalin controlled projects, worksites, activities, employees, contractors, consultants and visitors. (Note: if client or local legislation requires more stringent controls, then those controls shall be implemented.).

8.2.1 REASON FOR INCLUSION

Excavations and trenches can lead to Immediately Dangerous to Life or Health situations and must be effectively controlled to prevent incidents. The most frequent reasons for incidents involving excavations and trenches include:

1. Inadequate job planning or job assessment.
2. Inadequate training or competency.
3. Failure to identify the location(s) of buried utilities.
4. Failure to properly cut back or shore walls, resulting in collapse and entrapment.
5. Equipment operating too close to the edge of an excavation or trench.
6. Spoils piles left too close to the edge, resulting in collapse and entrapment.
7. Falls into the excavation from unprotected edges.
8. Inadequate means of egress.

8.3 DEFINITIONS

- **Cut back** means the process of, battering, sloping or benching an excavation to prevent wall collapse, slippage or shelling.
- **Coring** means any activity involving vertical or horizontal penetrations into the ground of surface including, but not limited to, auguring, bore holes, installation of stone columns and/or piles, or creating opening in floors or walls.

- **Excavation** means any man-made cut, cavity, trench, or depression in the earth's surface formed by earth removal.
- **Shoring** means a pre-fabricated or hand built structure installed into the excavation to prevent collapse of the excavation walls.
- **Shotcrete** means the process of installing anchors, ties and mats onto a vertical face of an excavation and then applying concrete to create a solid face.
- **Spoil** means the materials removed from the excavation or trench.
- **Trench** means a narrow underground excavation that is deeper than it is wide, and is no wider than 15 feet (4.5 meters). **See Appendix A for trench diagrams.**

8.4 DEPLOYMENT

SNC-Lavalin project management carries the obligation to ensure the requirements established in this protocol are uniformly and consistently applied on SNC-Lavalin controlled projects. In cases where an excavation or trench is under the direction and control of a project contractor or subcontractor, SNC-Lavalin project management will require the contractor or subcontractor to uphold and maintain the requirements established herein.

The requirements of this protocol are as follows.

8.4.1 PROJECT AND EQUIPMENT REQUIREMENTS

1. Ensure that all employees, contractors, consultants and visitors who will or may be required to create, enter or work in an excavation or trench are informed of these protocols.

2. All excavations greater than 6 meters in depth shall be assessed and approved by a Professional Engineer.

3. All excavations exceeding 1.2 meters in depth must be cut back or shored in accordance with prevailing legislation unless otherwise approved in writing by a Professional Engineer.

4. Trenches more than 1 meter deep and over 6.0 meters in length shall have a means of egress located every 6.0 meters along the trench unless otherwise approved in writing by a Professional Engineer.

5. All spoils materials shall be kept a minimum of 1.0 meters back from the edge of a cut back excavation, or, the distance equalling the depth of the vertical face of the excavation when cut back is not used, unless otherwise approved by a Professional Engineer.

6. All mobile equipment operations shall be performed in accordance with Protocol 1 – Vehicles and Mobile Equipment.

7. All buried utilities within the excavation or trench area shall be identified and protected from damage, or, shall be de-energized or controlled to prevent energy release. Control of energy release shall be performed in accordance with Protocol 4 – De-Energization, Isolation, Lock-Out and Tagging.

8. All excavations with a vertical face greater than 1.8 meters high shall be perimeter protected to prevent falls into the excavation. Perimeter guardrail protection shall comply with Protocol 5 – Working at Heights.

9. All lifting operations (e.g. placement of shoring cage in excavation, lowering of rebar, pipes etc into the excavation/trench) shall be performed in accordance with Protocol 6 – Lifting Operations.

10. Barricades and/or plates shall be used to protect or cover any excavation or trench which crosses a site or public roadway or sidewalk and shall be designed/approved such that they are appropriate for the use (e.g. load consideration for vehicle and/or pedestrian traffic, etc.).

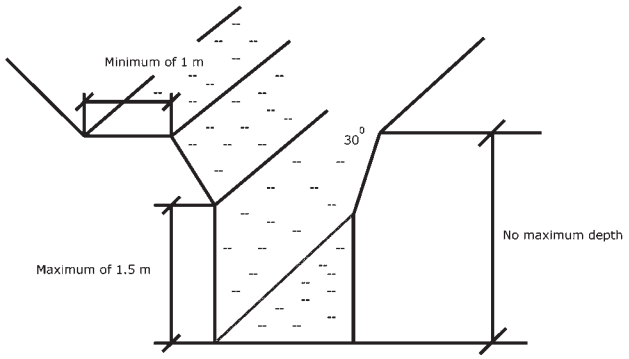
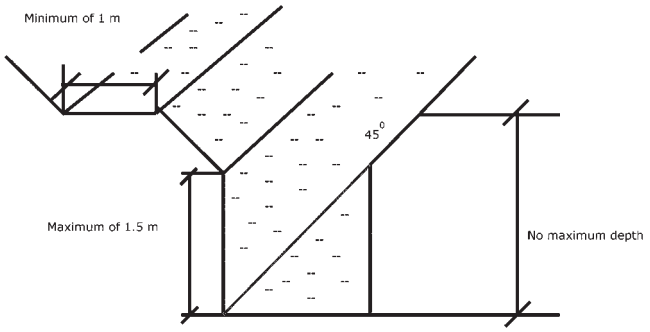
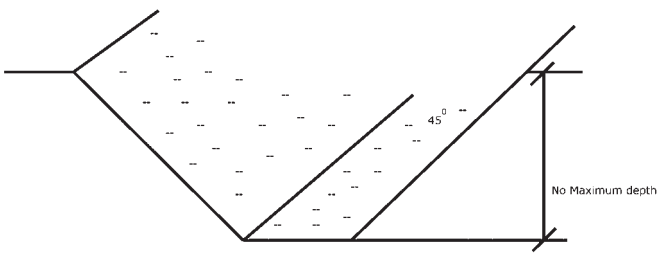
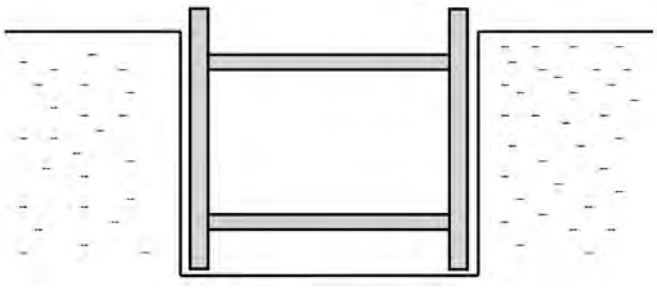
8.4.1.1 SOIL CLASSIFICATION, CUT BACK AND SHORING

1. Ensure assessment of the soil conditions and classification of soil type as applicable.

2. Ensure soil stabilization through cut backs, shoring or a combination of both. See the charts below for cut back guidelines.

3. Ensure shoring systems are appropriate to soil conditions and work activities and are inspected and certified by a Professional Engineer as applicable.

4. Ensure a design and construction plan is developed and followed for all excavations which use shotcrete walls as the principle method of shoring. The excavation design and construction plan must be approved by a Professional Engineer.

Type of Soil	Compressive Strength (kPa)	Cut back diagram
A: hard and compact the walls are sloped to within 1.5 meters of the bottom of the excavation at an angle of not less than 30 degrees from the vertical	144 <	
B: Likely to crack or crumble the walls are sloped to within 1.5 meters of the bottom of the excavation at an angle of not less than 45 degrees from the vertical	48 – 144	
C: Soft, sandy or loose the walls are sloped from the bottom of the excavation at an angle of not less than 45 degrees from the vertical	< 48	
Any	n/a	

Excavation Depth (m)	Soil type	Angle (º)	Cutback Distance (m)
3	A – Hard	30	1.5m @ 30 º = 2.6
	B – Cracks	45	1.5m @ 45 º = 1.5
	C – Sandy	45	3.0m @ 45 º = 3.0
5	A – Hard	30	3.5m @ 30 º = 6.0
	B – Cracks	45	3.5m @ 45 º = 3.5
	C – Sandy	45	5.0m @ 45 º = 5.0

8.4.2 PROCEDURAL REQUIREMENTS

1. All contractor excavation programs shall meet the prevailing legislated requirements and be compliant with these protocols.

2. A documented risk assessment shall be conducted before the commencement of excavation work and at any time the scope of work changes. The risk assessment shall include:
   a) identification of buried utilities and planned methodology for exposure.
   b) identification of overhead utilities and protective measures.
   c) equipment requirements and means of access/egress.
   d) cut back and/or shoring system details.
   e) spoils removal and stockpile methods, including placement locations.
   f) personnel access and egress routes and associated ladders, stairs.
   g) influence of weather on the condition of the excavation (e.g. deteriorating face or cut back, accumulation of water, etc.).
   h) evaluation of potential air qeuality and hazardous materials issues within the excavation (e.g. accumulation of equipment fumes. petrochemical/groundwater contamination, biological hazards, etc.).

3. Develop and implement written excavation procedures which shall be reviewed annually. The procedures shall include directions for:
   a) ensure that excavations and trenches are inspected daily or as conditions change.
   b) ensure that personnel are made aware of the excavation through flagging, marking, safeguards or other appropriate and effective means.
   c) ensure that excavations and trenches that personnel may be required, or permitted to enter, are kept free of an accumulation of water that may pose a hazard to the occupants.

d) ensure that spotter personnel are used whenever mechanical excavation work comes within 1 meter of a buried utility. Manual excavating or hydro-vac shall be performed within 1 meter of the buried utility until it is adequately exposed.

e) ensure that personnel properly enter and exit shoring cages.

f) ensure that personnel do not work in insufficiently sloped or unprotected excavations greater than 1.2 meters deep,

g) emergency response and incident management.

4. An excavation permitting system shall be used for all excavations containing buried utilities, voids, manholes etc. The excavation permit shall be approved by a qualified person prior to work commencing.

5. Ensure that locate and as-built drawings are readily available for review by equipment operators and spotter personnel.

8.4.3 PEOPLE REQUIREMENTS

6. Ensure proper training and instruction is provided to all personnel involved in excavating and working in an excavation, including:

   a) what the risks are.

   b) what the controls/safeguards are.

   c) emergency response and incident management and where to get additional information,

7. All personnel involved in excavating and exposing buried utilities must review and sign the Excavation permit before commencing work.

8. Process to ensure that only appropriately competent persons act as spotters to guide equipment operator near buried utilities.

APPENDIX A

Exavation

A man-made cut, cavity, or depression in the earth's surface.

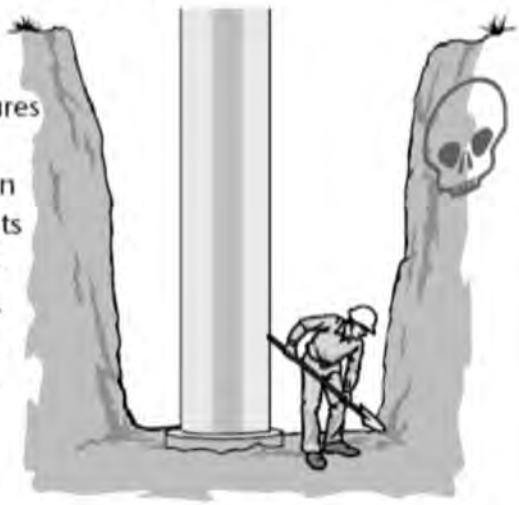
Open-face excavation

Trench

- Deeper than wide
- No more than 15 feet wide at the bottom

Open-face Trench

Forms or other structures installed in an excavation that reduce its width to less than 15 feet, measured at the bottom.



INDEX

F

G

H

I

J

L

M

N

O

P

R

S

T

V

W

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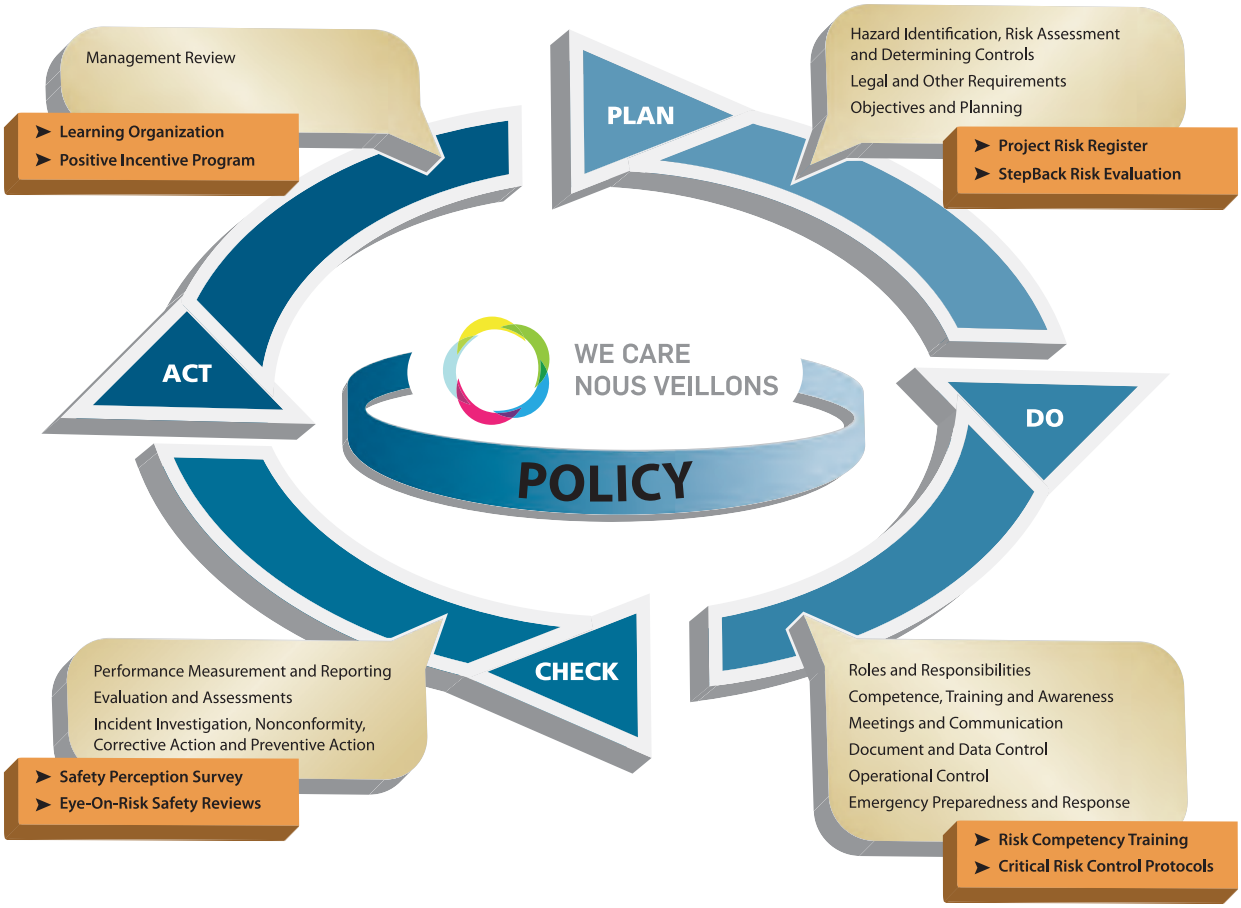


For further information or questions
on these and other Safety Programs, please contact the applicable
SNC-Lavalin Health and Safety representative.

6845.2.1.1-EN-Rev.5 12/11

SNC·LAVALIN

DOCUMENTATION, PACKAGING, MARKING AND SHIPPING INSTRUCTIONS

02	**July 07,2011**		J.Yee		
01	**May 12,2011**		J.Yee		
00	**August 09**		A.Fingercwajg		
Rev.	**Date**	**Description**	**Prepared**	**Checked**	**Approved**

INDEX

1.0 PURPOSE

1.1 Introduction

These instructions cover the general requirements for standard Packaging & Marking for all types of Goods (equipment & materials) for international shipments. It is designed to serve as a guide to a minimum acceptable level of Packaging. The Supplier published specifications will supersede these instructions as long as the minimum SNC-Lavalin Inc. requirements are met and they have been approved by SNC-Lavalin Inc. for each project.

The following instructions are intended as minimum requirements, and adherence to these instructions in no way absolves or relieves the Supplier of any responsibility or obligation outlined elsewhere in the Purchase Order.

Methods used shall be such as to warrant safe preservation to protect materials against environmental induced corrosion, damage and or degradation during the storage, handling and delivery of the commodity to its ultimate destination at the lowest reasonable cost.

Responsibilities will be defined for the Supplier and the Contractor, throughout this Documentation, Packaging, Marking and Shipping Instruction (GDPMSI), providing the minimum requirements for material preparation, preservation and seaworthy packing.

This GDPMSI will become an integral part of the conditions of all Purchase Orders generated by the Contractor.

The acceptance of the Purchase Order implies that the Supplier agrees to accept all conditions and will follow all instructions, set forth therein, and that the Supplier will reimburse the Contractor for any demurrage, penalties and fines, due to the Supplier's negligence to comply with these instructions. Aforementioned includes losses or damages due to use of inadequate protective materials, faulty or insufficient packing, improper marking and/or incorrect documentation.

1.2 Definitions

Contractor	SNC-Lavalin Inc. (SLI) for the execution of the Project.
Package	Any outside enclosure such as a case, crate, barrel, drum, bundle or other such facility used to enclose or protect the items in transit.
Delivery Terms	International standard delivery terms (INCOTERMS 2010) define the transfer of title of Goods and the responsibilities of each party in the agreement. The Purchase Order details the Delivery Terms, under which the Supplier is obligated to deliver the Goods.
Purchase Order	The contractual document issued by Contractor for the Purchase of Goods and which defines together with its attachments the duties and obligations of the parties.
Supplier	A Company or individual selected from the Project Suppliers List to supply Goods for the project to whom a Purchase Order is placed
Forwarder	Supplier of Transportation services acting for and on behalf of Contractor. Forwarder may also provide Customs Clearance services.
Goods	All material and equipment, consumable or non-consumable, hazardous or non-hazardous, described within or not, or as part of the sub-items of the purchase order.
Packaging	The preparation, preservation, unitization, and protection of the equipment/materials purchased, in order to prevent loss or damage through the transport chain (by road, rail, air, and ocean) and storage during minimum 12 months after delivery at Job-Site.
Packing List	The shipping document detailing the description of Goods, shipping configuration of items, number of items contained within any Package, dimensions & weights for each Package and any other specific requirement (i.e. P.O. line item weight, etc.) if required.
Hazardous Cargo	Dangerous cargo marked by Supplier such as explosives, flammable, corrosives, poisons, precisely and strictly in accordance with rules and regulations of the country of origin, as well as the International Maritime Dangerous Goods Code (IMDG) for ocean freight, or International Air Transport Association Regulations (IATA) for air freight.
Job-Site	The area where the Goods are to be delivered and if not the job-site then to a destination to be determined by the Contractor.

2.0 CONFLICTING REQUIREMENTS

In case of conflicting requirements, the following items govern in descending order of precedence.

a) Agreements outlined in mutually approved minutes of meetings subsequent to the issuance of the purchase order.

b) Purchase Order and relevant revisions or supplements.

c) Specifications detailed herein.

3.0 GUIDELINES FOR PACKAGING

Packaging means to efficiently and effectively protect Goods, from the moment they leave the factory until they are installed on Job-Site.

Packaging shall be sufficient to withstand without limitation, rough handling during loading/unloading, sea, air and inland transport, and exposure to extreme temperature, salt, and precipitation during transit, and outdoor storage. Packaging includes pre-packaging treatment and protection activities such as application of anti-corrosion, coating, vacuum, pealing, desiccants, solvents, etc. Depending on their type, Goods are to be protected against both mechanical damage (shocks, rupture, breakage, loss) and corrosion (rain, salty atmosphere, sand, etc.).

In every instance the desiccant/moisture absorbent supplied within the Packaging must be suitable for outdoor storage during extreme temperature variances (+40 to –40 C) at the Contractor jobsite for a minimum of 6 (six) months. The Supplier will ensure that locations and expiry date of the desiccant is clearly identified on each package to ensure change out of desiccant occurs.

3.1 Minimum Preparation Requirements by the Supplier

Regardless of General Purchase Conditions, the Supplier has ultimate responsibility to assure that Goods shall be adequately prepared to provide against entry of dust, sand, water, damage, theft, rust, etc. with inner Packaging and wrapping, prior to export boxing. This constitutes preparation and Packaging of the Goods which includes all pre-crating protection activities, such as application of anti-corrosion coatings, vacuum packing, desiccants, solvents, end caps, etc. (Specific lubricants types, inhibitors and other internal detail preservation requirements are the responsibility of the Supplier.

The sealing barrier, if any, shall be such that the Goods can be identified (e.g., by customs authorities) without breaking the sealing (This will not apply to foil bag).

3.2 General Packaging Instructions

In article below (3.3) is reported a brief summary on different allowable types of packing and materials to be used.

The metric system for weights and dimensional measurements shall be used where ever possible and depending on normal customs and practices of the shipping location.

Please note that “special” handling for certain types of equipment may be included in the Purchase Order. These specific packaging instructions will take precedence over requirements stated below. It remains the Supplier’s responsibility to supply this minimum or better and more suitable protection and/or packaging than as specified below, to ensure safe arrival of the Goods at their ultimate destination. Any variances from this must be mutually agreed upon by both the Supplier and Contractor.

The Supplier will be responsible to identify products that will be harmed by the extreme weather and temperature changes, as well as those products require inside temperature controlled storage.

Goods of more than one Purchase Order shall not be packed together in one package.

Outside packaging MUST take into consideration risk of exposure to a variety of extreme climatic conditions for inland transport and short & long term storage at the Job-Site. This protection must be effective for a 12-month period after delivery on Job-Site.

Spare Parts shall be packed separately.

3.3 Types of Packaging

In accordance with the nature of the contents, the following types of Packaging shall be considered.

Inner or outer Packaging will not be returned, unless otherwise specified in the order.

The structural characteristic will be explained below, and details of each type of Packaging will then be listed.

Under no circumstances shall Fibreboard, Cardboard, or similar cartons to be used as outside Packaging.

3.3.1 Wooden Case

The cases must always allow for handling by fork lift truck; they must therefore be provided with battens which allow the forks to pass at right angles beneath the longest side.

Base boards must be simply fined. The base must not be covered with tarred paper or polythene to allow for ventilation and water drain from the case.

In some instances, tarred paper may be allowed to avoid moisture from getting in through the bottom of the case.

The base structure (flats and boards) must be such as to equally distribute the weight of the apparatus.

The cases and crates are subdivided into three categories:

- weight of contents up to 500 kg
- weight of contents up to 2,000 kg
- weight of contents up to 20,000 kg (*)

- (*) In the case of exceptional and particularly cumbersome equipment (e.g. apparatus weighing over 20,000 kg), Supplier will consult Contractor to agree the most appropriate type of Packaging.

- <u>Cases up to 500 kg (reference: attachment A)</u>

  Carrying built crossed bars: Where the contents permit cases may be without base slat, these will be replaced by carrying crossbars to permit movement with a fork lift truck and will also serve as a batten for lifting ropes. Minimum dimensions of the base bars: 6 x 10 cm. The carrying crossbars on the boarding and on the cover must have minimum dimensions of 10 x 2.5 cm.

  Planking: Planking must be 2 to 2.3 cm thick.

  Base: Base planks must be 3 cm thick.

  Bands: Each case must be bound with at least two bands.

  Cover: The cover must be lined internally with polytethylene sheet (top) and a sheet of tarred paper (bottom).

- <u>Cases up to 2,000 kg (reference: attachment B)</u>

  Base Blocks: Cases must be provided with battens on the bottom parallel to the longitudinal access.

  The dimensions of the battens must be 12 x 12 cm, spacing approx. 60 cm.

  The section and the space between must be proportionate to the structural characteristics, dimensions and weight of the product.

  The ends of the slats must be bevelled at 45° to allow for the positioning of ropes.

Slats: Slats 8 cm thick should be placed crossways beneath the beams, raising the Package for lifting ropes or to allow movement with a fork lift truck.

The position and number of the slats will be determined in accordance with the length of the case and the relative centre of gravity.

The slats must be about twice as wide as they are thick and may be fixed by screw (preferred), nails or staples.

Base: The base boarding must be 4 cm thick and be nailed or bolted or screwed to the base crossbars.

Planks: Planks must be laid vertically so as to achieve improved resistance to superimposed weights.

Stiffening struts: Stiffening struts must be placed immediately beneath the cover (10 x 4 cm minimum and 80 cm minimum spacing).

Since their objective is to protect the case against the pressure imposed by the lifting ropes, the dimension of the struts must be proportionate to the weight of the Package and to its size.

Cover: Horizontal bracing may be external or internal. The dimensions and spacing will be proportionate to the dimensions and weight of the case.

The cover must be lined internally with polyethylene sheet (top) and a sheet of tarred paper (bottom).

- <u>Cases up to 20.000 kg (reference: attachment C)</u>

They are similar to the previous category. Obviously they must be sturdier.

Planking: Planking must be 3 cm thick.

Bottom boards: Closed tight and of the following dimensions:

12 x 12 cm for weights up to 6,000 kg
15 x 15 cm for weights up to 9,000 kg
20 x 20 cm for weights up to 20,000 kg

Base: The base boarding must be at least 5 cm thick and be bolted or screwed to the base beams.

Cover: Horizontal bracing may be external or internal. Section 20 x 4 cm (80 cm max spacing) the cover of these cases must be supported by a lattice frame (section approx. 15 x 3 cm). The squares or rectangles in the lattice may not exceed 40/50 cm at the side, to obtain a sufficiently resistant cover.

The cover must be lined internally with polyethylene sheet (top) and a sheet of tarred paper (bottom).

3.3.2 Wooden Crates

General

All wood and/or lumber used in Packaging, pallets or for securing within containers must be heat treated and/or fumigated so that they meet with the requirements of the country of export and/or destination . The treated Packaging materials must be marked with a universally recognized symbol or another approved by the Canadian Food Inspection Agency (CFIA) or other internationally recognized organization, prior to any shipments being released by the Vendor, to demonstrate they meet with the requirements of the recipient country. Recycled, remanufactured or repaired wood Packaging material should be re-certified and re-marked.

Plywood made from veneer which has been rotary cut, sliced or sawed, must be well seasoned, commercially dry and free from defects that would materially lessen the strength. Plywood must be at least 3 ply for boxes when cleated and at least 5 ply for boxes when nailed. Nailed boxes must be assembled with grain of outer plywood face in the direction of the longest faces of the box and securely nailed or fastened to corner posts or ends. Boxes exceeding 17 kg (35 pounds) must have 4 vertical corner posts or other equally suitable devices or fasteners.

All components of such material should be treated. Any and all costs associated as a result of non-compliance to phytosanitary regulations including the ISPM 15 regulation shall be to the seller's account.

Export and International

Supplier shall abide by and be fully compliant with the International Standards for Phytosanitary Measures (ISPM #15) as described in The Guidelines for Regulating Packaging Material in International Trade set out by the Secretariat of the International Plant Protection Convention administered by the Food and Agriculture Organization (FAO) of the United Nations.

As an exporter, the Canadian law requires that importing countries phytosanitary import requirements be met as provided in policy D-01-5 of CFIA.

Import into Canada

Supplier shall abide by and be fully compliant with The Entry Requirements for Wood Packaging Materials Produced in All Areas Other Than the United States and China (D-98-08) as set out by the CFIA. In the case where wood Packaging materials are produced in China the CFIA directive (D-98-10) is applicable. Canada has adopted the Regulatory Guidelines Established in International Standard for Phytosanitary Measures as set out by the FAO.

These regulations apply to all non-remanufactured and non-treated wood utilized for crates, pallets, skids, case, bracing, spacers, bearers, dunnage etc. except between Canada and the United States of America. Participating countries at the time include Canada, United States, Mexico, European Union, Korea, China Australia and New Zealand. Other countries must be verified by project.

The wood Packaging must be heat heated or fumigated using methyl bromide at rates specified in policy D-98-08 (CFIA).

The treatment or a process of treatment must be officially endorsed by the National Plant Protection Organization (NPPO) of the exporting seller.

The treated Packaging must be marked with a universally recognized symbol or another approved by the CFIA prior to any shipments being shipped by the seller.

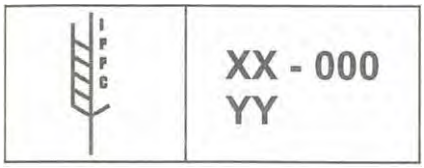
Recycled, remanufactured or repaired wood Packaging material should be re-certified and re-marked. All components of such material should be treated.

Marking

Seller must ensure that the internationally approved mark to certify that the wood Packaging material that bears the mark has been subjected to an approved measure and is clearly visible on the crate, dunnage, case, pallet, etc… for approval of entry. A sample of the logo is available from CFIA and the FAO.

The mark shown below is to certify that the wood Packaging material that bears the mark has been subjected to an approved measure.

The mark should at minimum include the:



- Symbol
- ISO two letter country code followed by a unique number assigned by the NPPO to the producer of the wood Packaging material, who is responsible for ensuring appropriate wood is used and properly marked
- IPPC abbreviation for approved measure used:
  - HT-Heat Treated
  - MB- Methyl Bromide
  - KD-Kiln Dried
  - CPI-Chemical Pressure Impregnation

- Marking should be:

  - according to model shown above
  - legible
  - permanent and not transferable
  - placed in a visible location, at least two opposite sides of the article being certified.

Non-Compliance

Any costs associated with the inspection or with bringing a shipment into compliance is the responsibility of the Supplier. Failure to meet foreign import requirements may result in the refusal of entry of the shipment, destruction of the wood Packaging, suspension of trade and domestic penalties or fines. Any such costs will be to the seller's account.

Reference Material

Details of these regulations are available on the internet:

a) Canada: www.inspection.gc.ca

b) International: www.fao.org

c) Other site: www.dcmnr.ie

3.3.3 Metal and PVC Barrels

Barrels with a capacity of less than 100 litres will be packaged in crates or arranged on pallets protected with a heat-shrunk cover and cross hoops.

Barrels with a capacity of/or greater than 100 litres will be sent individually.

Metal Strapping shall be of unannealed steel and applied with stretching tool and secured with crimped steel seals. Sizes of strapping utilized should follow latest practices developed by manufacturers depending on weight of package being strapped.

Nails should be cement coated or spiral type and should comply with latest issue of CSA Standards.

3.3.4 Wooden Drums (Wooden Reels)

Drums should be made of robust construction to afford effective protection during transport and handling. Wooden reels must be complete, in good condition and have been recently painted with waterproof paint.

Drums must be closed by staves nailed to the flanges with strengthening boards, 8 x 8 cm, placed laterally below the staves at distance of 50 cm.

For drums over 1.5 m in diameter, these reinforcing boards must be replaced by stays bolted to the flanges.

A sheet of tarred paper and a polystyrene sheet must be placed beneath the staves.

Drums must have at least 2 complete turns of strapping.

3.3.5 Equipment on Saddles and Skids

Openings in equipment shall be closed by metal sheets or wooden covers and painted a different colour. Sheets and covers shall be firmly attached to equipment or material, i.e. NO tape but preferably bolting.

All skid and saddle locations shall be indicated by the Supplier on the transport and lifting drawing (reference point 9) and approved by Contractor engineering department. Surface areas which may come into contact with slings during lifting are to be covered with wooden hurdles.

The equipment shall be fitted with suitable lifting lugs, or be properly marked as where to place the slings. The Centre of Gravity (CG) shall be indicated by the Supplier**.**

(For cargoes originating from the European Union, all lifting devices supplied, shall be officially Certified by a recognized authority. Subject certificate shall be sent to Contractor Inspection Department before the effective transport date).

3.3.6 Twenty (20) and Forty (40) feet not-Returnable Shippers Owned Containers

The use of ocean freight containers as Packaging (for sea transportation) shall be formally forbidden, except by Contractor's written authorization.

40' metal containers may be used for the consolidation and packaging of equipment. The contents of the containers must be properly blocked and braced in order to prevent any movement inside the container. Weight will be properly distributed in container.

Containers are to be new, or if previously used then they are to be free from dents and perforations and require a marine survey certificate certifying they are wind and water tight and conform to CSC standards. 20' containers are not generally recommended and will only be accepted if the Supplier requests in writing and receives Contractor's authorization to use twenty-foot containers.

The Contractor reserves the right to request also RINA approval.

3.3.7 Bundle and Loose GOODS

Only pipes, steel structures and plates can be packed in bundles or loose.

Each length of pipe of 150 mm or larger diameter shall be treated as an individual package and marked accordingly. Pipe smaller than 150 mm shall be bundled by strapping cleats or cradles of 50 x 100 mm lumber above and below the load. Ends of pipe must be capped if not in crates.

The Packaging detail will be shown in the point 3.4.

3.4 Supply Categories

Main supply categories listed below shall be packed in accordance with the types of Packaging shown in point 3.3.

3.4.1 Machinery (pumps, compressors, turbines, engines, ventilators including blowers, reduction gears, bridge cranes)

The type of Packaging used for machinery will be a wooden case.

In order to protect the machinery, heat-insulated bag must be used and, to maintain the humidity at 35%, dehydrating agents must be placed inside the bag.

All auxiliary threaded connections must always be hermetically sealed by means of threaded metal plug, and greased.

Machine finished surfaces shall be coated for protection against water and humidity for ocean shipment. All unfinished surfaces of machinery are to be given one coat of rust protecting paint.

All unprotected metal surfaces subject to corrosion or deterioration, shall be coated with a soft drying petroleum base preservation compound. Care shall be exercised in applying preservation coatings so as to ensure that items fabricated of leather, mica, rubber and similar materials are not coated with the preservative compound.

All critical working surfaces such as close tolerance shafts, bearings, seals, and spindles, shall be protected from the entrance of dirt and moisture by wrapping with a greaseproof waterproof paper having a neutral pH factor. This wrapping shall be secured firmly in place with pressure sensitive tape or wax coated twine. All openings of electric motors, generators and other electrical equipment shall be sealed with pressure sensitive tape. Brushes and armatures of motors and generators shall be also wrapped with a piece of Grade A greaseproof paper.

VPI, VCI, and Vapour Barrier papers to be utilized where critical moving parts of machinery, are subject to rusting due to condensation. These uses are limited by the various metal content of certain products.

Equipment such as electronics and other instrumentation shall be packed in an interior moisture-vapour-proof barrier with silica gel, or a comparable desiccant, to absorb moisture within the package and marked fragile. Where required equipment will be vacuum packed to ensure materiel is not damaged by elements during transport or storage period in tropical climates.

Openings in electric motors, generators and other electrical equipment shall be sealed with waterproof tape or in some equally efficient manner. A protective paper (Grade A - Greaseproof or equivalent) shall be inserted between the brushes and armature of motors and generators.

Fragile items shall be wrapped in crepe cellulose wadding or some equally efficient cushioning material and/or floated in excelsior. Fragile articles must be packed in substantial wooden cases with special precautions against risk of breakage.

3.4.2 Cables and any Kind of Material Wound on Drum

Drums: Cables and any kind of material wound on drum (flexible tubing i.e. hose, multiple tubing, copper cables and tubes) will normally be supplied on wooden drums (wooden reels).

Sizes must be those specified in the Data Sheet, and the tolerances allowed under the relevant standards must be observed.

Cases: Power and instrument cables and copper tubing wound in skein (small dimensions) should be packed in cases.

3.4.3 Pipes and Tubes

Steel pipes: Pipes of carbon steel, of low-alloy steel, galvanized, in diameter up to ½" (15 mm) and less than 2 mm in thickness will be packed in crates, the gross weight of each crate not to exceed 1,500 kg.

Crates must contain, so far as possible pipes of the same diameter, length, composition and thickness. Pipes are to be wrapped in polyethylene sheet and packed tightly inside the crate.

Pipes over ½" (15 mm) and up to 6" (150 mm) in diameter are to be made up into bundles that can easily be handled and stacked, with fastenings of twisted steel rope (4 strands) of a minimum thickness of 5 mm, positioned 1 m apart.

Internal pipe surfaces must be protected through closure of the two ends by plastic caps secured by adhesive tape. The bundles should contain pipes of the same diameter, thickness, composition and length.

Pipes over 6" (150 mm) in diameter will be despatched loose.

If necessary these pipes can be strengthened to prevent ovalization or deformation. The ends will be protected by pressure caps and taped or bolted to flange

Pipes in stainless steel, copper and aluminium must be packed in cases.

Pipes in PVC and glass fibre must be packed in wooden case protected against deformation during transport or ambient temperatures while stacked in the open.

Tubing for exchangers must be closed at the ends with wooden or plastic plugs, secured in bundles and packed in cases. The equipment must be wrapped in polyethylene sheet and held firmly in position inside the case.

Tubing for instruments will be packed in wooden cases secured by metal bands. Tubing with threaded ends must be provided with metal or plastic plugs to protect the thread.

3.4.4 Fittings

Flanges:

All flanges must be protected against oxidation (corrosion for the stainless steel types) by means of special semi-permanent grease.

Carbon steel flanges of small dimensions up to 6” (150 mm) will by threaded necklace fashion, placed in strong polyethylene or similar bags and packed in wooden cases (not exceed 1,000 kg in weight).

Carbon steel flanges over 6” (150 mm) must be assembled in piles held together by at least tie-bolts, and packed in wooden crates.

Discs of soft material must be interposed between the flanges.

Stainless steel flanges must be pre-packed in the manner described for carbon steel flanges and packed in cases. The flanges will be wrapped in polyethylene sheet inside the cases.

PVC and glass fibre flanges up to 4” (100 mm) will be packed in wooden cases and those of larger dimensions in wooden crates.

General fittings:

All fittings made of carbon steel, drawn, forged and, in particular, threaded, must be protected against oxidation (corrosion for the stainless steel types) by means of special long lasting grease and bevels should be provided of appropriate protections.

Fittings up to 6” (150 mm) will by threaded necklace fashion, placed in strong polyethylene or similar bags and packed in wooden cases (not exceed 1,000 kg in weight). Each bag will contain items of the same type.

Fittings over 6” (150 mm) will be arranged, unassembled, in wooden crates.

All fittings in stainless steel, copper and aluminium alloy pre-packed as described for fittings in carbon steel and packed in wooden cases.

Fittings in PVC and glass fibre, up to 6” (150 mm), will be packed in wooden cases and, those over 6” (150 mm) in wooden crates.

Accessories for tubing: All accessories for tubing (blinds, sealing, steam traps, hoses, spring supports, flow spy-hole, sprayers, etc. will be properly protected against corrosion with the application of a preservative, placed in polyethylene bags and packed in cases

3.4.5 Valves

Steel Valves: All valves must be protected against oxidization by means of special long lasting grease and flanges will be closed with laminated discs and rubber gaskets.

Gate valves will be dispatched in the closed position, but plug cocks must be open.

Valves of up to 4” (100 mm), as well as threaded necklace fashion and placed in polyethylene bags, will be in wooden cases.

Valves of over 4” (100 mm) will be packed in wooden crates after hand wheels and moving parts have been protected by means of polyethylene hoods and cushioning materials. Valves will be packed vertically to prevent damage to hand wheels or the hand wheels can be removed

Stainless steel valves: Stainless steel valves will be protected in the manner prescribed for carbon steel valves and packed in wooden cases.

3.4.6 Gaskets

Gaskets will be grouped by type, material and size.

Metal gaskets and ring-joints will be treated with long-lasting grease and individually wrapped in waxed, passivating crepe paper. Small-diameter gaskets will be placed in ventilated polyethylene bags, duly identified, then in waterproofed boxes and finally packed in wooden cases. Large-diameter gaskets will be attached to wooden frames and packed in wooden cases. The cases must contain instructions regarding unpacking of contents.

3.4.7 Equipment (vessels, columns, boilers, etc.) and Skids (complete plant package).

If the package is transported already assembled there is no need for Packaging as such. It will be sufficient for any projecting of especially vulnerable parts which cannot be dismantled to be protected by means of boxing and binding. All threaded connections must be fitted with plug, greased and bound with tape and flanges must also be closed using steel discs and rubber gaskets bolted to the flanges.

For prefabricated sections consisting solely of metal structures, suitable strengtheners in wood or iron must be provided to prevent permanent warping and/or deformation during the various stages of handling and transport. Stays, beams, crosspieces and lifting hooks must be applied at the most suitable positions for prevention of damage.

Any equipment required for transport and/or to place on board or unload the above packages, such as spreaders, saddles, sized ropes, stiffening structures etc., is included in the supply and the above mentioned equipments will follow the Goods to the final destination.

3.4.8 Steel Structures

Steel structures involving structures over 5 mm thickness will be tied in bundles that can easily be handled and stacked, with fastenings of steel rope of a minimum thickness of 5 mm. Each bundle should be provided with eyebolts for lifting purposes.

Structural work, unless otherwise indicated, must be appropriately grouped, with individual pieces being pre-welded to ensure they are sufficiently robust.

Welding operations must not impair in any way the soundness and usability of the items being dispatched, and not be undertaken for structural items that have been galvanized, treated with preservatives or any other surface preparation.

Structural work of a thickness under 5 mm should be packed in wooden crates.

Small items, such as brackets, tacking plates, rings, hooks, etc., should be packed in wooden cases.

Steps iron will be dispatched as follows: the step elements will be tied into bundles and the safety caging will be assembled at the installation Job-Site, and the calendared elements should be tied into bundles separately from the uprights, which should also be tied in bundles.

3.4.9 Linkage, Nuts and Bolts

Stays, nuts, bolts, metal inserts, etc., unless protected by other stable agents (galvanized, etc.) will be greased, sorted into types, enclosed in polypropylene bags and packed in wooden cases. Items must be identified by means of a label tied onto the outside of the sack, and another label placed inside.

Small sized nuts and bolts should be placed in cartons and packed in wooden cases.

3.4.10 Plates

Raw plate and shell-plate: Plates and shell-plates comprising a single package do not require any special Packaging. Planking or boards should be inserted as spacers between each plate to facilitate hoisting.

In stacking shell-plates, the first plate must rest on saddles or wedges to avoid any deformation.

Plates assembled in bundles must be held together with bands of stainless steel. If plates have no chamfers for welding, it is expedient to weld vertically pieces or straps onto the sides of the bundles to make them more compact. Wooden beams should be interposed between each bundle to facilitate lifting.

Stainless steel plates: Plates of this type must be packaged, secured with stainless steel bands and packed in wooden cases. A sheet of passivity or waxed paper must be laid between the plates.

3.4.11 Electrodes

Electrodes will be packed in wooden cases and pre-packed as follows:

Individual Packaging of electrodes will be marked with the denomination of the electrode they contain and its technical characteristics, wrapped in heat-shrunk polyethylene.

Packaging will then be placed inside heat-sealed bags into which moisture-absorptive agents have first been placed.

3.4.12 Tiles and Cements

Tiles: Ordinary and refractory tiles will be packed in wooden cases in a criss-cross pattern. Tiles will be protected by coverings of polyethylene, which will allow for the circulation of air. Cases must be strapped.

Refractory items in general must be packed in cases.

Cements: Ordinary and refractory cements must be placed in multilayer paper bags and then in a double bag of polyethylene and packed in wooden cases.

The volume of each Packaging should be one (1) m^3 approx.

3.4.13 Air Coolers

Fin surfaces must be protected on both sides with a layer of galvanized sheet, suitably attached to the cleat of the bale. Finned tubes must be suitably separated from one another by spacers to protect them during loading and unloading operations.

The detached parts of refrigerating units, such as hubs, driving shafts, bearings, etc., must be packed in wooden cases. Before being placed in the cases, parts must be carefully greased and wrapped in anti-corrosive waxed paper.

3.4.14 Electrical and Telecommunications Goods (electric motors, transformers, power-battery, telephone equipment, electrical equipment in general).

All Goods should be packed in wooden cases. MIL-B-131-F Foil bags and moisture-absorptive agents will be used in all cases. To prevent the protective bag from being damaged, any sharp edges on the equipment must be padded. In case of vulnerable parts of equipment that cannot be treated with protective substances, self-adhesive waxed paper impregnated with passivity substances can be used.

The main instruments on boards, panels and control desks, which are likely to suffer damage during carriage, handling or storage, should be dismantled and packed in cases. Panel coupling elements for medium and low voltage distribution boards and motor control panels will be packed in separate cases.

Accumulator batteries, appliances and instruments made of brittle materials must be given a form of protection inside the cases.

Switchboards and control panels must be packed as follows:

a) No case should contain more than three coupled panels or boards.

b) Arcing contact parts, if positioned in the contact-breakers and isolators, must be firmly secured; if they are being dispatched separately, each must be packed individually inside the case to avoid breakage of the contact.

Switchboards, control panels and control desks should be packed in wooden cases, together with all their accessories.

Motors will normally be supplied without the couplings. Motors will be firmly bolted down to the bottom of the case, and suitably protected. Junction boxes must be placed with the connection and coupling output channel towards the bottom. The drive shaft of the motor must be greased and protected.

Fluorescent lamps should be packed separate from the frames. They must be protected against possible breakage during loading, unloading, and transport. Frames must be packed in wooden crates separate from the lamps.

Mercury-vapour lamps and incandescent lamps must be provided with protection inside the case by means of spacers of poly-sponge or other suitable material.

Shunt and connection boxes must be packed in cases.

Large transformers must be packed in crates. It must be possible to fasten a sling through the transformer eyebolts even after Packaging. Any dismantled parts must be empty of oil and packed in cases. Measuring and control instruments must be dismantled and packed in wooden cases. The transformer must be bolted down to the base and held securely inside the crate to prevent it from moving.

Small transformers up to 2000 kVA, must bepacked in wooden cases.

3.4.15 Instruments (Control and safety valves, instrument and control panels, analysers, digital indicators, automotive valves, electronic computer systems, instrumentation in general, etc.)

Instruments equipment must be suitably packed in wooden cases.

Individual appliances must be packed in cases and enclosed in MIL-B-131-F Foil Bag. Apparatus must be cushioned before being placed in the bags.

Before the bags are sealed, moisture-absorptive agents must be inserted, and a partial vacuum must be created inside the bag.

Precision instruments must be wrapped in anti-corrosive waxed paper, padded and enclosed in protective bags in which moisture- absorptive agents have been placed; they must then be put inside a Packaging of foamed polystyrene of a suitable shape. The whole will then be placed in a water-resistant carton long-fibre natural craft board. The cartons must all be stowed next to one another inside a wooden case.

The Supplier of Goods is ultimately responsible to adhere to ALL regulatory requirements for Health, Safety and Environmental concerns of the Country of exportation and of importation (GSPLAJ), in regards all Goods used in export Packaging.

3.5 Packaging Inspection

Irrespective of the Delivery Term agreed in the Purchase Order, the preparation for export shipping (including Packaging) may be subject to inspection by Contractor or Contractor’s representative.

The Supplier shall give the Contractor written notice of no less than ten (10) days of the time and place at which the Goods are to be packaged for shipment.

The client or appointed representative may be present at Supplier's shop/factory prior to shipment and at dockside prior to loading aboard ship. Inspection shall not relieve Supplier of any responsibilities or obligations under the terms and conditions of the Purchase Order. Contractor reserves the right to reject the Packaging found not adequate during inspection. In such cases, Contractor will ask Supplier to immediately repack the Goods in acceptable Packaging for account of Supplier. If the Packaging rejection occurs at the port of loading, the repackaging activities must be carried out at dockside in the notified working day and all costs to obtain entry authorization by Port Authorities will be the responsibility of Supplier.

To obtain such authorization Supplier may contact the Contractor's appointed Forwarder.

If any part of the Goods for any reason whatsoever has not been inspected during the fabrication or before Packaging, the Contractor shall have the right to inspect the Goods at the agreed delivery point, provided that Contractor notifies Supplier of its intent to do so by their written order to proceed with the Packaging.

3.6 Packaging & Packaging Waste (European Union only)

All parties involved will comply with the European Packaging & Packaging Waste legislation in force (directive number 94/62/EC of December 20, 1994) or when situated outside the European Union the local legislation in force will apply.

4.0 MARKING INSTRUCTIONS

Each case, bundle, crate or container which is larger than two cubic meters shall be stencilled with indelible ink over coated with clear preservative on two opposite sides other than the side on which it rests or it is intended to be stacked, with the following marks in five centimetres letters and numbers, all in the English language. Packages smaller than two cubic meters may use labels reduced in size, and if necessary, the label may be affixed using a tag.

When an individual shipment consists of multiple cases, skids, crates, containers or other then each shall be individually and sequentially numbered.

All boxes and crates shall bear the following markings:

a) Name of Contractor
b) Project Name, Contract and P.O. numbers
c) Port of Destination
d) Equipment Tag Number (to be specified by the Supplier)
e) Name of Supplier
f) Seller's Ref. Number (to be specified by the Supplier)
* g) Case Number _____ of _____
(Continuous series)
h) Dimensions in meters (width, length, height, to be specified by the Supplier)
i) Volume in Cubic Meters (to be specified by the Supplier)
j) Gross Weight in Kilograms (to be specified by the Supplier)

k) Net Weight in Kilograms (to be specified by the Supplier)
l) Colour Codes, when required (to be specified by the Supplier)

In accordance with the characteristics and different requirements in loading, unloading and shipping different Contract Equipment, the package shall be conspicuously marked with "Handle With Care", "Right Side Up", "Keep Dry", etc., in English and with appropriate international trade practice marks and illustrative marks, such as (Please refer to attachment D):

a) Chains

Indicates the place through which lifting chains are to be passed for loading and unloading. The chain shall be painted red.

b) Cross Sign

Indicates the centre of gravity of the case.

c) Umbrella

Indicates that equipment must be stored in a warehouse with extreme care.

d) Glass Cup

Indicates that the shipment is fragile and should be handled with extreme care.

e) Slinging Points

Seller shall indicate sling points and/or furnish slinging diagram

To facilitate identification of the contents, in case of breakage or deterioration of packaging, the packed equipment or machine should be also marked on one of its sides, and, if this should not be possible, marks shall be stamped on corrosion resistant sheet metal or other suitable corrosion resistant material, which shall be fixed to the equipment in such a way, as to avoid being detached during handling.

In the case of goods which, because of their nature, are customarily supplied and accepted by the Contractor without packaging, marks and indications, shall be stamped on two sides of the equipment as described above.

All unpacked equipment, cases, parcels or bundles weighing more than 4 (four) metric tons, shall bear indications of their center of gravity using international symbol and of the appropriate places though which lifting braces are to be fixed for the adequate handling during loading, transfer and unloading operations.

All cases, crates and bundles weighing a metric ton or more shall have a mark, indicating the maximum load that can be placed on top of them.

One set of packing lists shall be in a waterproof bag affixed to the case, bundle, crate, or container and covered with a metal plate. This metal plate must be placed in the left top quarter of one of the largest surfaces and firmly affixed. One additional copy of the packing list shall be included inside the case, crate, or container.

International symbols are to be stencilled using indelible red ink over coated with clear preservative to prevent erosion. Any crate(s) identified as containing dangerous goods are to be prepared as a shipment separate from the main consignment and shall contain a separate set of packing lists. Appropriate markings identifying the contents, the product identification numbers, and any other markings required for the transport of dangerous goods shall be clearly affixed to or stencilled on the crate(s) on the two opposite sides other than the side on which the crate rests or is intended to be stacked. On cylinders the safety marks must appear on shoulder.

The colour to be used shall contrast with the package surface (never use yellow or red paint).

Black or white paint are recommended.

Packages/equipment of five tons or more must be marked with slinging points and also clearly show on all sides the centre of gravity (CG). This is of paramount importance for Pressure Vessels and Heat Exchangers.

Packages containing Hazardous Material / Dangerous Goods are to be marked on at least two sides with appropriate labels in conformity with IMDG/IATA regulations. Chemicals/ Dangerous Goods shall be identified on a separate invoice, packing list and Bill of Lading. All hazardous Goods shall be identified by appropriate hazard class and technical/proper shipping name (Refer to attachment F).

All spare parts orders must be clearly marked as spares and shall not be included with main equipment.

Shipping marks must appear on all packages and all shipping documents such as packing lists, invoices.

Bundles and loose items which are not suitable for application of shipping marks directly onto bundles or pieces, must be supplied with at least 2 (two) indestructible labels, 1 (one) at each end, bearing shipping marks. Labels are tied firmly to bundles with pieces of steel wire.

Metal or other weatherproof tags shall be clearly legible and must invariably be affixed to bundles and single units at both ends. Do not use linen, paper or light cardboard tags.

Hand lettering with felt tip markers is not acceptable.

Precautionary statements will be stencilled on each package to indicate proper handling and storage.

MINIMUM REQUIREMENTS

----------60 cms x 40 cms----------

Marks:

Consignee	:	AAAA
Project Number	:	Job No. XXXX
Final Destination	:	BBBB
P.O. No.	:	
Supplier's Name	:	
Country of Origin	:	
Item No.	:	
Description of Material	:	
Package No.	:	1 of ..., 2 of ..., etc.
Gross Weight	:	Kg
Net Weight	:	Kg
Dimensions	:	cms (L x W x H)
Volume	:	CBM

Storage Recommendations:

Cargo Handling Symbol:
(Identify / describe)

Special Instructions:

Stencil on two sides and one end in clear characters at least 5 centimetres high (where case size permits, otherwise use optimum size for each package dimension).

For the identification of Goods subject to special handling, the following international symbols shall be used to ensure proper handling and warehousing (see Attachment 0):

Symbol	Description	Remarks (symbols to be shown on)
1	THIS SIDE UP	All Top corners
2	FRAGILE GOODS – HANDLE WITH CARE	All Top corners
3	KEEP DRY	All Top corners
4	PROTECT FROM SOLAR RADIATION	All Top corners
5	USE NO HOOKS	All sides
6	CENTRE OF GRAVITY	Two sides of packages over 2,000 kg
7	SLING HERE	All slinging points

Special remarks: symbols 15 cm high to be painted in black, on bright surface.

All boxes and crates are to be marked clearly on all four sides:

"HANDLE WITH CARE"
"RIGHT SIDE UP" and
"KEEP DRY"

5.0 PACKING LIST GENERAL REQUIREMENTS

The Supplier will not ship Goods and materials from the point of origin, regardless of the delivery terms included in the Purchase Order, until the final release for shipment is issued to the Supplier by the Contractor's Representative.

90 (Ninety) days prior to the Contractual shipping date, Supplier must supply the Contractor with 4 (four) copies of shipping drawings for each large piece exceeding 10,000 kilograms or 12.2m L x 3m W x 2.7m H meters.

The shipping drawing must show at least the following information;

- Purchase Order No.
- Item No.
- Overall Dimensions (length x width x height)
- Total Weight
- Centre of Gravity
- Lift Points
- Any Special Lifting Requirements (i.e., use of lifting beam)

Supplier must submit a “provisional packing list” (provisional packing list is to include estimated weight and dimensions of all packages) 30 days prior to scheduled shipping date which must include the following information:

- Confirmation of Purchase Order shipping date.
- Quantity
- Description
- Reference Tag Number (where applicable)
- Supplier’s reference part number and serial number if applicable.
- Estimated gross weight (kilograms) of each shipping item (crate, skid)
- Length, width and height (meters) of each shipping item (crate, skid)

30 (Thirty) days prior to the Contractual shipping date, Supplier must furnish Contractor a copy of safety information for all easily combustible Goods, dangerous Goods and poisonous Goods.

These safety instructions must include the following information:

- Name of Goods
- Nature of Goods
- Measure of protection
- Emergency treatment
- Material Safety Data Sheets
- IMCO Code
- UN Product Code

30 (Thirty) days prior to the Purchase Order shipping date Supplier must furnish Contractor with a description of the "special precautions" to be taken for the equipment/material with special requirements for temperature, shock, etc., during the transportation and storage.

Upon the receipt of the release for shipment from the Contractor Inspection group, the Supplier will be obligated to submit the final packing list (c/w weight and dimensions) to the Contractor.

Any shipment that proceeds without an authorized order (release for shipment) will be subjected to charges not exceeding the freight charges.

Item numbers shall be listed accurately on the packing list to allow proper identification.

The packing list shall indicate details of the items packed, piece by piece, accessory by accessory (Purchase Order line item level). Indication of sets, lots or the like is not allowed.

Whenever packages are stuffed into containers, details of their contents shall be listed.

Monetary value shall never be indicated on any packing list.

One copy of the packing list shall be placed inside the box and two copies of it shall be fixed to the outside of the packing in a waterproof envelope protected by a plastic or aluminium cover, marked “packing list”.

6.0 STORAGE RECOMMENDATIONS

The Supplier’s storage recommendations shall be marked on each Package and indicated on the packing list.

The symbols for the type of storage are:

- X or “A” = storage in heated/ventilated warehouse and with special precautions (air conditioning)
- XX or “B” = storage in closed warehouse
- XXX or “C” = storage in open shed
- XXXX or “D” = storage in open air (covered by tarpaulins)

If for any reason, Contractor is unable to accept dispatch of the Goods at the time when the Goods are due and ready for dispatch, Contractor shall so inform Supplier in writing and Supplier shall store the Goods, safeguard it, and take all steps to prevent its deterioration during such storage and Contractor shall be liable to Seller:

a) if applicable, for that instalment of the Contract Price that would have been paid in accordance with the Contract had the Goods been dispatched and

b) for the reasonable justified costs, including insurance of so doing, after a period of grace of 2 (two) months free storage (unless otherwise specifically provided).

7.0 OCEAN FREIGHT TRANSPORTATION

7.1 Ocean Containers

Contractor will position the Shipping Company containers c/o Supplier’s shop/factory and all costs for containerization of the Goods (stowing, securing, stuffing, etc.) will be for account of Supplier.

The material to be loaded into containers must be packed according to point 3.3.6.

Container inspection, loading, securing and limitations will be in accordance with International Standards and Maritime Law & Regulations, regardless of the country of export.

Material is to be bundled, boxed or crated restricting weight to a gross maximum of 4 metric tons. After cleaning and preserving, all equipment shall be packed in waterproof paper lined export type shipping containers.

Large pumps, compressors, and other heavy machinery that will not be damaged by water or exposure may be packed in open crates or semi-boxed. All openings of pipe,

large valves, and machinery must be protected by wooden or PVC covers or plugs, and the machined threads must be covered by caps or wrapping to protect against damage in transit.

Up to 225 kg

Boxes for weight of contents up to 225 kg shall be constructed with minimum 2.54 centimetres cleats and of nominal 2.54 centimetres lumber or equivalent plywood, and shall be strapped with two 1.90 centimetres unannealed flat steel strapping secured with crimped steel seals.

225 kg to 500 kg

Boxes for weight over 225 kg to 500 kg shall be constructed of nominal 2.54 centimetres lumber or equivalent and be modified to include a skid base of nominal 2.54 centimetres deck, nominal 5 centimetres x 10 centimetres lumber skids and minimum 5 centimetres x 10 centimetres frame members. Boxes shall be strapped with a minimum of two x 3 centimetres unannealed flat steel strapping secured with crimped steel seals.

501 kg to 4000 kg

Boxes for weight in excess of 500 kg shall have skid type bases. These skids shall be minimum nominal 7.5 centimetres x 10 centimetres or 10 centimetres x 10 centimetres lumber secured to headers with 1.25 centimetres machine bolts. The deck shall be of nominal 2.54 centimetres lumber or heavier. Framing members of the sides and ends shall be of nominal 5 centimetres x 7.5 centimetres or heavier. The sheathing shall be of nominal 2.54 centimetres lumber or plywood equivalent.

Top construction shall be of nominal 2.54 centimetres lumber with waterproof paper liner supported by minimum 5 centimetres x 10 centimetres lumber joists on edge, where the width of the case so requires, and cleared to the sides. The corners of prefabricated panels shall be reinforced by the addition of 3 centimetres steel straps where necessary.

Over 4000 kg

Where the weight exceeds 4000 Kilos, all construction will be in accordance with above specification however material used is to be altered as the weight is increased.

Ventilation shall be provided in all shipping containers to permit free circulation of air by spacing of floor boards 0.63 centimetres to 0.48 centimetres apart and by drilling a cluster of holes in the sides of large cases upward from the outside at 45°. These should be a minimum of five such holes 1.25 centimetres in diameter.

Heavy machinery shall be mounted and bolted to the skid which shall be of sufficient strength to provide support and to prevent distortion.

TABLE OF SKID SIZES

Gross load Weight (kg)	Max. skid Length (m)	Runner size (centimetres)
225-450	2.44	5 x 10
451-1,000	4.88	7.5 x 10
1,001-5,000	6.10	10 x 10
5,001-10,000	9.15	10 x 15.25
10,001-15,000	9.15	15.25 x 15.25
15,001-25,000	9.15	15.25 x 20
25,001-36,000	10.67	20 x 20
36,001-45,500	10.67	20 x 25

All skids will be spaced no greater than 1.22 metre apart, centre to centre. The headers will be the same size as the skid runners and shall be bolted into each skid runner. The deck of the skid shall be a minimum of 5 centimetres lumber. All internal frame work shall be a minimum of 10 centimetres lumber and shall have diagonal bracing.

If the length exceeds the limit shown in the table above the next larger size is to be used.

7.2 Break-Bulk Cargo (Conventional)

In general, break-bulk cargo is any ocean cargo which is not containerized, exceeds the inside dimensions and weight limitations set for specific types of containers or otherwise designated as such, as per the delivery requirements specific to the project.

8.0 AIR FREIGHT

Cardboard Containers

Cardboard containers may only be used for airfreight, if they meet IATA packaging requirements. Otherwise, any material packaged in cardboard containers must be repackaged or enclosed in another crate or bundle.

Machinery Boxes

Material is to be bundled, boxed or crated restricting weight to a gross maximum of 2,720 kg. All openings of pipe, large valves, and machinery must be protected by wooden or PVC covers or plugs, and the machined threads must be covered by caps or wrapping to protect against damage in transit. Maximum size for boxes or crates is not to exceed 152.4 cm D x 274.3 cm W x 152.4 cm H.

Up to 225 kg

Boxes for weight of contents up to 225 kg shall be constructed with minimum 2.54 cm cleats and of nominal 2.54 cm lumber or equivalent plywood, and shall be strapped with two 1.9 cm unannealed flat steel strapping secured with crimped steel seals.

225 kg to 500 kg

Boxes for weight over 225 kg to 500 kg shall be constructed of nominal 2.54 cm lumber or equivalent and be modified to include a skid base of nominal 2.54 cm deck, nominal 5.08 cm x 10.16 cm lumber skids and minimum 5.08 cm x 10.16 cm frame members. Boxes shall be strapped with a minimum of two – 3.18 cm unannealed flat steel strapping secured with crimped steel seals.

501 kg to 2,720 kg

Boxes for weight in excess of 500 kg shall have skid type base. These skids shall be minimum nominal 7.5 centimetres x 10 centimetres lumber secured to headers with 1.25 centimetres machine bots. The deck shall be of nominal 2.54 centimetres lumber or heavier.

Framing members of the sides and ends shall be of nominal 5 centimetres x 7.54 centimetres or heavier. The sheathing shall be of nominal 2.54 centimetres lumber or plywood equivalent.

Top construction shall be of nominal 2.54 centimetres lumber supported by minimum 5 centimetres x 10 centimetres joists on edge, where the width of the case so requires, and cleated to the sides. The corners of prefabricated panels shall be reinforced by the addition of 3 centimetres steel straps where necessary.

SKIDS

Heavy machinery shall be mounted and bolted to a skid which shall be of sufficient strength to provide support and to prevent distortion.

TABLE OF SKID SIZES

Gross load Weight (kg)	Max. skid Length (m)	Runner size (centimetres)
225-500	12.70 x 24.13	5 x 10
501-2,720	12.70 x 24.13	7.54 x 10

All skids will be spaced no greater than 1.22 metre apart, centre to centre. The headers will be the same size as the skid runners and shall be bolted into each skid runner.

The deck of the skid shall be a minimum of 2.54 centimetres lumber. All internal frameworks shall be a minimum of 5 centimetres lumber and shall have diagonal bracing.

Contoured Structural Container / Igloo

Contoured containers/Igloos shall be constructed as described below:

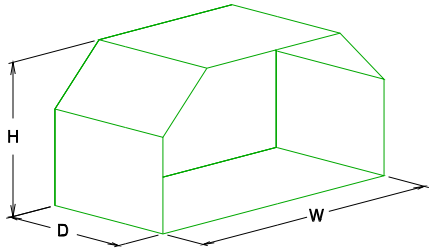


Figure 1: AWS type container

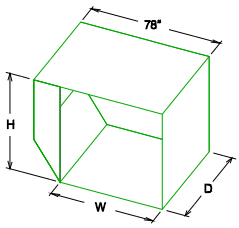


Figure 2: AVE type container

Class	Size	IATA Description
AWS	Full	Maximum gross weight (including tare) 2,720kg 1.55 m L x 3.17 m W x 1.62 m H Vol: 7 cubic meters
AVE	Half	Maximum gross weight (including tare) 1,590kg. 1.55 m L x 1.58 m W x 1.63 m H Vol: 4 cubic meters

Containers shall have skid type bases. These skids shall be a minimum nominal of 7.54 centimetres x 10 centimetres lumber secured to headers with 1.25 centimetres machine bolts. The deck shall be of nominal 2.54 centimetres lumber or heavier. Framing members of the sides and ends shall be of nominal 5 centimetres x 7.54 centimetres or heavier. The sheathing shall be of nominal 2.54 centimetres lumber or plywood equivalent. Top construction shall be of nominal 2.54 centimetres lumber supported by minimum 5 centimetres x 10 centimetres joists on edge and cleared to the sides. The corners of prefabricated panels shall be reinforced by the addition of 3.17 centimetres steel straps where necessary.

9.0 HAZARDOUS MATERIALS & DANGEROUS GOODS

Transportation of these good must comply with all International, Federal, Provincial, State and municipal regulations.

For any materials or residues which are deemed by the appropriate transport regulatory authorities to the hazardous or regulated cargo for transportation, the Supplier must provide the Contractor in writing, with advance notice, the following safety instructions:

i. Name of goods
ii. Nature of goods
iii. Measure of protection
iv. Emergency treatment
v. UN Number
vi. IMCO code
vii. Safety Data Sheets
viii. Spreader Bar details c/w Certified Calculations

All hazardous goods must be packaged in accordance with appropriate transportation mode rules and regulations. Supplier must ensure all shipping units comply with the packing/packaging provisions of the International Maritime Dangerous Goods (IMDG) or International Air Transport Association (IATA) code, as appropriate to the mode of transportation. Supplier must ensure that hazardous materials, especially liquids, are in suitable containers that will allow use without spillage and can be satisfactorily resealed after a portion of the material has been extracted. (Re-closed containers should allow normal handling and transport without significant escape of liquids or vapours. Containers of 5 liters or more of hazardous, low-viscosity liquids such as paint thinners, chlorinated solvents, and insecticides should have a retractable metal or plastic spout or a similar design that will meet the stated objective).

Ensure all packages are properly and adequately marked and labelled in compliance with provisions of the IMDG or IATA code and properly display safety marks, product identification number(s), and any other information required by the regulations governing the transport of dangerous goods.

The Supplier must assist the Contractor in obtaining all necessary certificates and permits.

These requirements also affect the transport of solvents, pre-mixed paint, equipment with batteries, oil filled equipment, magnetized materials, pressurized equipment or containers, etc. The specific mode of transport being employed and the quantities involved may determine if the cargo is classified as dangerous or not.

Thirty (30) days before the consignment is due to be dispatched, the Supplier must send to the Contractor the following documents for each product:

- Multimodal dangerous Goods form for sea freight transport correctly completed and signed
- Shipper's declaration for airfreight transport correctly completed and signed
- Material safety data sheet

Hazardous material shall be identified on a **separate invoice and packing list** to those for non-hazardous material. All hazardous material shall be identified by the appropriate hazard class and technical or proper shipping name. All invoices and packing lists for hazardous material shall contain the following statement:

"*This is to certify that the above-named material is properly classified, described, packaged, marked and labelled, and is in proper condition for transportation according to the appropriate Government or International Transport regulations.*"

NAME	COMPANY NAME
TITLE	SIGNATURE
HAZARD CLASS NO	TECHNICAL SHIPPING NAME

The Supplier shall produce any necessary hazardous cargo certificates, in accordance with the appropriate Government and International Transportation regulations for all shipments.

10.0 Heavy Lifts / Oversized Cargoes (Abnormal Loads)

Goods exceeding one of the following dimensions and/or weight are to be considered to be heavy lifts and/or oversized cargoes.

Loads

Length : 12 meter
Width : 2.50 meter
Height : 2.50 meter
Weight : 25 Tons

If the above-mentioned figures will be exceeded, Supplier must give advance notice to Contractor and shall present to Contractor transport and lifting drawing(s).

Plus showing, other information below:

- Purchase Order/Tag number.
- Weight and dimensions of each piece.
- Centre of Gravity (CG).
- Lifting lugs and/or sling locations.
- Size of lugs.
- Saddle locations (incl. width, height and weight).
- Any specific transport requirements.

Drawing packages are to be provided by Supplier (numbers to be determined on a case-by-case basis by the Contractor), a minimum of 90 (ninety) days prior to "Ready for Shipment" date.

Heavy-lifts and/or over-sized Goods shall be accompanied with "spreader bars" whenever required by the Contractor or the Job-Site. The Supplier will specify each item with lifting and sling points that will distribute the load equally and keep the item in a stable, horizontal position when lifted by one hook. All items up to 125 tons are to be designated for a single point lifting method.

11.0 Domestic Packaged Shipments

10 (Ten) days prior to the contractual shipping date, Supplier must provide (via Courier Express or email) two copies of the shipping documents to the Contractor addressed as follows:

- Contractor (As agents or as representatives for – when applicable)
- Contractor's Buyer, (project office address)

Attention: Document Controller, Project: (project number and project name).

At time of shipment, a final packing list shall be prepared by Supplier for each package, showing the equipment / material description and appropriate tag number where applicable. **1** (**One) copy** of the packing list shall be placed inside the shipping container / crate affixed to the equipment / material, **1** (**One) copy** shall be secured in a weatherproof pouch firmly attached to the outside of each crate/pallet etc.

12.0 INTERNATIONAL SHIPMENTS

12.1 For shipments destined to Canada:

a) 2 (Two) original copies of a Commercial Invoice with Harmonized System code per item,

b) 1 (One) original copy of the NAFTA Certificate with HS code per item,

c) If a NAFTA certificate is not available or not applicable, then two (2) original copies of a Certificate of Origin (if applicable)

d) Packing List and/or a separate packing list for each shipment (in this latter case the Commercial Invoice must indicate 'partial shipment' and be issued for each individual shipment, the total of which must equal the total shipment quantity/value).

e) Copy of truck bill, airway bill or bill of lading.

f) 1 (One) copy of each of the above to be sent to the Logistics Lead of the project or to the Buyer at the given address via email or courier, if no Logistics Lead is assigned to the project.

The 'Importer of Record' should clearly show: **********

It is the responsibility of the equipment Supplier to define and supply the HS Code description on the Commercial invoice and on the NAFTA Certificate. If the Supplier is unable to supply or is unsure of the HS code to be used, they must then contact the Project appointed Customs Broker for assistance.

In order to comply with Canada Customs Non-Compliance regulations, the Commercial invoice must imperatively show the following elements:

- Supplier name and details.
- Invoicing address.
- Purchaser / Consignee's name and details (XXX location purchasing the Goods).
- Delivery address, if different from consignee's address.
- Other references such as invoice and purchase order numbers.
- Country of Origin (a blanket certificate of origin or an affidavit might be asked upon request to prove the origin of the Goods). The terms "Manufactured in" and "Made in" are the only acceptable terms.
- Mode of transportation.
- Currency of settlement.
- Number of packages
- Specification of commodities (kind of package, marks and numbers, general description and characteristics such as proper identifying description in commercial terms).
- Unit and total price paid or payable in the currency of settlement.
- Invoice total
- Total weight
- Originator: name of the person completing the invoice.
- Customs Broker details and contact

12.2 For other International shipments

The following minimum documentation will be required for the clearance of all commercial shipments irrespective of the mode of shipment. This documentation is to be prepared and supplied by the SUPPLIER:

a) Commercial Invoice

1 (One) original and 2 (two) copies destined to Customs Broker.
1 (One)) copy destined to Contractor's Representative.

b) Certificate of Origin

1 (One) original and 2 (two) copies destined to Customs Broker.
1 (One) copy to Contractor's Representative

These documents must be sent to the following parties' indicating the Project name and Project number:

- Contractor (As agents or as representatives for – when applicable)
- Contractor's Buyer, (project office address)
- Document Controller
- Contractor's appointed Freight Forwarder

All documents must be received by the Customs Broker and Contractor Representative 15 (fifteen) days prior to the schedule date of arrival of the shipment. All documentation shall be addressed according to instructions issued by the Contractor.

Documentation for international shipments will vary depending on the importing Country requirements and existence of special trade arrangements between Country Nations.

Specific or additional documentation needs and completion instructions will be provided to the Supplier prior to any shipment being agreed upon and will be included as part of the Purchase Order (Special) Terms and Conditions.

In order to ensure that the above documents are verified properly in time for shipment, the original copies should be couriered. If the documents are not correctly completed the Supplier will be advised that new documents are needed. Shipments will not be expedited until all Import related documents are completed and in good order.

13.0 Export permits

The following requirements on Export Permits are applicable to all Projects where goods are being purchased.

The Supplier must advise the Contractor of all Export Permits required for the export of the Goods covered by the Purchase Order.

This is a condition of the validity of the Purchase Order that the required Export Permits for the Goods be issued in time for the scheduled delivery, failing which the Purchase Order shall irrevocably be deemed null and void, and Contractor shall in such event not be liable to the Supplier for any damages nor compensation.

The Supplier shall at its own cost obtain the required Export Permits.

Should the Contractor be the Exporter of Record, the Supplier shall, at its own cost, assist the Contractor in all aspects in preparing applications for the export permits and in obtaining the required approvals. Where, under the delivery term, the Supplier is responsible for obtaining the required export permits, the Supplier shall do so at its own cost.

14.0 Attachments

ATTACHMENT A CASE FOR WEIGHTS UP TO 500 KG

ATTACHMENT B CASE FOR WEIGHTS UP TO 4,000 KG

ATTACHMENT C CASE FOR WEIGHTS UP TO 20,000 KG

ATTACHMENT D INTERNATIONAL HANDLING SYMBOLS

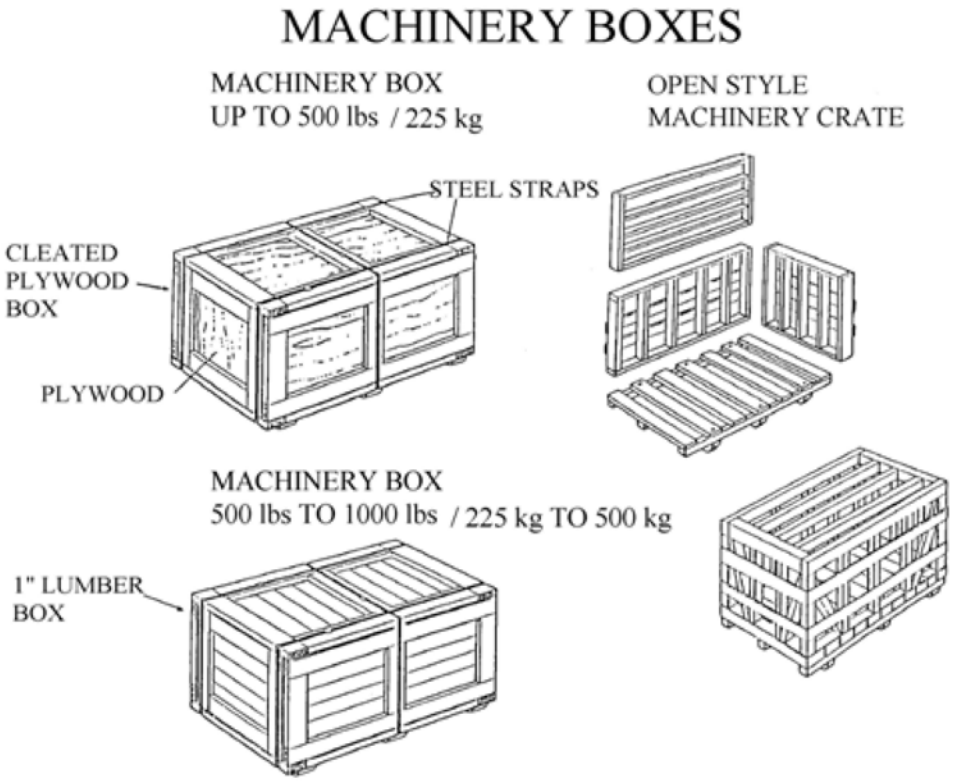
ATTACHMENT E INTERNATIONAL SYMBOLS

ATTACHMENT F HAZARDOUS INTERNATIONAL SYMBOLS

ATTACHMENT G AIRCRAFT PALLET SIZES

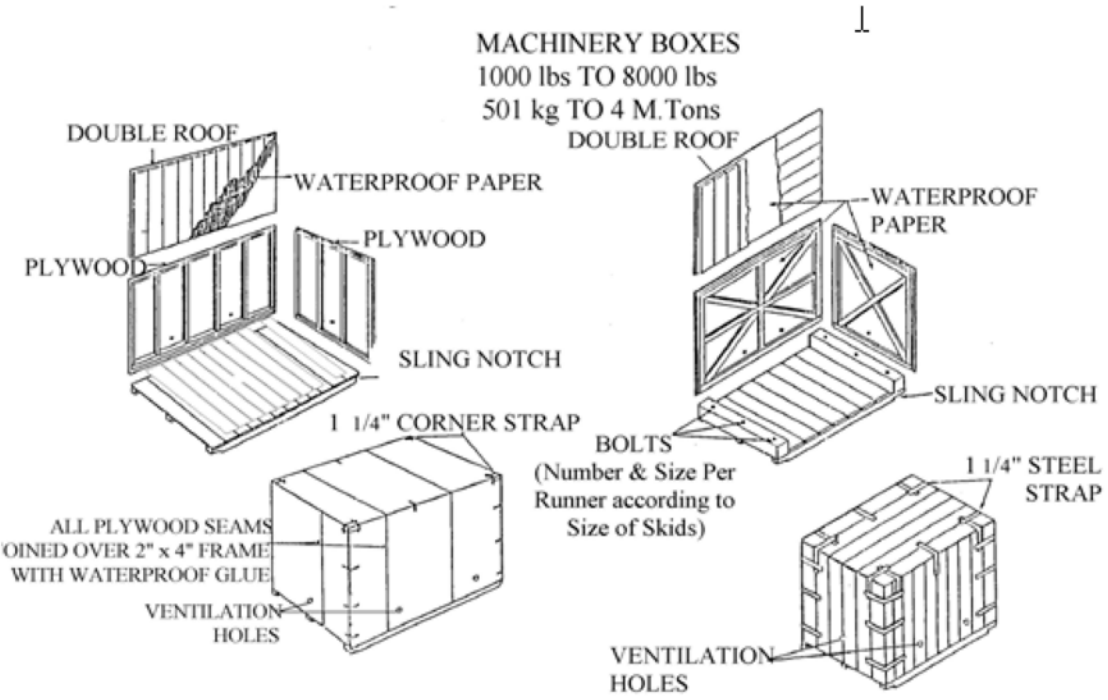
SNC·LAVALIN

ATTACHMENT A
CASE FOR WEIGHTS UP TO 500 KG

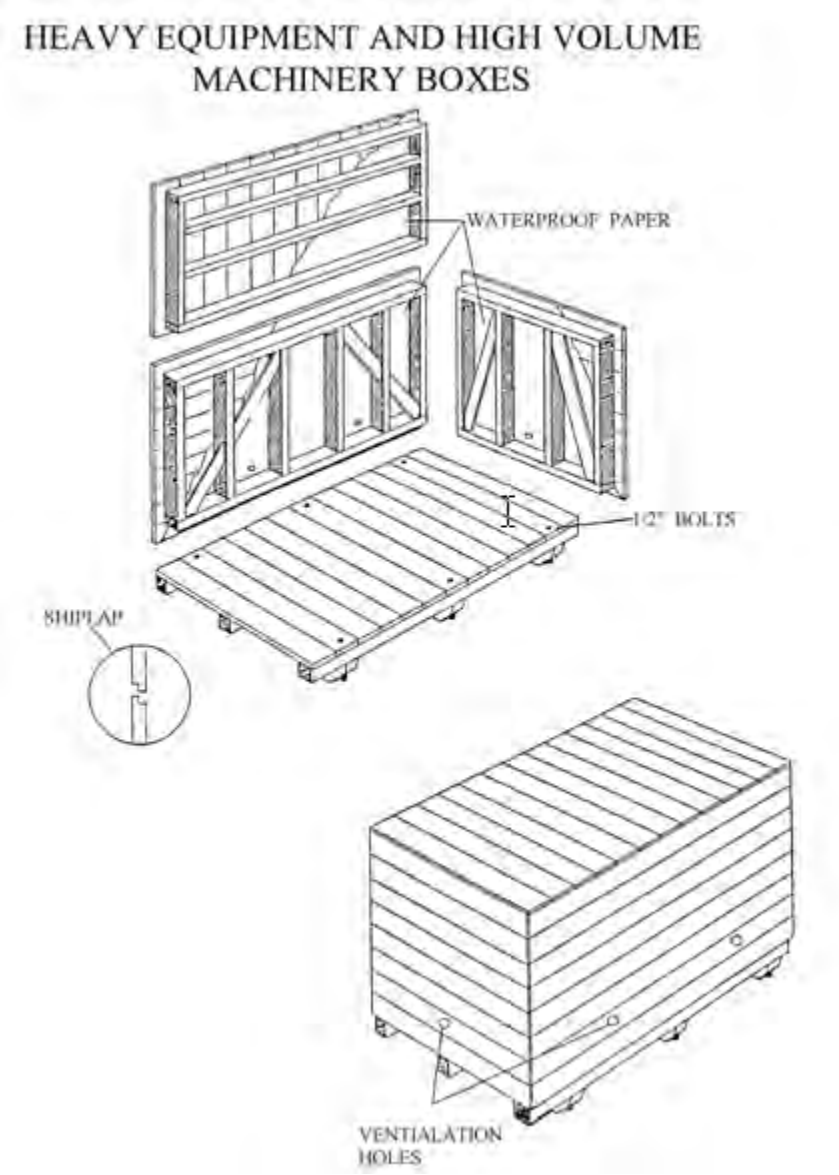


SNC·LAVALIN

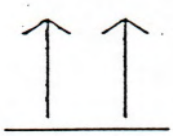
ATTACHMENT B
CASE FOR WEIGHTS UP TO 4,000 KG



ATTACHMENT C
CASE FOR WEIGHTS UP TO 20,000 KG



ATTACHMENT D
INTERNATIONAL HANDLING SYMBOLS



1

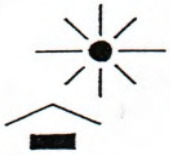
THIS SIDE UP

2

FRAGILE GOODS

3

KEEP DRY



4

PROTECT FROM SOLAR RADIATION

5

USE NO HOOKS

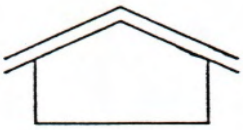
6

CENTRE OF GRAVITY

7

SLING HERE

STORAGE RECOMMENDATION

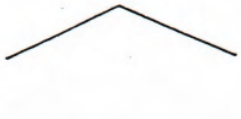


A

STORAGE IN HEATED/VENTILATED WAREHOUSE AND WITH SPECIAL PRECAUTIONS (AIR CONDITIONING)

B

STORAGE IN CLOSED WAREHOUSE



C

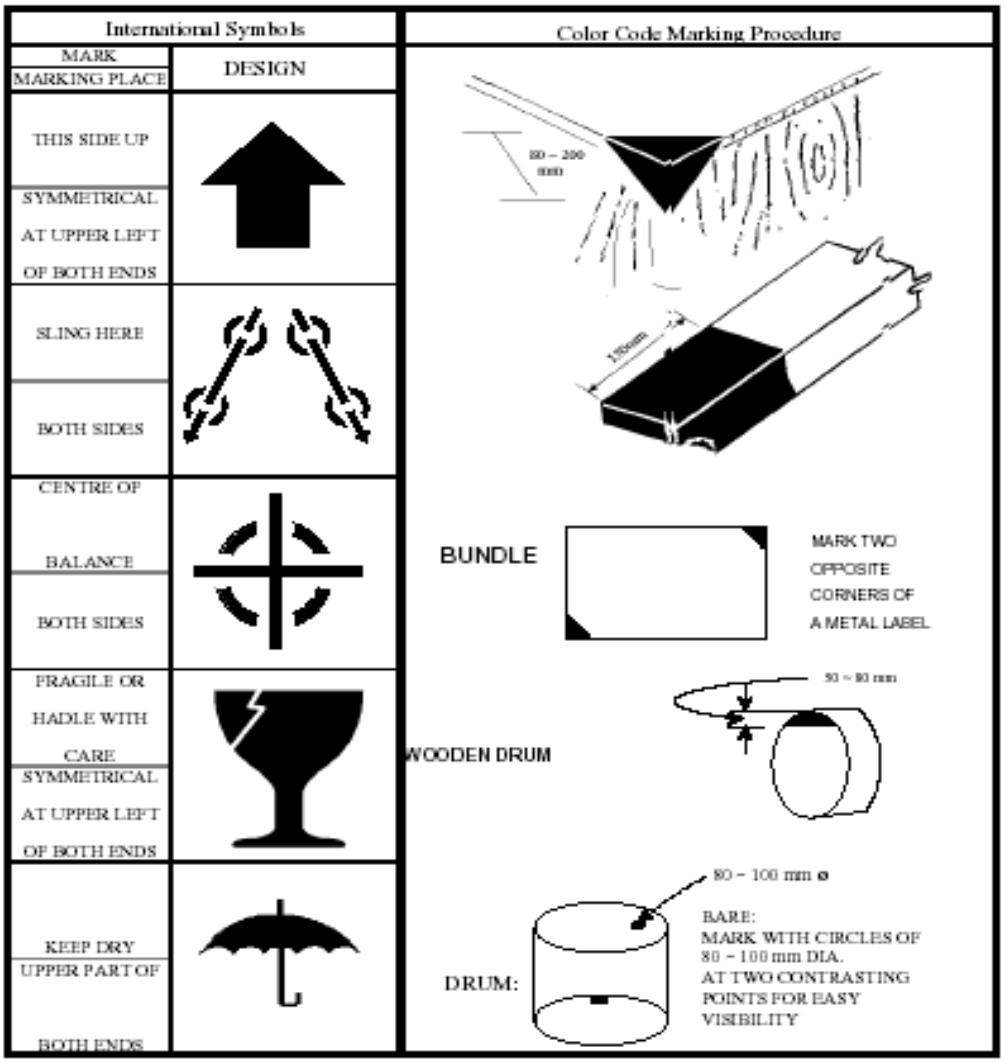
STORAGE IN OPEN SHED

D

STORAGE IN OPEN AIR

JR

ATTACHMENT E
INTERNATIONAL SYMBOLS



ATTACHMENT F
HAZARDOUS INTERNATIONAL SYMBOLS

SAFETY MARKS

- Class 1 explosives

- Class 2 gases

- Class 3 flammable liquids

- Class 4 flammable solids, spontaneously combustibles and substances that, on contact with water, emit flammable gases

- Class 5 oxidizing substances and organic peroxides

New !!!

- Class 6 poisonous (toxic) and infectious substances

- Class 7 radioactive materials

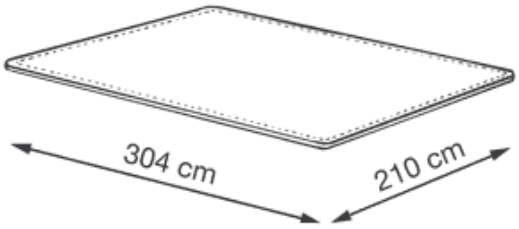
- Class 8 corrosives

- Class 9 miscellaneous products or substances miscellaneous identified dangerous goods certain specified goods considered dangerous to the environment dangerous wastes

ATTACHMENT G
AIRCRAFT PALLET SIZES

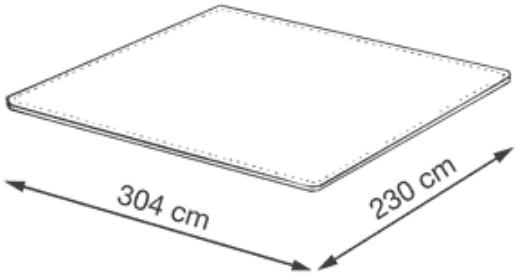
Standard Pallet

Type:	Standard Pallet
Code:	P1P, PAG, PAJ
Base Dimensions:	318 x 224 cm
Internal Dimensions:	304 x 210 cm
Loadable in:	A310-300, A300-600, A340-200, A340-300,9, B747-400, B747-200 Combi, B747-400 Combi, B747-200 SF, B747-200 F, B737-300 F, DC8-73 F



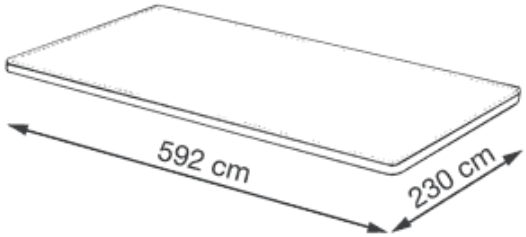
10ft Pallet

Type:	10 ft Pallet
Code:	P6P, PQP, PMC
Base Dimensions:	318 x 244 cm
Internal Dimensions:	304 x 230 cm
Loadable in:	A310-300, A300-600, A340-200, A340-300, B747-400, B747-200 Combi, B747-400 Combi, B747-200 SF, B747-200 F



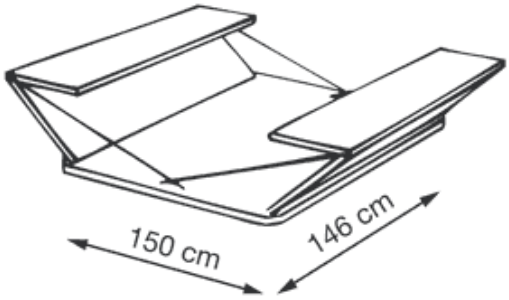
20ft Pallet

Type:	20-ft-Pallet
Code:	P7E, PGE
Base Dimensions:	606 x 244 cm
Internal Dimensions:	592 x 230 cm
Loadable in:	B747-200 Combi, B747-400 Combi, B747-200 SF, B747-200 F



A320/A321 Pallet

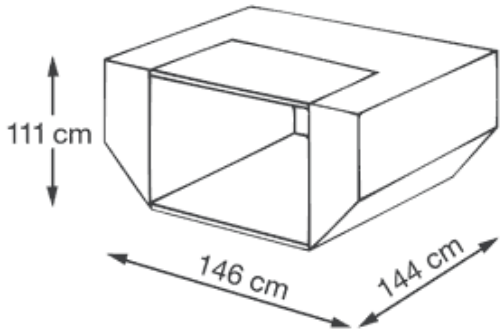
Type:	A320/A321 Pallet
Code:	PKC
Base Dimensions:	156 x 153 cm
Internal Dimensions:	150 x 146 cm
Loadable in:	A320/200, A321/100



Aircraft Container Sizes:

A320/A321 Container

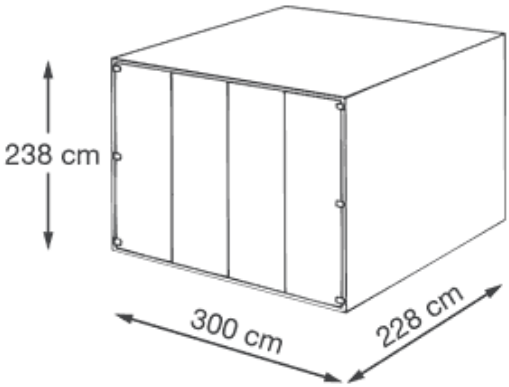
Type:	A320/A321 Container
Code:	AKH
Base Dimensions:	156 x 153 cm
Height:	114 cm
Volume:	3.5 cbm
Internal Dimensions:	146 x 144 x 111 cm
Loadable in:	A320-200, Airbus A321-100



10 ft Container

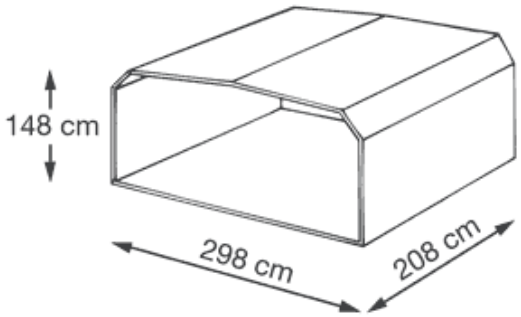
Type:	10 ft Container*
Code:	AQ6, AMA, AQA, AMG
Base Dimensions:	318 x 244 cm
Height:	244 cm
Volume:	17 cbm
Internal Dimensions:	300 x 228 x 238 cm
Loadable in:	B747-200 Combi, B747-400 Combi, B747-200 SF, B747-200 F

* Flexible doors/solid doors



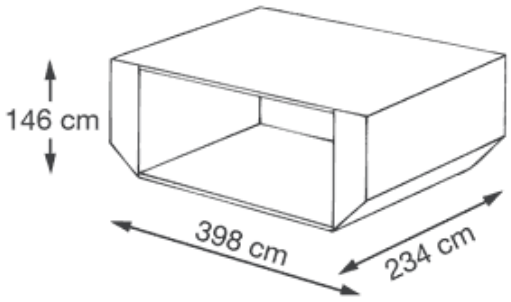
AAN Container

Type:	AAN Container
Code:	AAN
Base Dimensions:	318 x 224 cm
Height:	156 cm
Volume:	9 cbm
Internal Dimensions:	298 x 208 x 148 cm
Loadable in:	A310-300, A300-600, A340-200, A340-300, B747-200, B747-400, B747-200 Combi, B747-400 Combi, B747-200 SF, B747-200 F, B737-300 F, DC8-73 F



AMF Container

Type:	AMF Container
Code:	AMF
Base Dimensions:	318 x 244 cm
Height:	163 cm
Volume:	13 cbm
Internal Dimensions:	398 x 234 x 146 cm
Loadable in:	A310-300, A300-600, A340-200, A340-300, B747-200, B747-400, B747-200 Combi, B747-400 Combi, B747-200 SF, B747-200 F



nalcor energy
LOWER CHURCHILL PROJECT

SNC·LAVALIN EPCM consultant for Nalcor

HEALTH AND SAFETY MANAGEMENT PLAN

Nalcor Doc. No. LCP-PT-MD-0000-HS-PL-0001-01

Comments:	Total # of Pages: (Including Cover):
This document supercedes LCP-SN-CD-0000-HS-PL-0001-01	138

Status / Revision	Date	Reason for Issue	Prepared by	Functional Manager Approval	Quality Assurance Approval	Project Manager (Generation + Island Link) Approval
B3	19-Jun-2013	Issued for Use	D. Riffe	J. Kean	D. Green	R. Power
B2	05-Oct-2012	Issued for Use				
B1	07-May-2012	Issued for Use				

Inter-Departmental / Discipline Approval (where required)

Department	Department Manager Approval	Date
	Name	
	Name	
	Name	
	Name	

TABLE of CONTENTS

Executive Summary

Nalcor Energy is committed to develop the Lower Churchill Project (LCP or the Project) with complete dedication to minimizing the risks of injury or ill health to personnel and damage to property or the environment as low as reasonably practicable. Nalcor Energy believes that safety and health performance is fundamental to the achievement of project success, as well as its overall business and project objectives. It is therefore the Project Delivery Team's expectation and requirement that all personnel associated with the Project will play an integral role in the implementation of its occupational safety and health strategy, performing at the highest possible levels and fostering continuous improvement in the areas of safety and health.

This Safety and Health Plan provides guidance on how the Lower Churchill Project work scope can be safely executed. This Plan is focused for all levels of LCP management and specifically identifies the strategies and practices that project personnel will employ to ensure that health and safety performance excellence is achieved. Individual responsibility and total commitment to a strong safety culture are well defined and established elements for achieving Incident and Injury-Free performance on the Project are in place.

Nalcor believes sound health and safety performance is fundamental to successful business performance. It is therefore the requirement and expectation of the Project Delivery Team that all personnel associated with the Project shall play an integral part in the full implementation of the health and safety management strategy, performing at the highest possible levels and fostering a focus on continuous improvement in health and safety. Eliminating all work related injuries, while effectively managing and executing the project, is what ultimately defines us, as well as the overall success of the project.

Nalcor believes that achieving its safety commitment of "Zero Harm- Nobody Gets Hurt" requires a proactive health and safety management system is in place at the work-face level for all contractors and suppliers. The Health and Safety Management vision of the Lower Churchill Project is the ***"Relentless pursuit of an injury and illness free workplace where nobody gets hurt."*** Project excellence is not achievable without performance excellence in safety.

Key Focus Areas:

Nalcor recognizes that the following focus areas of the health and safety program are the key to the success of its Health and Safety effort. All Health and Safety Plans associated with the Project should include the following key focus areas and the intent of the initiatives:

- Management Commitment: Management must convince the workplace that safety is a core value by actively and visibly participating in the health and safety effort and by providing adequate resources.
- Workplace Participation: All personnel must actively participate in the health and safety effort to promote understanding, ownership and commitment.
- Effective Communication: Open and honest communication across all levels of personnel, supervision and management must be achieved. The safety process must reinforce and foster mutual feedback and respect.
- Positive Reinforcement: Positive reinforcement and constructive feedback must be promoted to ensure that desired worksite behaviors occur frequently.
- Performance Measurement: Leading indicators must be captured, analyzed and communicated to indicate how the workplace is proactively committed to the achievement of an injury/incident free working environment.
- Caring about the Worker: Focus must be placed on the worker as an individual. A work environment, which is safe and maintains a high level of employee morale and positive attitude must be created and maintained.
- Empowerment: Personnel must be empowered to immediately stop any unsafe behaviors or conditions that they find during the course of their work. Personnel must correct these unsafe behaviors or conditions as soon as practicable.
- Accountability: All personnel must understand that each individual is responsible for his or her own safety. First line supervision must understand that they are accountable for the safety of their direct reports and that they must undertake the coaching role.
- Competency: All personnel must be fully competent to perform their daily work activities in a safe and productive manner.
- Pro-activity: A pro-active approach to the health and safety effort must be emphasized and practiced. This will allow unsafe workplace behaviors and conditions to be addressed before they turn into incidents.
- Risk Management: A process to identify and mitigate hazards must be implemented. When hazards are identified, steps must be taken to eliminate or reduce exposure by designing in safety, changing work procedures, requiring additional PPE or raising safety awareness.

- Systemic Approach: Ensure that all systems are designed to include a clear description of scope and objectives; processes and procedures used in the work activity, identify workers and management responsible for the execution of the processes and procedures, a measurement and verification process and a feedback system that analyses measurement and verification information for continuous improvement.
- Partnership: Learn from others to evaluate and implement the best possible health and safety practices used for implementation.

Key Strategies for Achieving the Project's Safety Management Vision

1. *Ensuring clear accountability for safety performance with line management. This may be accomplished through:*

- Clearly defined roles and responsibilities within the job description of each member of line management;
- The establishment of Safety performance targets for each member of line management;
- Periodic performance reviews (at least annually) shall be carried out to assess overall safety performance and accountability of line management; and
- Line management health and safety performance initiatives, creativity and timely achievement of established targets will be recognized/rewarded, as appropriate. Poor overall performance will be noted and discussed with individual with an action plan to enhance overall performance.

2. *Implementing a formal leadership training program for all levels of management and supervision. This strategy will be accomplished by ensuring that:*

- All project management and supervisory personnel attend and actively participate in the SLI safety leadership training program as soon as practicable.
- Project management and supervisors are encouraged to attend follow-up training sessions as and when provided.
- All Leadership Training Program attendees are encouraged to implement lessons learned from the training into the work environment, as well as engaging others in working discussions with Health and Safety as the issue.
- Leadership is encouraged to interact with other leaders/managers to discuss lessons learned and implementation strategies.

3. *Demonstrating tangible commitment and involvement by Senior Management towards the "relentless pursuit" of safety performance excellence is essential. This will be realized by:*

- Providing the appropriate level of resources, equipment and personnel to execute each work task safely.
- Actively participate in FELT Leadership, which includes strong, visible management commitment; recognizing management's role of being a teacher, trainer and coach; always maintaining effective communications; and undertaking timely and meaningful auditing and re-evaluation processes.
- Establishing and maintaining Health and Safety as our core value through continually safeguarding the well-being of project personnel, the general public, and the environment through safe and environmentally responsible work practices associated with the design, construction, transportation and commissioning. Health and Safety must not be prioritized along with other business priorities.
- Continually striving to maintain an accident and incident free working environment at all project and contractor work sites, and ensuring total compliance with all Health and Safety applicable regulations.
- Always challenge and correct wherever possible any Unsafe Acts, Conditions or Procedures in a timely manner;
- Be actively involved in the SWOP process.

4. *Selecting competent contractors for executing the work, while coaching and guiding them in the delivery of the Project in order to achieve our Vision. This is best accomplished by the following:*

- The Project Delivery Team, through line management will ensure that contractor Health and Safety performance is monitored and unsatisfactory Health and Safety performance and mitigating action are addressed in contract terms and conditions and duly executed as and when appropriate.
- The Project Delivery Team will ensure an effective and workable procedure is in place to evaluate and select third party services by: Ensuring that prior to commitment the risks are appropriately reviewed, mitigating measures identified/addressed;
- The Project Delivery Team will define third party performance expectations, communicate and monitor contractor performance requirements that:

- Establish and execute contracts and agreements that clearly incorporate Health and Safety requirements;
- Become actively involved in monitoring, mentoring and coaching Contractors, Ensure Contractors' roles and responsibilities are clearly defined;
- Establish Health and Safety performance targets, metrics and measures; Ensure Health and Safety performance with contractors are regularly reviewed and communicated and Integrate appropriate actions/performance enhancement plans to improve overall contractor performance.
- The Project Delivery Team and Line Management will periodically coordinate and/or conduct internal and external Health and Safety audits on contractors and third party performance.

5. *Involve all workers in safety management. This will be initiated by the following:*

- Ensuring that all employees and contractor understand that they have a stake in the overall success of the project --- Health and Safety is everyone's responsibility.
- Actively encourage employee involvement by holding them accountable and ensuring everyone does their part through periodic monitoring, inspections, assessment and audits.
- Encouraging participation into the Joint Occupational Health and Safety Committee (JOHS).
- Incorporating daily safety inspections as part of the employee/contractor job task.
- Ensuring employees and contractors are informed about safety inspections, injury and illness statistics, and other safety-related issues.
- Management and line supervisors should assign meaningful tasks to employees and contractors that support safety.
- Management and line supervisors should place value in employee/contractors input and feedback with regard to improving the safety and health program, as they often know more about safety problems and solutions than managers do.
- Holding employees accountable by:
  - Including safety and health responsibilities in job descriptions; including compliance with safe work practices a part of performance evaluation;
  - Setting and measuring achievements toward meeting safety targets;
  - Ensuring employees/contractors with reckless or unsafe behaviours are appropriately disciplined and recognizing employees and contractors who contribute to keeping the workplace safe.

6. *Utilizing safe work practices/behaviors to avoid accidents. This is best accomplished utilizing the following practices:*

- Site Health and Safety Orientations must be carried out prior to work commencement at the construction site. The Health and Safety orientation is the most important communication tool that management has to clearly convey the safety expectations and responsibilities of the job task and working environment. To ensure everyone knows how hazards will be effectively identified, communicated and controlled.
- Ensure safe work practices are clearly defined, documented and communicated to employees and contractors.
- Utilize SWOP *(Safe Workplace Observation Program)* as a means of not only recognizing unsafe work practices and behaviours, but recognizing the application of safe work practices and behaviours. *Please refer to Appendix "C", page 76 for additional information about the SWOP.*
- Incorporate and communicate Lessons Learned from incidents and near misses. Encourage reporting and investigating near-miss incidents and gleaning lessons learned and communicating them to other potentially affected personnel.
- Target safe work practices and procedures with the primary goal of eliminating incidents and injuries in the workplace.
- Employ frequent opportunities for reminders of established safe work practices and behaviors to employees and contractors.
- Solicit feedback and input from employees and contractors regarding enhancement of safe work practices/behaviours for tasks they are frequently involved with executing. Ensure that this feedback is heard, evaluated, addressed and timely feedback is provided in all cases.
- Review safe work practices periodically (at least annually) to ensure they are effective, meet regulatory requirements.

7. *Risk management and control practices can best be incorporated in daily work activities utilizing the following practices:*

- A TBRA (task-based risk assessment) is a risk management tool that should be used to evaluate risk prior to a new or complex work activity. The TBRA identifies personnel interaction with the work activity, the tasks to be performed, and the hazards associated with those tasks. The TBRA identifies known and potential hazards and emphasizes risk reduction.

- Step Back 5X5 is a process that that encourages workers to identify hazards associated with all tasks before starting a job. It helps to promote a hazard management culture through continual self-evaluation. It is based on the principle of "engaging the mind before engaging hands" by: Stepping back 5 paces from the job; Investing 5 minutes (nominal) to step through the job mentally and identify plans to control hazards before starting the job. It is an informal personal planning process and essentially a mental JHA applied before starting all jobs.
- Systematically listen to those personnel that understand the risks of a particular task not only when a crisis occurs, but as the right way to manage activities on the project.
- Develop safe working rules, practices and procedures based on risk experience, safety knowledge and competent work direction.
- Assess all anticipated known risks prior to starting a new activity or one that is conducted very rarely.
- Ensure employees and contractors are effectively trained in risk management practices and procedures, as well as actual application of risk management in actual practice. This includes processes, methods and tools available.
- Stimulate and maintain the desire and commitment of line management, contractors and employees to perform risk management practices in daily work activities.

8. *Establishing strong functional expertise in health and safety management who are fully engaged in both strategic direction-setting and day-to-day project delivery activities. This can be accomplished by the following:*

- Selecting trained, capable, educated and experienced health and safety personnel to provide appropriate guidance and direction for the overall health and safety management effort strategically and on a daily basis.
- Providing strong functional and technical expertise to support the execution and implementation of health and safety practices, policies, and processes relative to contractor and employee safety.
- Focusing function and technical support on effective contractor Health and Safety management throughout the course of the project.
- Preparing and reviewing project safety and security management plans.
- Supporting the project level execution of contractor qualification and performance assessment processes.
- Supporting and contributing to the health and safety performance reporting processes.
- Supporting and facilitating construction, contractor and employee Health and Safety training.

- Monitoring regulatory developments, evolving issues and industry best practices, and proactively facilitates the continuous improvement of the Major Projects health and safety management system.
- Providing coaching and mentoring to applicable Project Management to enhance Major Project's Health and Safety objectives.

9. *Focus on measuring leading indicators (e.g., field observations, interventions and worksite inspections. This can be achieved through due consideration of the following:*

- Project Management actively supports the concept of utilizing leading indicators as a measure for proactively controlling loss/damage.
- A 'balanced scorecard' providing information on a range of Health and Safety activities will be utilized for the project rather than a single performance measure.
- Measurement of leading indicators provides information on how the Health and Safety Management System operates in practice, and identifies areas where remedial action is required and provides a basis for continuous improvement and provides a mechanism for feedback and consequential motivation.
- Employees and Contractors must clearly understand exactly what proactive/leading indicators are being measured and what significance the use of the measurement will have on producing the desired performance result.
- Leading indicators are to be utilized as a means of publicizing data with the project workforce which focuses attention on a particular program area and is by doing so will lead to safety improvements in a short period.
- Key Project activities in the Health and Safety Management System that need to be promoted, reinforced and visibly drive the culture will be selected and measured, wherever possible.

10. *Development of an incident management and emergency response management plan/program that reflects the uniqueness/specifics of the work and associated work locations. This can be achieved with consideration of the following:*

- Identifying all reasonable/probable risk events/scenarios specific to the Lower Churchill Project that may require incident management and/or emergency response. Examples for the LCP will include (but not limited to): fire, explosion, flooding, civil unrest, equipment failure, vehicle/transportation incidents (including helicopter incidents), extreme weather, missing or lost personnel.

- Ensuring adequate resources are available at the site location or, where possible, mutual aid agreements are established which would allow appropriate resources to be moved to the site in the event they are required.
- Identifying Key Incident/Emergency Response Personnel, Communications Links, Roles and Responsibilities, Emergency Support Services, Logistics coordination, Alert/Emergency Criteria. Current contact numbers must be continuously updated/maintained.
- Ensuring key communications links are established, communicated, maintained and tested via drills on a frequent basis.
- Developing procedures which provide clear instructions to Emergency Response Team with a focus of minimizing and/or containing damage and risk to others.
- Ensuring external agencies such as the RCMP, RNC are contacted as and when appropriate and stipulated in the incident/emergency management procedures.
- Business Recovery measures are identified and implemented after the incident/emergency is stabilized and under control.
- Fully investigate all emergency response incidents (and other incidents as appropriate) to identify lessons learned and communicate these to affected personnel.

1.0 Purpose

The purpose of this document is to outline the overall Health and Safety Management Plan for the management of Occupational Health and Safety on the Project. This *LCP* Health and Safety Management Plan defines the LCP expectations for health and safety planning and performance and describes how the Project will establish the Health and Safety Management System and implement the associated initiatives. It serves to provide the guidance, framework, and details of how the Safety Credo will be embedded with the LCP.

This Health and Safety Management Plan has been developed in full alignment with the Safety and Health Management System and all applicable Nalcor Energy Resources safety and health policies. The Safety and Health Management System and applicable processes and procedures will be utilized throughout the Project. In the event that any contract/subcontract company or functional group has control mechanisms, safety work practices than are identified in the plan, the more rigorous of the two will be implemented.

This Health and Safety Management Plan will help ensure that work conducted at all stages of the LCP complies with the intentions of the overall Health and Safety Management System, Health and Safety Policy and the Safety Credo.

The Project Delivery Team must fully understand and effectively apply the LCP Health and Safety Management Plan, as well as supporting documents, policies, programs and procedures, to all phases of design, construction, commissioning and full power. The ultimate objective to ensure that all risks are minimized to as low and reasonably practicable (ALARP) and a relentless pursuit of an incident free working environment is maintained at all times.

The LCP Health and Safety Management Plan must be utilized effectively by all Lower Churchill Project Delivery Team Members. Contractors and subcontractors must have Health and Safety Plans that align with this plan. For the Strait of Belle Isle Crossing (SOBI), the Contractor executing the work will bridge to this Health and Safety Plan via coordination mechanisms.

2.0 Scope

The Project Delivery Team provides the overall project management for the planning and execution of the LCP, will fully utilize this Health and Safety Management Plan. It is intended that this Health and Safety Management Plan be applied to all parties associated with the LCP, including Nalcor Energy LCP Employees, Contractors, Suppliers, and Consultants. It is a key functional component of the overall LCP Project Management System. Nalcor Energy LCP will require each of its contractors to have an effective and functional health, safety and environment management system in place which is reviewed during the contract bidding evaluation phases of all planned and executed contract activity. Consistency of the contractor Health and Safety Management System with the Nalcor Energy LCP Health and Safety Plan shall be addressed through a bridging document. Periodic due diligence audits will be conducted by Nalcor Energy LCP Health and Safety personnel to ensure all objectives, programs and practices monitored are maintained and achieved.

The LCP Health and Safety Management Plan is applicable for all phases of the Lower Churchill Project, including Planning, Design (Preliminary and Detailed), Procurement, Construction, Over-site, Completion and Ready for Operations. This includes the following Sub-Projects of the LCP, Phase I:

- Muskrat Falls Generation
- Labrador-Island Transmission Link
- Labrador Transmission Assets

This Health and Safety Management Plan is intended to incorporate all applicable Nalcor Health and Safety Practices, Policies, Procedures and Programs as well as achieve compliance with applicable legislation and regulations, which includes the Newfoundland-Labrador OHS Act and Applicable Regulations. Variations in the standards must be communicated to all LCP Personnel, which includes all Contractors and Sub-contractors.. As such, this Plan will function as an overarching document and focal point standard by which the SLI Health and Safety documents and subcontractor documents must bridge and adhere to.

3.0 Definitions

Hazard
The potential to cause harm, including ill health and injury, damage to property plant, products or the environment, production losses or increased liabilities.

Integrated Management System (IMS)
A framework of “coordinated” and “controlled” functional management resources, processes, procedures and tools that organize and direct the LCP with regards to established “project success criteria”, as defined in the LCP Project Charter.

Project Delivery Team
The Project Delivery Team includes managers who functionally report up to the LCP Project Director.

Management System (functional)
This system identifies management resources, processes, procedures and tools necessary to facilitate the achievement of the accountabilities/responsibilities of a functional group. The LCP functional groups correspond to the various functional responsibilities such as Health and Safety, Environmental, Quality, Engineering, Commercial Services, Project Services, etc., as identified in the Project Charter.

4.0 Abbreviations and Acronyms

A/I	Accident/Incident
ALARP	As Low as Reasonable Practicable
ATV	All-Terrain Vehicle
CoF	Certificate of Fitness
CSA	Canadian Standards Association
DnV	Det Norske Veritas

FMEA	Failure Modes and Effects Analysis
FTA	Fault Tree Analysis
H&S	Health and Safety
HAZID	Hazard Identification Review
HAZOP	Hazard Operability Review
HSE	Health, Safety and Environment
ER	Emergency Response
ISO	International Organization for Standardization
PDT	Project Delivery Team
JOHS	Joint Occupational Health and Safety
LCP	Lower Churchill Project
LITL	Labrador Island Transmission Link
LMS	Learning Management System
LTA	Labrador Transmission Assets
MF	Muskrat Falls
MOC	Management of Change
MSDS	Material Safety Data Sheet
NE	Nalcor Energy
OHSAS	Occupational Health and Safety Assessment Standard
PMT	Project Management Team
PPE	Personal Protective Equipment
PTW	Permit to Work
QRA	Quantitative Risk Assessment
RCMP	Royal Canadian Mounted Police
RFO	Ready for Operations
RNC	Royal Newfoundland Constabulary
SCAT	System Causation Analysis Technique
SLI	SNC Lavalin, Inc
SOBI	Strait of Belle Isle
SWOP	Safe Workplace Observation Program
TDG	Transportation of Dangerous Goods
TBRA	Task Based Risk Assessment
TLV	Threshold Limit Value
TSA	Task Safety Analysis
WHMIS	Workplace Hazardous Material Information Sheet

5.0 Managing Health and Safety on the Lower Churchill Project

Nalcor bears ultimate responsibility for Health and Safety Management and performance within the Lower Churchill Project. In terms of practical implementation of Health and Safety arrangements described in this Plan, the LCP Vice President expects his Management Team to take the lead in ensuring that all applicable arrangements are implemented within their areas of authority.

Nalcor Energy's Safety and Health Internal Responsibility System (IRS) is the cornerstone on which the Safety and Health Program is based. It is also a set of legal obligations for managing occupational health and safety. The defining principle of the IRS is that everybody within the organization from members of the Board of Directors to a temporary front line employee has a role and responsibility for safety and health. A second, and equally important, principle is that solutions to safety and health issues in the workplace come from employees themselves i.e. internal to the organization. While it is recognized that external assistance may sometimes be required, e.g. OH&S Branch of Government, it should be the exception rather than the rule.

An IRS works when:

- There is an unbroken chain of responsibility for safety and health flowing down through the organization and accountability for fulfilling safety and health obligations flows upward through the organization;

- Each employee takes the initiative on safety and health issues and works to solve problems and make improvements on an ongoing basis; and

- Depending on their position within the organization, their qualifications and authority, each employee accepts responsibility and accountability for their defined role.

Figure 1.0: Nalcor's IRS

The Health and Safety function exists to provide the necessary support, advice and guidance to assist personnel discharge their health and safety obligations. The Health and Safety function also audits the Lower Churchill Project systems and activities to provide assurance that our Health and Safety implementation is compliant with applicable legislation or other relevant standards and improvement opportunities are identified and acted upon.

This Plan is built on the following Nalcor Energy commitments:

- The Nalcor Energy "Safety Credo" (Section 7)
- The Nalcor Energy "Guiding Principles" (Section 7)
- The Nalcor Energy "Core Elements" (Section 7)

The following chart represents the overall hierarchy for Lower Churchill Project Health and Safety Management Documents, Plans, Policies and Procedures.

5.1 Health and Safety Management Interface

For MF, LTA and LITL, LCP Site Personnel will interface via daily, weekly and monthly meetings and stewardship sessions with the Project Delivery Team to ensure that:

- Safety and health goals and objectives and scope are fully understood and discussed by all management positions responsible for safety and health.
- The Project Delivery Team and all LCP personnel must clearly understand their roles and responsibilities for all project activities.
- All Management personnel on the project must clearly understand the processes and procedures linked to their areas of responsibilities.
- Joint construction and facility inspections must be conducted in an atmosphere of mutual cooperation to promote visible participation and endorsement of safety and health plan objectives whenever possible.
- The interface process must be reviewed on a periodic basis; continuous improvement plans are formatted and implemented as and when required.

For the Strait of Belle Isle (SOBI) Marine Crossing, the Contractor(s) executing the work will interface via daily, weekly and monthly meetings and stewardship sessions as warranted with the Project Delivery Team. The objectives of these interface sessions are as follows:

- Safety and health goals and objectives, as well as work scope are fully understood and discussed by all management positions for safety and health.

- The Contractor(s) management personnel must clearly understand their roles and responsibilities for all project activities, as well as the processes/procedures linked to their areas of responsibilities.
- Site inspections must be conducted periodically in an atmosphere of mutual cooperation to promote visible participation and an endorsement of safety and health plan objectives whenever possible.
- Plans for continuous improvement must be developed, implemented and progress tracked periodically.

Upon completion of principal Construction, The critical phases of commissioning and RFO (Ready for Operations) will require that additional Health and Safety Roles and Responsibilities must be carried out to ensure safe transition from Construction to Operations. These include, but are not limited to, the following:

- Health and Safety Management Plan for RFO developed and communicated in advance of RFO Activities.
- Risk Assessments/Task Analysis are executed during commissioning phases.
- Emergency Response Planning and Drills (Training and Establishing Roles and Responsibilities with Operations during Transition Period)
- Develop Health and Safety Procedure for Handover to Operations Personnel with roles and responsibilities clearly defined.
- Ensure appropriate Health and Safety Resources are in place to provide adequate oversight.
- Communications procedures must be developed, clearly defined and communicated to all affected parties.
- Ownership of process procedures must be clearly defined in a procedure
- Post Testing Debriefs must be carried out, fully documented and maintained on file.
- Health and Safety Equipment for RFO must be clearly defined, purchased and available on site in adequate timeframe to ensure coverage is 100% at minimum.

The following chart depicts how Health and Safety will interface with the Lower Churchill Project during three distinctive project phases engineering/ design/procurement; early works phase construction; and construction phase. Health and Safety Management Plans for the Lower Churchill Falls Operation will be developed, communicated and implemented prior to project handover/operations.

Health and Safety Focus Areas during Principle Construction Phases		
Engineering/ Design/ Procurement	**Early Works Phase Construction**	**Construction Phase**
• Health and Safety Planning Documents (Safety, Medical, Security, ERP)	• Early Works- Health and Safety Plan – Site Plans	• Construction Phase - Health and Safety Plan – Site Plan
• Constructability Reviews (per Component)	• Risk Assessments	• Logistics/Transportation Oversight
• Contract Evaluations/Input/ Procurement	• Task Safety Analysis (TSA's)	• Task Safety Analysis (TSA'S)
• Design Reviews	• Emergency Response Planning/Training/Drills	• Emergency Response Planning/Training/Drills.
• Risk Assessment Reviews- Confirm all Health and Safety Hazards/Risks are identified and mitigations are to be in place.	• Oversight Audits and Inspections (worksites, security, medical, regulatory compliance)	• Oversight Audits and Inspections
• Contract Work Scope Development	• Health and Safety Training (Energy Isolation –Lock-out/Tag-Out; Confined Space; Step Back)	• Critical Lifts- Planning, Analysis, Execution
• Risk Register	• Health and Safety Kick-off Meetings and Orientations	• Document Management
• Training Plan	• Ensure all operations are meeting Nalcor LCP Standards	• Coaching
• Equipment Selection and Procurement	• Logistics/Transportation Oversight.	• Health and Safety Training (Confined Space, Energy Isolation, Step-Back)
• Establish High Level Health and Safety Performance Standards	• Establish High Level Health and Safety Performance Standards	• Establish High Level Health and Safety Performance Standards
• Define Vulnerabilities in Design, Construction, Procedures and Mitigations	• Track incident trends and implement mitigation measures.	• Track incident trends and implement mitigation measures.

5.2 Lower Churchill Project Requirements- Health and Safety Integration

Health and Safety has been identified as a cornerstone of the overall Lower Churchill Project Requirements. It must be fully integrated into all phases of the project. Nalcor has elected to adopt the OHSAS 18000 (an internationally recognized ISO formatted standard for Occupational Health and Safety) as its standard for health and safety policies, procedures and programs for the corporation and the Lower Churchill Project.

The OHSAS methodology and requirements require full integration of Health and Safety into in all stages and aspects of the Lower Churchill Project. The Newfoundland and Labrador Occupational Health and Safety Act and associated regulations must always be considered as one of the documents to be consulted in support of the integration.

Effective planning for health and safety is essential if the LCP is to be delivered on schedule, without cost overrun, and without experiencing incidents or damaging the health of site personnel. A focus on continuous review, oversight and improvement must be undertaken and maintained to ensure the flawless execution of this project. The following chart reflects how health and safety will be integrated into the Lower Churchill Project:

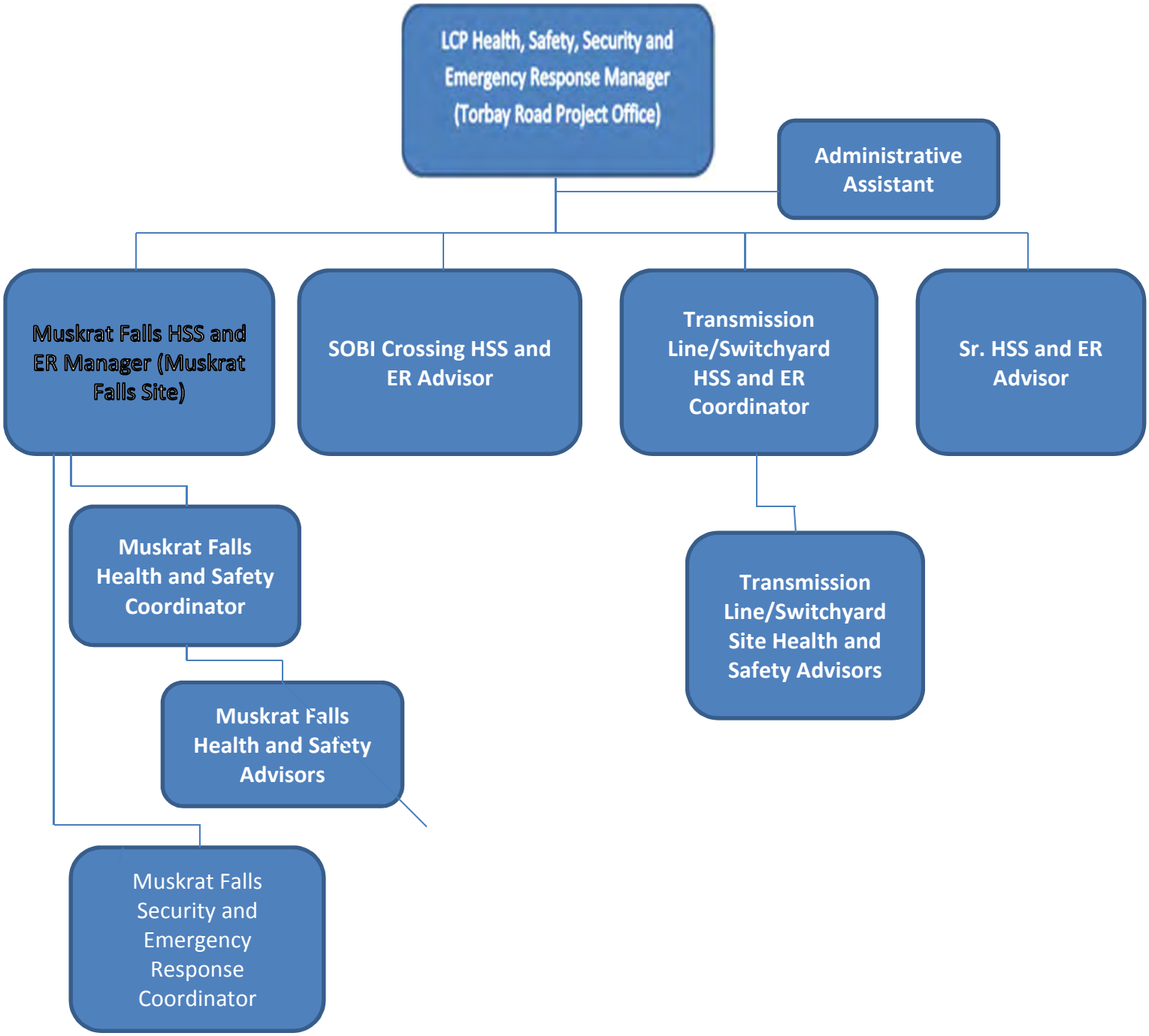
Figure 3.0: Integrating Health and Safety with Lower Churchill Project Requirements:

5.3 Health and Safety Organization – Lower Churchill Project

The Health and Safety Organization within the Lower Churchill Project will be provided with the appropriate level of support throughout the course of the project. The overall responsibility for safety performance on the project will be the responsibility of Nalcor Energy Corporation. However, Health and Safety support will engage the resources of all personnel to fully support through total buy in to the project standards, programs, policies and procedures.

As noted on the organizational chart on the next page, the Health and Safety Organization will include health and safety professionals from Nalcor, SLI and sub-contractors. The Health and Safety Organization is made up of the following support functions and organizations:

- The Project Delivery Team will have project oversight in terms of establishing governing corporate policies, procedures and programs. Corporate support includes oversight/auditing, policy and procedure development, safety and health initiatives and functional/directional support.
- The **Health, Safety, Security and Emergency Response Manager for the Lower Churchill Project,** located in St. Johns Torbay Road Office, will be providing functional support and expertise to the project as well as monitor and manage the overall health and safety direction of the Lower Churchill Project. Ensures consistency in direction, competencies, regulatory compliance, as well as implementation and application of Health and Safety policies, programs, procedures and strategies. The **LCP Senior HSS and ER Advisor** will report directly to the LCP HSS and ER Manager and provide technical HSS and ER Support for the LCP, as and when required.
- The **Muskrat Falls Health, Safety, Security and Emergency Response Manager** (located at the Muskrat Falls Site) will report directly the Muskrat Falls Site Manager with a functional reporting to the LCP HES, Safety, Security and Emergency Response Manager. **The Muskrat Falls Health and Safety Coordinator** will be responsible for monitoring, tracking and reporting day to day activities at the Muskrat Falls Site and will have **Health and Safety Advisors** reporting to this position. The Muskrat Falls Security and Emergency Response Manager will report to the Muskrat Falls HSS and ER Manager and providing support to Transmission Line/Switchyard Activities and Operations as well.
- The **SOBI Crossing HSS and ER Advisor** will report directly to the SOBI Crossing Project Manager with functional support from the LCP HSS and ER Manager.
- The **Transmission Line/Switchyard HSS and ER Coordinator** will report to Component #3 and #4 Site Managers with functional support from the LCP HSS and ER Manager. This position will also manage and direct activities of the **Transmission/Switchyard Health and Safety Advisors**, who will provide on-site Health and Safety Support.



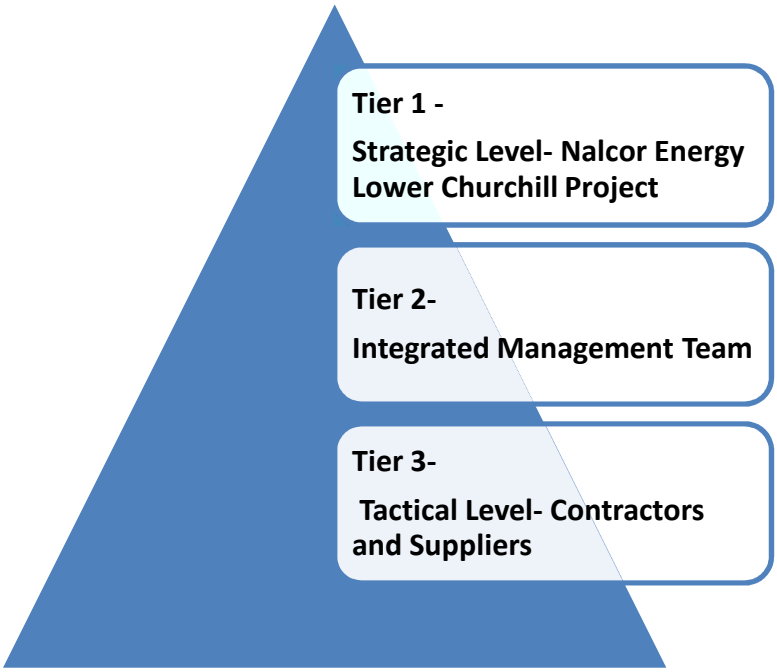
Lower Churchill Project
Health, Safety, Security and Emergency Response (HSS&ER)
Functional Organization Chart

6.0 Roles and Responsibilities:

This section denotes specific roles and responsibilities for key positions within the project team. If each individual filling these positions effectively executes these roles/responsibilities, the building of an effective health and safety culture will be assured.

The following chart (along with the explanation below it) identifies the three distinctive tiers with respect to how Occupational Health and Safety is typically managed in an Integrated Management Model and will be managed for the Lower Churchill Project. The Tiers identify the level of involvement for Nalcor Energy, the Project Delivery Team, as well as Contractors and suppliers- with each taking on a broader role. The chart also clearly defines roles and responsibilities within each tier level.

Figure 4.O: Occupational Health and Safety Management Roles and Relationships for Project Delivery Team Scope- Lower Churchill Project



Tier 1: Strategic Level

- Communicates and demonstrates Zero Harm- Nobody Gets Hurt Commitment.
- Establish LCP Safety Management System and Strategic Management Plan
- Establish expectations of Consultant's Health /Safety Plan through Coordination Procedures
- Review and Approve Health and Safety Plan and Site Plans

- Chair Project Level Health and Safety Steering Committee.
- Monitors Performance and coaches Consultants, Contractors and Suppliers to achieve desired outcomes.

Tier 2: Project Delivery Team

- Responsible for scope level management of work.
- Develops a LCP Health and Safety Management Plan based upon Nalcor's Health and Safety Management Plan
- Develops Site Specific Health and Safety Plan for all work sites.
- Establishes the necessary plan enablers (people, processes and tools)
- Selects subcontractors and suppliers who are able to execute their work scope safely.
- Demonstrates Zero Harm- Nobody gets hurt commitment.
- Reviews and approves sub-contractors Health and Safety Management Plans
- Charters and Chairs site Health and Safety steering committee.
- Monitors performance and coaches sub-contractors to achieve desired outcomes.

Tier 3 Tactical Level

- Develops a Project Health and Management Plan based on its company Health and Safety Management Plan
- Develops Site Specific Health and Safety Plan(s) for its work site
- Utilizes its people, processes, and tools to manage work-face safety.
- Focuses on Task Based Hazard Management and Work Competency
- Participates in Health and Safety Steering Committees
- Proactively engage the worker to promote a "Zero Harm- Nobody Gets Hurt" mindset.

6.1 Project Director

The Project Director is responsible for ensuring the Lower Churchill Project – Health and Safety Management Plan is fully implemented and effective, providing input on strategy development for each project deliverable, sanctioning the manpower and resources necessary for implementation of the LCP Health and Safety Management Plan and holding personnel accountable for its implementation and continued maintenance. The Project Director communicates and coordinates with Nalcor Corporate Staff, as well as Project Staff on a daily basis.

The Project Director's responsibilities from a Health and Safety perspective include (but are not limited to) the following:

- Clearly communicate health and safety expectations for the project.
- Demonstrate tangible commitment and involvement toward the relentless pursuit of safety performance excellence.
- Provide leadership for full implementation of safety and health policies, management systems and safety requirements to achieve health and safety objectives.
- Ensuring compliance with all applicable regulatory requirements is achieved and maintained.
- Be responsible for safety and health of personnel.
- Be a good role model for others to follow. Continually promote a high level of health and safety awareness.
- Periodically audit the health and safety programs effectiveness with the target for continuous improvement.
- Ensure all incidents are reported and investigated as required and corrective action taken to prevent recurrence.
- Ensure all core competencies and training needs are identified and training objectives outlined and achieved.
- Take all reasonable measures to prevent injuries to all personnel on the site (including visitors), who are exposed to hazards on the worksites under their control.
- Actively participate in safety plan activities
- Recognize significant safety achievements/accomplishments
- Reinforce health and safety as integral core values.
- Enhance workplace morale and attitudes

6.2 Project Managers

The Project Manager is responsible for ensuring the Lower Churchill Project – Health and Safety Management Plan is fully implemented and effective, providing input on strategy development for each project deliverable, sanctioning the manpower and resources necessary for implementation of the LCP-Health and Safety Management Plan and holding personnel accountable for its implementation and continued maintenance. The Project Manager communicates and coordinates with the Project Staff on a daily basis.

The Project Manager's responsibilities from a Health and Safety perspective include (but are not limited to) the following:

- Clearly communicate health and safety expectations to the respective Project Management Team.
- Provide effective leadership and guidance at the Project Management Level for full implementation of safety and health policies, management systems and safety requirements to achieve health and safety objectives.
- Demonstrate tangible commitment and involvement toward the relentless pursuit of safety performance excellence.
- Ensuring compliance with all applicable regulatory requirements is achieved and maintained during project planning, design, construction and overall execution of the project.
- Support and attend (where possible) the formal health and safety leadership training periodically.
- Be responsible for safety and health of all project personnel.
- Be an engaged role model for others to follow. Continually promote a high level of health and safety awareness.
- Assist the Project Director, as well as the Safety and Health Manager, to audit the health and safety programs effectiveness with the target for continuous improvement.
- Ensure all incidents are reported and investigated as required and corrective action(s) taken to prevent recurrence and communicated to others to prevent recurrence.
- Ensure all core competencies and training needs are identified and training objectives outlined and achieved within the Project Management Team.
- Take all reasonable measures to prevent injuries to all personnel on the site (including visitors), who are exposed to hazards on the worksites under their control.
- Actively participate in safety plan activities as well as periodic reviews.
- Recognize significant safety achievements/accomplishments
- Reinforce health and safety as integral core values.
- Enhance workplace morale and attitudes through effective communications, recognizing accomplishments and outstanding safety and health performance.

6.3 LCP Health, Safety, Security and Emergency Response Manager

The Nalcor Energy LCP Health and Safety Manager is responsible for ensuring the LCP-Health and Safety Management Plan is developed in conjunction with those developed by Nalcor Energy Corporate policies and best practices, regulatory guide lines, major contractors, and

communicated to the Project Director, as well as all Nalcor Energy LCP managers, supervisors and employees, contractors, subcontractors and consultants.

The LCP Health and Safety Manager's responsibilities include (but are not limited to) the following:

- Clearly communicate safety and health expectations for the project.
- Be responsible for promoting safety and health practices, policies and procedures for all personnel.
- Be responsible for establishing strong functional expertise in health and safety management, who are fully engaged in strategic-direction setting and day-to-day project delivery activities with Area/Scope Managers and Construction Managers.
- Provide technical expertise and guidance pertaining to safety and health related issues, conditions, incidents and actions.
- Take all reasonable measures to prevent injuries to all personnel on the site (including visitors), who are exposed to recognized hazards on the worksites under their control.
- Demonstrate tangible commitment and involvement toward the relentless pursuit of safety performance excellence.
- Coach Management and Supervisory Staff on effectively incorporating safety and health practices, policies and procedures as and when necessary
- Provide safety feedback to workers, supervisors, and managers
- Be a visible and effective role model for others to follow. Continually promote a high level of safety and health awareness.
- Actively participate in safety planning activities
- Coordinate formal Health and Safety leadership training for all levels of management and supervision.
- Recognize significant safety achievements/accomplishments in a timely manner
- Continually reinforce safety and health as integral core values.
- Enhance workplace morale and attitudes through effective interaction.
- Periodically audit the health and safety programs effectiveness with a target of continuous improvement and establish key performance indicators.
- Ensure all incidents are reported and investigated as required and corrective actions are taken to prevent recurrence. Communicate lessons learned from incidents and near misses to potentially affected personnel to better prevent recurrence.
- Ensure all core competencies and training needs are identified and training objectives achieved.

- Monitor effectiveness of hazard evaluation and reporting process.
- Actively participate in the audit/assessment process, providing guidance, support and professional expertise.

6.4 LCP Health and Safety Management Team

The LCP Health, Safety, Security and Emergency Response Management Team responsibilities from a Safety and Health perspective include (but are not limited to) the following:

- Ensuring that supervisors, leaders and employees comply with the requirements of the LCP-Health and Safety Management Plan to the extent applicable to their respective mandates.
- Attend and participate in formal Health and Safety Leadership Training targeted at all levels of management and supervision.
- Ensuring that health and safety programs comply with contractual and regulatory requirements.
- Reinforcing that workers are informed of site specific hazards and conditions and are adequately trained in safe work practices and procedures.

6.5 Supervisors, Leaders and Employees

Supervisors, Leaders and Employees are responsible for:

- Fully understanding the LCP-Health and Safety Management Plan and communicating the specific requirements applicable to their team members and contractors ensuring that deliverables are met within the stipulated timeframes.
- Line Management will be held accountable for the Safety and Health Performance of their subordinates and contractors.
- Communicating health and safety expectations to your subordinates and always being a good role model and example.
- Actively participate in Health and Safety Plan activities.
- Ensuring compliance with all corporate policies, procedures and practices included in this Management Plan and applicable regulatory requirements.
- Confirming that all workers are suitably trained and adequately qualified and have sufficient knowledge and experience to perform their work safely.
- Participation in hazard assessments carried out at the work sites.

- Promptly report high potential health and safety near-misses and incidents.
- Monitor the worksite and correct any unsafe conditions or unsafe worker behaviors promptly.
- Attend and participate in formal Health and Safety Leadership Training targeted at all levels of management and supervision.
- Ensure recognized hazards are eliminated to the extent practicable and ensuring any remaining identified hazards are adequately controlled/communicated to affected personnel. Identify and correct unsafe behaviors and conditions as soon as practicable.
- Always provide constructive feedback to subordinates.
- Continually assess leading and lagging performance indicators for trending to define and implement continuous improvement opportunities.
- Ensure appropriate personal protective equipment is readily available at the worksite, correctly used, stored and maintained and replaced when necessary.
- Be a safety resource and informal trainer/coach.
- Understand the capabilities and limitations of subordinates.
- Make every effort to enhance workforce morale and attitudes.

6.6 Project Delivery Team, Employees, Consultants and Staff

Project Delivery Team, Employees, Consultants and Staff are responsible for ensuring the LCP Health and Safety Management Plan is maintained and followed and identifying areas for continuous improvement to their respective managers and supervisors. Additionally, they are responsible for the following:

- Acquaint themselves with the recognized hazards that may exist in the activity they will be undertaking or the locations they will be working and the appropriate mitigating measures.
- Be a good role model to co-workers.
- Actively participate in Safety Plan Activities.
- Refuse to undertake unsafe work or utilize unsafe equipment believed to be unsafe.
- Perform all tasks with due regard to safety, as well as health and safety of co-workers, the public and the environment. Pre-plan safety as an integral core value.
- Participate in safety orientations, training sessions, programs and meetings and make positive suggestions to improve worker safety (utilize the SWOP program)
- Comply with all applicable safety policies, procedures, programs and regulatory requirements.
- Always use the required personal protective equipment and clothing.

- Report all safety, health and environmental incidents, as well as near-misses to your supervisor.
- Continually evaluate your own competency and make every effort to enhance your skills and capabilities.
- Know your co-worker's abilities and limitations, as applicable.
- Always use the appropriate safety and personal protective equipment required for the job.
- Report all unsafe conditions, imminent danger and potential hazards to your supervisor immediately.

6.7 Contractors and Sub-contractors

Contractors are responsible for familiarizing themselves with the LCP-Health and Safety Management Plan and workers are orientated to the safety plan to ensure that health, safety and environmental objectives are achieved and maintained. All Contractors and Sub-contractors providing a service or support to the LCP-Health and Safety Management Plan are required to work in accordance with the provisions of this Plan.

Additionally, they are responsible for the following:

- Acquaint themselves with the hazards that may exist in the activity they will be undertaking or the locations they will be working as well as appropriate mitigating measures.
- Refuse to undertake unsafe work or utilize unsafe equipment believed to be unsafe.
- Perform all tasks with due regard to safety, as well as health and safety of co-workers, the public and the environment.
- Participate in safety orientations, training sessions, programs and meetings and make positive suggestions to improve worker safety.
- Comply with all safety policies, procedures, programs and regulatory requirements.
- Always use the required personal protective equipment and clothing.
- Report all safety, health and environmental incidents, as well as near-misses to your supervisor.
- Report all unsafe conditions, imminent danger and potential hazards to your supervisor immediately.

NOTE: All personnel related to the project are responsible for their own safety, the safety of their fellow workers and for applying these LCP-Health and Safety Management Plan principles to their work task each day.

Utilizing a well-defined bid and selection process; Nalcor Energy-Lower Churchill Project Contractors are responsible for providing fully certified equipment onshore and offshore (where applicable) that meets its class designation including the equipment, crews, and Health and Safety management systems. The contractor also operates and maintains the right to the obligations defined in the Contractor's Health and Safety Policies and Procedures to ensure that health safety and environmental management is integrated into all of its business activities, all contractors will:

- Advise each manager, supervisor, employee and contractor of his/her Health and Safety Roles and responsibilities prior to job commencement;
- Comply fully with all applicable Health and Safety laws and regulations;
- Provide safe working rules, practices and procedures based on risk experience, safety knowledge and competent work direction;
- Assess all anticipated known risks prior to starting a new activity or one that is conducted very rarely;
- Ensure employees are qualified and trained to perform the tasks they are assigned;
- Make every effort to eliminate or minimize potential damage to equipment, vessel or environment;
- Investigate all incidents/accidents and take corrective action as appropriate;
- Ensure an immediate and effective response to emergencies is established and maintained and that all personnel understand their roles and responsibilities;
- Provide competent and trained professional staff to support Health and Safety activities;
- Monitor and report Health and Safety performance with a focus on continuous improvement; and
- Establish a strong Health, Safety and Environmental culture within all working groups/teams and contractor for The Lower Churchill Project.

Every employee of the main contractor has the responsibility to:

- Promptly report all hazards, incidents and near miss occurrences;
- Practice good "common sense" safety principles;
- Provide constructive ideas and concerns so as safety efforts and initiatives might be further strengthened;
- Become actively involved in the Health and Safety Program; and
- Comply with all federal, provincial and local regulations directly related to health, safety and environmental.

The above objectives will be accomplished by implementing the Health and Safety Plan in conjunction with the Lower Churchill Project and Contractor Health and Safety Policies and Procedures, as well as the Newfoundland and Labrador OHS Act and associated regulations. ***NOTE: In the event of a conflict within this plan and the contractor's plans, the most stringent requirement will always take precedence.***

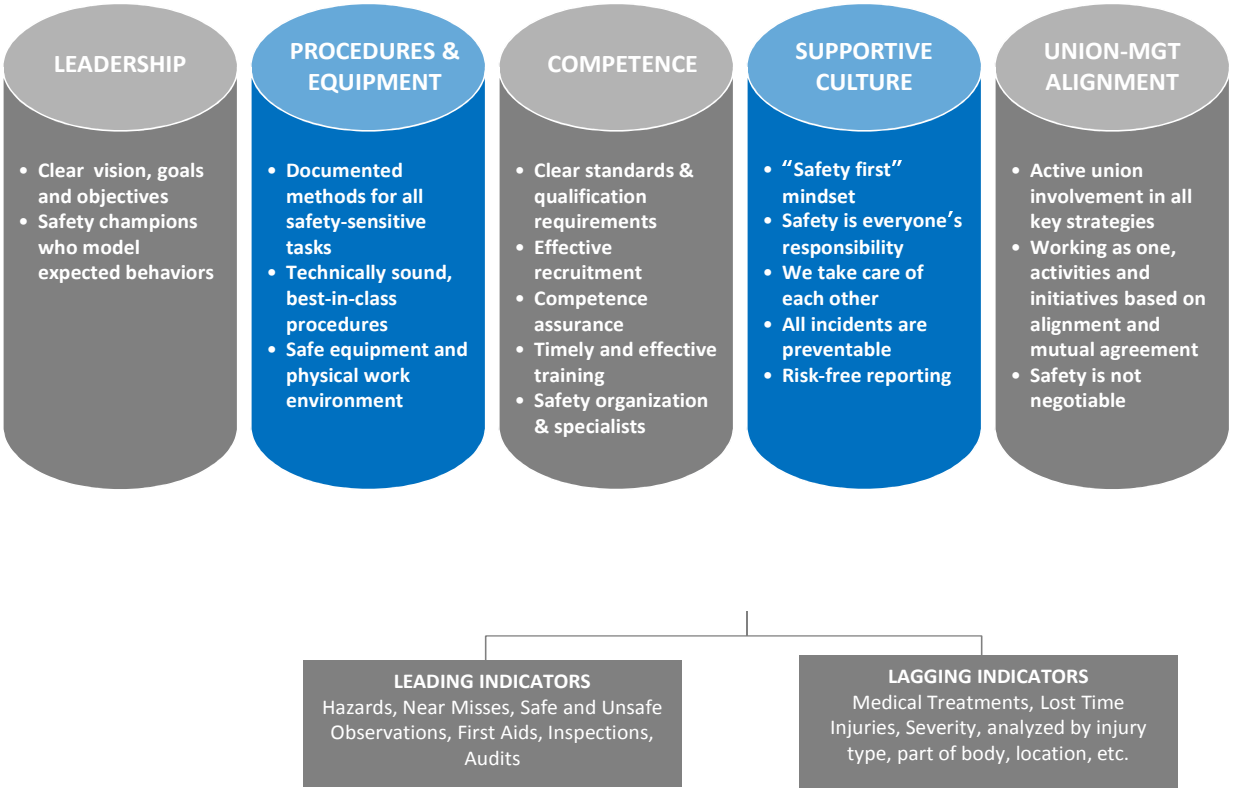
6.8 Accountability

All Personnel working on the Lower Churchill project are accountable for:

- Establishing and maintaining Occupational Health and Safety through continually safeguarding the well-being of project personnel, the general public, and the environment through safe and environmentally responsible work practices associated with the design, construction and transportation of the Nalcor Energy-Lower Churchill Project structures and equipment;
- Continually striving to maintain an accident and incident free "Zero Harm – Nobody Gets Hurt" working environment at Nalcor Energy-Lower Churchill Project and its contractors work sites and
- Ensuring total compliance with all Health and Safety applicable regulations.
- All Personnel involved in the Nalcor Energy-Lower Churchill Project are accountable for keeping to the following Safety Rules:
- Ensure Health and Safety always remain core values within all aspects of the project and are not prioritized along with other business priorities;
- Always follow established Safe Practices and Procedures – if they are not safe, advise your Supervisor and have them changed or modified;
- Always challenge and correct wherever possible any Unsafe Acts, Conditions or Procedures that you observer or otherwise come to your attention;
- Report all Safety Observations and Undesired/Near Miss Events and use your Safe Workplace Observation Program (SWOP) cards; (see it – fix it – report it)
- Only start on a task when you have all the authorizations and permits in place; and
- Always STOP/Intervene a task if you are not satisfied that it is safe to continue or it presents a risk to others.

7.0 Health and Safety Management System Framework

Figure 5.0: Health and Safety Management System Framework



The foundation of the Health and Safety Functional Management System Framework has been established and implemented based on the following:

- Safety Credo (Section 7.1- Figure 6.0))
- Health and Safety Policy, (Sections 7.2 and 7.3)
- Guiding Principles and Performance Objectives, (Section 7.4)
- Occupational Health and Safety Management Plan (A Management Plan that describes in detail of how the specific guiding principles and objectives will be achieved using specific enablers.),
- Enablers (People, Practices, Procedures and Tools that enable the implementation of the Plan.),
- Roles and Responsibilities (Section 8)
- Individual Behaviors and Actions. (Engaging personnel to act in a manner so as to minimize risk to the individual, the environment and stakeholders.).

7.1 Safety Credo

Our approach to managing safety on the Lower Churchill Project is rooted within the Safety Credo. Every member of the Lower Churchill Project is expected to work in accordance to the Safety Credo (Section 9.0) and to utilize the available tools and procedures that are required to complete their job safely.

The safety of our employees, contractors, visitors and the public is our first and most important priority. Our goal is a workplace where nobody gets hurt -- zero harm -- and a working environment where each and every employee is always concerned for their own safety and the safety of others. Everyone on the Lower Churchill Project is personally committed to these basic safety values as the foundation for our success as a safety leader.

The Safety Credo has three (3) basic rules to live by:

- I always follow safety requirements and best practices
- I always take time to complete my work safely
- I always take action when I see unsafe acts or conditions

Figure 6.0: Safety Credo

7.2 Health and Safety Policy

A written general policy statement can effectively reflect corporate management's positive attitudes and acceptance of overall responsibility for health, safety and environmental protection. It demonstrates to NE-LCP managers, supervisors, employees, contractors, subcontractors, consultants and visitors that the health and safety of workers and the preservation of the natural environment is a priority and takes precedence over expediency and shortcuts.

The LCP Health and Safety Policy reflects the Project Delivery Team's commitment to Health and Safety and forms the basis upon which the Health and Safety Management Plan, and as well as the LCP Health and Safety Management Plans of all Contractors, Suppliers, and Consultants working on the LCP is based.

This Policy and the goals embodied within it outline management's commitment to maintaining a safety culture within our organization, in the organizations of our contractors and subcontractors and in all project activities. It mandates the tangible demonstration of this commitment through compliance with the Health and Safety Policy and by making continual improvement an integral part of activities.

7.3 Nalcor Energy Corporate Occupational Health and Safety Policy

Nalcor Energy
Occupational Health and Safety Policy

The safety of our employees, contractors, visitors and the public is our first and most important priority. Our goal is a workplace where nobody gets hurt -- zero harm -- and a working environment where each and every employee is always concerned for their own safety and the safety of others. In support of this goal, Nalcor Energy and its employees are committed to the following guiding principles

1) Employees will govern their actions in accordance with Nalcor Energy's Internal Responsibility System for safety. This includes adherence to the principles of employee and role related responsibilities for their personal safety and the safety of their co-workers, contractors, visitors, and members of the public.

2) Nalcor Energy shall establish and maintain an Occupational Health & Safety Management System (HSMS) which:
   a. meets or exceeds legislated requirements and is compliance with accepted industry standards and practice; and
   b. documents health and safety objectives for Nalcor Energy; and
   c. contains a mechanism for performance measurement and continuous improvement; and
   d. facilitates both the formal and informal involvement of employees in the development, maintenance, and improvement of occupational health and safety within the organization.

President and CEO
Nalcor Energy

Rev: 02
June 8, 2009

7.4 Guiding Principles

The guiding principle upon which this Health and Safety Management Plan is built includes the following:

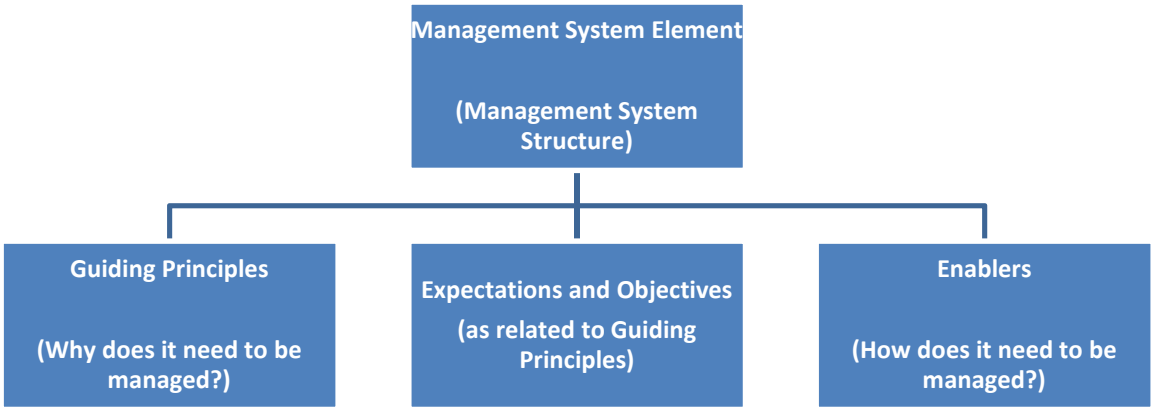
- All incidents are preventable.
- Ownership by senior management and on-site supervision is mandatory through direct involvement, a review of Health and Safety programs and efforts, and a focus on continuous improvement. Management must lead by example.
- Ensure appropriate resources and personnel are provided and available to execute the work safely and without adverse impact to health.
- Safety is a line organization function and cannot be delegated.
- As reasonable and practicable, Project Delivery Team has an obligation to eliminate or mitigate all known hazards and to ensure workers are fully competent and are supervised by a competent individual in the tasks to be performed.
- Management must understand and incorporate various safety practices and processes within the LCP and recognize when work activities, practices and procedures come in conflict with one another and instituting measures for mitigation.
- All Project Delivery Team personnel and contractor personnel associated with the work have the right to be aware of the hazards, the right to participate, and the obligation to stop unsafe work without retribution.
- All personnel associated with the work are empowered to contribute to the Health and safety efforts.
- Safety performance requires establishing procedures and programs, conducting training, contractor employee involvement, routine self-evaluation, and continuous improvement.
- Prospective contractors must clearly understand that past health and safety performance will be part of the criteria used to select contractors to perform work for the LCP.
- When necessary, a contractor is expected to improve or implement processes where gaps exist between their programs and the LCP's expectations.
- Continuous improvement must be a permanent objective for the LCP. Opportunities for improvement must be identified, evaluated and applied systematically and logically.

7.5 Health and Safety Management Plan Format

The LCP Health and Safety Management Plan is structured in accordance with the OHSAS 18001 Plan-Do-Check-Act Model for continuous improvement. It also incorporates the seven core elements of Health and Safety Management as noted below:

Figure 7.0: Seven Core Elements of Health and Safety Management

The Health and Safety Management Plan is structured to be both user-friendly and a useable resource. The basic format of the Plan includes a listing of sub-elements, guiding principles and enablers as defined below:



7.5.1 Element 1: Leadership (Commitment, Personal Behavior, Accountability):

The Project Delivery Team is responsible for supporting the development, implementation and assessment of safety and health initiatives and control mechanisms addressing emerging issues and providing feedback as and when appropriate. The Project Management Team must establish the overall tone of Health and Safety Management and its foundation of the project's overall culture.

Leadership Expectations: It is expected that all members of the Project Delivery Team will:

- Ensure that a positive Health and Safety Culture and Management System are established, implemented, communicated and supported at every level of the organization
- Communicate health and safety performance expectations to others.
- Visibly demonstrate their commitment to the achievement of the Project's Health and Safety goals and objectives.
- Be interested, visible and active in promoting Health and Safety processes and initiatives.
- Deal promptly and appropriately with Health and Safety improvement actions and suggestions within their area of control.
- Give appropriate consideration of Health and Safety performance as a key indicator of overall performance requiring equivalent management effort.
- Establish and maintain the standard for acceptable Health and Safety behaviors within the project by setting a model example themselves.

- Nominate Health and Safety Management Representative responsible for the overall coordination of the Management System and ensure the representative is trained in each of the Management Elements, expectations and roles responsibilities.
- Allocate appropriate resources to achieve our health and safety priorities and objectives.
- Where applicable, a clear Zero Tolerance policy is communicated to all employees (Examples include Drug and Alcohol Policy, Workplace Violence/Horseplay, etc.)
- A clearly defined disciplinary program must be communicated to all employees and applied fairly and uniformly.
- A clearly defined substance abuse prevention policy is posted and included in orientation literature
- Business Code of Conduct is posted and in place

Demonstrating Health and Safety Leadership: The Project Management Team can demonstrate Health and Safety Leadership by the following:

- Carry out site visits with the principle objective to review, discuss or promote Health and Safety issues.
- Establish, Manage and Track Project and Individual Health and Safety performance toward established goals and objectives. Promote overall Health and Safety Performance Awareness.
- Make health and safety a key agenda item at Management Meetings.
- Taking a proactive approach to the prevention of incidents as an integral part of our operations overall.
- Become actively involved in Health and Safety Coordination and Steering Committee (JOHS).
- Strive to achieve all aspects of personal health and safety performance contract.
- Include health and safety roles, responsibilities and accountabilities in manager's job descriptions.
- Include health and safety performance as an integral part of the performance appraisal process.
- Include the nominated health and safety Management Representatives on the organization chart.
- Ensure effective health and safety Orientation Programs are in place covering Safety Standards, Policies, Procedures and Core Values.
- Enable Supervisor health and safety Responsibility to be provided periodically.
- Provide Behavior based health and safety Training Programs periodically.
- Ensure Behavioral observations are performed.

- Encourage health and safety Surveys be performed, analyzed and used to establish corrective actions, as appropriate.

Taking Personal Responsibility: The Project Delivery Team, as well as personnel at all levels, must take personal responsibility for Occupational Safety and Health. To accomplish this, all personnel should exhibit the following:

- Sincere caring for others, their safety and their well-being.
- Be aware of their influence as a role model at work and during their spare time.
- Sound health and safety behavior on and off the job.
- Intervene constructively with at-risk behaviors and conditions
- Are attentive to others behavioral changes, and respond appropriately
- Follow defined Health and Safety policies, procedures, rules and standards.

Understanding Accountabilities: Everyone associated with the Lower Churchill Project, its operations and activities is accountable for their actions. Deviations from standards of acceptable behavior are dealt with in a fair and consistent manner. Personnel at all levels of the organization must:

- Understand what is expected and are held accountable for their actions and inactions.
- Use their authority and responsibility to react to all observed or known at risk behaviors or unsafe conditions.
- Respond in an open and fair manner to incidents reported and issues raised.
- Practice tolerance for mistakes but are aware of and accept consequences for reckless behaviors.
- Must be open and receptive to constructive feedback from others.

7.5.2 Element 2: Communications (processes, information and documentation)

Effective and open communications are essential to the success of any project. Successful internal communication is crucial to the development of an informed and motivated workforce. Efficient external communications preserves Nalcor's reputation and enhances our business standing and credibility.

Communications Expectations: For effective communications, arrangements must be made which ensure that Managers can:

- Identify, develop and maintain systems for the control of information necessary for working safely and assure regulatory compliance with health and safety issues.

- Ensure that personnel are properly informed of health and safety risks and control measures.
- Encourage employees at all levels to raise health and safety concerns without reprimand and shall respond to these concerns in a timely and appropriate manner.
- Fully support consultation on health and safety matters to explore opportunities for influencing issues.
- Ensure health and safety campaigns and initiatives receive adequate publicity.
- Support health and safety representatives and committees to contribute to the Project's health and safety performance.
- Establish an effective channel between management, employees, third parties and clients concerning existing, new or evolving health and safety issues.
- Encourage Personnel at all levels to give feedback, propose improvements, share information and best practice.
- Support proper liaison with clients, contractors, sub-contractors and external bodies on health and safety issues occurs.
- Ensure that the LCP is represented on industry bodies and positioned to influence and shape Health and Safety policy and regulatory matters.
- Health and Safety achievements are given due publicity and recognition.

Establishing Effective Health and Safety Communications: Effective communications can be achieved through effective training, interaction, forums, policies, programs and health and safety meetings. The following Health and Safety Communication tools have been put in place to enable effective communications:

- Periodic health and safety meetings/daily toolbox talks carried out at the worksite.
- Health and Safety Representatives committee meetings (JOHS Committee)
- New Employee Orientation Sessions
- Periodic Project newsletters
- Health and Safety bulletins and alerts (Communicating Lessons Learned)
- Industry forum representation and participation
- Management site visits with focus on Health and Safety
- Meetings with clients, contractors/subcontractors on health and safety issues.
- Emphasize and promote health and safety publicity campaigns
- Effective communication channels are in place without filtering mechanisms
- Forward communications which outline changes to health and safety practices, policies and procedures

- Training programs reviews carried out periodically to ensure current technology, applicable risks and regulatory requirements are addressed
- Employees suggestion program
- Encourage use of a Safety slogan/theme program
- Participate and support Safe Work Observation Program (SWOP)
- Track leading and lagging indicators

Expectations concerning Information and Documentation Management: The availability of accurate, relevant and current information and documentation is a key contributor to successful health and safety performance. Processes for capturing and sharing knowledge are in place to deliver the best available health and safety practice to our operations. Effective information and documentation management systems are in place such that:

- Drawings and other pertinent documentation necessary for health and safety compliant operations are identified, current and readily accessible.
- All applicable regulations, codes and standards are identified, current and readily accessible.
- Document retention and archiving requirements are established and satisfied.
- The currency of the system and procedures is ensured.
- Roles and responsibilities in relation to information and documentation management are clearly understood.
- Appropriate use is made of electronic information management systems.

Effective Information and Documentation Management Mechanisms: The following mechanisms and management systems can be utilized to effectively store, research, retrieve and retain Project Information and Documentation:

- Integrated Management System
- Document management system
- Health and Safety plans and interface documents
- Health and Safety library and databases
- Internet
- Communicating Health and Safety Regulatory Changes and Interpretations
- Document Retention Procedures/Programs.
- Document Disaster Recovery Procedures

- Periodic Assessment/Audits of Informational Systems for Effectiveness, Compliance with Policies and Procedures.
- Regulatory Compliance Plan in place.
- Lessons learned capture and implementation process.

7.5.3 Element 3: Organization (competence, personal development, roles/ responsibilities):

The success of Health, Safety and business performance within the Lower Churchill Project is largely influenced by the competency of employees, contractors and sub-contractors. While the maintenance of a stable, competent and motivated workforce is also a critical factor. In order to ensure competency and personal development, Managers will assure that:

- Effective recruitment, selection and placement processes are in place and fully functional.
- Health and Safety competence requirements are identified, gaps analyzed and training programs are in place to close the gaps.
- A health and safety mindset and competence requirements are applied in recruiting, selection, succession planning and promotion at all levels.
- Personal appraisal/performance and development reviews are undertaken for employees.
- LCP employees are encouraged and supported in their career development.
- To the extent practicable, succession planning is in place.
- Ensure that a comprehensive training program is in place for all individuals to ensure the correct level of competence and health and safety awareness is attained prior to any change in their job duties.
- Health and safety training is provided by competent personnel and its effectiveness is properly reviewed.

Means to Accomplish Workforce Competency and Personnel Development: Occupational Health and Safety must be included as a part of overall:

- Recruitment, selection and placement procedures.
- Resource forecasting and allocation.
- Project site inductions.
- Position/role descriptions including competency requirements.
- Succession planning.
- Competency Assurance Systems/Testing and Verification.
- Personal appraisal and development programs, including a review of overall health and safety performance

- Training need analysis
- Training matrices / plans
- Program effectiveness evaluation including review of assigned tasks and targets with respect to health and safety roles.
- Competence training in health and safety policies and procedures, hazards awareness and required certifications

Understanding Roles and Responsibilities within the Organization: The defining and understanding of individual roles and responsibilities are key to the achievement of our project health and safety objectives. It is very important that the appropriate level of resources is allocated and responsibilities are clearly defined and communicated. To do so, arrangements must be in place to ensure that:

- Health and Safety roles and responsibilities are a clearly defined and integrated part of all job task roles, and are clearly communicated and understood.
- Appropriate resources are allocated to enable Project Delivery Team to reach its Health and Safety objectives.
- Appropriate health and safety resources are allocated in relation to project execution.
- A health and safety function is in place to support the organization, is identified on organization charts, and reports at the highest appropriate level within the organization.
- Health and Safety committees and representatives are appointed, their roles are defined and they are involved in health and safety processes at all levels

Policies, Procedures and Programs for Assuring Competency/Personal Development: The following policies, procedures and programs are in place within the Lower Churchill Project to assure competency and personal development:

- Recruitment, selection and placement procedures.
- Resource forecasting and allocations.
- Position descriptions which include clearly defined health and safety competency requirements.
- Orientation/ Induction training program focusing on these expectations given to all employees
- People surveys and interviews.
- Site health and safety procedures.

- Health and Safety resources included in budgets.
- Health and Safety function identified on organization chart and participates in business management meetings as appropriate.

7.5.4 Element 4: Management of Risk/Emergency Preparedness/Health (risk assessment, emergency preparedness, occupational health, MOC)

The Lower Churchill Project must ensure that Occupational Health and Safety Risks arising from, or associated with its activities are identified, addressed and effectively managed, so as to eliminate or reduce them to a level that is as low as reasonably practicable (ALARP). An effective means of risk management must be in place and fully functional and ensure the following:

- Health and Safety risks are identified and their consequences and probabilities properly assessed to ensure that risks, so far as reasonably practicable, are assessed based on probability of occurrence, risk, severity, consequences to personnel and the environment and are controlled utilizing the following hierarchy (preferred actions to least desirable actions): a) Risk Elimination, b) Engineering Design to Mitigate Risk, c) Incorporate Safety Devices for Risks that cannot be mitigated, d) Provide Warning Devices or e) Personal Protective Equipment.
- Appropriate risk reduction or mitigation measures are identified and implemented and managed to completion.
- Risk assessments are facilitated and undertaken by competent personnel including, where necessary, expertise external to the Project.
- Risk assessments are subjected to an appropriate review and validation process.
- Risk assessments are properly documented and action items closed in a timely manner.
- Affected personnel are made aware of, and understand risk assessment results and recommendations relating to their activity.

Enabling Measures to the Risk Assessment/Mitigation Process: The following processes can assist with the execution of an effective risk assessment/mitigation task:

- Risk Policy is in-place and supporting risk management program which includes the assessment of Health and Safety related risks.
- Ensure identified risks are addressed at the appropriate level within the project organization, given the nature and magnitude of the risk.

- Ensure adequate risk control equipment/practices are included as part of design, construction and operations.
- Risk register and risk mitigation / control plan are in-place and updated periodically.
- Risk mitigation /control measures are effectively communicated to all affected personnel.
- Throughout the project execution phases perform various health and safety specific risk assessment / management activities.
- Conduct risk/hazard assessments, including the following techniques: HAZID (Hazard Identification), HAZOP (Hazards Operability Analysis), QRA (Quantitative Risk Assessment), FTA (Fault Tree Analysis), FMEA (Failure Modes and Effects Analysis).
- Conduct constructability assessments with due consideration of Health and Safety Factors/Issues.
- Conduct Task Based Risk Assessments (TBRA- Refer to Section 13.1))
- Implement Step Back 5 x 5 (Utilizing the 5x5 Risk Matrix to evaluate a particular work tasks)
- Implement WHMIS
- Conduct Manual and Equipment handling risk assessments (Refer to Section 13.1)
- Conduct ergonomic assessments
- Conduct fire risk assessments
- Implement hazard recognition and reduction methods included in training

Changes in operations, organization, facilities, systems and procedures must be properly evaluated and managed in such a way as to minimize any potentially adverse Health and Safety impacts. Best Practices should be captured during the transitional phase. For changes of this nature, the following measures must be in place to allow for proper assessment and control:

- Organization, staffing, roles and responsibilities for change management
- Management systems, processes and procedures
- Facilities, plant, process and equipment
- Work scope/tasks include change management documentation requirements.
- Regulations, procedures and standards
- Changes are appropriately documented, reviewed, approved, communicated and authorized prior to execution
- Change implemented is periodically monitored and reviewed and any action items resulting from the review are addressed in a timely manner prior to change closure

Enabling measures for Managing Risk as a result of Changes to Organization, Facilities, Systems and Procedures:

- Management of change process
- Personnel transfer/promotion processes
- Change control processes and procedures
- Levels of authority for change approval
- Monitoring, audit and review processes
- Change item action tracking
- Document/Communicate Changes
- Review/Approval Process
- Work scope changes
- Matrix of compliance related to authority rules and regulations.
- Monitoring, audits and review process
- Revision controlled technical documents

Emergency Preparedness is essential in order to protect personnel, the environment and assets. Emergency Response Plans are in place to allow us to respond effectively and efficiently in the event of an actual emergency. In order to effectively respond to an emergency, the following systems, plans, procedures and training must be in place:

- Emergency response plans are based on an assessment of potential incidents and threats, and are documented and well understood by all affected parties
- Emergency response management plans/programs must reflect the uniqueness/specifics of the work and associated work locations.
- Personnel with emergency response roles and responsibilities are fully trained and competent
- Appropriate emergency response facilities and equipment are provided and maintained in fully operable condition.
- Personnel security is assessed and included in emergency response plans.
- Interface arrangements with contractors, subcontractors and the community include well defined emergency response responsibilities.
- External communication roles concerning emergency responses are documented and understood by all parties.
- Emergency response drills and exercises are undertaken regularly.
- The competency of those involved in ER is assessed on an ongoing basis.

Emergency Response Plan Effectiveness/Efficiency: To best ensure the effectiveness and efficiency of the Emergency Response Plan, the following will be implemented at the Project Office and/or Field Construction Sites:

- Coordination procedures and documents clearly defining Emergency Response roles and responsibilities with contractor interface.
- Emergency Response procedures and plans have been established and organization will be fully trained
- New employee / visitor orientation includes Emergency Response overview and discussion of specific roles and responsibilities.
- Periodic Emergency Response drills and exercises will be carried out with the target of continuous improvement.
- Emergency Response training conducted including hands-on and simulated exercises, as appropriate.
- Duty rosters established and maintained current insuring that all key positions will be fully manned.
- Emergency Response facilities on site established and maintained in fully operable condition (e.g. first aid equipment, firefighting equipment, and emergency phone numbers posted at conspicuous locations).
- Evacuation plans prepared and in place and known to appropriate personnel.
- Equipment inspection records established and maintained current.
- Media interface training for emergency situations.

Occupational Health: The Lower Churchill Project will actively monitor its activities to ensure that appropriate measures and programs are in place to protect our employees from harm as a result of occupational health hazards. To accomplish this, Managers will ensure that:

- Prevent occupational illness or injury to the Project Team and field workforce by managing medical, public health and occupational health risks.
- Minimize the seriousness of injuries and illnesses by ensuring access to quality primary and emergency medical care.
- Ensure that well planned, well documented and drilled procedures are in place for responding to remote medical incidents requiring significant medical attention and/or evacuation.
- Verify that all National, Provincial and Local Health Regulations are incorporated in Project plans and facility designs.

- Ensure satisfactory health management of Project sites through Health inspections and surveillance.
- All employees are encouraged to raise occupational health issues and concerns as they arise.
- Establish expectations that construction and installation contractors implement procedures and programs for ensuring healthy working conditions for personnel during the course of the project.
- Ensure communication of known health related hazards and remedial measures to all affected personnel.
- Ensure that project activities do not inadvertently affect the health of project personnel or local communities.
- Appropriate corrective/ preventative measures are implemented in a timely manner.
- Follow-up actions are taken to ensure appropriate provisions are adopted and fully implemented.
- Identify and implement regulatory and best practice medical practices, procedures and programs.

Implementing Health Measures and Programs: Methods for Implementing Measures and Programs designed to protect all personnel from harm as a result of Occupational Health Hazards include the following:

- Employee Health Questionnaires
- Food Services Contractor Health Plans must be prepared and periodically reviewed/updated which include organization charts, medical emergency response, worker immunizations/medical evaluations, known health risks, training requirements and health inspections, food handling, preparation and storage requirements.
- Ensure all personnel are fully trained and prepared for working conditions in Newfoundland and Labrador.
- Applicable periodic physicals
- Health communications through bulletins, e-mails, programs, training and procedures.
- Follow-up medical examinations, as identified and applicable.
- Medical evaluations for known and specified regulated activities
- Health Risk Assessments
- Worksite Health Assessments
- Worksite Health Inspections
- Health Awareness Training

- Health Related Awareness Bulletins
- Budget for medical and health assessments related to remote project locations, during planning phase.

7.5.5 Element 5: Third Party Relations (Clients/Partners, Contractors/Suppliers, Community)

Establishing and Maintaining Effective Client/Partner Relationships: Effective Client and Partner interfaces and working relationships are critical for the Lower Churchill Project and for our common Health and Safety Performance. We work closely with clients and partners to manage our roles and align expectations and goals. Arrangements must be in place to ensure that:

- Health and Safety expectations, objectives, responsibilities, roles and interfaces are clearly defined, documented and agreed between the involved parties.
- An open dialogue on Health and Safety issues is retained at appropriate levels within the organization.

Client/Partner Interface Processes: Processes that enable more effective Client/Partner Interfaces include the following:

- Health and Safety meetings (or segments of meetings)
- Bridging documentations
- Audit plans
- Reporting processes
- Role and responsibility definitions.

Third Party Contractors and Suppliers: The risk presented by third parties (contractors/sub-contractors and suppliers) can have a significant impact on the Project's health and safety performance and reputation. Such risks need to be properly managed to minimize potentially adverse effects. Third party health and safety performance is reflected in the overall LCP performance. To maximize Health and Safety Performance, the following must be considered and implemented:

- Third parties are selected based in part on consideration of their Health and Safety performance, planning, programs, policies and procedures.

- Health and Safety programs and overall compatibility with the Project's Management Systems.
- Third parties Health and Safety standards must be broadly similar to those of the Project and are appropriate to the risk criticality of the services and products provided.
- Suppliers and sub-contractors are involved at an early stage to allow risks to be identified and properly managed.
- The Project requirements with respect of Health and Safety Responsibilities and performance are defined and communicated to third parties.
- Third parties have clearly defined roles and responsibilities for their individual managers.
- Interfaces between the Project and third parties is clearly defined and effectively managed.
- Monitoring of third party performance includes Health and Safety and deficiencies are identified and corrected and preventative measures are put in place.
- Contractors/subcontractors and suppliers understand that consequence for poor Health and Safety performance, or lack of agreed improvements, can be up to and including stop work orders and in extreme cases termination of work
- Lessons learned from third parties are captured and openly shared within the Project Delivery Team.

Effective Selection Processes: Processes that enable the effective selection of contractors and suppliers include the following:

- Selection strategy documentation for major and minor package suppliers
- Contractor pre-qualification and selection process
- Pre-bid Meeting reviewing Health and Safety Expectations with bidders
- Pre-contract award Health and Safety assessment
- Safety performance terms and conditions included in contacts
- Health and Safety Coordination Procedures contained in all contracts
- Health and Safety development program/improvement plan
- Regular meetings with all contractors
- Site visits to Contractor/Supplier Worksites
- Interface documentation review
- Performance monitoring plans and strategies
- Periodic Performance Audit and associated follow-up
- Contract and/or project close-out reports
- Contractor Health and Safety Plan prepared to address the specific scope of work

Relationships with Neighboring Communities: Keeping good community relations are crucial for our long term success. In the course of the Lower Churchill Project, we must be focused on being a good neighbor and seek to find opportunities to contribute to the well-being of communities in which we operate. Effective means of ensuring good relationships are maintained with Neighboring Communities include ensuring the following:

- Risks to the communities associated with the Lower Churchill Project are openly communicated to the appropriate parties in a timely manner.
- Our project contributes in a positive manner to the communities where we operate.
- We cooperate with authorities, non-government organizations and industry organizations on health and safety matters.

Maintaining Effective Relationships: Good relationships with the Neighboring Communities of the Lower Churchill Project worksites are very important to the overall success of the project. Effective means of maintaining Community relationships include the following:

- Emergency response plans (including the focus on the neighboring community)
- Open facility and family days with health and safety focus, as and when appropriate.
- Health and safety initiatives with local schools, and voluntary groups
- Stakeholder management plans that include consideration for health and safety issues through all phases of the project.

7.5.6 Element 6: Product Realization:
(Equipment and Materials)

Interfaces and relationships with clients and partners are critical for the Lower Churchill Project overall Health and Safety performance. The Project Delivery Team will work closely to manage our roles and align expectations and goals. To accomplish this, the following arrangements must be in place:

- Proper selection and specification of the facility, equipment and materials take place.
- Effective procurement processes and quality control systems are in place to minimize risk importation.
- Facility, equipment and materials provided are safe, compatible, of good quality and fit for their intended service and are renewable/recyclable (whenever possible).

- Fully compliant with equipment inspection, certification, quality assurance and maintenance requirements.
- Appropriate information, instruction and training on the safe use, handling storage and environmentally sound methods of disposal of plant, equipment and materials are made available to affected personnel.

Ensuring Project Facility, Equipment and Materials meet Project Expectations: Ever effort will be made to ensure that applicable standards, standard industry practices and regulatory requirements utilizing the following processes:

- Specification and procurement processes are in place and reviewed periodically.
- Operating, inspection and maintenance procedures including health and safety stipulations.
- WHMIS assessments/product data sheets.
- Certification plans are in place and reviewed periodically.
- Information, instruction and training are current, available and reviewed.

7.5.7 Element 7: Continuous Improvement (Incident Investigation and Analysis, Audits, Measurement Review and Improvement Initiatives):

A continuous improvement mechanism must be implemented to consistently evaluate the mechanisms and controls being utilized to achieve the key safety elements. The following are effective means of evaluating the key safety elements:

Audits and Assessments: Audits/assessments are often utilized as a prudent means to monitor compliance and help elevate continuous improvement. On the LCP, Project and Regulatory requirements will be audited periodically to ensure effective management. Audits, assessments, and performance review activities and systems are various means to assure compliance with both internally and externally imposed standards within the project. Arrangements for audits and assessments will include the following:

- Audit programs that specifically address Health and Safety practices, policies and procedures that are in place and ensure they are followed.
- Audit scopes and frequencies are risk based.
- Audits are conducted by competent persons.
- Findings and actions are agreed with auditors and well documented.
- Audit results are communicated to the appropriate level of management.

- Lessons learned are shared with appropriate parties.
- Audits will be carried out to regularly access compliance with the elements of the Health and Safety Management Plan.
- Periodically, access compliance with health and safety regulatory requirements will be evaluated.
- Audits may also be performed by personnel outside the project, having health and safety expertise and auditing expertise.
- Auditors are identified, notified and involved in the planning and process to the appropriate level.
- Findings are properly communicated to auditors and to an appropriate level of Project management, along with any trends noted.
- Findings resulting from an audit are assessed, documented, prioritized and monitored until satisfactorily resolved.
- Audit entitlement/expectation is agreed with clients and documented in contract and interface documents.
- Properly constituted management reviews will be undertaken periodically.
- Effective health and safety audit procedures are in place to evaluate compliance with work procedures, work rules and permits for critical tasks/activities

Audit Effectiveness: To ensure overall audit effectiveness, the following procedures, programs and follow-up must be in place:

- Documented Audit programs and defined schedules
- Auditing procedures and well defined protocols
- Auditor training program
- Timely Audit reports, Responsible Individuals Assigned Actions (as appropriate), Target Dates for Completion and Follow-up
- Internal and external audits are conducted
- Periodic Review of Audits, Audit Trending and Communicating Trends to Management.
- Interface documents
- Multi-faceted/disciplined teams to perform the audit.

Measurement and Review: Interfaces and relationships with clients and partners are critical for our overall health and safety performance. We will work closely with clients and partners to manage our roles and align expectations and goals. This will be further enhanced using the following:

- Leading and lagging health and safety indicators are measured, reviewed and used as input to generate improvement initiatives.
- Health and Safety feedback from all parties is used as input to improvement plans.
- Health and Safety driven management reviews are conducted periodically.
- Improvement plans include data from all available and applicable sources.
- Processes exist to manage health and safety improvement actions to completion.
- Health and Safety improvement plans are considered in the Project strategy process.

8.0 Contractor Management

For onshore and offshore (where applicable for the SOBI work) construction, exploration and development operations the work activities will be performed using contracted equipment and personnel. The competency and behavior of the contractors along with their integration into the operation as a whole can have a major impact on health, safety and environmental performance. Where applicable, LCP will ensure union management on health and safety are working cooperatively in the achievement of its vision. The Nalcor Energy-Lower Churchill Project will strive to engage reputable and fully qualified contractors who have demonstrated an ability to conduct their activities in a manner consistent with the Nalcor Energy Health and Safety core elements as outlined above. The Lower Churchill Project has established certain minimum requirements and expectations that will ensure contractors conduct their activities in a safe and environmentally sound manner. These requirements form the basis of the Nalcor Energy guidelines and are conveyed to prospective contractors during the bid process.

8.1 Contractor Selection Criteria

All contractors are formally evaluated on their health, safety and environmental performance prior to awarding of a contract. To assist Nalcor Energy LCP in evaluating the quality and effectiveness of contractors' health and safety management systems, each prospective contractor will complete and submit, in support of the bid proposal, Nalcor Energy LCP Bid Evaluation Questionnaire that provides an overview of the contractors Health and Safety management system in terms of the following:

- Health and Safety Policy and commitment
- Management Involvement and Leadership
- Hazard Assessment and Risk Control
- Appropriate Safe Practices, Procedures and Rules

- Training Program including Orientation and Competency
- Communications/Health and Safety Meetings
- Incident Reporting, Investigation Policy and Analysis
- Regulatory Requirements/Compliance Plan
- Personal Protective Equipment (PPE) Policy and Program
- Environmental
- Emergency Preparedness
- Accident Statistics and Records
- Modified Work Programs/ Early Return to Work
- Maintenance Policy and Programs
- Substance Abuse and Testing and Accommodation Programs
- Subcontractor Management and Control Programs.

8.2 Contractor Health and Safety Performance Measurement

Details and frequencies of any monitoring, audits and review of health and safety performance are contained in the Contractor's overall Performance Reporting Procedures and the contractor's management systems.

Health and Safety statistics are prepared on a monthly basis by the Health and Safety Coordinator and forwarded to the Project Delivery Team for review. Additionally, a monthly update will be provided to the project management team including the contractor's workforce to provide feedback on Health and Safety performance and facilitate opportunities for continuous improvement.

The Lower Churchill Project will ensure the timely follow-up and completion of corrective actions identified through field inspections, audits, incident investigation and safety meetings. It is the responsibility of the Senior Manager on a work site or marine vessel to ensure that all corrective actions are implemented and closed out in a timely basis. It is the responsibility of the Contractor Health and Safety Manager to ensure that actions items are traced for verification of close out. As and when necessary, the Project Delivery Team will coach and guide the contractor in the delivery of the Project in order to achieve its Vision.

9.0 Appendices:

Appendix "A"-Rights and Responsibilities of Employees

Appendix "B": Health and Safety Training

Appendix "C": Hazard Identification and Evaluation

Appendix "D": Changes/Modifications to Procedures/Equipment

Appendix "E": Work Standards, Practices and Procedures

Appendix "F": Personal Protective Equipment

Appendix "G": Working in Cold Environments

Appendix "H": WHMIS

Appendix "I": Transportation

Appendix "J": Work Site Hazards (Wildlife Management

Appendix "K": Workplace Security

Appendix "L": Nalcor Corporate Safety and Health Standards

Appendix "M": Electrical Safety

Appendix "N": Nalcor Corporate Safety and Health Programs

Section 9.0 – Appendix "A"

Rights and Responsibilities of Employees

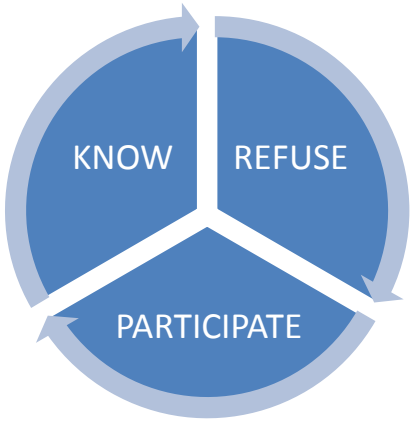
Appendix "A"-Rights and Responsibilities of Employees

Each and every employee has certain rights under provincial Occupational Health and Safety law, including:

- Right to Know about the hazards within their workplace - All persons have the right to know of any working condition that may in any way pose a health safety and environmental hazard or risk within the workplace; (e.g. WHMIS).

- Right to Refuse hazardous work - All personnel have the right to refuse work when they have reasonable grounds to believe that the work may be hazardous to them, to their fellow worker and to the facility/vessel.

- Right to Participate in the development, implementation and improvement of environmental health, and safety programs - All persons have the right to participate in identification and management of Health and Safety issues; e.g. JOHS Committee



Right to Know

The Nalcor Energy-Lower Churchill Project, in cooperation with its major contractors, will use a variety of processes to ensure all employees, including contractors, sub-contracted employees and following consultants are informed of any hazards that may be present in the workplace. These programs include the following:

- Employee Training and Orientations
- Occupational Safety & Health Committees/Representatives

- Group Safety Meetings
- Task Based Job Safety Analyses
- Permit to Work System
- Onsite Emergency Drills
- Signage and Placards
- Safety Alerts and Bulletins

Additionally, applicable Health and Safety documents and relevant legislation including the Contractor Safety Plan will be made readily available to all personnel.

Right to Refuse

As per section (45) of the Newfoundland and Labrador Occupational Health and Safety Act – Chapter O-3 (1992):

1. A worker may refuse to do work that the worker has reasonable grounds to believe is dangerous to his or her health or safety, or the health and safety of another person at the workplace:

    a. Until remedial action has been taken by the employer to the worker's satisfaction;
    b. Until the committee or worker health and safety representative has investigated the matter and advised the worker to return to work; or
    c. Until an officer has investigated the matter and has advised the worker to return to work.

2. Where a worker refuses to do work under subsection (1) his or her employer may reassign the worker to other work that is reasonably equivalent to the work he or she normally performs and the worker shall accept the reassignment until he or she is able to return to work under subsection (1).

3. Where a worker is reassigned to other work under subsection (2) the employer shall pay the worker the same wages or salary and grant him or her same benefits the worker would have received had the worker continued in his or her normal work.

4. Where a worker has reasonably refused to work under subsection (1) and has not been reassigned to other work under subsection (2) the employer shall pay the worker the same wages or salary and grant the worker the same benefits the worker would have received had the worker continued to work, until he or she is able to return to work under subsection (1).

5. A reassignment of work under subsection (2) is not discriminatory action under section

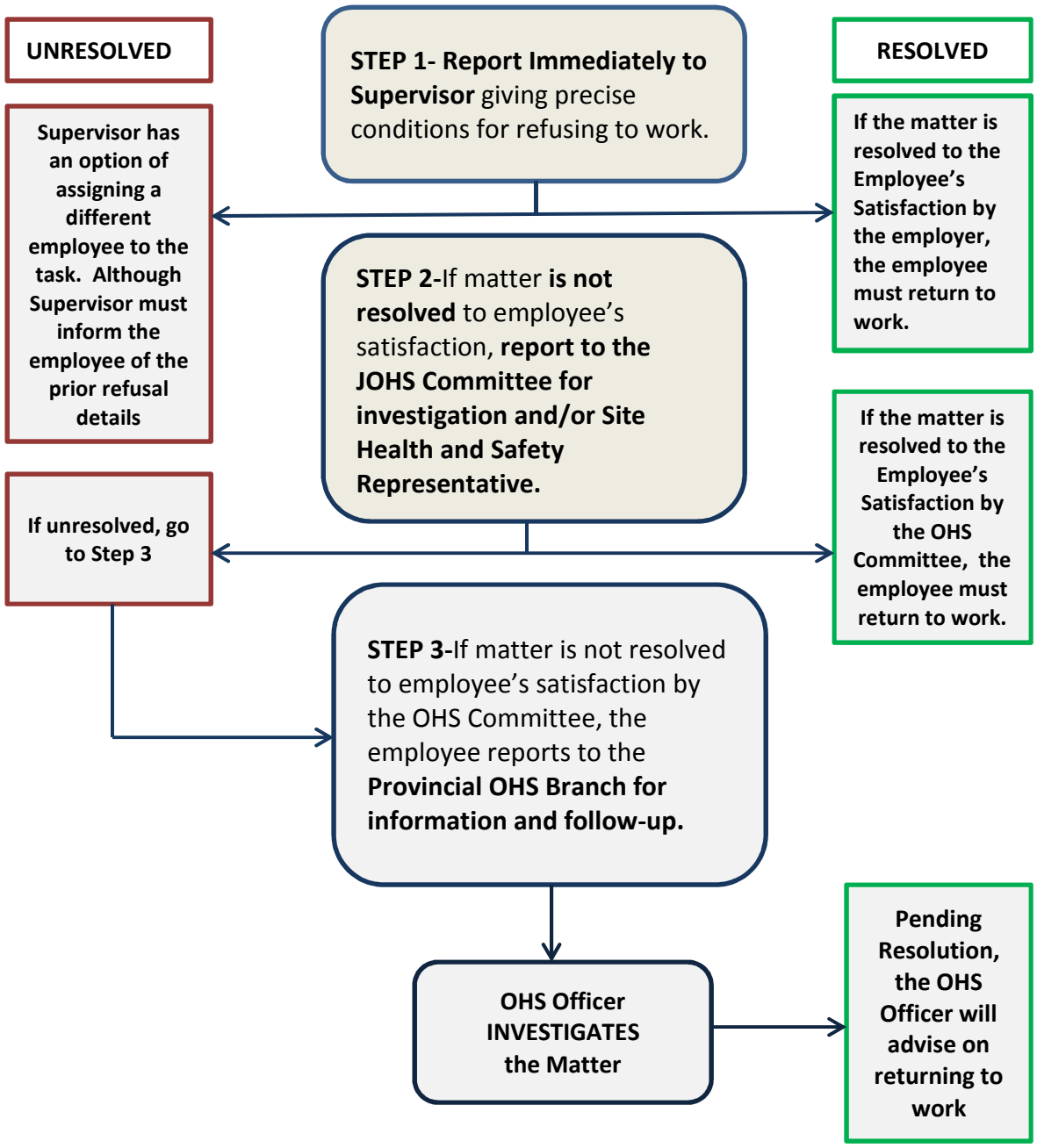
Discriminatory Action Prohibited

Section 49 of the Health and Safety Act of Newfoundland and Labrador states that an employer or union shall not take a discriminatory action against a worker by dismissing him or her or by deducting wages, salary or other benefits, or by taking other disciplinary action against him or her:

- Because of the worker's participation in or association with the committee, worker health and safety representative or workplace health and safety designate at the workplace, or because the worker is a worker health and safety representative or workplace health and safety designate;
- Because the worker has testified or is about to testify in a proceeding or inquiry under this Act or regulations;
- Because the worker has given information to the Workplace, Health, Safety and Compensation Commission, an officer or another person concerned with the administration of the Act or the regulations concerning the health, safety and welfare of workers at his or her workplace; or

- Because the worker has reasonably refused to work under his or her right to do so.

Right to Refuse- Three Step Process For Resolution (as per OHS Act):



Right to Participate (JOHS Committee)

Under PART IV of the OCCUPATIONAL HEALTH AND SAFETY ACT - COMMITTEES, REPRESENTATIVES AND DESIGNATES section (25) of the act identifies the Operations of committees, representatives and designates;

An employer shall ensure that:

- An occupational health and safety committee is established;
- a worker health and safety representative is appointed; or
- a workplace health and safety designate is designated; and
- a copy of the Act/ regulations under the Act are easily accessible.

Minutes of all regular meetings and special committee meetings shall be recorded in the form prescribed by the commission and one copy shall be kept on file with the committee, one copy shall be filed with the commission, one copy shall be posted in a prominent place in the workplace and one copy shall be forwarded to Nalcor Energy-Lower Churchill Project Health and Safety Group.

A worker health and safety representative or a workplace health and safety designate shall report to the commission in the form required by the commission.

An occupational health and safety committee shall:

- Meet within 2 weeks of its establishment;
- Elect co-chairpersons as required by subsection 38(6) of the Act;
- And notify the commission of the elected co-chairs.

Health and Safety (JOHS) Committee

It is the policy of the Nalcor Energy-Lower Churchill Project as well, as a regulatory requirement,` to ensure that all personnel are provided an opportunity to be involved in EHS development and improvement efforts. Formal Health and Safety Committees provide leadership and direction for the company and its business units and allow for participation and input at all levels. The Health and Safety Committee structure is designed to establish positive,

two-way communication throughout the organization and facility. The organization and function of the Health and Safety Committee shall be designed to meet the intent of applicable Newfoundland and Labrador legislation. The Committee shall:

- Consist of at least equal worker and management representation; Conduct meetings on a regular monthly basis or (every 3 weeks for rotational crews where applicable);
- Prepare Committee meeting minutes and post minutes on the vessel or in onshore office bulletin boards for worker review and submit signed copies of these minutes to the Operator and the regulator; and
- Shall seek to identify aspects of the workplace that may be unhealthy and/or unsafe.

In addition, as required under the Occupational Health and Safety Regulations, the Committee shall

- Be notified and consulted where there is a likelihood that the safety or health of an employee is, or may be, endangered by exposure to a hazardous substance;
- Be informed of all injuries and other “Hazardous Occurrences”; and
- Participate in incident investigations.
- Have the right to accompany an officer of the division when health and safety inspections are being conducted.

NOTE: During the Nalcor Energy-Lower Churchill Project all Safety Committees shall hold meetings on a monthly basis. If there are worker crews who change shift (e.g. every 3 weeks for rotational crews where applicable) each crew will have in place a safety committee.

Section 9.0 – Appendix "B"

Health and Safety Training

Appendix "B": Health and Safety Training

The following Health and Safety Training Opportunities will be provided to Employees, Consultants and Contractors to ensure core competencies are established and maintained.

Health and Safety Induction/Orientation

Prior to mobilization to any of the Lower Churchill Project work sites an Health and Safety Inductions/Orientations will be conducted for all LCP senior management personnel, employees, contractors, subcontractor, visitors and consultants. The Induction/Orientation shall provide an overview of the LCP and Contractor Health and Safety Programs and the Induction/Orientation will include the following:

- Project Overview
- Health and Safety Goals and Objectives
- Health and Safety Responsibilities
- Alcohol and Drug Policy
- Communications
- Training & Competency
- Hazard Identification and Reporting
- Personal Protective Equipment
- Site Specific Safety Policies
- Inspections and Audits
- Incident Reporting and Investigation
- Environmental Protection and Waste Management
- Emergency Preparedness
- Site Security

Informal Communications and Promotion

In addition to the induction and orientation, communication of Health and Safety Performance related information:

- Monthly Health and Safety Performance Updated
- Notices and Bulletins

- Safety Alerts
- Posters

Personnel Qualifications Competency and Training

The Lower Churchill Project will ensure all project personnel are suitably qualified and trained as per the Contractor's "Training Matrix". The company training matrix will identify the training requirements for each position within the contractor's organization and will comply with Provincial and Federal legislative requirements and guidelines. Internal controls will be established by the Lower Churchill Project to ensure all appropriate personnel comply with the requirements and contractual arrangements and will require all contractors to cooperate in this effort.

Contractor's formal and in-house competency and training programs must consider the level of training required for the position and responsibilities of the personnel involved. The aim of their training programs is to provide an understanding of their procedures, equipment, risks and potential hazards that may occur. Details respecting Contractor's Competency and Training process shall be guided by the following:

- Selection and Control of Contractor Personnel;
- Competence Assessment and Records;
- Training;
- Induction Programs.

Health and Safety Training Matrix

Contractors will maintain independent training matrices which identifies the training requirements for each position in their respective organizations. The training matrix will be maintained up to date to ensure that personnel onshore/offshore have received the required regulatory and job specific training.

Service companies will be required to maintain a training matrix to ensure that all personnel who are working onshore/offshore on vessel are trained and competent in their positions. Training Matrices must be made available on work vessels (as appropriate) and at the worksites onshore/offshore.

Section 9.0 – Appendix “C”

Hazard Identification and Evaluation

Appendix "C": Hazard Identification and Evaluation

Job tasks will be reviewed and assessed for hazards/risks and risk management will be applied and utilized to reduce the risk as low as practicable. The following Nalcor risk methods and programs will be utilized on the Lower Churchill Project:

Be Safe Program

BeSafe is a behavior-based safety program designed to develop skills in employees so that they can have respectful safety discussions with others. It is part of Nalcor's second phase of a safety culture initiative aimed at strengthening personal responsibility for safety. It provides a standard conversational structure with which respectful discussions can occur around positive safety behaviours or potentially unsafe behaviors.

It allows employees to: Clearly and respectfully communicate safety concerns or observations, reinforce positive safety behaviours and engage in a collaborative problem solving approach to identify options to overcome potentially unsafe behaviours.

The objectives of the *BeSafe* program are to: understand key components of Nalcor's Safety Culture including Personal Responsibility for Safety. understand what ***BeSafe*** is and why it is needed and practice ***BeSafe*** discussions

BeSafe is a 3-step process that provides guidance on safety conversations.

1. Say Something	**B** **E** **S**	Behaviour is the focus Express your observations Safety is the motivation
2. Discuss Options	**A** **F**	Acknowledge the other person's view Form an agreement
3. Express thanks	**E**	Express gratitude

Task Based Risk Assessment (TBRA)

The "Task Based Risk Assessment (TBRA)" will provide LCP personnel with guidance and information with respect to the assessment of risk associated with hazards that will be present in the activities of the Lower Churchill Project. A TBRA will be conducted and/or reviewed when the following circumstances apply:

- When a job is being undertaken for the first time and the risks are unknown
- For non-routine jobs or new jobs where experience is limited
- Any job that is intuitively deemed to be a high risk
- IF IN DOUBT- CARRY OUT A JOB SAFETY ASSESSMENT (TBRA)

During the planning and preparation phase, TBRA, including hazard identification and hazard analysis, will be conducted by a multi-discipline team that brings expertise and knowledge in Construction, Drilling, Engineering, Operations and Health and Safety. All contractors involved in Task Based Risk Assessments will follow their own Risk Matrix System if compatible and acceptable to the Lower Churchill and Nalcor Energy corporate "Tasked Based Risk Assessment" procedure. The identification of occupational work hazards will be conducted utilizing but not limited to the following guidelines;

- Hazard Identification
- Specific Hazard Assessment
- Identify Hazard Effect and who may be affected
- Identify Risk Rating
- Identify Controls
- Review Residual Risk After Controls Are Applied
- Document and Record
- Approval to Proceed

- Permit to Work Systems
- Regular Site Inspections by the Contractor Health and Safety Personnel and
- Audit of compliance and effectiveness to Safety Management Systems periodically assisted or conducted by Lower Churchill Project Health and Safety Personnel.

The need for continual monitoring and identification of hazards both at the operations and management levels is recognized as important by Lower Churchill Project and Contractors. These systems are in place to ensure that all incidents are reported, the causes investigated and any necessary amendments made to operating practices or training of personnel are detailed in the Health and Safety Management Systems.

All Health and Safety risks, including risks associated with change, must be identified and effectively managed. Task Based Risk Assessment identification includes evaluating and prioritizing risks utilizing the Lower Churchill Project Risk (or contracted company) matrix to establish a definitive overall risk characterization and then eliminating or controlling the risks. These systems confirm that there is a two-way flow of communication/ information between all project personnel.

In addition to pre-tour meetings, toolbox/tailgate meetings, work permits, etc., a TBRA gives the crew performing a particular job the opportunity to formally identify the dangers and hazards associated with that job and also what potential injuries and/or damage could result from them. Further, it allows the crew performing that job to clearly communicate what is to be done in order to eliminate or isolate those dangers and hazards so the work can be completed safely. Wherever possible, an alternative means of accomplishing the activity that removes the risk entirely shall be sought.

Inspections and Audits

Lower Churchill Project Inspections and Audits shall be conducted on the contractors to identify potential health and safety issues. The purpose of the inspection and audit process is to:

- Identify and correct actual or potential hazards;
- Ensure continued compliance with regulations and company standards;

The following is a summary of potential inspections/audits for the marine vessels and equipment:

- Transport Canada Inspections;
- Classifications Survey;
- Nalcor Energy-Lower Churchill Project Inspections and Audits.

A Health and Safety Inspection Checklist is included in Appendix "O"

Behavioral Based Safety Program

A Behavioral Based Safety Program is a tool used to continuously improve safety performance through the identification, observation and reduction of at-risk behaviors and the elimination of incidents. Contractors who have these programs in place will use their programs to enhance overall safety performance in the work place (e.g. STOP, etc.). These programs shall be similar to the Lower Churchill Project and Nalcor Energy Corporate "Safe Workplace Observation Program (SWOP) (see it – fix it – report it)". This tool is for all employees to use when identifying or observing hazards in the work place. The workers shall immediately correct and/or report potential hazards to their immediate supervisors and shall use the Nalcor Energy-Lower Churchill Project SWOP program or the contractor's similar booklet to record the hazard observation and actions taken to mitigate such hazards.

The Lower Churchill Project has a goal of becoming a safety leader. One of the key components in achieving "best in class" safety performance is a well developed system for the reporting, review, and analysis of sub standard conditions and practices (acts) as well as loss and "near miss" incidents.

The Safe Workplace Observation Program (SWOP) has been designed with a simple concept in mind: If an individual sees something that does not appear to be safe, if appropriate, they must

take immediate action to correct it and then report the situation to their Supervisor for follow-up.

By reporting your "Observations" an individual will be helping to ensure that the conditions, practices (acts), or situations that create hazards in the workplace are identified, analyzed, and corrected before a significant loss can occur.

Since it is also important to recognize when something is done well, SWOP also has a commendation component to recognize the importance of celebrating successful safety performance.

Permit to Work (PTW)

Nalcor Energy-Lower Churchill Project takes into consideration that contractors will operate their business aspects at the work site and will require contractors to employ a permit to work system.

A "Permit to Work" system is a formal written system which provides a means of managing non-routine and higher risk tasks and activities. The permit to work procedures provide a method for supervisors and crew members to follow when undertaking certain types of tasks recognized to generate particular exposures to personnel or the site. The PTW system also furnishes management a formal method to administratively coordinate and control work that may adversely impact other concurrent work, impair safety systems or otherwise endanger personnel at the work site. The permit to work also provides a means of formal communications between personnel involved with the permitted job and those personnel that may be affected by it, and supervisors who have influence on how, when and where the work is done. The PTW system shall:

- Limit the scope of the task;
- Ensure supervisors and crew members follow procedures, are well informed, understand and follow the applicable safety precautions and recognize the need for and use of required safety equipment; (E.g. Personal Protective Equipment)
- Control the work within specified time limits;
- Encourage pre-task planning in order to minimize risk to personnel at the work site, and reducing the inconvenience and interference to other operations/activities as well as reduce any adverse impact;

- Enhance awareness of personnel responsible for overall safety by providing documented details of any known risks, of potentially hazardous activities in progress and appropriate mitigating measures;
- Provide a continuous control and record of ongoing work activities, detailing the nature of the work, required precautions/safeguards, and the responsible competent person in charge, this control and recording will be identified in a detailed "Permit to Work" system/process;
- Ensure that upon completion of work, equipment and site are left in a fully operable state, as well as a tidy and safe condition; and
- Provide formal notification of completion of all work to the Person in Charge (PIC). This notification is a part of a "Permit to Work" system/process.

The issue of a permit to work does not, by itself, make a job safe. A permit to work is not simply permission to carry out a potentially hazardous task, but a critical communications and training tool for all affected personnel. It is part of a clearly defined system which assists in determining how a job can be performed safely; precautions that may need to be taken; specific procedures to safely perform the task; and ways to reduce the risk and hazards related to specific tasks. In accordance with Health and Safety Procedures, the use

of permits is mandatory for certain operations; these include but are not limited to the following:

- Pressurized systems where there is a possibility of pressure release;
- Any marine vessel work performing over the side work;
- Hot/Cold work;
- Entry into confined space;
- Working on or isolating mechanical, pneumatic or electrical equipment;
- Any diving activities;
- Work involving handling of dangerous materials such as explosives etc.; and
- Heavy lifts.

All new personnel shall receive induction and awareness training on the PTW and contractor JRS where applicable or the Lower Churchill Project TRSA process if required.

Incident Investigation and Reporting

The Lower Churchill Project is committed to providing a safe and healthy workplace for its employees, contractor personnel, subcontractor personnel, vendors and the general public. Safety is our No. 1 priority and it is one of the company's seven core values. Nalcor is committed to ***Zero Harm – Nobody Gets Hurt***. We believe this is both achievable and sustainable, while we each have a personal responsibility for safety. The incident management plan must reflect the uniqueness/specifics of the work to be carried out and associated work locations.

Every Accident/Incident is a combination of causes. The Lower Churchill Project through the application of our Health and Safety Management system will endeavor to prevent incidents from occurring. The Lower Churchill Project encourages a culture where accidents/incidents are reported without prejudice. The Lower Churchill Project's Health and Safety Management system will be used to identify and report all accidents/incidents that occur in the workplace. In the event that an accident/incident does occur it will be investigated to the extent required to determine the basic and root cause and to effect appropriate corrective actions.

Accident/Incident investigations will be initiated as promptly as possible. The findings of the investigations will be documented and appropriate recommendation(s) will be developed and communicated to prevent recurrence of similar or other incidents. The appropriate ensuring

recommendations will be assigned to an individual/position and implemented. All decisions and actions will be communicated.

Any accident/incident that could have resulted in significant injury or property damage (near miss) and all incidents that result in injury or property damage (including spills) will be investigated.

Accidents/Incidents (A/I) Investigations

Accidents and Incidents that must be investigated include the following:

- Fatalities
- Lost Time
- Medical Aid
- Vehicle Accidents/Incidents
- Fires and Explosions
- Chemical and Pollutant Spills
- High Potential Near Miss incident

All employees are required to report any and all accidents/incidents/near miss incidents/spill hazard to their immediate Supervisor immediately. The supervisor will discuss the occurrence with the reporter in order to determine corrective actions. The Supervisor will immediately report the accident/incident/near miss incident/spill hazard to his Manager who will in turn report to the Lower Churchill Project representative on site immediately or within a 24 hour period of being notified of the incident. A final written A/I report shall be forwarded to the Lower Churchill Project representative no later than 14 days after the initial report was made. The A/I report shall identify the basic and root causes, recommendations and responsible person to ensure that recommendations and actions are completed and closed. The Contractors/sub-Contractors shall ensure that mitigations are taken and ensure that such incidents may never re-occur.

Accident/Incident Regulatory Reporting Requirements

Under section 54 of the Newfoundland and Labrador Health and Safety Acts and Regulations requirements:

1. Where an accident takes place at a workplace:

- That results in serious injury to a person or results in the death of a person; or
- That had, or continues to have, the reasonable potential of causing serious injury to or the death of a person

The employer, or principal contractor shall immediately notify the Assistant Deputy Minister of the accident by reporting through the 24 Hour Accident Reporting Line (709) 729-4444.

2. Where an accident is reported under subsection (1), notification shall immediately be given to the committee, the worker health and safety representative or the workplace health and safety designate.

Section 9.0 – Appendix "D"

Changes and Modifications to Procedures and Equipment

Appendix "D": Changes and Modifications to Procedures and Equipment

Modification of Contractors Procedures and or Personnel

Changes and modification applies to changes to programs, procedures, equipment and organizational structure, which may impact the health, safety, environment and financial wellbeing of the project. To better manage and control significant and/or major changes to or within the organization or contracted companies may require a more formal approach to accomplish the desired changes efficiently (e.g. Change Management). Such changes shall be reviewed through the Task Based Risk Assessment process, as any significant and critical changes should be subjected to an analysis, assessment and communication process.

Contractor Equipment Modification

Where significant modification are intended, it is the responsibility of the contractor to ensure that changes process is followed and a formal approval process is initiated for any significant equipment modifications. Depending upon the degree of modification requested a certifying authority's approval may be required.

Equipment Fitness for Purpose

Any equipment used within the Lower Churchill Project, where applicable, shall have a Certificate of Fitness (CoF) for the area of operations. The contractor shall ensure that equipment complies with any regulatory requirements and industry standards and maintained. For example if a marine vessel is to be used on the Lower Churchill Project it shall meet all Transport Canada classification requirements, either costal trade or ocean going. Any equipment on the vessel that is not under the jurisdiction of Transport Canada may be certified by a certifying company (e.g. DnV). All certificates for vessels/equipment must be made available on the vessel or equipment used onshore must have a current safety inspection certificate and be made available for review.

The Lower Churchill Project will ensure that all Contractor equipment is fit for purpose. Only appropriately certified equipment will be used. If proper certification does not arrive with the equipment, the equipment will not be put into service until such time as verification can be made.

Any additional HS critical equipment requires appropriate certification prior to use (e.g. pressure vessels, materials handling equipment and lifting gear). It is the responsibility of the

Contractor to ensure that any such additional equipment is fit for purpose and safe to use prior to commencing service.

All lifting equipment (e.g. lifting slings, shackles, pad-eyes, etc.) is visually inspected by a competent person from the contractor prior to use and certified by a qualified 3rd party at least semi-annually. Certification certificates must be at the work site for review by the Lower Churchill Project personnel. A color coding system shall be in place for the purpose of identifying dates for inspection and/or testing. All Kevlar slings must be kept stowed in a secure area of the Tool Room and shall be used for specific uses only and visually inspected prior to each use and again before returning to the Tool Room.

The Lower Churchill Project will foster recognition and agreement from all contractors that reliance on the certification process alone is not sufficient to reduce operational risk of equipment design and construction to “As Low As Reasonably Practicable” (ALARP), and that this requires the personal, active, and visible involvement and participation of all workers and management at all levels.

Section 9.0 – Appendix "E"

Work Standards, Practices and Procedures

Appendix "E": Work Standards, Practices and Procedures

The work standards, practices and procedures described in this section are designed to reduce the likelihood of accidents/incidents in the workplace and are consistent with the Lower Churchill Project safety policies and procedures, safety management principles and legislative requirements. This section does not, however, cover all aspects of safety and special circumstances that may arise which will require professional judgment and common sense.

Occupational Health Hazards

The health hazards most commonly encountered in worksite operations include the following:

- **Chemical Hazards** - Hazards resulting from harmful exposure to hazardous chemicals stored, handled or used in the workplace.

- **Illumination Hazards** - Hazards resulting from prolonged exposure to inadequate levels of lighting.

- **Radiation Hazards** - These are hazards resulting from exposure to harmful levels of ionizing and non-ionizing radiation.

- **Biological Hazards** - These are hazards resulting from exposure to living organisms such as viruses, bacteria, fungi and parasites.

Control of Occupational Hazards

The following engineering and administrative controls, safe work practices and personal protective equipment will be used to control exposure to occupational health hazards:

Chemical Hazards

As per the Canadian Federal requirements all worker working in a work place that will be exposed to or working in close proximity to Chemicals and Controlled products will have completed training in Workplace Hazardous Materials Information System (WHMIS), or equivalent training.

Noise Hazards

Where sound levels in a space exceed 85 dB, the entrance(s) to that space will be fitted with a sign identifying it as a “High Noise Area”. The maximum time exposure of a worker in that space will not exceed the limits prescribed the American Conference of Governmental Industrial Hygienists Threshold Level Booklet. Where it is not reasonable or practicable to maintain the prescribed limits, appropriate hearing protection will be used.

Illumination Hazards

All lighting systems, including emergency lighting, will be properly maintained.

Radiation Hazards

Storage, handling and use of radioactive substances will be licensed by the Canadian Nuclear Safety Commission. The amount of radioactive substances will be kept at a minimum stock necessary to carry out operations, and will be stored away from accommodation areas and passageways in a steel weather-proof container that is properly labeled.

Biological Hazards

Hygiene inspections will be conducted of accommodation areas, including food storage and preparation areas where applicable.

Section 9.0 – Appendix “F”

Personal Protective Equipment

Appendix "F": Personal Protective Equipment

All persons working on the LCP including visitors, will be required to use personal protective equipment (PPE) that is appropriate for the work being performed and the nature of the hazards involved. No person will be permitted to enter an area, or perform any work, where personal protection is required unless that person is correctly attired with the necessary protective clothing or equipment.

All personnel on site will be required to wear standard PPE (i.e, hard hat (with side impact protection), safety boots, high-visibility safety vest, and safety glasses meeting requirements noted below). With respect to the requirements for additional PPE, a risk assessment will be carried out prior to work commencement to determine additional PPE requirements considering site conditions, the nature of the work activity and associated safety risks.

Nalcor Energy requires contractors to ensure that their personnel are instructed in the proper use and care of that equipment.

Cold Temperature Clothing

Clothing must be suitable for the working conditions and must provide protection for low temperatures, high wind velocities and the resulting wind chill factors. The following chart is for determining wind chill factors:

Wind Speed (km/hr)	Air Temperature (Celsius)																
	0	-1	-2	-3	-4	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60
6	-2	-3	-4	-5	-7	-8	-14	-19	-25	-31	-37	-42	-48	-54	-60	-65	-71
8	-3	-4	-5	-6	-7	-9	-14	-20	-26	-32	-38	-44	-50	-56	-61	-67	-73
10	-3	-5	-6	-7	-8	-9	-15	-21	-27	-33	-39	-45	-51	-57	-63	-69	-75
15	-4	-6	-7	-8	-9	-11	-17	-23	-29	-35	-41	-49	-54	-60	-66	-72	-78
20	-5	-7	-8	-9	-10	-12	-18	-24	-30	-37	-43	-49	-56	-62	-68	-75	-81
25	-6	-7	-8	-10	-11	-12	-19	-25	-32	-38	-44	-51	-57	-64	-70	-77	-83
30	-6	-8	-9	-10	-12	-13	-20	-26	-33	-39	-46	-52	-59	-65	-72	-78	-85
35	-7	-8	-10	-11	-12	-14	-20	-27	-33	-40	-47	-53	-60	-66	-73	-80	-86
40	-7	-9	-10	-11	-13	-14	-21	-27	-34	-41	-48	-54	-61	-68	-74	-81	-88
45	-8	-9	-10	-12	-13	-15	-21	-28	-35	-42	-48	-55	-62	-69	-75	-82	-89
50	-8	-10	-11	-12	-14	-15	-22	-29	-35	-42	-49	-56	-63	-69	-76	-83	-90
55	-8	-10	-11	-13	-14	-15	-22	-29	-36	-43	-50	-57	-63	-70	-77	-84	-91
60	-9	-10	-12	-13	-14	-16	-23	-30	-36	-43	-50	-57	-64	-71	-78	-85	-92
65	-9	-10	-12	-13	-15	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
70	-9	-11	-12	-14	-15	-16	-23	-30	-37	-44	-51	-58	-65	-72	-80	-87	-94
75	-10	-11	-12	-14	-15	-17	-24	-31	-38	-45	-52	-59	-66	-73	-80	-87	-94
80	-10	-11	-13	-14	-15	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
85	-10	-11	-13	-14	-16	-17	-24	-31	-39	-46	-53	-60	-67	-74	-81	-89	-96
90	-10	-12	-13	-15	-16	-17	-25	-32	-39	-46	-53	-61	-68	-75	-82	-89	-96
95	-10	-12	-13	-15	-16	-18	-25	-32	-39	-47	-54	-61	-68	-75	-83	-90	-97
100	-11	-12	-14	-15	-16	-18	-25	-32	-40	-47	-54	-61	-69	-76	-83	-90	-98
105	-11	-12	-14	-15	-17	-18	-25	-33	-40	-47	-55	-62	-69	-76	-84	-91	-98
110	-11	-12	-14	-15	-17	-18	-26	-33	-40	-48	-55	-62	-70	-77	-84	-91	-99
	0 to -10 Low			-10 to -25 Moderate			-25 to - 45 Cold			-45 to -59 Extreme			-60 Plus very Extreme				

High Visibility Vests, Coats, Shirts, Jackets on the work site must be compliant with the most current CSA Z96.1 standard.

All personnel working near "energized" electrical equipment or transmissions lines shall wear Fire Retardant Coveralls (Nomex or equivalent). All coveralls must be equipped with high visibility materials/reflective stripping as per the latest CSA Z-96.1 standard.
When construction site personnel are exposed to the hazard of moving vehicles or heavy equipment, they shall wear distinguishing apparel containing highly visible material suitable for daytime or night time use. Work Vests, Coveralls or Jackets must be equipped high visibility, reflective striping as per CSA Standard- Z 96.1, "Guideline on the Selection, Care and use of High-Visibility Safety Apparel (HVSA)."

Protective Headwear

Protective hard hats are designed to protect the wearers' head from impact (including side impact) and penetration of falling objects. All personnel will ensure that their industrial protective headwear meets the design standards set out in CSA Standard CAN/CSA Z94.1-92 will be worn when outside offices and other exempt areas. Hardhat liners or other apparel suitable to protect the neck and head from cold injury must be worn with the hardhat in extreme cold. All hard hats must be provided with side impact protection.

Protective Footwear

Protective footwear that meets the design standards set out in CSA Standard CAN/CSA Z195-02 (Green Triangle) will be worn when outside offices and other exempt areas. Safety boots must have Grade 1 Toe Protection. Those personnel working in and around electrical power generation and transmission links must wear electrically resistive safety boots (Orange Omega Symbol) In terrain conditions where there is a risk of ankle injury or falls, footwear with ankle support (between 6 and 8 inches boot height) and aggressive treads must be worn on the site.

Eye and Face Protection

Eye and face protective equipment that meets the design standards set out in CSA Standard CAN/CSA Z94.3.1 will be worn where there is a potential for an injury to the eyes, face, ears or front of the neck. Industrial safety glasses with permanent side shields will be worn when outside offices and other exempt areas. Plastic Lenses must be treated to block UV rays. Safety glasses must have non-conductive frames. CSA approved safety eyewear is required at all times on work sites, except in vehicles and camp facilities.

The minimum standard for eye protection is CSA approved safety glasses with fixed side shields. Full-face shields, mono goggles or other types of eye protection must be worn when safety glasses are not adequate to protect from impacts (i.e. grinding, abrasive blasting etc.).

Contact lenses should not be worn in areas where dust is common or strong chemicals are used. Where there is a potential for chemical or particulate exposure to the eyes, ensure an appropriate portable eye-wash system, capable of delivering approximately 0.4 gallons per minute for at least 15 minutes, is readily available. Safety goggles face shields or glasses with

side shields are also required to be worn to protect from splashes or particle projectiles. Contact lenses should always be removed to adequately flush foreign substances from the eyes. Prescription vision correcting eyeglasses must be CSA approved safety glasses with rigid side shields or worn under approved safety glasses.

Hearing Protection

Hearing protection that meet the design standards set out in CSA Standard Z94.2-02 will be used where sound levels exceed 85 decibel. CSA Standard Z94.2 94 hearing protectors such as earmuffs or earplugs will be available and worn in high noise areas (above 85 dB (A) or whenever there is a risk of hearing impairment. Workers should be made aware of their reduced ability to hear warnings and noises when wearing ear protection.

A contractor whose workers will be exposed to noise levels at or in excess of 85 dB(A) must have a noise management plan. The plan will address how workers will be monitored and protected from excess noises.

Hand Protection

Gloves suited for the work will be worn to protect against cuts, burns, electricity, chemicals and exposure (heat or cold) to the elements. In most cases, cotton work gloves suitable for visitors/inspectors to the work site. For material and equipment handling tasks, leather palmed gloves must be worn to provide adequate hand protection. For handling chemicals or hydrocarbon products, chemical resistant gloves must be worn. For any question regarding types of gloves for a particular task, the supervisor or safety representative should be contacted.

Skin Protection

An apron, full-face shield and rubber gauntlet-style gloves will be provided to every person required to handle caustic soda, acids or other corrosive products. Barrier creams or lotions will be provided to workers who may experience a rash on their skin from chemical irritants.

Fall Protection

Every person who works from an unguarded structure that is more than 2.4 m above the nearest permanent safe level, or is above an open pit, hopper, moving machinery parts or water, will use fall protection equipment that meets the design standards set out in CSA Standards Z259.2.1-98 (CAN/CSA-Z259.10-06 - Full Body Harnesses). Fall protection systems may include barricades, guard rails, work platforms and scaffolding. Contractors must use fall protection to protect themselves from falling. In addition, personal fall restraint and arrest systems will be used where necessary.

- Ensure that systems are designed and constructed as per regulatory requirements.
- Ensure temporary structures are inspected prior to use, regularly during use and when transferred.
- Ensure all fall arrest systems, devices and procedures comply with regulatory requirements.
- Ensure workers who will use fall protection systems are competent and adequately trained in fall protection systems (i.e. hazards, use, limitations, inspections etc.).The Newfoundland OHS Regulations require that all workers required to utilize fall protection equipment must complete a training program on fall protection as prescribed by the WHSCC.
- Ensure workers have reviewed the fall protection rescue plan and signed off to ensure they understand it.
- Fall restraint systems must be used when working above, over moving machinery or over water where, due to temperature or depth, or current movement, self-rescue is difficult or impossible.
- Ensure lifelines optimize connection points for workers' personal fall-arrest devices.
- Ensure workers connect lanyards so that the maximum free fall is restricted to 1.2m or otherwise prescribed in current regulatory requirements. Position personnel to prevent pendulum swing falls
- Part of the harness system is a shock absorbing lanyard with locking snaps. Ensure the shock-absorber end is always connected to the safety harness. It is recommended that a full body harness with two shock absorbing lanyards attached to the back "D" ring is worn. NOTE: Fall arrest systems may have various applications during the course of the project and their configurations could be different from what is recommended above. Any deviations to the system noted above should be approved by the LCP Muskrat Falls Health and Safety Manager or LCP Muskrat Falls Health and Safety Coordinator.
- Ensure anchoring points meet the health and safety requirements
- A subcontractor whose workers are exposed to the risk of falling must have a fall protection plan for the work. The plan must assess the fall hazards, fall protection and maintenance of fall protection equipment and the plan must be communicated with all workers at the job site.

Drowning Protection

All personnel working near or over the water are required to wear a personal flotation device meeting CAN/CGSB – 65-CCP-14M. Additionally, all personnel who work over-the-side of a marine vessel or in an area where there is a danger of falling overboard will be required to use a life jacket or personal floatation device that meets the design standards set by the Canadian General Standards Board and the Canadian Shipping Act and Regulations. The floatation device must meet the CGSB Standard CAN/CGSB 65.11-M88 or equivalent.

Respiratory Protection

In areas or spaces where there is a hazard of an airborne hazardous substance or an oxygen deficient atmosphere, respiratory protection equipment that is listed in the NIOSH Certified Equipment List will be required. Training will be provided specific to the equipment to be used

prior to actual usage. Respiratory Protection must be CSA approved and meet the requirements of CSA Z94.4. (Selection, Use and Care of Respirators)

Section 9.0 – Appendix “G”

Working in Cold Environments

Appendix "G": Working in Cold Environments

The ability of workers to function and work normally in cold environments is affected by the degree and extent of exposure to sub-zero conditions. Additional precautions must be considered with regard to using lifting equipment in extreme cold temperatures.

Contractors must be adequately prepared to ensure personnel are not put at risk due to exposure to cold conditions. The following standards must be followed when personnel are required to work in cold conditions. The changes to human performance under such conditions are due to two main factors:

1. The environmental temperature
2. The clothing required to maintain a safe core body temperature and to fully function in the environment in the execution of an assigned task.

Cold Safe Work Standards

Rest breaks must be planned for and utilized to allow workers to warm up particularly their extremities. These breaks should not be less than 10 minutes in length and should be taken in a heated area. Outer clothing should be removed to prevent overheating and sweating when in the heated area. Returning to cold work while damp or sweaty may result in rapid chilling. The following recommended work practices should be followed:

Under conditions of continuous work in the cold:

- Heated warming shelters (i.e. bus, vehicles) should be provided. Workers should be encouraged to use these at regular intervals, the frequency of use depending on the severity of environmental exposure.

- When entering the heated shelter, outer and middle clothing layers (as necessary) should be removed to prevent overheating and to permit dampness to evaporate. A change of dry clothing may be necessary.

- Warm fluids should be consumed at the work site to provide energy, warmth, and replace fluids lost during work. Significant fluid loss can occur in the cold due to sensible and insensible sweating, breathing, and the extra energy requirements of working in the cold. Dehydration in the cold is a serious concern, increasing a worker's susceptibility to hypothermia.

- The onset of severe shivering, the feeling of excessive fatigue, drowsiness, irritability or euphoria are indications for immediate return to the shelter.

Warm up Schedule for Cold Temperatures

AIR TEMPERATURE SUNNY SKY		NO NOTICEABLE WIND		8 KPH WIND		16 KPH WIND		24 KPH WIND		32 KPH WIND	
°C	°F	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to - 28°	-15° to -19°	Normal work hours and break periods	1	Normal work hours and break periods	1	75 min.	2	55 min.	3	40 min.	4
-29° to -31°	-20° to -24°	Normal work hours and break periods	1	75 min.	2	55 min.	3	40 min.	4	30 min.	5
-32° to -34°	-25° to - 29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease	
-35° to - 37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease			
-38° to - 39°	-35° to -39°	40 min.	4	30 min.	5	Non-emergency work should cease					
-40° to -42°	-40° to -44°	30 min.	5	Non-emergency work should cease							
-43° & below	-45° & below	Non-emergency work should cease									

Source: American Conference of Governmental Industrial Hygienists, Inc. (ACIGH) 1999.

Notes:

1. *The schedule applies to any 4-hour work period with moderate to heavy work activity, with warm-up periods of 10 minutes in a warm location, and with an extended break (e.g. lunch) at the end of the 4-hour work period in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at –35oC with no noticeable wind, a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period because they generate less body heat when they are less active and therefore, will get colder sooner.*
2. *The following is suggested as a guide for estimating winds velocity if accurate information is not available: 8 kph: light flag moves; 16 kph: light flag fully extended; 24 kph: raises newspaper sheet; 32 kph: blowing and drifting snow.*
3. *If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be*
   a) *special warm-up breaks should be initiated at a wind chill of about 1750 W/m2, and*
   b) *all non-emergency work should cease at or before a wind chill of 2250 W/m2. Wind chill cooling rate is defined as heat loss from a body expressed in watts per meter squared which is a function of the air temperature and wind velocity upon the exposed body.*

In general, the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing are appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder range because windy conditions rarely prevail at extremely low temperatures.

The following table presents a minimum recommended schedule of maximum cold weather work periods that must be followed by a rest period. The table takes into account the combination of wind and temperature, and applies to moderate to heavy work activity. The notes on the page after the table explain how to adjust its recommendations for lighter work activity.

Threshold Limit Values for Work and Warm-up Schedule for 4 Hour Shift

These TLV's apply only for workers in dry clothing.

Special Precautions

Exposure to vibration may increase a worker's susceptibility to cold injury because of the way that vibration can reduce circulation, particularly in the extremities.

Work performed in snow or ice-covered terrain may require tinted safety eyewear with side shields for protection from glare.

Workers with health conditions that affect normal body temperature regulation or impair

circulation e.g. Raynaud's syndrome, diabetes, thrombophlebitis, etc. should take appropriate precautions when working in the cold.

Body parts that have sustained a frostbite injury are sensitive to re-injury. Workers should be aware of this and limit opportunities for re-injury.

If loose or bulky clothing is worn, special care should be taken when working around moving equipment or machinery to prevent clothing entrapment.

Section 9.0 – Appendix “H”

WHMIS (Workplace Hazardous Materials Information System)

Appendix "H": WHMIS (Workplace Hazardous Materials Information System)

The Workplace Hazardous Materials Information System (WHMIS) is a Canada-wide Hazard Communication System that deals with the most basic aspects of health and safety at worksites where chemicals are handled. It is fundamental "right to know" legislation. It enables anyone at a worksite to become knowledgeable about the hazards of the chemicals they handle or are potentially exposed to. Information about hazardous materials or "controlled products" will be provided in two forms:

- Labels or placards on the product containers, and
- Material Safety Data Sheets (MSDS).

Suppliers of controlled hazardous products and employers are both responsible for providing information of the controlled hazardous products and material.

Roles/Responsibilities

Supplier Responsibilities

- Appropriate labeling hazardous materials supplied to the workplace, and
- Preparation of the applicable MSDS.

Employer Responsibilities

- Must make the information available to all workers and ensure that a hazardous substance inventory is maintained for the regulated hazardous materials encountered on the worksite.
- Employers must have a corresponding current MSDS located for easy access by all employees. MSDS expire after three years and must therefore be renewed at the three year point or, the manufacturer can supply written confirmation that since no changes to the product/MSDS have occurred, the life of the existing MSDS is extended by attachment of the written notice.
- Employers must ensure all personnel that would potentially handle or be exposed to controlled products receive adequate training in Workplace Hazardous Materials Information System (WHMIS) and this training is current.

Worker Responsibilities

- Hazardous products are labeled with supplier labels and/or appropriate worksite labels or other required identification;
- Comply with corresponding current MSDS requirements; and
- Are handled and stored in accordance with Company and legislated requirements.

Labels

- All products shall meet the following label requirements:
- Controlled products, chemicals and other hazardous materials, which have been brought to the workplace, must have a “Supplier Label” attached. If no label is attached or exists, the product should not be accepted, and returned with the carrier;
- The supplier label identifies the product and provides basic hazard information and hazard prevention measures;
- Symbols and written material are used on the labels so that you can immediately recognize the associated hazards;
- Controlled products manufactured at the worksite are to be labeled with “Worksite Labels or placards”. These include controlled products from outside whose original supplier labels may have been damaged, bulk containers of controlled products, and products that have been decanted;
- The worksite label identifies the product and includes basic information on its safe use, handling, storage, and disposal and refers the user to the Materials Safety Data Sheet (MSDS);
- The Hazard Symbol Chart below describe all symbols and classifications to help you prepare a worksite label; and
- For information on the symbols that do or do not apply, consult the respective MSDS. Only those symbols that do apply should be identified on the worksite label.

WHMIS Hazard Symbols

Symbol	Description
	**A:** Compressed Gas (Oxygen, acetylene, Propane, aerosol spray cans, etc.)
	**Class B:** Flammable and Combustible Materials
	**Class C** - Oxidizing Materials that can emit Oxygen and thereby help other materials burn

<u>Class D: Poisonous and Infectious Materials</u>

	**D1 -** Materials causing immediate and serious toxic effects
	**D2 -** Materials causing other toxic effects that cause long-term eye/skin irritations
	**D3 -** Bio-hazardous infectious materials (Live bacteria or viruses)
	**Class E** - Corrosive materials that cause burns through the skin or eyes, or by inhalation
	**Class F** - Dangerously reactive materials that can burn or explode if exposed to excessive heat, shock, or mixed with other chemical products.

Material Safety Data Sheets

MSDS provide detailed information on controlled products. MSDS must be made available at the field office/worksite for all controlled products that you will come in contact with. If you find that a MSDS is not available, contact your supplier immediately; they are responsible for providing you with a current MSDS for the product. WHMIS requires a current MSDS to be supplied by the manufacturer of the product. MSDS have a shelf life of three years.

The nine essential sections of a MSDS are as follows:

1. Product Identification and Use: This includes the manufacturer and supplier's name, address and telephone number, the product identifier, and product use. A distributor buying a controlled product for resale does not have its own identification on the MSDS.
2. Hazardous Ingredients: This provides a list of chemical identifications of all controlled products and their concentrations. Where a concentration is expressed as a percentage, it is generally by weight.
3. Physical Data: This includes the physical properties of the controlled product such as odor, density, boiling point, melting point, etc.
4. Fire or Explosion Hazard: This provides information such as the flammability limit, upper and lower explosive limits, and means of extinction.
5. Reactivity Data: This includes the conditions under which the material is unstable, the names of the substances that the product is incompatible with, and the hazardous decomposition products.
6. Toxicological Properties: This provides information on the possible health effects of the product from acute or chronic exposure, exposure limits, and names of toxicologically synergistic products.
7. Preventive Measures: This provides the required personal protective equipment (PPE), specific engineering controls, emergency procedures, waste disposal, and storage and shipping requirements.
8. First Aid Measures: This includes specific first aid measures for workers.
9. Preparation Information: This provides the name and telephone number of the group preparing the MSDS and the date of preparation.

Waste Management

For the identification, classification, handling and disposal of waste potentially generated during the Lower Churchill Project, please refer to the LCP Waste Management Plan which is part of the overall LCP Environmental Management Plan.

Transportation of Dangerous Goods (TDG)

Dangerous goods include potentially hazardous materials such as explosives, compressed and liquefied gases, flammable liquids and solids, oxidizing materials, and other substances that are poisonous, infectious, radioactive or corrosive. The Transportation of Dangerous Goods Act (TDG) exists to protect people, the environment, or property when goods are being transported by road, rail, sea or air. Shippers, carriers and receivers are all responsible for ensuring that shipments of dangerous goods comply with federal, territorial, provincial and municipal laws. Payments of any fines assessed are the responsibility of those failing to comply.

Responsibilities of the Consignor

The consignor (the shipper) must ensure that in accordance with TDG Regulations the goods are:

- Classified
- Packaged
- Marked
- Labeled
- Documented
- The consignor must provide to the carriers a copy of the shipping document and placards, if necessary. Consignors must also report any dangerous occurrences in accordance with the regulations.

Responsibilities of the Carrier

Carriers must follow all applicable TDG and other legal requirements. They are responsible for:

- Checking the shipment before accepting it;
- Checking the documentation for accuracy;
- Mounting placards;

- Maintaining or replacing safety marks, labels, and placards, if necessary;
- Ensuring that the driver has in their possession a current TDG certificate;
- Ensuring proper shipping documents as outlined in the regulations are in the vehicle including MSDSs;
- Delivering shipping documents as outlined in the regulations; and
- Reporting any dangerous occurrences that happen during transport.
- Transport vehicle has provisions for containing and cleaning any minor spills that may occur and the driver has been trained to carry out the task as required

Note: TDG Certificates are required to be renewed every three (3) years.

Transportation of Dangerous Goods Classifications

Class 1: Explosives

 1.1 Major Explosion	 1.2 Major Projection	 1.3 Major Fire
 1.4 Localized Explosion	 1.5 Insensitive Mass Explosion	 1.6 Extremely Insensitive

Class 2: Gases

 2.1 Flammable Gas	 2.2 Non-Flammable, Non-Toxic Gas	 2.3 Toxic Gas	 Oxidizing Gas

Class 4: Flammable Substances

 4.1 Flammable Solid	 4.2 Spontaneously Combustible	 4.3 Dangerous When Wet

Class 5: Oxidizers / Organic Peroxides

 5.1 Oxidizer	 5.2 Organic Peroxides

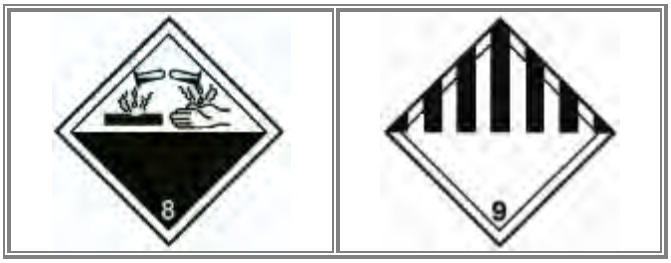
Class 6: Toxic / Infectious Substances

 6.1 Toxic	 6.2 Infectious (Label)	 6.2 Infectious (Placard)

Class 7: Radioactive

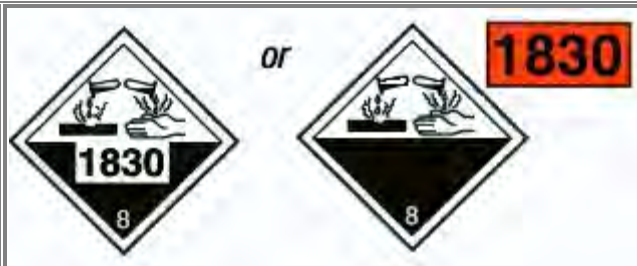
 (Labels or Placards)	 (Labels or Placards)	 (Labels or Placards)	 (Placard Only)

Class 8: Corrosives Class 9: Miscellaneous



UN Number, Packing Groups, Mixed Load

UN Number (Label)



UN Number (Placard)

Packing Groups

I Great Danger
II Moderate Danger
III Minor Danger

Mixed Load (Placard)

Section 9.0 – Appendix "I"

Transportation

Appendix "I": Transportation

Aircraft Safety – Helicopters/Fixed Wing Aircraft

During the course of the Lower Churchill Project, workers may be required to use helicopters to access remote areas to undertake fieldwork or use charter fixed wing aircraft to access areas when commercially scheduled flights are not available. During new hire orientation sessions, aircraft safety requires discussion by a competent individual. All personnel that are required to fly are aware of safety practices/procedures. The following will serve to acquaint workers with the general procedures governing passenger conduct working in and around helicopters and fixed wing aircraft.

Pre-Flight Information

- Prior to boarding the aircraft, all passengers will participate in the safety orientation conducted by the pilot will conduct. A safety orientation will be conducted whenever a new passenger joins the flight or the aircraft type changes.
- Pilot will provide instructions on operating latches, stowage of gear and prohibited items, location of emergency equipment and survival equipment in that model of aircraft as well as how and when to approach or disembark the aircraft.
- Pilot will identify the location of the survival kit. Confirm the kit is adequate to support the number of people in the aircraft.
- Pilot will advise the emergency landing posture for the aircraft type that is to be used that day.
- All passengers will advise the pilot it is their first flying experience or if they have any personal concerns.
- All passengers must dress accordingly; consider the environment and the weather conditions that might be encountered.
- Advise the pilot of the equipment and hazardous goods that you are going to bring on the aircraft.
- Carry, on your person, a reserve of any special medication you require, as delays may occur.

Embarking and Disembarking – General Aircraft

- Passengers shall approach, board or leave the aircraft only when directed to do so by the pilot or qualified ground crew member.

- Passengers shall obey all instructions given by the pilot.
- Use hearing protection devices provided.
- Conversation with the pilot should be restricted during the take-off and landing phases of the flight, as should intercom discussions among passengers.
- Smoking is prohibited within 10 meters of the landing pad, aircraft maneuvering or parking areas.

Embarking and Disembarking – Helicopter

- It is preferred that the helicopter be shut down for loading and unloading passengers; in the event this is not possible, passengers shall approach, board or leave a helicopter only when signaled to do so by the pilot.
- Eye protection will be worn while boarding and leaving a helicopter that is not shutdown.
- Passengers shall approach and leave the helicopter within the pilot's field of view and walk in a crouched position while under the main rotor.
- Passengers shall only approach a helicopter, in uneven terrain, by moving up-slope or disembark by moving down-slope.
- Passengers shall not walk behind the rear doors of the helicopter cabin.
- Passengers shall not carry any objects to or from the helicopter above shoulder height.
- Hardhats, baseball caps or other headgear shall be carried to and from the helicopter or be equipped with chin straps for use near helicopters.
- Passengers will leave the helicopter and move away during refueling.
- During arrival and departure of helicopters, stay off the landing pad to avoid exposure to flying particles and secure all equipment within the down wash zone of the landing pad.

Vessel Operations

LCP, Contractor and subcontractor workers may be involved in boat operations during the course of the Lower Churchill Project. All workers shall wear a Canadian Coast Guard approved personal floatation device when traveling by boat and when working over water where there are no handrails or lifelines. Specific site conditions will be assessed for hazards using the appropriate risk assessment tool (JSA, LMRA etc.) and additional procedures be developed and implemented as needed.

Before boarding any sea going vessel, personnel working on the vessel must be trained in:

- Survival at sea
- Aircraft rescue at sea
- Cold weather and arctic survival

General Vehicle Safety

It is imperative for workers to exercise a high level of safety responsibility when operating a vehicle either on or off the highway or on any of the sites of the Lower Churchill Project.

All drivers will:

- Possess a valid driver's license.
- Drive at or below posted speed limits.
- Use a vehicle suitable for the conditions expected.
- Will make them-selves familiar with the vehicle jacking tools, emergency equipment and ensure the vehicle has a serviceable spare tire.
- Prior to getting into a vehicle, walk around the vehicle to check for obstacles or hazards.
- Wear a seat belt at all times when the vehicle is in motion. When travelling on frozen lakes or rivers the use of seat belts is not mandatory. Vehicle speed must be appropriate for the ice conditions.
- Be responsible for passenger safety. All passengers shall wear seat belts at all times when the vehicle is in motion and it is the responsibility of the driver to ensure such.
- Drivers may acknowledge an in-coming call on a two-way radio and will immediately park in a safe location to continue the conversation. Drivers must park in a safe location to retrieve messages or initiate calls.
- Conduct a "Walk Around" Vehicle inspection prior to operating the vehicle each day.
- Comply with traffic laws when operating the vehicle.
- Obey all flag persons, posted signs and warnings when driving on public roads, private roads, property, sites or plants.
- Weather conditions permitting, turn off the engine and set the parking brake when the vehicle is left unattended.
- Turn off the engine when fuelling the vehicle. Check the oil level each time the vehicle is refueled.
- Report any incident involving the vehicle and/or injury immediately or as soon as reasonably possible to a Supervisor.

All-Terrain Vehicles and Snowmobiles

All-Terrain Vehicles have been increasingly used to undertake work in terrain where regular vehicles cannot operate. All ATV and snowmobile operators shall:

- Have a valid operator's license.
- Be competent in operating an ATV or snowmobile.
- Prior to using an ATV or snowmobile, walk around the unit and check for obstacles or hazards.
- Operate the ATV and snowmobile according to provincial or territorial regulations.
- Operate and maintain the ATV or snowmobile according to manufacturer recommendations.
- Wear the protective equipment specified in the provincial or territorial regulations and by the manufacturer.
- Inspect the ATV or snowmobile before each use.
- Use ramps to load and unload the ATV and snowmobiles from vehicles or trailers.

Heavy Equipment Hazard Zone

Workers must remain aware of the hazard zone that exists around heavy equipment:

- The work area (including turning radius) surrounding hoes, cranes and drills will be marked with barricade tape.
- Unauthorized workers will remain outside of the marked hazard zone.
- To ensure safety of personnel when loading and unloading materials or products from heavy equipment, “wheel chocks” must be used and the area flagged off.

Section 9.0 – Appendix "J"

Work Site Hazards (Wildlife Management)

Appendix "J": Work Site Hazards (Wildlife Management)

We live in harmony with most wildlife in Newfoundland and Labrador, often without even realizing it. Our forests and barrens are home to many animals. Unless we intentionally seek them out, some people can go a lifetime without being aware of their presence. As long as humans and wildlife respect each other's' boundaries, conflicts can be avoided – but we all have to do our part to make sure we don't encourage behavior that could cause problems for wildlife, such as Coyotes and Black Bears.

Identifying Coyotes

The Eastern Coyote belongs to the Canidae family, which also includes wolf, fox and dog. Like most animals, coyotes usually have a natural fear of people, but they also possess natural intelligence and can quickly get used to life in residential areas as long as they have easy access to food. Although attacks on humans are extremely rare, they can occur if a coyote becomes too comfortable around people and starts associating humans with food.

If a coyote enters your work site/area you should never approach a coyote, if a coyote approaches you take the following steps:

- Give it an escape route.
- Throw rocks, sticks or other objects at the coyote.
- If the coyote continues to approach, back away slowly and move toward buildings or human activity.
- Do not turn away or run. This will encourage the coyote to chase you.

Identifying Black Bears

Black Bears are bulky animal with a moderate-sized head; a tapered, brownish muzzle and long nostrils; rounded ears; small eyes; and a short tail. Coat is usually black, sometimes with a white patch on the throat or chest. Feet are furry with five curved, non-retractable claws. Similar to the coyote, black bears usually have a natural fear of people, but they can quickly get used to life in residential areas as long as they have easy access to food. Although attacks on humans are extremely rare, they can occur if a black bear becomes too comfortable around people and starts associating humans with food.

Little can be done to manage habituated bears. Avoid creating problem bears by making sure food, trash and other attractants are stored properly. Although black bears are usually timid and attacks are extremely rare, they are wild animals and can be dangerous.

If a black bear enters your work site/area takes the following steps;

- Stay calm.
- Use “Bear Bangers” or similar noise makers
- Give the bear space and an escape route.
- Speak calmly and firmly, avoid eye contact, and back away slowly
- Never run or try to climb a tree.
- If the bear begins to follow you, drop something (not food) to distract it.
- Be cautious around females with cubs.
- If the bear attacks you, fight back and make a lot of noise. Do not "play dead."

Polar Bears

Although Polar bear encounters in Newfoundland and Labrador are rare, they have been sited in both areas over the last few years. Polar bears are among the largest carnivores in the world. They are strong, fast and agile on ice, land, as well as in water. The best way to be safe is to avoid them completely at all times.

Polar Bear live mainly on sea ice or on land within a few kilometers of the coast. In summer, polar bears often travel along coastlines using points of land and rocky islets near the coast to navigate. They also travel inland and have been seen as far as 150 kilometers from the coast.

To best avoid encounters with all bears, it is always important to stay alert. It is recommended that in remote areas to always travel in groups of at least four people and stay together to increase safety. Creating noise while walking through remote areas will communicate your presence. It is important travel in daylight and be aware of your surroundings. Polar bears may be hard to see. Avoid areas of restricted visibility, pushed up sea ice, boulders, driftwood or vegetation. Watch for tracks, droppings and diggings.

Never approach a bear. Polar bears defend their space and may consider you a threat. Never feed bears or other wildlife. A bear that associates humans with food is dangerous. Never approach a wildlife carcass. A bear may be in the area. Leave immediately.

It is possible to have an encounter with a polar bear by chance or because it is attracted to your activity. Polar bears are curious and may investigate any strange object, smell or noise. Always stay calm and assess the situation. Each encounter with a polar bear and bears generally is unique. Good judgment, common sense and familiarity with bear behaviour are important.

- Curious Bears - If a bear knows you are there and shows signs of being curious such as moving slowly with frequent stops, standing on hind legs and sniffing the air, holding its

head high with ears forward or to the side, moving its head from side to side, or trying to catch your scent by circling downwind and approaching from behind, do not run. Back away slowly. Help the bear identify you as human by talking in low tones. Move slowly upwind of the bear so that it can get your scent. Always leave an escape route for the bear. Do not run.

- Defensive Bears - If a bear has been surprised at close range or shows signs of being agitated or threatened such as huffing, panting, hissing, growling, jaw-snapping, stomping its feet, staring directly at a person, or lowering its head with ears laid back, do not run. Back away slowly. Do not shout or make sudden movements. Avoid direct eye contact. Act non-threatening. Be prepared to use deterrents. Do not run.
- Predatory Bears - If a bear shows signs of stalking or hunting you such as following or circling you, approaching directly, intently and unafraid, returning after being scared away, or appears wounded, old or thin, do not run. Group together and make loud noises. Be prepared to use deterrents. Be prepared to fight back. Do not run.
- Bears With Cubs - Never get between a bear and her cubs. If you come across a bear with cubs, do not run. Group together and leave the area immediately. Be prepared to fight back if she attacks.

If you experience a polar bear attack use any available weapon such as rocks, blocks of ice, knives, skis or poles.

Section 9.0 – Appendix “K”

Workplace Security

Appendix "K": Workplace Security

To address instances where security could be compromised (unauthorized access) at the construction site security practices must be properly implemented. Access to and from construction site locations will be restricted to authorized personnel only and that have a proper site orientation. Temporary vehicle gates will be installed at entrance points to the construction site location and controlled by security personnel.

The following security measures and precautions will be taken during the course of the project:

- The Site Security Provider will be responsible for placement of the security workers during and after work hours as and when warranted.
- All authorized visitors must sign in and out. All visitors must meet training requirements.
- Control of equipment and materials entering and leaving the site will be strictly monitored.
- Any hazardous wildlife sightings, security issues and incidents must be reported immediately to the designated LCP Site Environmental Advisor designated representative.

Any illegal conduct by personnel on the construction site is grounds for immediate removal and subject to be turned over to local RCMP.

Section 9.0 – Appendix "L"

Nalcor Corporate Safety and Health Standards

Appendix "L": Nalcor Corporate Safety and Health Standards

The following is the most current list of Nalcor Corporate Safety and Health Standards:*

4.4.3.2.2	**Internal Safety and Health Communications**
4.4.6	**Electronic Device Use Standard**
4.4.6.1	**Contractor Safety Management**
4.4.6.11	**Energized Power Line Hazards Permits**
4.4.6.12	**Work Methods**
4.4.6.2	**Confined Space**
4.4.6.3	**Electrical Safety Program**
4.4.6.3.1	**New Worker Hard Hat Program**
4.5.1.1	**Data Trending and Analysis**
4.5.3.1	**Incident Investigation and Reporting**

* *A number of the Corporate Health and Safety Standards are undergoing approval process at the current time*.

Section 9.0 – Appendix “M”

Electrical Safety

Appendix "M": Electrical Safety

General:

Only a worker qualified to work on electrical conductors and equipment shall be authorized to do the work. (OH&S Regulations, Section 478 (2))

Approved live line techniques as determined through a formal risk assessment shall be utilized when performing such work. OH&S Regulations 478 (3)

The supervisor shall appraise the work and decide whether it can be done safely. If in doubt, he/she shall refer the job to the next level of supervision.

No other work shall be done on a pole or structure upon which live line work is in progress. This rule also applies to the pole or structure on either side of the pole being "worked on".

If possible, work on energized lines or apparatus should be done from below.

When it is necessary for one worker to change his/her working position on a pole or tower, other workers shall not do any work on energized conductors until the worker changing position has reached his/her new position.

Workers doing live work shall devote their undivided attention to the work at hand. Unnecessary conversation shall be avoided.

Neutral wires carried horizontally on the side of the pole below energized conductors shall be removed from the pole or covered with protective cover-up devices before work on the energized conductors is begun.

Neutral circuits shall never be open. Before a job is started, exposed vertical ground wire on wood pole structures within the work area shall be removed or covered with protective cover-up devices. Extreme care shall be exercised to prevent gaffing of protective cover-up devices.

Minimum Approach Distances:

Workers shall maintain a Working Minimum Approach Distance from all Energized parts when working on or near energized Conductors. Working Minimum Approach Distance (MAD) formerly Working Limits of Approach (Qualified Persons) is defined as the shortest distance allowable between energized live conductors and any part of a worker's body, material, or tool the worker is handling.

Live Line Techniques are required for any approach to energized conductors that is closer than the distance specified in the Working Minimum Approach Distance table. Under no circumstances shall the worker's body, material, or tool the worker is handling come closer to the energized conductor then the distance specified in the Minimum Air Insulation Distance (MAID) formerly Absolute Limit of Approach (Qualified Persons) table, unless an Approved direct contact technique is being utilized.

Nalcor Energy Minimum Approach Distance

Nominal Operating Voltage		Minimum Air Insulation Distance- MAID		Minimum Approach Distance- MAD	
phase to phase	phase to ground	mm	m	mm	m
4.16 kV	2.4 kV	140	0.14	750	0.75
12.47 kV	7.2 kV	140	0.14	750	0.75
13.8 kV	7.96 kV	140	0.14	750	0.75
29.94 kV	14.4 kV	290	0.29	900	0.90
33 kV	19.05 kV	390	0.39	1000	1.00
34.5 kV	19.92 kV	390	0.39	1000	1.00
46 kV	26.56 kV	490	0.49	1100	1.10
66 kV	38.105 kV	600	0.60	900	0.90
69 kV	39.837 kV	600	0.60	900	0.90
138 kV	79.674 kV	900	0.90	1200	1.20
230 kV	132.79 kV	1400	1.40	1700	1.70
735 kV	424.35 kV	5400	5.40	5700	5.70

There is no Minimum Air Insulation Distance at these voltages when working directly on Primary Voltage Circuits using rubber gloves or other approved direct contact techniques. Unless working under the close supervision of a Qualified Person, unqualified persons shall not be allowed to approach exposed energized electrical lines or apparatus any closer than the distance specified below.

Contractors (unqualified persons) are expected to comply with the limits of approach as outlined in the OHS Regulations. The work of contractors must be stipulated in the respective electrical safety programs.

Minimum Approach Distance (Unqualified Persons)

Nominal Circuit Voltages (phase to phase)	CSA Voltage Range (phase to ground)	Minimum Clearance (meters)
0.75 kV – 25 kV	0.4 – 22kV	3.0
-69 kV	22 - 50 kV	3.0
-138 kV	50 – 90 kV	4.0
-230 kV	120 – 150 kV	4.6
-345 kV	190 – 220 kV	5.2
-735kV	220 - 345 kV	6.7

Live Line Tools:

All Live Line work should be planned and carried out to facilitate removal of live line tools and protective cover-up devices at the end of the workday. Hot sticks and protective cover-up devices are all-susceptible to tracking and corona damage if left on the line for long periods, especially in inclement weather. Whenever possible, the hanging of live line tools on Conductors should be avoided.

Live line tools should not be used in rain, high winds, fog, or snow. In an emergency where fuse cutouts and/or disconnects must be operated, extra precautions shall be exercised such as the: wearing of rubber gloves; use of rain guards on the stick; and application of silicone to the stick immediately prior to use.

When using live line tools, workers shall not place their hands closer to the energized metal parts of the tools than that recommended below:

Normal Circuit Voltage	Minimum Voltage and Clear Stick Distance (meters)
0.75 – 25 kV	0.7
46 kV	0.8
69 kV	0.9
138 kV	1.1
230 kV	1.5
345 kV	2.1
735 kV	4.6

- Except as necessary to secure or release them, hold out ropes or live line tools being used to spread or raise conductors shall be securely fastened and workers shall not hold them.

  - The responsibility for seeing that live line tools are frequently inspected, tested and cleaned shall rest with the Supervisor.

- Live line tools such as grip-all sticks, switch sticks, and tools used in the everyday operations shall be dielectrically tested yearly or anytime they become suspect.

- Live line tools such as wire tongs, tie sticks, link sticks, strain sticks, and tools used exclusively for live line maintenance and generally transported in a proper trailer or carrier shall be dielectrically tested every three (3) years or anytime they become suspect.

- Live line tools showing any leakage shall not be used and shall be tagged with a Defective Tool or Equipment Tag and taken out of service.

- Fiber ropes and slings, used in conjunction with live line maintenance, shall be considered live line tools. Their care and storage shall receive the same attention as other live line tools.

Storage:
All live line tools not being regularly transported should be stored in a dry location and should not be tampered with or handled by un-authorized persons. Live line tools shall be kept free from dirt and moisture, and under no circumstances shall any live line tools be laid directly on the ground.

Transportation:
Live line tools should be transported and remain in the special portable containers designed for their transportation in a manner which prevents mechanical damage and provides protection from the weather.

Servicing:
Live line tools in unsafe condition and requiring treatment or repairs shall be tagged with a Defective Tool or Equipment Tag and exchanged for a tool in good condition. Un-authorized persons shall undertake no repairs.

Protective Rubber Gloves:

Workers shall not touch or work on any exposed energized lines or apparatus except when wearing personal protective equipment approved for the voltage to be contacted.

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Rubber gloves are not to be worn while climbing structures due to the risk of accidental punctures from wood splinters and other sharp pole hardware. However, rubber gloves shall be put on before entering the Minimum Approach Distance to energized lines or equipment and shall not be removed until the worker is completely out of the Minimum Approach Distance zone.

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Only approved insulating gloves shall be used. Insulating gloves shall never be worn inside out or without leather protectors. They shall be exchanged any time they become damaged or if the worker to whom they are assigned has reason to doubt their condition. Leather protectors or over gloves shall not be worn except when in use over insulating gloves. When not in use, insulating gloves shall be stored in an approved canvas bag, in a cool dry place, away from high voltage equipment, and never stored inside out.

Insulating gloves shall be inspected for cracks or other damage and shall be given the roll and air test before each use.

Class 0 insulating gloves shall be worn on lines or equipment energized at 50 volts AC or 120 volts DC up to 750 volts AC/DC or when deemed necessary by the Supervisor.

Where the use of Class 0 gloves reduces the dexterity such that a greater hazard is created the work may be performed with insulated tools or equipment only. For example, working on protection and control circuitry behind a substation protection panel requires fine motor skills in a confined area. As such, in this case, the work may be performed without rubber gloves PROVIDED that the worker is using properly rated insulated tools and equipment.

Note: This exception does not apply to work involving aerial service conductors, street lighting, meter removal and other similar activities. In these cases, rubber gloves are mandatory, unless the line or piece of equipment has been confirmed to be de-energized and grounded.

Cover-up Devices:

Protective cover-up devices shall be used on primary voltage conductors, low voltage conductors, telephone circuits, and other wires which are immediately above, below or

adjacent to the work area. Except for the part of the conductor which is being worked upon, when work is to be done on or near energized lines all energized and effectively grounded conductors or guy wires within reach of any part of the body while working shall have protective cover-up devices applied.

Line hose, hoods, blankets, line guards, etc., shall be visually inspected before each job. In applying protective cover-up devices, workers shall always protect the nearest and lowest wires first. In removing protective cover-up devices, the reverse order shall be maintained. When possible, protective cover-up devices shall be applied from a position underneath the conductor.

Rubber blankets and other protective cover-up devices shall not be placed on the ground without first protecting them from physical damage and moisture by means of a tarpaulin, canvas, or protective mat. To avoid corona and ozone damage, protective cover-up devices shall not be allowed to remain in place on energized lines or apparatus for long periods, nor stored in close proximity of energized equipment.

When not in use, protective cover-up devices shall be protected from mechanical and chemical damage, and shall always be stored in the containers provided or in special compartments on trucks. Nothing else shall be stored in these containers or compartments.

Arc Flash:

Arc Flash is a serious type of electrical explosion that can cause considerable property damage, personal injury, and even death. Any worker who is assigned to work or switch exposed energized equipment rated at 600 volts or above, shall wear the appropriate Personal Protective Equipment as prescribed in the charts below as a minimum.

For more information, please refer to Nalcor Corporate Health and Safety Standard 4.4.6.

Section 9.0 – Appendix "N"

Nalcor Corporate Safety and Health Programs

Appendix "N": Nalcor Corporate Safety and Health Programs

The following is the most current list of Nalcor Safety and Health Programs

- **Hazard Recognition, Evaluation and Control and TBRA Information**-Hazard recognition, evaluation and control is a thorough examination of an operation (workplace) for the purpose of identifying what actual and potential hazards exist, evaluation the level of risk in each exposure and making decisions about the effectiveness of new and existing controls. Hazard recognition, evaluation and control are also a major part of the task based risk assessment process.

- **Burning and Welding-** Due to the inherent hazards associated with the use of portable gas or electric arc equipment, burning and welding in any location not specifically designed for such activity is a high risk task. Areas specifically approved for burning and welding are enclosed by non-combustible walls, partitions or spark-tight curtains with non-combustible floors, ceilings and contents.

- **Corporate Fall Protection Program** Nalcor Energy (Nalcor) is committed to providing a safe work environment for its employees and preventing occupational injuries due to falls. Fall Protection is an integral part of our commitment to a safe work environment. Any time a worker is exposed to a fall hazard there will be a procedure and equipment to reduce and/or eliminate the hazard of working at height. Fall Protection shall be achieved through a hierarchy of controls that will involve all levels of management, supervisory and field personnel. This hierarchy shall be: elimination of hazards through engineering (design) and procedural practices; control and mitigation of hazards through passive fall protection; travel restraint systems; the use of fall arrest systems; and finally the use of administrative controls. Supervisors and workers shall be expected to assess the risks associated with a task and ensure that proper mitigation is in place to protect them while climbing and working at heights. Where a worker is unsure of the methods, equipment or procedures to reduce the risk they are to seek direction from their supervisor.

- **Disability Management Policy Statement** - Nalcor Energy is committed to assisting employees who have been injured on the job to return to work in a timely and safe manner through early intervention and active case management. To fulfill this commitment Nalcor Energy has established a Disability Management Program with a primary focus of providing injured employees a timely return to suitable and meaningful employment consistent with their functional abilities and competencies. The Disability Management Program process, as outlined in the Leadership Element of the Corporate Occupational Health and Safety Management System is consistent with the requirements of Sections 89 and 89.1 of the Workplace Health, Safety and Compensation (WHSC) Act and applicable policies of the WHSC Commission including the requirement to maintain active communication with

injured employees, to protect the confidentiality of personal information, and to make every effort to accommodate injured employees per the Re-employment Obligations and Duty to Accommodate provisions of the WHSC Commission Policy RE-18. All stakeholders, whether they be management, union leadership, or employees, are responsible for actively developing, participating and cooperating in the disability management process

- **Incident Investigation** - Incident investigation processes are used to gather accurate information about, and analysis of, safety incidents, including "near misses", to determine the contributing factors to help minimize the risk of recurrence, identify key prevention initiatives, and generate lessons learned. This is documented and communicated internally though the Corporate SafeWorkplace Observation Program (SWOP). While this database specifically addresses safety incidents, SWOP is also utilized to document and track incidents and/or loses related to the environment and property. Employees are required to report all safety incidents, including near misses, to ensure that appropriate preventative measures can be implemented to minimize risks, prevent recurrence and for continual improvement of the safety management system. Refer to Nalcor Corporate Health and Safety Standard 4.5.3.1

- **Noise Level Surveys and Hearing Conservation** - Nalcor Energy shall inform its employees of excessive noise levels in the workplace and provide working conditions and protective equipment to reduce the levels of exposure to those established by the Occupational Health and Safety Act & Regulations.

- **Personal Protective Equipment** - Nalcor Energy requires all employees and contractors wear approved Personal Protective Equipment (PPE) while working in designated work areas and while performing tasks where the use of PPE is compulsory.

- **Safety Footwear and Protective Clothing Allowance** Nalcor Energy will provide financial assistance to employees who, by the nature of their work, are required to purchase PPE, safety footwear and/or protective clothing. Employees covered by a Collective Agreement should refer to the appropriate clause in their Agreement.

Section 9.0 – Appendix "O"

Nalcor Health and Safety Field Inspection Checklist

Appendix "O": Nalcor Health and Safety Field Inspection Checklist

General Information and Directions

The purpose of the H&S Field Inspection Checklist is to provide reference and record for conducting a site/field inspection.

When conducting an inspection of a specific field, use the list of items under each heading as a guide to identify areas of potential hazards or areas which need to be addressed.

Assure that all deficiencies, items marked "Not Acceptable", are actioned via the Safe Workplace Inspection/Tour section of SWOP. Take note of the item and its corresponding SWOP observation reference number in the table provided.

For further information regarding HSE inspections, please refer to MSD-HS-011 Lower Churchill Project – HSE Inspection Guidelines.

Specific Field Input Directions

Place a checkmark in the box for each item which applies to the inspection (Acceptable, Not Acceptable, Not Applicable).

Any items which have been identified as "Not Acceptable" require corrective action and a SWOP card must be completed for each. Note the item and its corresponding SWOP card reference number in the table provided on the form.

Return the completed inspection form to the LCP-HSE Department along with any SWOP cards which may have been completed by hand. SWOP cards may also be submitted electronically

Guidelines for Use

Introduction

The purpose of the H&S Field Inspection Checklist is to provide reference and record for conducting a site/field inspection.

Using the Checklist

When conducting an inspection of a specific site/field, use the list of items under each heading as a guide to identify areas of potential hazards or areas which need to be addressed.

Assure that all deficiencies, items marked “Not Acceptable”, are actioned via the Safe Workplace Inspection/Tour section of SWOP. Take note of the item and its corresponding SWOP observation reference number in the table provided.

For further information regarding HSE inspections, please refer to MSD-HS-011 Lower Churchill Project – HSE Inspection Guidelines

Item	Accept	Not Accept	N/A
SITE GENERAL			
Lighting levels adequate for tasks performed.			
All light bulbs/tubes working and lighting covers adequately clean.			
General condition of walls, floors, floor coverings and ceilings good.			
Ventilation ducts clean and unobstructed.			
Staff/kitchen facilities provided away from work areas.			
Staff/kitchen facilities clean and tidy.			
HOUSEKEEPING			
Areas, accesses and landings free of obstructions/tripping hazards.			
Materials arranged/stored safely (including flammables).			
Tools orderly and clean. Unnecessary tools removed.			
Adequate disposal containers available/maintained.			
Adequate storage facilities provided.			
HYGIENE FACILITIES			
Toilets available and working.			
Cleanup facilities available.			
Areas clean and cleaning records maintained.			
FIRST AID			
Certified First Aider(s) identified and available.			
First aid station(s) available and appropriately equipped.			
Locations of first aid kits labeled and easily accessible.			
EMERGENCY RESPONSE			
Emergency exit routes identified and signed.			
Emergency exit lights operational.			
Emergency exit doors clear and easy to open.			
Required fire extinguishers up-to-date.			
Fire extinguishers identified by signs and 1 m clear area around.			
Evacuation maps displayed and up-to-date.			
Muster stations clearly marked.			
Emergency phones numbers displayed.			
Chief and emergency wardens identified and available.			

Item	Accept	Not Accept	N/A
Emergency alarms checked and tested.			
Emergency equipment available (eye wash, chemical spill kit).			
PERSONAL PROTECTIVE EQUIPMENT (PPE)			
Adequate PPE provided where necessary (gloves, hard hats, etc).			
PPE properly worn where necessary.			
PPE stored and maintained correctly.			
JOB SITE POSTING / SIGNAGE			
Contractor identification sign.			
Contractor safety program.			
OH&S Act and Regulations.			
H&S Representative (name, trade, employer).			
First Aid Certificate.			
Warning signs and barricades adequately posted.			
HAZARDOUS MATERIALS			
Up-to-date MSDS available (no more than 3 years old).			
MSDS available where chemicals are used.			
Containers appropriately labeled.			
Hazardous materials safely stored and/or segregated.			
ELECTRICAL HAZARDS			
All electrical equipment in good condition.			
Electrical equipment inspected and maintained.			
Power boards used. Not double adaptors and piggyback plugs.			
Leads secured and not potential trip hazards.			
Power tools grounded or double insulated (CSA approved).			
Ground fault circuit interrupters in place.			
Explosion-proof devices where required.			
Equipment locked-out for repair.			
Compliance with corporate work protection code.			
Temporary power supply properly identified.			
Overhead lines flagged and secured.			
HAND/POWER TOOLS AND EQUIPMENT			
Guards in place/functioning.			
Grinding discs – speed rating and condition.			
Appropriate retainers (sockets, chippers, etc.)			

Item	Accept	Not Accept	N/A
Tools/equipment in good condition.			
Defective equipment tagged as required.			
LADDERS, STAIRWELLS AND RAMPS			
No cracks or defects.			
Non-slip feet/bases.			
Correctly used and tied off.			
Non-metallic ladders used.			
Proper size and type.			
Proper handrail and landings.			
Proper filler blocks in metal stairs.			
Proper cleats on ramps.			
SCAFFOLDING			
Appropriately tagged and signed by installer.			
Footings properly supported and nailed.			
Top rail, mid rail and toe board in place.			
Properly erected.			
Proper access platform.			
Acceptable loading.			
Properly attached and capable of at least 4 times maximum load (suspended).			
Outrigger beam tied to fixed support with adequate counterweight (suspended)			
All mechanical/electrical devices in good condition (suspended).			
Independent lifelines for each worker (extend to ground) (suspended).			
SAFE WORK PRACTICES			
Personnel trained/qualified for the task.			
Permit to Work / Isolations / Lockouts used.			
Working and Height			
Safe Lifting Practices (Mechanical/Manual)			
Confined Space Entry procedures and testing.			
Precautions for work at high pressure in place.			
Hot/Cold Work			
Testing procedures.			

Additional Notes/Observations	SWOP Ref.

LOWER CHURCHILL PROJECT

Risk Management Requirements for Contractors and Suppliers

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TABLE OF CONTENTS

PAGE

1 INTRODUCTION

All key decisions made by the Lower Churchill Project team are risk-based. Package management is not an exclusion from this rule. Package risk management process adopted by the Project supports selection of Contractors and Suppliers in a way that allows reduce overall Project risk exposure. Same time, it promotes and supports development of effective Contractor's/ Supplier's risk management.

1.1 Purpose

To facilitate effective package risk management and put forward Risk Management Requirements for Bidders (Contract pre-award) and Contractors/ Suppliers (Contract post-award).

1.2 Scope

The scope of this document covers management of risks within the package scope both during the bidding process and after a Contract is awarded. It identifies general package Risk Management Requirements (Figure 1), namely, general guidelines to

- reply to the package Risk Questionnaire (pre-award),
- prepare package Risk Management Plan including package Risk Register (pre-award),
- update package Risk Management Plan (post-award),
- produce Monthly Risk Reporting (post-award).

Normally, a requirement to reply to the Risk Questionnaire is part of any package RFP. Whereas requirements to produce Risk Management Plan/ Risk Register or Monthly Risk Report (items A03 and A04 of SDRL) could be included to/ excluded from the package Risk Requirements. If included to the Requirements, the specific content of these documents will be stipulated by the package RFP (pre-award requirements) and the awarded Contract (post-award requirements) depending on the package scope, form / type of contract and package criticality.

If part of the package scope is to be actually performed on Contractor's/ Supplier's behalf by another parties, associated risks should be reflected in documents listed above.

1.3 Definitions

Bidder: any entity that responds to a package request for purchase (RFP) issued by SNC-Lavalin on behalf of Nalcor Energy.

Contractor: Any entity that is awarded a contract package to provide on-site construction and/or installation services to Nalcor Energy, with SNC-Lavalin acting as the Nalcor's representative for contract administration.

Fixed Price Contract: a form of contract when payment to deem to cover all costs, overheads and profits, wherein the Contractor/ Supplier includes all necessary contingencies for possible risks. Usually includes Liquidated Damages clauses for a case of Contract term's violations. This type of Contracts is characterised by higher Contractor's/ Supplier's risk exposure.

LCP: The Lower Churchill Project.

RAM: Risk Assessment Matrix is tool to measure deviations from package Contract objectives.

RBS: Risk Breakout Structure identifies sources of risks relevant to package delivery, may be based on package WBS and reflect technical, commercial, organizational, economic, etc. aspects.

Reimbursable Contract: a Contract when all costs incurred in the performance of the Contract are reimbursed and a fee is paid to cover profit and overheads. This type of contracts is characterised by higher Owner's risk exposure.

Risk: A risk is a future event that, if occurs, may cause deviations from the Contract.

Risk Management: The systematic application of management procedures and practices aimed at establishing the context for identifying, analyzing, evaluating, addressing, monitoring and reporting risks.

Risk Register: a log of package risks identified and managed by a Bidder or Contractor/ Supplier that includes risk descriptions, risk addressing actions, assessments of the risks before and after addressing, etc.

SLI: SNC-Lavalin Inc.

SDRL: Supplier Document Requirement List (document "Contractor Document Requirements"/ SLI # 505573-0000-37AG-I-0015). It includes the document requirements for either a Contractor or Supplier depending on a type of a package.

Supplier: Any entity that is awarded a Contract to provide equipment, materials or services to Nalcor Energy, with SNC-Lavalin acting as the Nalcor's representative for contract administration.

Unit Price Contract: a form of contract when payment to deem to cover fixed sum for each completed unit of work including all unit costs, overheads and profits as well as all necessary contingencies. This type of contracts usually used in case of construction packages is characterised by sharing of risks between the Owner and a Contractor/ Supplier. Namely, a Contractor/ Supplier bears the unit price risks, whereas the Owner covers risks associated with uncertainty about number of units.

2 RISK MANAGEMENT DELIVERABLES

This section contains general guidelines on preparing major package risk management deliverables. Specific requirements and content of the deliverables (e.g., list of risks that are subject to Monthly Risk Reporting, etc.) will be defined by corresponding sections of RFP and the Contract.

2.1 Risk Questionaire (Pre-award)

Risk Questionnaire contains a number of generic questions about Bidder's existing risk management system applicable to the proposed package Contract. In addition, some package related risk questions are included. They are based on risks preliminary identified by the Package Owner. The Risk Questionnaire is included to all package RFP's as a mandatory requirement. The Risk Questionnaire responses will be considered in the evaluation of Bidders.

2.2 Risk Management Plan (Pre-award & Post-award)

Depending on the package scope, form / type of contract and package criticality, package Risk Management Plan could be part of the Risk Requirements (SDRL item A04) both pre-award and post-award.

If included to the Requirements pre-award, the Risk Management Plan developed by a Bidder as part of the RFP response will be used for evaluation of Bidder's capability and should contain following items:

- Description of risk management process steps adopted by a Bidder for the contract scope of work / service (usually consists of risk identification, risk assessment "as-is" (before addressing), risk addressing, assessment "to-be" (after addressing), retirement and acceptance of risks)
- Description of organizational context of risk management (usually includes responsibilities of team members in the risk management process, types and frequencies of risk review meetings, risk reporting and communications including rules to prioritize risks, etc.)

- Description of tools used to support the risk management process (usually includes list of risk categories (e.g. Risk Breakdown Structure (RBS)), Risk Assessment Matrix (RAM) and Risk Register)

Figure 2 provides the Risk Assessment Matrix (RAM) recommended to Contractors/ Suppliers for LCP. (Specific descriptions of risk impacts could be amended in some cases to better reflect package scope, budget and schedule.)

Risk Management Plan pre-award should contain full package Risk Register developed by a Bidder as an appendix using RAM of Figure 2.

Upon award of a Contract, the initial Risk Management Plan should be reviewed with the Package Owner. The content of a Risk Management Plan post-award (including list of risks included to Risk Register) is a subject to the Contract's Coordination Procedure. Guidelines to prepare Risk Registers are described in section 2.3.

2.3 Risk Register (Pre-award & Post-award)

A Risk Register is a log of package risks identified, assessed and addressed by a Bidder or Contractor/ Supplier. If indicated in a particular RFP, the full Risk Register should be submitted by a Bidder with its accompanying Risk Management Plan as part of response to Request for Proposals and will be considered by SLI during the evaluation process.

Depending on the form/ type of contract, managing of and reporting on some of the package risks post-award would be delegated to Contractor/ Supplier and becomes part of the package scope. However, reporting on some risks could not be mandatory in terms of these Risk Requirements. Same time, Contractor/ Supplier is encouraged to manage corresponding risks as part of its internal risk management. The list of risks that become part of the Risk Register post-award and subject to Monthly Risk Reporting (section 2.4) should be agreed and reflected in the Contract's Coordination Procedure. Its content depends on form/ type of contract and normally includes only risks of Medium and High level.

In case of fixed price/ unit price types of Contracts of supply packages, only risks of Schedule and Quality impacts normally become subject to reporting by Contractor/ Supplier post-award. Although, in

case of fixed price/ unit price types of Contracts of on-site construction/ installation packages besides risks of Schedule and Quality impacts risks of Safety and Environment impacts become the subject to the Risk Requirements.

In case of reimbursable types of Contracts, Cost impacts become a subject to Risk Requirements for both supply and construction/ installation packages.

Managing risks of impacts on Reputation is optional in terms of these Risk Requirements for any types of contract. However, a Contractor/ Supplier could be interested in managing corresponding risks on its own by obvious reasons.

The approved list of package risks that become part of the Risk Register post-award and subject to Monthly Reporting (section 2.4) should be reflected in the Contract's Coordination Procedure.

Following items should be included to a Risk Register both pre-award and post-award for each selected risk (Figure 3):

- Risk Identification No.
- Risk title
- Risk definition (recommended is three part risk definition: cause(s) – risk event – impact(s))
- Comments (additional relevant notes and insights on risk definition and description)
- Risk status (it could be proposed, active, retired, accepted)
- Risk owner (a member of the Bidder's or Contractor's/ Supplier's team who is responsible for managing of a risk)
- Risk category (as part of Risk Breakdown Structure it could point to technical, commercial, organizational, economic, etc. types of risks)
- Assessment of probability of occurrence and impact(s) before addressing ("as-is") (according to the RAM)
- Response strategy (avoid, mitigate, transfer, accept)
- Addressing actions (particular steps to support selected addressing strategy including measures in place)
- Action status (it could be proposed, active, on-hold, completed, retired)

- Comments on progress of the addressing strategy and actions (is used in Monthly Reporting post-award)
- Assessment of probability of occurrence and impact(s) after addressing ("to-be") as if all the proposed addressing actions were already implemented (according to the RAM)

Note: As a general rule, representatives of SLI and/ or Nalcor Energy do not take part in risk identification and assessment sessions in case of fixed price and unit price types of Contracts, while in the case of reimbursable type of contract their participation would normally occur. Specific level of involvement of representatives of SLI and Nalcor Energy in risk identification and assessment sessions is to be stipulated by the Contract's Coordination Procedure.

Following contract award the approved Risk Register should be regularly updated by the Contractor/ Supplier during the phases of the package delivery and submitted as part of Monthly Progress Reports.

2.4 Monthly Risk Report (Post-award)

Monthly risk reporting (as part Monthly Progress Reports) is defined by item A03 of SDRL and consists of two parts. Part One is a structured narrative that describes major risk activities and events during the reporting period and should contain:

- Comments on major changes in the risk register (addition of new risks or addressing actions, change of risk ownership or status, retirement of risks, risk re-assessments, etc.) with a focus on Medium and High level risks.
- Highlights of 5 to 7 most important package risk management activities and events (e.g., risk reviews and workshops (internal and with sub-vendors), implementation of addressing actions and possible related issues, successes and failures related to risk management, any occurred risks, etc.)

Part Two is an updated package Risk Register.

3 RISK MANAGMENT REVIEWS

Standard requirement is to hold Monthly Risk Reviews based on submitted Monthly Risk Reports.

Review requirements, including types and frequency of the risk management reviews and audits post-award, will be initially introduced in the package RFP and finally stipulated by the Contract's Coordination Procedure.

4 FIGURES

4.1 Summary of the Risk Requirements for Bidders and Contractors/Suppliers

	Requirement	Description	Reference Documents
Pre-Award	Risk Questionnaire	Contains list of generic risk questions as well as package specific ones; requirements are described in section 2.1.	Appendix of RFP
	Risk Management Plan	Provides description of the risk process, organizational context and tools adopted by a Bidder; requirements are described in section 2.2.	SDRL item A04; Appendix of RFP
	Risk Register (part of the Risk Management Plan)	A log of package risks developed by a Bidder including their assessments before addressing, their addressing actions and assessment after addressing; requirements are described in section 2.3.	SDRL item A04; Appendix of RFP
Post-Award	Risk Management Plan	Provides description of the risk process, organizational context and tools adopted by a Contractor/ Supplier and agreed upon in the Contract's Coordination Procedure; requirements are described in section 2.2.	SDRL item A04; Contract's Coordination Procedure
	Monthly Risk Report	A summary of monthly activities carried out by a Contractor/ Supplier aimed at addressing selected risks; the Coordination Procedure of the Contract defines if all package risks are subject to monthly reporting or only selected ones; requirements are described in section 2.4. Normally, Monthly Risk Reports are a subject to Monthly Risk Reviews.	SDRL item A03; Contract's Coordination Procedure
	Risk Register (part of the Monthly Report)	The Coordination Procedure of the Contract defines if all package risks are subject to monthly reporting by the Contractor/ Supplier or only selected ones; requirements are described in section 2.3.	SDRL item A03; Contract's Coordination Procedure

4.2 Recommended Package Risk Assessment Matrix

Risk Ranking Score = (Impact Score) x (Probability Score)	Risk Level Colour Code	Low	Medium	High

		IMPACT				
		Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Extreme (5)
PROBABILITY	>90% Almost Certain (5)	5	10	15	20	25
	50% - 90% Likely (4)	4	8	12	16	20
	1% - 50% Possible (3)	3	6	9	12	15
	0.1% - 1% Low (2)	2	4	6	8	10
	< 0.1% Rare (1)	1	2	3	4	5
PROJECT OBJECTIVES	**Capital Cost, $M**	**< 0.1**	**0.1 - 1**	**1 -- 10**	**10 - 100**	**>100**
	Schedule, Mos (First Power Target Date)	**< 0.25**	**0.25 - 1**	**1 -- 3**	**3 -- 12**	**>12**
	Product Quality (Availability, Reliability, Performance)	Potential degradation of element performance, system level not affected.	Decrease in system performance, however still above requirement.	Decrease in system performance eliminates all design and operating margins.	Decrease is system performance that substantially affects performance objectives.	System requirement is not achieved, safety objectives are not achievable. System or element is effectively useless.
	People (Health & Safety)	Minor impact on personnel. First aid only. No lost time.	Potential to cause medical treatment of personnel. Lost time incident.	Injury to personnel that does not result in some permanent disability. Multiple lost time incidents outside established targets.	Serious personal injury resulting in permanent disability. Total lost time well outside established targets to the point where operations are temporarily suspended.	Potential to cause single or multiple fatalities.
	Environmental (Physical)	Slight Effect: e.g. Non-reportable spill or release contained within the immediate work area, negligible financial consequences, no lasting effect.	Minor Effect: e.g. Sufficiently large contamination or discharge to damage environment, but no lasting effect. Single breach of statutory or prescribed limit or single complaint.	Localized Effect: e.g. limited discharges affecting the local area and damaging the environment. Repeated breaches of statutory/regulatory limit or multiple complaints.	Major Effect: e.g. Severe environmental damage. The company is required to take extensive measures to restore the damaged environment. Regulatory restriction or enforcement action probable.	Massive Effect: e.g. Persistent severe environmental damage or severe impact extending over a large area resulting in major financial implications for the Project. Direct impact on public with prosecution possible.
	Reputation	No or very minor media attention. Little or no loss in Package Owner's trust.	Some unfavourable media attention. Some loss in Package Owner's trust which can easily be rebuilt.	Local media coverage only. Some loss in Package Owner's trust that will require commitment to rebuild.	Local and possibly national media coverage. A loss in Package Owner's trust that it is doubtful whether it can be rebuilt.	National and international media coverage. An irreparable loss in Package Owner's trust.

4.3 Sample Risk Register Template

RISK DEFINITION				RISK ATTRIBUTES			ASSESSMENT "AS-IS"							RISK ADDRESSING				ASSESSMENT "TO-BE"						
ID	Title	Three Part Definition	Comments	Status	Owner	Category	Probability	Cost	Schedule	Product Quality	Safety	Environmental	Reputation	Response Strategy	Action(s)	Action Status	Comments on Progress	Probability	Cost	Schedule	Product Quality	Safety	Environmental	Reputation
R-1	Sub-Vendor's Skilled Labour Availability	Due to heated market conditions in Sub-Vendor's industries, **shortage of Sub-Vendor's skilled labour could take place**, leading to longer delivery timelines and overall package schedule delays	TBD	Proposed	TBD	Commercial	3	0	4	0	0	0	4	Mitigate-Prevent	TBD	Proposed	TBD	3	0	4	0	0	0	4

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Lower Churchill Project

Project-Wide Environmental Protection Plan Component 1 and 4b

SLI Document No. 505573-0000-68RA-I-0005-10

Nalcor Reference No. LCP-SN-CD-0000-EV-PL-0002-01-B11

Date: 14-Feb-2013

Prepared by:

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Verified by:

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Environmental Manager

Approved by:

Normand Bechard
Project Manager

REVISION LIST

Revision					
N°	By	Appr.	Date	Revised pages	Remarks
10	LR	DH	12-Feb-2013	ALL	Updated based on Regulatory Comments
09	LR	DH	18-Dec-2012	ALL	Updated based on Regulatory Comments
08	LR	DH	23-Nov-2012	ALL	Updated based on Regulatory Comments
07	LR	DH	27-Sep-2012	ALL	Updated to be aligned with other management documents
06	LR	DH	27-Sep-2012	ALL	Updated to be aligned with other management documents (rejected)
05	LR	KD	11-Apr-2012	ALL	Removed several sections as requested by Nalcor
04	AH	KD	10-Apr-2012	ALL	Included regulator comments and additional Nalcor comments
03	LR	KD	23-Mar-2012	ALL	Volume II references removed
02	MW	KD	12-Dec-2011	ALL	Addendum – change to page 39 and fixing spacing issue.
01	MW	KD	10-Nov-2011	ALL	Addendum – Document Name Change
00	MW	KD	31-Oct-2011	ALL	Final Report
PB	MW	KD	19-Oct-2011	ALL	Issued for Review

MAINTENANCE OF THE PROJECT-WIDE ENVIRONMENTAL PROTECTION PLAN (P-WEPP)

This P-WEPP will at times require updating in response to changes in the Project, contractor work methods, group structure, or technological advancements that provide higher level of environmental protection. The subsections below indicate the process with respect to maintenance and implementation of the P-WEPP.

Initiating Revisions

This P-WEPP is a controlled document and revisions may only be processed by SNC Lavalin's (SLI's) Environmental Manager. It is anticipated that most of the revisions to this P-WEPP will be initiated by the environmental management team at the site or at the Lower Churchill Project office in St. John's.

Nalcor staff shall request revisions through document control. P-WEPP holders and readers/reviewers (within SLI, government agencies, contracting firms, other stakeholders, etc) may request revisions by forwarding a completed Revision Request Form (RRF), provided in Section 8, to SLI's Environmental Manager. These revision requests will be screened and reviewed by SLI in conjunction with Nalcor staff, and forwarded to SLI's Project Manager for approval.

Compliance Instructions

Revision requests that have been accepted by SLI's Project Manager will be sent to SLI's Environmental Manager for distribution to key Project participants as "Compliance Instructions". These instructions shall be signed off by key holders of the P-WEPP and returned within two (2) days of receipt. A log of compliance instructions shall be maintained by SLI's Environmental Coordinator (Hydro), and these will be incorporated periodically into a revised edition of the P-WEPP.

Revision Procedures

Revisions to the P-WEPP shall be made annually, or as required, in accordance with SLI's document control procedures. SLI's Environmental Manager will issue the accepted revisions of the P-WEPP to key holders, Contractors, and readers/reviewers. Each revision will be accompanied by a Revision Control Record (provided in Section 8) that:

a) Identifies all compliance instructions that have been issued since the last revision; and

b) Lists the sections being superseded.

Within two working days of receiving a revised Plan, P-WEPP holders shall:

a) Familiarize themselves with revised sections of the P-WEPP*;*

b) Incorporate all revisions into their areas of responsibility, as appropriate;

c) Ensure that all personnel are familiar with the revisions; and

d) Acknowledge receipt of the revised P-WEPP by forwarding via fax, email, or mail a signed and dated Acknowledgement Form to SLI's Environmental Manager. The Receipt of Revision Acknowledgement Form is located in Section 8.

TABLE OF CONTENTS

Page No.

LIST OF FIGURES

Page No.

LIST OF TABLES

Page No.

ABBREVIATIONS AND ACRONYMS

Abbreviation	Description
ACA	Ammonical Copper Arsenate
ACZA	Ammoniacal Copper Zinc Arsenate
CCA	Chromated Copper Arsenate
CCME	Canadian Council of Ministers of the Environment
C-SEPP	Contract-Specific Environmental Protection Plan
CuN	Copper Naphthenate
DFO	Department of Fisheries and Oceans Canada
DOEC	Newfoundland and Labrador Department of Environment and Conservation
DNR	Newfoundland and Labrador Department of Natural Resources
EA	Environmental Assessment
EEM	Environmental Effects Monitoring
ERP	Emergency Response Plan
FSL	Full Supply Level
GAP	Storage and Handling of Gasoline and Associated Products Regulations, 2003
H&S	Health and Safety
HVac	High Voltage Alternating Current
HVdc	High Voltage Direct Current
kVac	Kilovolt Alternating Current
kVdc	Kilovolt Direct Current
LSL	Low Supply Level
MCTS	Marine Communication and Traffic Services
MSDS	Material Safety Data Sheets
MSRP	Master Spill Response Plan
MW	Megawatt
NE-LCP	Nalcor Energy – Lower Churchill Project
NWPA	Navigable Waters Protection Act
P-WEPP	Project-Wide Environmental Protection Plan

Abbreviation	Description
PAO	Provincial Archeological Office
PCP	Pentachlorophenol
RCC	Roller Compacted Concrete
RCP	Regulatory Compliance Plan
RFP	Request for Proposals
RP	Rehabilitation Plan
RRIF	Revision Request Initiation Form
SLI	SNC Lavalin Inc.
SOP	Standard Operating Procedures
TC	Transport Canada
TSS	Total Suspended Solid
WHMIS	Workplace Hazardous Materials Information System
WMP	Waste Management Plan – Component 1 and 4b

1 INTRODUCTION

Environmental Protection Plans are of critical importance to large construction projects. The Project-Wide Environmental Protection Plan (P-WEPP) will ensure a high level of environmental protection in all of the Project's work areas during construction and commissioning. This P-WEPP is a working document for use at site by Project personnel and contractors. It will help ensure conformance with both NE-LCP and SLI policy statements. It also will serve as a tool for Project participants, including regulators, to monitor regulatory compliance and to improve on environmental performance.

This P-WEPP contains standard environmental protection procedures, or mitigation measures, for activities commonly associated with large projects of this type. The objectives of this P-WEPP are to:

a) Anticipate potential negative environmental effects associated with construction; and

b) Implement appropriate mitigation measures to minimize or avoid negative effects where practical.

Negative effects include impacts to air quality and climate, groundwater and surface water resources, soil, biota and their habitats, human health and communities, and natural and historic resources.

Reference documentation including publically available Federal and Provincial reference documents, guidelines, fact sheets and operational statements for information detailed in the P-WEPP is located in reference document # GV-0003-01. A list of reference documents is outlined in Section 9.

1.1 PURPOSE

The purpose of this P-WEPP is to establish work practices and assign roles and responsibilities that all Project participants shall follow to mitigate negative

environmental effects associated with construction and commissioning of the Lower Churchill Project.

Specifically the purpose of this P-WEPP is to:

a) Document the conditions and requirements of Environmental Assessment (EA) release;

b) Outline the Lower Churchill Project's commitments to minimize potential environmental effects - including commitments made in the Environmental Impact Statement (Nalcor, 2009) and during the regulatory review process under the Joint Review Panel (JRP);

c) Provide concise and clear instructions to Lower Churchill Project participants regarding procedures for protecting the environment and minimizing potential impacts to the environment;

d) Provide direction to Lower Churchill Project participants regarding issues and concerns of stakeholder groups including aboriginal peoples, fisheries groups, landowner groups and the public;

e) Provide a reference document for Lower Churchill Project participants to use when planning and/or conducting specific construction and commissioning activities;

f) Provide direction for environmental orientation programs for Lower Churchill Project participants;

g) Document changes to the P-WEPP originating through the interactive revision process;

h) Provide a reference to applicable legislative requirements and guidelines; and

i) Provide a detailed summary of environmental issues and protection measures to be implemented during construction.

1.2 SCOPE AND APPLICATION

The scope of this P-WEPP covers the engineering, procurement, construction, and commissioning phases of the Lower Churchill Project for Components 1 and 4b. The focus of the P-WEPP is on construction activities, including activities along the transmission line from Muskrat Falls to Churchill Falls, the proposed reservoir, site access roads, accommodations complex, laydown areas and the Muskrat Falls generation facility. Section 2 describes the Project in more detail.

Please note that there are additional components of the Project that are outside the scope of this P-WEPP. They include the following:

- Component 2: Gull Island Generation Facility
- Component 3: an ac to dc converter station at Muskrat Falls near the lower Churchill River in Central Labrador; a dc to ac converter station at Soldiers Pond, with some associated Island system upgrades; electrodes, in the Strait of Belle Isle (L'anse Au Diable, Labrador) and Conception Bay (Dowden's Point, Newfoundland); transition compounds at Forteau Point and Shoal Cove; ac switchyards at Soldier's Pond and Muskrat Falls; and synchronous condensers at Soldier's Pond.
- Component 4a: Labrador Island Transmission Link: an overhead HVdc transmission line from Muskrat Falls to the Strait of Belle Isle (approximately 383 km); an overhead HVdc transmission line from the Strait of Belle Isle to Soldiers Pond on the Island's Avalon Peninsula (approximately 695 km); an overhead electrode line from the Soldiers pond to Dowden's Point (approximately 12km) and an overhead electrode line from the HVdc transmission line to Lanse-au-diable (approximately 22km).
- The cable crossing at the Strait of Belle Isle.

In addition, this P-WEPP does not cover the Operations phase of the project and a separate EPP for this will be developed and submitted at a later date.

This P-WEPP is one component of the Lower Churchill Project's *Environmental Management Plan (SLI Document # 505573-0000-68RA-I-0004, NE-LCP Document # MFA-SN-CD-0000-EV-PL-0001)*. Other subordinate documents of the Environmental Management Plan include the following:

a) *Contract-Specific Environmental Protection Plan (*C-SEPP*) Template (SLI Document # 505573-0000-68RA-I-0011, NE-LCP Document # LCP-SN-CD-0000-EV-PL-0006-01)*

b) *Rehabilitation Plan (RP) (SLI Document # 505573-0000-68RA-I-0007, NE-LCP Document # LCP-SN-CD-0000-EV-PL-0004-01);*

c) *Regulatory Compliance Plan (RCP) (SLI Document # 505573-0000-68RA-I-0003, NE-LCP Document # LCP-SN-CD-0000-RT-PL-0001-01); and*

d) *Waste Management Plan (WMP) - Component 1 and 4b (SLI Document # 505573-0000-68RA-I-0008, NE-LCP Document # LCP-SN-CD-0000-EV-PL-0005-01)*.

Nalcor's Emergency Response Plan and Master Spill Response Plan (MSRP) are companion documents to the Environmental Management Plan. The MSRP shall be used by contractors as a basis for preparing their own spill response plans.

This P-WEPP applies to all Project participants, including NE-LCP, SLI, contractors, subcontractors, suppliers, service providers, and all employees of these organizations.

Given the Lower Churchill Project's magnitude, accepted *Contract-Specific Environmental Protection Plans (*C-SEPP*s)* shall be required. C-SEPP*s* shall be prepared by all contractors for all construction contracts to ensure that effects on the environment are minimized to the extent practical. These C-SEPP*s* shall provide sufficient detail on the Contractor's:

a) Scope of work;

b) Methods of construction;

c) Sequence of activities;

d) List of resources (i.e. equipment and site workforce);

e) Temporary and permanent installations;

f) Environmental protection procedures and alternative procedures, if required; and

g) Environmental contingency measures.

This P-WEPP shall serve as a resource to contractors as they prepare their own C-SEPPs. Contract packages shall include C-SEPP templates, with specific instructions on how these templates are to be properly completed. All C-SEPPs shall require acceptance by both SLI and NE-LCP prior to the contractor's mobilization to site.

In certain cases, particularly in areas where environmental risks are elevated, specific mitigation measures shall be engineered for the Project. These measures, detailed in the form of technical specifications and construction drawings, shall form part of the contract packages.

2 PROJECT DESCRIPTION

2.1 MUSKRAT FALLS HYDROELECTRIC DEVELOPMENT (COMPONENT 1)

Muskrat Falls is one of two hydroelectric developments being planned for the lower Churchill River. The remotely controlled nominal 824 MW Muskrat Falls Hydroelectric Development will be composed of the following sub-components and associated ac connector lines to an ac switchyard:

a) 16 km of permanent access roads, including upgrading of existing roads and new construction;

b) Reservoir, approximately 60 km long and 101.4 km^2 in total area;

c) Replacement fish habitat;

d) A north roller compacted concrete (RCC) overflow dam;

e) Gated spillway including:

   i) Approach and discharge channels; and

   ii) Vertical lift gates.

f) A close coupled intake and powerhouse including:

   i) intakes with gates and trash racks;

   ii) concrete lined water passages;

   iii) turbine/generator units at approximately 206 MW each with associated ancillary electrical/mechanical control equipment;

   iv) power transformers (includes 1 spare), located on the draft tube deck of the powerhouse; and

   v) 2 overhead cranes;

g) A south dam;

h) Component diversion works (i.e. cofferdam and spillway for diversion channel);

i) Stabilized north spur;

j) ac switchyard at Muskrat Falls; and

k) Churchill Falls switchyard extension.

Figure 2-1 shows the current concept for the generating facility.

Figure 2-1: Muskrat Falls Generating Facility (Component 1)

2.2 SUB-COMPONENT 4B: HVAC OVERHEAD TRANSMISSION LINE MUSKRAT FALLS TO CHURCHILL FALLS

a) Transmission lines from Muskrat Falls to Churchill Falls:

i) 2-315 kV ac, 3 phase lines, double bundle conductor;

ii) Single circuit galvanized lattice steel guyed suspension and rigid angle towers; and

iii) 250 km long.

2.3 CONSTRUCTION RELATED INFRASTRUCTURE

Construction related infrastructure will be established to support construction activity for components 1 and 4b. Some of this infrastructure is temporary and shall be decommissioned before the end of the construction phase. It is anticipated that the following infrastructure will be required:

a) A 1,500 person accommodations and administration complex (for construction period);

b) Access roads associated with the main dam structure, the accommodations complex and reservoir;

c) Diversion facilities (i.e. upstream and downstream coffer dams, the latter of which is to be removed prior to tailrace flooding);

d) Borrow pits and quarries;

e) Construction bridge;

f) Concrete and crushing plants;

g) Construction power and site communications infrastructure;

h) Reservoir clearing camps and wood storage yards;

i) Material storage and laydown areas including the potential use of port facilities (if upgrades are required to port facilities they shall be completed by the responsible party);

j) Fuelling and fuel storage facilities;

k) Spoil areas;

l) Muskrat Falls 25 kV construction power line & construction power terminal substation;

m) HVac transmission line construction camps; and

n) Trash and debris collection boom, associated roads and debris storage areas.

3 ROLES AND RESPONSIBILITIES

The Lower Churchill Project environmental management team is comprised of Nalcor Energy – Lower Churchill Project (NE-LCP) and SLI environmental, engineering, and construction management staff. A responsibility matrix is provided in Figure 3-1. Figure 3-2 illustrates the team structure. Roles and responsibilities of team members are further defined in the sections that follow.

Activity	SNC-Lavalin Inc	Project Manager	Environmental Manager	Environmental Co-ordinator (Hydro)	Environmental Co-ordinator (Transmission)	Permits Co-ordinator	Component Manager	Construction Managers	Interface Manager	Area Manager	On-Site Environmental Coordinator	On-Site Environmental Monitor	SLI Staff	Nalcor Energy	Contractors
Development of the P-WEPP		A	R	R	S	S	S	S	I	I	I	I	S	C	I
Review of P-WEPP		A	R	I	C	C	C	C	C	C	I	I	I	C	I
Accept P-WEPP		I	I	I	I	I	I	I	I	I	I	I	I	A	I
Implementation of the P-WEPP		A	R	R	R	S	R	R	I	R	R	R	R	C	R
Management/Revisions of the P-WEPP		A	R	R	R	C	I	C	I	I	S	S	S	C	I
Development of the C-SEPP		I	S	S	S	S	S	S	I	I	I	I	I	C	A/R
Review of the C-SEPP		A	R	R	R	C	C	C	I	I	I	I	I	C	I
Accept C-WEPP		A	R	R	R	I	I	R	I	I	I	I	I	R	I
Implementation of the C-SEPP		R	R	R	R	R	R	R	I	R	R	R	R	C	A/R
Management/Revisions of the C-SEPP		R	R	R	R	S	I	R	I	I	S	S	S	C	A/R
Toolbox Meetings		R	R	C	C	C	R	R	I	C	R	R	I	I	A/R
Project Environmental Awareness															
(i) SLI Employee Orientation		A	R	R	R	S	R	R	R	R	R	R	R	I	I
(ii) Visitor Orientation		A	R	R	R	I	R	R	R	R	R	R	R	I	I
(iii) Contractor Orientation		A	R	R	R	S	R	R	R	R	R	R	S	I	R
Environmental Compliance Monitoring															
(i) Daily Field Reports		A	R	R	R	S	R	R	I	C	R	S	S	I	C
(ii) Quarterly Environmental Audits		A	R	R	R	C	C	S	I	I	S	S	I	C	C
(iii) Annual Environmental Performance Review		A	R	S	S	S	C	S	I	I	S	S	I	C	I
Managing Compliance Tracking Registry		A	R	R	R	R	I	R	I	S	S	S	S	C	I
Environmental Effects Monitoring		I	I	I	I	I	I	C	I	I	I	I	I	A/R	C

Accountable, **R**esponsible, **S**upports, **C**onsulted, **I**nformed
P-WEPP: Project-Wide Environmental Protection Plan
C-SEPP: Contract-Specific Environmental Protection Plan

Figure 3-1: Responsibility Matrix

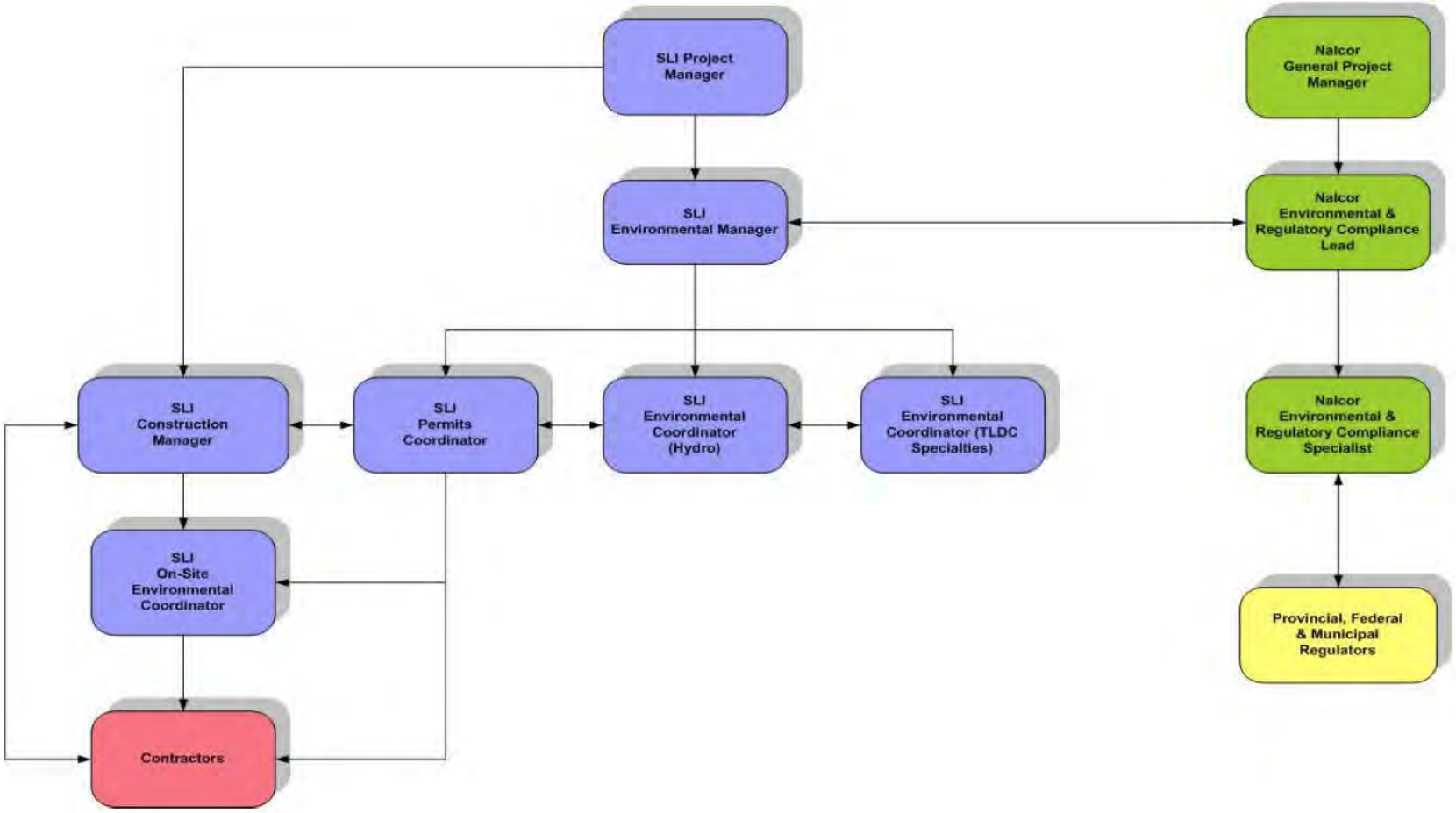

Figure 3-2: Lower Churchill Project Hydroelectric Generation Facility Project: Environmental Management Team

3.1 NALCOR ENERGY – LOWER CHURCHILL PROJECT

3.1.1 NE-LCP Auditing Function

NE-LCP shall periodically perform audits on SLI's performance as it relates to the P-WEPP.

3.1.2 Individual Responsibilities

NE-LCP's General Project Manager shall be accountable for the acceptance of the P-WEPP and responsible for the acceptance of the C-SEPP. NE-LCP's General Project Manager shall be consulted on the various aspects of P-WEPP management. This person shall also be consulted on environmental compliance monitoring processes such as daily field reports, quarterly environmental audits and annual environmental performance reviews. Environmental effects monitoring is the responsibility of NE-LCP and the General Project Manager shall be accountable for this. NE-LCP's General Project Manager shall be supported in this function by NE-LCP's Environmental and Regulatory Compliance Lead and Environmental and Regulatory Compliance Specialist.

3.2 SLI

3.2.1 SLI Auditing Function

The purpose of the auditing function shall be to evaluate the performance of the P-WEPP and to identify opportunities for continual improvement.

Auditing shall consist of daily field reports, quarterly environmental compliance audit reports and annual performance reviews.

The daily field reports shall be completed by the On-Site Environmental Monitors, who review daily activities of the Contractors.

The quarterly environmental compliance audit reports shall be completed by SLI Environmental Coordinators for the Transmission and Hydro components. The reports shall document all incidents of non-compliance with the P-WEPP and their

causes. SLI's Environmental Coordinators shall distribute the environmental compliance audit reports to relevant Project participants.

The annual performance review shall be completed by the key members of the environmental and construction teams. This audit shall include a review of all work activities that relate to environmental concerns, issues and/or mitigations and shall include a review of environmental audits carried out by NE-LCP during the year. The review process shall give all parties a chance to evaluate overall environmental performance and compliance with government regulations, permits, this P-WEPP, and C-SEPPs.

3.2.2 Individual Responsibilities

SLI Project Manager: The SLI Project Manager shall be accountable for development, implementation and management of the P-WEPP and shall be informed of acceptance of the P-WEPP. This person shall be responsible for implementation and management of C-SEPPs and be accountable for review and acceptance of C-SEPPs. The Project Manager shall be informed of all activities accountable and responsible by NE-LCP. The Project Manager is considered to be responsible for implementation and management of C-SEPPs, along with the Contractor.

SLI Environmental Manager: The SLI Environmental Manager shall be responsible for the development, review, implementation and management of the P-WEPP and review, acceptance and implementation of the C-SEPP as well as all environmental compliance monitoring. SLI's Environmental Manager shall be informed of all activities accountable and responsible by NE-LCP such as acceptance of the P-WEPP and C-SEPP and environmental effects monitoring.

SLI Environmental Coordinator (Hydro and Transmission): The SLI environmental coordinators for Hydro and Transmission together shall be responsible for implementation of the P-WEPP as it relates to their individual components. They shall support the Environmental Manager with managing changes to the P-WEPP. They shall also be responsible for review, acceptance and implementation of the C-

SEPPs. They shall be responsible for Project Environmental Awareness such as orientation of SLI employees, visitors and contractors. They shall be responsible for certain aspects of environmental compliance monitoring such as reviewing daily field reports, quarterly environmental audits and responsible for managing the non-conformance registry (in consultation with the Permits Coordinator). They shall be informed on environmental effects monitoring details.

SLI Permits Coordinator: The SLI Permits Coordinator shall provide support for the development and implementation of the P-WEPP and shall be consulted on management or revisions of the P-WEPP. This person shall provide support for C-SEPP implementation and project environmental awareness through orientation. SLI's Permits Coordinator shall provide support and consultation for several aspects of environmental compliance monitoring. This person shall also be consulted on the review of the P-WEPP to ensure compliance with permit conditions. The Permits Coordinator shall be responsible for managing the permit registry (in consultation with the hydro and transmission coordinators) and shall be informed of environmental effects monitoring details.

SLI Component Managers: The SLI Component Managers shall be responsible for ensuring the P-WEPP is included in procurement packages, which falls under implementation of the P-WEPP. They shall provide support for the development of the P-WEPP and the C-SEPP and shall be responsible for implementation of the C-SEPP. They shall be responsible for project environmental awareness such as orientation of SLI employees, visitors and contractors and ensuring daily field reports are completed. They shall be informed about all other aspects of the P-WEPP, C-SEPP and compliance tracking.

SLI Construction Managers: The SLI Construction Managers shall be responsible for overseeing construction management including management of on-site environmental issues through implementation of the P-WEPP. They shall also be responsible for the acceptance and implementation of the C-SEPPs and also for revisions to this document. The Construction Managers shall report directly to Nalcor's Site Manager and shall be responsible for certain aspects of environmental

compliance monitoring and compliance tracking. The Construction Managers shall also be responsible for ensuring visitors, contractors and SLI employees on the site receive the appropriate orientation and training required.

SLI Interface Manager: The SLI Interface Manager shall be informed on all aspects of the development and implementation of the P-WEPP and C-SEPPs. This person shall be responsible for project environmental awareness such as orientation of SLI employees, visitors and contractors. This person shall be informed during environmental compliance monitoring, compliance tracking and environmental effects monitoring.

SLI Area Manager: The SLI Area Managers shall be informed on all aspects of the development of the P-WEPP and C-SEPPs. They shall be responsible for ensuring implementation of the P-WEPP and C-SEPPs by contractors. They shall be responsible for project environmental awareness such as orientation of SLI employees, visitors and contractors. They shall be informed of environmental compliance monitoring and environmental effects monitoring and shall provide support for the management of the compliance tracking registry.

SLI On-Site Environmental Coordinator: This individual shall coordinate all activities and monitoring effort by the On-Site Environmental Monitors to ensure the P-WEPP, C-SEPPs, and permit conditions are complied with. The On-Site Environmental Coordinator shall report directly to SLI's Construction Manager, and interface functionally with the Environmental Coordinators (Hydro and Transmission) and the Permits Coordinator.

SLI On-Site Environmental Monitors: the On-Site Environmental Monitor shall monitor on-site Project activities, evaluate the Contractors' environmental performance with respect to requirements established in the P-WEPP and C-SEPPs, evaluate the performance of designed/constructed environmental mitigation systems through sampling and testing programs, and track on-site compliance with regulatory requirements and conditions of all permits and approvals. They shall be responsible for producing daily field reports as part of environmental compliance monitoring and

shall provide support for managing the non-conformance registry. The On-Site Environmental Monitors shall report directly to SLI's On-Site Environmental Coordinator and functionally to SLI's Environmental Coordinators. They shall interact with the Contractors on environmental procedures and requirements, participate in Project team meetings, toolbox meetings, conduct environmental reviews of drawings, and assist in the revision and update of the P-WEPP and C-SEPPs as necessary. The On-Site Environmental Monitors shall also be responsible for ensuring employees, visitors and contractors on the site receive the appropriate orientation and training.

3.3 CONTRACTORS

Contractors and Subcontractors shall build, supply and/or install various components of the Project, or be involved in provision of services to support construction and/or procurement, as defined in the work scopes of their respective contract packages. The contractors shall be accountable and responsible for implementing environmental protection procedures as outlined in the P-WEPP and developing, implementing, and maintaining their own C-SEPP, as applicable. They shall be responsible for holding toolbox meetings at the start of each shift to discuss health, safety and environmental issues and shall be responsible for developing their own orientation and training package to deliver to individuals entering worksites on their behalf in addition to the project training noted above. They shall ensure P-WEPP conditions are reflected in their proposals and bids and shall comply with all relevant regulations, guidelines, permits, approvals and authorizations. The contractor may be consulted, as required, on aspects of environmental compliance monitoring and environmental effects monitoring.

3.4 PROJECT ENVIRONMENTAL AWARENESS

3.4.1 Employee Orientation

A Project environmental orientation has been developed and shall be presented to all people that arrive at the Project site. The orientation is considered a prerequisite to entering any of the Lower Churchill Project sites.

Project environmental orientation shall include elements of this P-WEPP such as: environmental protection procedures; proper storage and handling of materials; encounters with wildlife, rare/endangered species, historic resources, waste management, and emergency response.

Project environmental orientation shall be delivered by experienced individuals with an in depth knowledge of the P-WEPP and a knowledge of construction and execution activities.

The project environmental orientation shall include a review of the following:

a) Environmental management;

b) Environmental considerations;

c) Non-compliance and corrective actions;

d) Environmental contingency measures;

e) Incident reporting requirements;

f) All permit-required work; and

g) Construction site rules and regulations.

All personnel who attend the Project Environmental Orientation session shall be required to sign an attendance sheet, and shall be provided with access to copies of the P-WEPP, or C-SEPP as appropriate, and documentation indicating the completed training and expiration dates.

3.4.2 Visitor Orientation

A temporary orientation shall be provided to those persons who have arrived at the project but will not be completing any field construction work (meetings, office work, deliveries, etc.). The visitor orientation shall cover relevant environmental protection measures, project emergency procedures, environmental incident reporting requirements, and other general project environmental requirements.

Any person, who has not taken the full orientation program, shall be supervised by a designated, oriented Project person at all times, and shall abide by the P-WEPP.

3.4.3 Contractor Orientation

Contractors may develop and deliver additional environmental orientations to their workforces, visitors, consultants and inspectors on the details of their C-SEPP, and/or corporate requirements. The Contractor orientations are subject to review and acceptance by SLI's Environmental Manager.

3.4.4 Toolbox Meetings

Toolbox meetings (short, informal meetings) shall be held by the contractor with its field crews and supervisors at the beginning of each work shift. The toolbox meeting shall involve discussion of work task assignments for the day and any associated safety hazards. These meetings shall also provide the opportunity to discuss environmental concerns and applicable mitigation measures that apply.

4 RELEVANT LEGISLATION

There are regulatory requirements at the provincial, federal and municipal levels that apply to the design and construction of the Project. Compliance will be evaluated through a program of environmental compliance monitoring, primarily implemented by On-Site Environmental Monitors.

The project has adopted Nalcor Energy's Corporate Environmental Policy and Guiding Principles and its Environmental Management System meets the requirements of ISO 14001:2009 (Environment). As a result, environmental protection measures and mitigation associated with this Project shall meet the same high corporate standard.

All work undertaken during the design, construction and commissioning phases of this project shall be in accordance with the most recent guidelines. For a detailed discussion of the regulatory requirements for the Project see the *Regulatory Compliance Plan (SLI Doc. No. 505573-0000-68RA-I-0003, NE-LCP Document # LCP-SN-CD-0000-RT-PL-0001-01)*.

4.1 FEDERAL

The following federal environmental acts apply to one or more aspects of Project:

a) *Canadian Environmental Assessment Act (CEAA);*

b) *Canadian Environmental Protection Act (CEPA);*

c) *Species at Risk Act (SARA),*

d) *Navigable Waters Protection Act (NWPA);*

e) *Transportation of Dangerous Goods Act, 1992;*

f) *Oceans Act;*

g) *Canada Shipping Act;*

h) *Migratory Bird Convention Act; and*

i) *Fisheries Act*.

4.2 PROVINCIAL

The following provincial acts and regulations apply to one or more aspects of the Project:

a) *Dangerous Goods Transportation Act;*

b) *Endangered Species Act;*

c) *Forestry Act;*

d) *Historic Resources Act;*

e) *Newfoundland and Labrador Lands Act;*

f) *Environmental Protection Act* (EPA);

- *i) Air Pollution Control Regulations, 2004*
- *ii) Gasoline Volatility Control Regulations, 2003*
- *iii) Pesticides Control Regulations, 2003*
- *iv) Storage and Handling of Gasoline and Associated Products Regulations, 2003*
- *v) Used Oil Control Regulations, 2002*
- *vi) Waste Diversion Regulations, 2005*
- *vii) Waste Management Regulations, 2003*
- *viii) Waste Material Disposal Areas, 1996*

g) *Nalcor Energy/Lower Churchill Generation Project Undertaking Order, Environmental Protection Act;*

h) *Wildlife Act; and*

i) *Water Resources Act;*

- *i) Well Drilling Regulations, 2003*

ii) *Water Power Rental Regulations, 2003*

iii) *Environmental Control Water and Sewage Regulations, 2003*

j) *Motorized Snow Vehicles and All-Terrain Vehicles Act*

i) *Motorized Snow Vehicles and All-Terrain Vehicles Regulations, 1996*

4.3 MUNICIPAL

In some areas, construction activity will take place within municipal boundaries. In these areas, local bylaws shall be complied with and permits obtained.

5 GENERAL ENVIRONMENTAL PROTECTION PROCEDURES

In general, environmental mitigation shall be planned and designed prior to issuing proposal calls for construction contracts. Environmental mitigation plans and specifications shall be incorporated into documents provided to prospective contractors for proposal purposes.

Environmental mitigation shall be consistent with applicable standards, codes, acts and regulations and the conditions of Environmental Assessment (EA) Release.

This section contains a comprehensive suite of Environmental Protection Procedures to be used.

The procedures in this section may need to be modified in the future to address new activities, unforeseen site conditions, changes in engineering design and/or construction work methods, or new environmental performance standards. These changes will be part of the maintenance of the P-WEPP as outlined in the front of this report.

5.1 SCHEDULING AND TIMING OF CONSTRUCTION ACTIVITIES

Construction planning is one of the most fundamental activities in the management and execution of construction projects. One of the most important factors in a large scale project is the scheduling and timing of various activities. Of primary importance will be maintenance of the Project schedule. However, sensitive time periods outlined in the section below shall be considered in Project planning where practical. Where activities are to be carried out during sensitive time periods additional mitigations shall be applied as required.

Environmental Concerns

Construction activities shall be organized so that various tasks that must be accomplished have the necessary precedence and resources required to complete the task.

Environmental Protection Procedures

a) A complete schedule of activities provided by the Contractor and accepted by On-Site Environmental Monitors shall be completed prior to commencement of any construction task and any restrictions on timing shall be noted on the schedule;

b) While the ideal time of year for construction near a body of water is early June through late October, due to the low flow and low rainfall period; construction will be occurring in other times and specific attention shall be paid to ensure environmental mitigations are applied during this period;

c) Stripping, grading, excavating and/or rehabilitation activities shall be scheduled to minimize the amount of time the soil is exposed to elements;

d) Activities shall be conducted in such a way as to reduce the amount of time spent in or around a stream or water body;

e) Construction activities shall be scheduled, where possible, to avoid any sensitive areas of fish and wildlife habitat and critical periods in fish and wildlife cycles. The sensitive life stages of wildlife in Labrador are illustrated in Table 5-1. These

are used to identify the timing of migration, spawning and calving in the vicinity of the site, which shall be considered, where possible, in the scheduling of construction activities; and

f) If timing is not ideal, alternative mitigations shall be implemented.

Table 5-1: Sensitive Life History Stages of Aquatic and Terrestrial Fauna *

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Aquatic												
Brook Trout												
Quananiche												
Lake Whitefish												
Lake Trout												
Northern Pike												
Burbot												
Suckers												
Terrestrial												
Early Nesting Waterfowl												
Late Nesting Waterfowl												
Forest Avifauna												
Raptors												
Caribou												
Moose												
Semi-aquatic Furbearers												
Terrestrial Furbearers												
Black Bear												

No interaction
Low Interaction
Moderate to High Interaction

*Table taken from Environmental Impact Statement, Lower Churchill Hydroelectric Generation Project

5.2 CONSTRUCTION ENTRANCE

Environmental Concerns

Construction entrances typically consist of a gated right-of-way and a security building. Environmental concerns include the vegetation clearing that may be required for the construction of these features, and tracking of dirt and mud from the site onto public roads and streets.

Environmental Protection Procedures

Measures to remove mud and dirt from vehicles, heavy equipment and pedestrians shall be required. Measures include rumble racks, tire washes and sediment traps.

a) All cleaning activities should occur on a gravel pad with runoff running through a sediment trapping device prior to discharge;

b) The gravel pad should be designed for the heaviest vehicle anticipated on site;

c) Ensure all site traffic use the facility and ensure the sediment trapping device is cleaned and maintained regularly;

d) Temporary erosion control measures shall be applied as required in the area of vegetation clearing for any gate areas or entrance buildings. See Section 5.25 for applicable control measures; and

e) Ensure proper cleaning of machinery/vehicles to prevent potential spread of invasive species.

5.3 LINEAR DEVELOPMENTS

Environmental Concerns

Linear developments encompass a diverse range of standard construction related activities such as ditching, right-of-way clearing, roads and transmission line construction. Environmental concerns associated with linear developments include potential sedimentation/erosion, and the loss of vegetation and fish/wildlife habitat. Linear features can also have a negative impact on caribou beyond habitat loss.

Environmental Protection Procedures

Road Construction & Ditching

a) Aggregate (fill) materials for construction purposes shall not be removed from any stream;

b) Sedimentation control measures as outlined in Section 5.25, Erosion Prevention and Sediment Control shall be followed. Solids that accumulate in a settling pond or behind a sediment trap shall be removed on a regular basis to ensure such systems remain effective;

c) Work shall not be undertaken on easily erodible materials, during or immediately following heavy rainfalls without approved protection measures in place;

d) Buffer zones shall be flagged prior to any disturbance activities, as required;

e) Natural vegetation shall be left in place where possible. Rights-of-way, particularly in areas of dense vegetation, shall be as narrow as practicable; loss of ground vegetation shall be kept to a minimum;

f) Roads shall be adequately ditched so as to allow for good drainage. Where possible ditches shall be kept at the same gradient as the road;

g) Drainage from areas of exposed fill shall be controlled by grade or ditching and directed to vegetated areas away from all watercourses and at least 30 m from stream crossings. These drainage areas shall be determined in consultation with the On-Site Environmental Monitors;

h) Surface water shall be directed away from work areas by ditching. Runoff from these areas shall have sediment removed by filtration or other suitable methods as outlined in Section 5.25 and shall be directed away from wetlands and watercourses;

i) The sediment control measures shall be determined on site by the Contractor personnel and accepted by the On -Site Environmental Monitor;

j) Check dams shall be used as required to reduce runoff from work areas with exposed soil;

k) In areas where natural vegetation must be removed, the topsoil layer shall be separately stored from grubbed material for rehabilitation;

l) Cut areas through silt and clay materials shall have erosion prevention measures (Section 5.25);

m) Temporary erosion control shall be applied on exposed slopes in sensitive areas immediately following exposure of a slope. A permanent control measure shall be installed shortly thereafter. See Section 5.25 for applicable erosion control measures;

n) The cutting and filling phase of road construction, and the development of other work areas, shall be conducted as outlined in the following procedures:

    i) Cutting and filling shall be done only upon completion of grubbing. Where engineering requirements do not require grubbing (e.g., within the buffer zone of a stream crossing), filling shall occur without any disturbance of the vegetation mat or the upper soil horizons;

    ii) Filling in the vicinity of stream crossings shall be done in a manner which ensures that erosion and sedimentation of watercourses, water bodies and other ecologically sensitive areas such as wetlands is minimized and done in strict compliance with the required watercourse alteration permits from the DOEC. The hydrologic function of wetlands shall be maintained;

iii) The infilling of watercourses and water bodies shall not be permitted except as authorized by regulatory agencies and with the approval of the On-Site Environmental Monitor. The On-Site Environmental Monitor shall inspect the work to ensure it is completed in compliance with the required watercourse alteration permits from the DOEC, a letter of advice from DFO (if issued) and the Authorization for Works or Undertakings Affecting Fish Habitat from DFO, if required;

iv) Buffer zones shall be maintained between the roads and the bank of any watercourse they parallel (refer to Section 5.18); and

v) Road fill shall be dry and ice free. On areas of sensitive terrain, excess fill shall be end-dumped from the established roadbed.

o) Culverts shall be installed to maintain natural cross-drainage and to prevent ponding;

p) The number of stream crossings shall be minimized. Where the road must cross a stream, the environmental protection procedures detailed in Section 5.17 shall be followed;

q) Where possible, construction activities shall avoid areas of wildlife concentrations to prevent undue disturbance of wildlife during critical periods (See Sections 5.1, 5.32 and 5.34). If encounters with wildlife are unavoidable, then contingency plans detailed in Section 7 shall be followed;

r) Boundaries shall be staked for all rights-of way, road easements, facilities, infrastructure and borrow sites that will be developed;

s) Where possible, rights-of-way shall avoid known archaeological, historical and/or spiritual sites and required buffers shall be respected (See Section 5.18). Where they cannot be avoided, the site shall be mitigated to satisfaction of Provincial Archaeological Office (PAO) prior to work proceeding. If any archaeological or historical sites are encountered (known or otherwise), all work shall cease in that area until approval to proceed has been granted by the PAO; and

t) Reference shall be made to the *Guidelines for Protection of Fish Habitat in Newfoundland and Labrador, 1998.*

Right-of-Way Clearing

a) All salvaged timber shall be piled at right angles to rights-of-way so as not to obstruct the access or work of others, damage vegetation or be placed within buffer zones of critical habitat;

b) Disposal of cleared non-merchantable timber, slashing and cuttings from cleared areas shall take place through mulching and/or piling to minimize the amount of slash. No burning of materials is permitted for this project;

c) If slash piles are to be used, they shall be piled so as not to cause unnecessary damage to vegetation outside the right-of-way. A 6.5 m break in slash piles shall be made every 200 m to allow for drainage and animal access. The maximum height of the piles shall not exceed 3 m; and

d) All conditions outlined under Road Construction and Ditching (above) as well as Transmission Line Development (below) that also apply to right-of-way clearing shall be adhered to.

Transmission Line Development

a) Where feasible and applicable, untreated wood should be used. Where untreated wood is not practical, it shall be treated with pentachlorophenol (PCP), chromated copper arsenate (CCA) ammonical copper arsenate (ACA), ammoniacal copper zinc arsenate (ACZA), or copper naphthenate (CuN) only (see Section 5.13.5.1 for information regarding the use of treated wood in and around waterbodies and protected water supply areas);

b) Access for the transmission line development shall follow the protective measures as listed above for roads and ditching;

c) Ground travel on the transmission line shall follow existing trails and tote roads where practical. Stream crossings shall follow DFO standard operating procedures (SOP) where feasible (i.e. one time ford, clear span bridge etc.)

Where the SOP cannot be adhered to, a stream survey and request for letter of advice from DFO may be required; and

d) Construction for overhead transmission lines shall follow DFO Standard Operating Procedures for stream crossings.

5.4 WINTER CONSTRUCTION

Environmental Concerns

The principal concerns associated with winter construction are potential effects on freshwater ecosystems and water quality.

Environmental Protection Procedures

a) Winter vehicles shall be confined to properly prepared, groomed and approved trails and to work sites;

b) Maintenance and refuelling of vehicles shall be restricted to designated areas;

c) Only streams or water bodies that are frozen shall be traversed, unless permits to ford are in place. (See the DFO Operational Statement for Ice Bridges and Snow Fills);

d) Any debris or materials placed upon the ice surface of any waterbody shall be removed immediately after job completion;

e) The ground must be frozen or a minimum 0.5 m snow cover for unfrozen ground is required for winter trails to avoid ground disturbance;

f) All known archaeological sites shall be avoided;

g) Snow removed for snow clearing operations shall be disposed of in areas directed by the On-Site Environmental Monitor; and

h) Gaps of at least 2 m shall be left in windrowed snow for ease of animal movements.

5.5 EQUIPMENT OPERATION AND MOVEMENT

A variety of equipment will be used on site during construction. This is a potential source of noise, air emissions, and potential leaks or spills.

Environmental Concerns

Noises associated with equipment operation and movement may negatively affect wildlife. Air emissions may have air quality implications. Accidental leaks or spills of fuel or other hazardous materials may affect soils, water, fish, vegetation and wildlife. Tracked equipment has the potential to disturb the ground around/at the site.

Environmental Protection Procedures

a) All approvals, authorizations and permits for Project activities shall be followed;

b) Noise control procedures shall be followed during construction (Section 5.31);

c) All equipment shall have exhaust systems regularly inspected and mufflers shall be operating in accordance with manufacturer's recommendations;

d) All equipment (e.g., diesel generators, etc.) shall meet the requirements of the *NL Air Pollution Control Regulations* under the *Environmental Protection Act,* as required. Diesel generators shall be registered with DOEC, as required. Refer to the guidance document for Approval of Diesel Generators (GD-PPD-061) for the registration form and guidance on completion;

e) All equipment use during construction shall follow the environmental protection procedures outlined in this P-WEPP. In the case of an accidental event resulting from the use of equipment (e.g., a fuel spill), refer to the contingency plans in Section 7;

f) All equipment on the Project site shall use only oils/lubricants that classify as "biodegradable" where feasible (see Section 5.13 for additional information on the use of biodegradable oils/lubricants);

g) ATVs and tracked vehicles shall only be used where necessary. ATV use shall comply with the Motorized Snow Vehicles and All-Terrain Vehicle Regulations,

1996, the Environmental Guidelines for Stream Crossings by ATV, 1994 and the DFO Fact Sheet ATVs, Fish Habitat and You;

h) The use of heavy equipment in or near water courses shall be minimized and restricted;

i) All equipment shall be regularly maintained and inspected. If problems are identified the equipment shall be taken out of service and repaired to prevent release of hydrocarbons into the environment; and

j) Best Management Practices outlined in “Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities” (May 2005, ChemInfo Services Inc. for Environment Canada) shall be implemented to mitigate air quality effects during the site preparation and construction phase, where practical.

5.6 VESSEL OPERATIONS (BARGE/BOATS)

Vessel traffic during construction may be required, including barges, tugs and ocean-going barges, and marine vessels to transport equipment and supplies to the construction sites. Heavy lift vessels shall be used for some of the larger modules particularly if they are being transported on the high seas. All vessels shall meet Transport Canada Regulations and standards, under the *Canada Shipping Act*, as well as international regulations established by the International Maritime Organization (IMO).

Environmental Concerns

Project vessel traffic may at times increase vessel traffic in Goose Bay and/or Cartwright. There is a risk due to increase in vessel traffic for vessels to collide, run aground and/or sink. Such events may lead to the accidental release of fuel and other hazardous materials to the marine environment. The release of non-compliant ballast water could also introduce non-indigenous species or deleterious substances into Canadian waters.

Environmental Protection Procedures

a) All vessel activity shall comply with the *Pollutant Discharge Reporting Regulations*, *Regulations for Prevention of Pollution from Ships* and *Dangerous Chemicals and Vessel Traffic Service Zones Regulations* as required under the *Canada Shipping Act*;

b) All commercial vessels twenty metres or more in length entering Goose Bay shall report to the MCTS centre;

c) The On-Site Environmental Monitors and the local public shall be advised of all particulars with regard to incoming/outgoing vessel traffic on a timely basis including updates regarding the estimated time of arrival/estimated time of departure (ETA/ETD) as advised by vessel masters;

d) Project vessel masters shall observe the following basic rules:

i) Demonstrate that they have a set of safety and emergency procedures on board;

ii) Advise the SLI site office of their time of departure from their port of origin and their estimated time of arrival at Happy Valley-Goose Bay or Cartwright;

iii) Notify the SLI site office of their progress at sea or, if stopping at other ports enroute, update their ETA;

iv) Relevant Canadian Hydrographic Charts or electronic charting systems shall be on board prior to leaving their port of origin; these charts shall be kept on board at all times;

v) Implement best management practices designed to achieve zero discharge of oily waste while at the site and along the shipping route;

vi) All Project-related vessels shall have onboard adequate oil spill response equipment to handle an accidental release of product into the environment; and

vii) Refer to the Master Spill Response Plan in the event or a spill or leak.

e) No Project-related vessels shall discharge wastes into surrounding waters. The discharge of garbage from ships into Canadian waters and the waters of the Fishing Zones of Canada is prohibited;

f) All crewmembers shall be familiar with emergency procedures for both life threatening and potentially polluting situations;

g) Vessel traffic shall not encroach on the marine or land portion of the Gannet Islands Ecological Reserve;

h) All stationary hazards, such as moored platforms or vessels, shall be clearly marked according to the *Navigable Waters Protection Act* and/or *Collision Regulations* under the *Canada Shipping Act*; and

i) All vessels shall comply with the *Ballast Water Control and Management Regulations SOR/2006-129,* under the *Canada Shipping Act.*

5.7 HELICOPTER TRAFFIC

Helicopter use at the Project site during construction will be required.

Environmental Concerns

Noise from the aircraft may disturb wildlife. Collisions with wildlife could result in mortality for both wildlife and humans and fuelling of helicopters may result in spills.

Environmental Protection Procedures

a) All aircraft shall maintain an altitude of no less than 500 m from concentrations of birds or other wildlife;

b) Flights for wildlife viewing or photography are not permitted, except when conducting wildlife surveys. Permits from the Wildlife Division are required for wildlife surveys;

c) The On-Site Environmental Monitor shall inform all charter pilots of the P-WEPP requirements;

d) All aircrafts shall inform the contractor of their expected arrival and departure times;

e) Aviation fuel caches shall have approval from Service NL;

f) The contractor shall ensure that helicopter landing areas are kept clear of equipment, materials/supplies at all times throughout the construction phase to avoid accidents or damage to the helicopter;

g) All aircraft operators shall review marine and aviation weather forecasts prior to departure;

h) Raptors (e.g., Bald Eagle, Osprey, Red Tailed Hawk) are known to nest within in the Project area. Under no circumstances shall nesting raptors be approached. The disturbance effects that helicopters have on nesting raptors can be detrimental for both the birds and the safety of the aircraft. All aircraft shall maintain a 300 m vertical and horizontal buffer from known active raptor nests between May 15 to August 15;

i) Locations along the Churchill River are known as spring and fall staging areas for waterfowl. Helicopters moving through these areas during this time (typically May or September) shall maintain a minimum altitude of 500 m from concentrations of waterfowl; and

j) The number of helicopter trips should be minimized to the extent feasible by combining trips or using other appropriate means of travel.

5.8 CLEARING OF VEGETATION

Environmental Concerns

Vegetation clearing (e.g., trees and shrubs) will be required during site preparation for work areas, laydown areas, roads, and for reservoir preparation. Environmental concerns include loss of habitat, sedimentation of watercourses, and disturbance or destruction of historic resources.

Environmental Protection Procedures

The following measures shall be implemented to reduce the potential effects of vegetation clearing:

General

a) All vegetation shall be removed in such a manner that will accommodate salvage of merchantable timber;

b) Clearing activities shall be limited to those areas that are required for reservoir preparation (i.e. trees in the stick-up and ice zones), as well as those areas that are required for construction of infrastructure;

c) All clearing shall comply with the requirements of all applicable permits, including a Commercial Cutting Permit and an Operating Permit;

d) A cutting permit shall be obtained prior to the start of any site clearing. Clearing and tree removal shall be restricted to the minimum areas needed for the site and stockpiles;

e) Clearing shall consist of cutting to within 15 cm or less of the ground and stockpiling of all merchantable timber; as well as the removal, piling and mulching of shrubs, debris and other non-merchantable timber in the area, as appropriate;

f) Disposal of cleared non-merchantable timber, slash and cuttings from cleared areas shall take place through mulching and/or piling to minimize the amount of slash. No burning of materials is permitted for this project;

g) If slash piles are to be used, they shall be piled so as not to cause unnecessary damage to vegetation outside the right-of-way. A 6.5 m break in slash piles shall be made every 200 m to allow for drainage and animal access. The maximum height of the piles shall not exceed 3 m;

h) Limits of clearing shall be shown on all drawings issued for construction. Only those areas designated on drawings shall be cleared. Trees shall be blazed/flagged at intervals in advance of clearing to demarcate the limits of the work. Blazed trees shall not be felled. For reservoir clearing however, the limits of work may not be marked in the field. Clearing activities shall not remove any trees outside the authorized clearing limits;

i) Slash and any timber shall not be permitted to enter any watercourse and shall be piled above spring flood levels;

j) Mechanical clearing by mechanical harvesters will likely take place within the reservoir area and main construction areas. For other clearing required, chain saws or other hand-held equipment may be used except where alternative methods or equipment are accepted by the On-Site Environmental Monitor;

k) Mechanical clearing by means other than mechanical harvesting equipment (i.e. bull dozer or excavators) shall not occur;

l) Fire fighting tools and water delivery systems must be available, as required, by the operating permit for the activity;

m) A buffer zone of undisturbed vegetation shall be maintained between construction areas and all water bodies (See DFO Operational Statement Aquatic Vegetation Removal in Freshwater Systems), watercourses, and ecologically sensitive areas (Section 5.18), unless otherwise authorized. Buffer zones within the reservoir shall be left in place and flooded. Buffer zone features shall be key elements of the environmental review of drawings prior to construction;

n) Where possible, timber shall be felled inward toward the work area to avoid damaging any standing trees within the immediate work area;

o) Workers shall not destroy or disturb any features that are indicative of a historical or archaeological site. Any such findings shall be reported immediately to the On-Site Environmental Monitor (see Sections 5.32.1 and 7.3);

p) Clearing activities between May 1 and July 31 shall be in compliance with the Avifauna Management Plan;

q) No clearing shall take place within 800 m of an active raptor nest between the months of May 15 to August 15. If a nest is encountered during clearing activities, all work shall stop until the site is evaluated and accepted by the On-Site Environmental Monitor, in consultation with the appropriate regulatory agencies;

r) If a tree containing an inactive eagle or osprey nest is encountered during site and reservoir clearing, the nest shall be assessed for viability and if the nest is deemed viable a platform shall be established as approved by the provincial Wildlife Division. For other raptors such as hawks and owls, active nests shall be identified as per the Avifauna Management Plan and appropriate buffers applied; and

s) If a tree containing an inactive raptor nest is encountered during transmission line clearing a platform will not be required as the tower will provide an alternative nesting site.

Merchantable Timber

a) Merchantable timber is defined as being 2.5 m or more in length with a top diameter not less than 9.1 cm and being of generally sound condition. Non-merchantable timber consists of all other vegetation with no merchantable value, such as small trees, shrubs, limbs and/or branches;

b) All merchantable timber shall be salvaged. It shall be cut into standard harvesting lengths (i.e., 2.5 - 3.5 m lengths), trimmed, and stored in identified stockpile

areas. For reservoir clearing, merchantable timber may be left as tree length. Figure 5-1 depicts poorly cut and piled wood and Figure 5-2 shows properly cut and piled wood; and

c) All merchantable timber within the specific clearing limits shall be stockpiled so as not to obstruct the access of work of others.

Figure 5-1: Poorly cut and piled wood

Figure 5-2: Proper way to remove, cut and pile wood

<u>Transmission Line/Road Rights-of Way</u>

a) All salvaged timber shall be piled at right angles to rights-of-way so as not to obstruct the access or work of others, damage vegetation or be placed within buffer zones of critical habitat; and

b) Slash and debris is to be disposed of as per items f) and g) of the general conditions outlined above.

5.9 PUMPS AND GENERATORS

Environmental Concerns

A variety of water pumps, hoses and generators will be in frequent use in many areas of the main construction site and at remote work camps. Environmental concerns are associated with any accidental spills or chronic leaks contaminating water bodies and soil. There may also be concerns with air emissions from generators on the site.

Environmental Protection Procedures

a) See Section 5.18 for required buffer zones for fuel and other hazardous materials storage and handling;

b) Drip pans shall be placed underneath pumps and generators. The drip pans shall be lined with absorbent material and shall have a cover to prevent water from entering. Absorbent material shall be kept at all sites where pumps and generators are in use;

c) Spill kits shall accompany all pumps and generators at the site (see Section 5.13);

d) Pumps and generators shall be located as far as practical from all waterbodies;

e) Pumps and generators shall be located on a level, stable surface. All pumps used for freshwater supply shall have a fine mesh screen on the intake hose;

f) Hoses and connections on equipment located near water bodies shall be inspected routinely for leaks and drips;

g) A water use license from the Water Resources Management Division shall be required for withdrawal of water from a waterbody;

h) All diesel generators on site shall meet the requirements of the *Air Pollution Control Regulations, 2004* under the *Environmental Protection Act* as required; and

i) All leaks shall be reported immediately to the On-Site Environmental Monitors. Upon detection of a leak, the equipment (i.e. pump, generator, etc.) shall be shut down immediately and corrective action taken to repair the leak and clean up any contaminated soil and/or water (Refer to the Master Spill Response Plan).

5.10 SURVEYING

Surveying activities may include: vegetation removal; traversing; establishing targets, permanent benchmarks and transponder stations.

Environmental Concerns

Surveying activities may disturb vegetation, wildlife, and historic resources.

Environmental Protection Procedures

Vegetation Removal

a) Where possible vegetation removal shall be scheduled to minimize disturbance to animals in sensitive areas or during sensitive time periods;

b) Width of survey lines shall be limited to that which is absolutely necessary for line of sight and unobstructed passage;

c) Whenever possible, cutting lines to the edge of open areas shall be avoided;

d) Trees and shrubs shall be cut flush with the ground wherever possible with stumps not to exceed 15 cm;

e) Cutting of survey lines shall be kept to a minimum;

f) All survey tape used at the site shall be made of biodegradable material;

g) All trees not exactly on transit lines shall be left standing and trees partly on line should be notched (notch not to exceed 1/3 tree's diameter) instead of removed, to allow sighting;

h) Discretion shall be used when large trees are encountered. For example, trees 30 cm at diameter breast height (dbh) or larger should, whenever possible, not be cut. On grid lines, trees of 30 cm diameter or larger shall be left intact and shall be traversed to continue the line;

i) Wildlife shall not be harassed or disturbed;

j) Vehicles shall yield the right-of-way to wildlife;

k) There shall be no cutting in areas designated as sensitive without notification of the On-Site Environmental Monitors;

l) Archaeological sites and features shall not be disturbed during survey work. Any historic resource discoveries shall be reported as per Section 5.32.1; and

m) Survey crews shall have a briefing on the recognition of historic resources prior to commencing work.

Traversing

a) ATVs shall not be allowed off the right-of-way, access and by-pass roads except where acceptable to the On-Site Environmental Monitor. ATV use shall comply with the *Motorized Snow Vehicles and All-Terrain Vehicle Regulations, 1996*, the *Environmental Guidelines for Stream Crossings by ATV, 1994* and the DFO Fact Sheet *ATVs, Fish Habitat and You*;

b) No motorized vehicles shall enter the areas designated as sensitive without notification of the On-Site Environmental Monitors;

c) Activity within sensitive areas shall be minimized; and

d) Walking in sensitive areas shall be restricted to established walking paths, where available.

Establishing Targets, Permanent Benchmarks and Transponder Locations

a) A driven T-bar, embedded to readily identify each benchmark location, shall be used;

b) Access to sensitive areas shall be accepted by the On-Site Environmental Monitors;

c) Standard iron bars and sledgehammers shall be used to establish benchmarks; and

d) Heavy equipment shall not be used to access sensitive areas.

5.11 DRILLING

5.11.1 Geotechnical

Drilling will be required as part of geotechnical investigations to recover soil samples, characterize the subsurface of proposed foundation, excavate areas and probe the bedrock surface. Seismic geophysical methods may also require drilling of shot holes in which small sources of energy (explosives, weight drop, air gun, etc.) are to be placed.

Environmental Concerns

The environmental concerns associated with drilling are surface disturbances, disposal of drilling fluids and cuttings, generation of dust, noise, and the potential effects on terrestrial habitats, historic resources, air quality and aquatic ecosystems.

Environmental Protection Procedures

The following mitigation measures must be followed when drilling at the site:

a) If water withdrawal is required for drilling, a request for project review to DFO is required. If a letter of advice is issued from DFO, all conditions shall be followed. A water use license is also required from the Water Resources Management Division;

b) Shot holes for seismic activities shall not be within 100 m of any water well, structure or buried service line;

c) Drilling mud, together with drilling cuttings and return water, shall be treated using a polydrill filter box or suitable alternative (See Figure 5-3). Solids collected shall be disposed of at an approved waste disposal site. All treated water shall be discharged on land to the environment in a manner that will promote permeation into overburden soils and will not enter or impair water bodies. If drilling mud is required, biodegradable products such as clear-bore or an approved equivalent shall be used. The type shall be documented and material safety data sheets (MSDS) provided and kept on file;

Figure 5-3: Poly Drill Filter Box used for solids removal in drilling applications

d) All discharges shall meet the Environmental Control Water and Sewer Regulations (ECWSR);

e) Drilling of boreholes shall be conducted in compliance with all conditions of the Exploration Approval for the work required under the *Mineral Regulations* issued under the *Mineral Act*;

f) All drilling equipment on the Project site shall use only oils/lubricants that classify as “biodegradable” (see Section 5.13 for additional information on the use of biodegradable oils/lubricants);

g) Due to the nature of drilling activities (quicksnaps, couplings) oil drops and leaks may occur. The area shall be cleaned up at every opportunity and all rigs shall be equipped with spill kits (as outlined in Section 5.13);

h) In the event of a hose rupture or loss of hydraulic fluid, the Master Spill Response Plan shall be followed;

i) Abandoned drill holes shall be sealed with a cement grout bentonite mixture;

j) If explosives are used in seismic shot holes, a blasting plan shall be reviewed with the On-Site Environmental Monitor to ensure any unexploded charges are removed from the holes prior to sealing;

k) Drilling sites shall be cleared of vegetation following the procedures detailed in Section 5.8;

l) Disposal of all drilling materials and associated solid wastes shall be undertaken in accordance with the procedures in Section 5.15;

m) Fuel shall be stored, handled and transported according to Section 5.13 and Section 5.18;

n) Water applications shall be used to control dust. Water-based drilling dust suppression systems may require anti-freeze in winter months, which shall be approved by the DOEC. The use of water for dust control or coring/wash boring shall be undertaken in a manner that ensures return water does not enter watercourses;

o) Drilling equipment shall have muffled exhaust to minimize noise.

p) No person shall deposit or permit deposition of oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds; and

q) If possible, drilling shall be scheduled to minimize disturbance to animals in sensitive areas during sensitive time periods.

5.11.2 Water Well

Water well drilling may be required on land during hydrogeological investigations to evaluate groundwater quality and quantity of bedrock aquifers.

Environmental Concerns

The environmental concerns associated with drilling water wells are surface disturbances, disposal of drilling fluids and cuttings, generation of dust, noise, and the potential effects on terrestrial habitats, historic resources, air quality and aquatic ecosystems.

Environmental Protection Procedures

Potential drilling sites in sensitive areas shall be confirmed by the On-Site Environmental Monitors.

a) Drilling sites shall be cleared of vegetation following the procedures detailed in Section 5.8;

b) Disposal of all drilling materials and associated solid wastes shall be undertaken in accordance with the procedures in Section 5.15;

c) Fuel shall be stored, handled and transported according to Section 5.13;

d) Drilling equipment shall have muffled exhaust to minimize generated noise; and

e) Drilling of water wells shall be conducted in compliance with the *Water Resources Act* and the *Well Drilling Regulations*.

5.11.3 Marine and Riverine Environment

Marine and riverine drilling may be required during geotechnical investigations to determine foundation conditions - assess stability, and underlying seabed or riverbed for Project infrastructure. Drilling shall be conducted from a barge of suitable size.

Environmental Concerns

The environmental concerns associated with this type of geotechnical drilling in a marine/riverine environment include pollution from the release of drill cuttings and other drilling related debris, fuel or other hazardous material, noise generated by drill operations, and disturbance of aquatic ecosystems (marine communities and/or individual species) caused by increased turbidity in the area proximal to the drill collar location.

Environmental Protection Procedures

a) All drilling equipment on the Project site shall use only oils/lubricants that classify as “biodegradable” (see Section 5.13 for additional information on the use of biodegradable oils/lubricants);

b) Potential drilling sites shall be inspected and accepted by the On-Site Environmental Monitor prior to drilling proceeding;

c) The drill rig shall be inspected for mechanical soundness prior to mobilization to the drill site. Barges used to support drilling shall be inspected and approved

prior to drill mounting onto barge. Any drilling activities from a barge in the Churchill River require a request for project review to DFO. If a letter of advice is issued from DFO, all conditions shall be followed. The drill crew shall also keep a daily log of inspections and mechanical soundness of barge and drill. Daily logs shall note the general stability of the drill rig and overall assessment of the surrounding sea/river state;

d) Following the initial inspection and prior to each drill mobilization, the drill rig and barge shall be inspected by the On-Site Environmental Monitor for potential environmental risks;

e) All fuel, lubricants and other hydrocarbons shall be stored, handled and transported according to Section 5.13. Only necessary quantities shall be stored at the drill rig at any time;

f) A spill containment boom shall be deployed around the barge until it is removed from the drill site;

g) Disposal of drilling materials and all solid wastes shall be undertaken according to Section 5.15;

h) Drilling equipment shall have muffled exhaust to minimize noise;

i) Turbidity from the release of drill water shall be localized to the area of the drill site and shall cease after drilling is complete. Release of suspended solids shall be frequently monitored by the On-Site Environmental Monitor;

j) All discharges shall meet the Environmental Control Water and Sewer Regulations (ECWSR);

k) Operations shall be suspended when weather and flow conditions exceed the capabilities of the drill and moorings to operate in a safe and effective manner. Guidelines relating to drill and moorings performance capabilities shall be established by H&S Coordinators and/or On-Site Environmental Monitors in consultation with the drilling foreman;

l) All drill workers shall be familiar with oil spill response procedures (Traffic Services Centre, Oil Spill Report – at sea or on land: 1-800-563-9089). Spill response equipment shall be on the barge at all times. All fuel spills shall be handled in accordance with the Master Spill Response Plan; and

m) In the event of a spill, all drilling activity shall cease until clean up is performed. Priority in the event of a spill shall be the safety of all crewmembers.

5.12 SURFACE WATER AND GROUNDWATER USE

Groundwater and/or surface water may be extracted from wells or intake structures at different project areas including the accommodations complex, concrete batch plant, southside access road, security building and various construction camps.

Environmental Concerns

Environmental concerns associated with water wells include potential for saltwater intrusion, proximity to sources of contamination, and excessive drawdown at the aquifer. Environmental concerns associated with surface water use at the site include excessive removal of water and the potential effect on fish habitat.

Environmental Protection Procedures

a) Wells shall be developed in consultation with the DOEC Water Resources Management Division to avoid areas of groundwater constraint such as potential sources of contamination (septic fields, landfills, etc.), proximity of other wells, and seawater;

b) Water extraction rates shall be established, under approval of the Water Resources Management Division, to address concerns for drawdown or potential effects on the water table, and to ensure withdrawal from surface water bodies does not affect the natural flow regime and fish/fish habitat;

c) Water withdrawal shall be documented in the Water Withdrawal Form located in Section 8;

d) Applicable reference documents include *Freshwater Intake End-of-Pipe Fish Screen Guidelines*, *1995, Freshwater Intake End-of-Pipe Fish Screen Fact Sheet, Guidelines for the Protection of Freshwater Fish Habitat in Newfoundland and Labrador, 1998* and the *Policy for Allocation of Water Use W.R. 88-1 (rev1995);* and

e) If water withdrawal is required, a request for project review to DFO is required. If a letter of advice is issued from DFO, all conditions shall be followed. A water use license is also required from the Water Resources Management Division.

5.13 STORAGE, HANDLING, USE AND DISPOSAL OF FUEL AND OTHER HAZARDOUS MATERIALS

A variety of fuels and potentially hazardous materials will be used during Project construction activities. Gasoline, diesel fuel, grease, motor oil and hydraulic fluids are all needed for equipment. Other potentially hazardous materials, which may be routinely used, include but are not limited to:

- Propane;
- Explosives;
- Acetylene (i.e. welding);
- Oxygen;
- Paints;
- Epoxies;
- Concrete additives;
- Wood Treatments;
- Antifreeze; and
- Cleaners and solvents.

Environmental Concerns

The primary concern regarding the use of fuel and hazardous materials is their uncontrolled release to the environment through spillage, and the subsequent adverse effects on human health and safety, terrestrial, aquatic and marine habitat and species, soil, and groundwater quality.

Environmental Protection Procedures

5.13.1 General Practices

All fuel, hazardous and controlled product storage areas, including temporary and permanent fuelling and fuel storage facilities shall be designed in accordance with applicable codes and regulations.

The *Storage and Handling of Gasoline and Associated Products Regulations, 2003* (referred to as the "GAP Regulations") under the Environmental Protection Act controls the construction, operation, and registration of "storage tank systems"[1] in the province of Newfoundland and Labrador.

Information on storage tanks, storage tank systems, and equipment storage tanks proposed for use on the Project shall be provided for review. Tanks that are not already registered under GAP shall be evaluated on a case-by-case basis to determine if GAP Regulations apply. Tank registration shall be accompanied by any necessary regulatory variances.

In general, the GAP Regulations apply to all stationary storage tanks and storage tank systems except in the following cases:

a) Tanks with capacities of 2,500 litres or less that are connected to a heating appliance;

b) Tanks that are designed, constructed and utilized in the inherent operation of a piece of equipment. In this case, the tanks must be physically secured and dedicated to the equipment requiring the fuel for its operation; and

c) "Mobile" tanks (e.g. tank trucks and tank truck trailers) used for temporary, stationary storage. In this case storage period must not exceed 14 days and no additional fuel can be added to the tank. There must also be a minimum of 14 days of downtime between separate storage periods and there can be no more than two, 14 day storage periods within a 12 month time frame.

[1] The GAP Regulations defines "storage tank system" as an "… atmospheric or low pressure closed tank container and all vents, fill and withdrawal piping associated with it installed in a fixed location and includes temporary arrangement on cradles and skids".

Note that all provisions of the GAP Regulations, including registration, apply for all tanks associated with mobile generators.

Consideration for the design and construction of storage facilities shall include:

a) Contracted fuel suppliers shall comply with the Lower Churchill Project's P-WEPP. A C-SEPP shall be developed by the contractor, including contingency plans which shall require acceptance by the project. Before transporting or positioning fuel at the site the contractor shall read and accept the Master Spill Response Plan;

b) All fuel storage and handling shall be in compliance with *GAP Regulations.* Necessary registrations and variances shall be obtained from Service NL for storage facilities, as required;

c) The Master Spill Response Plan that contains information regarding spills of fuel and hazardous materials shall be kept on site near all fuel storage facilities (see Section 7 in addition to fuel suppliers contingency plans);

d) Any soil contaminated by small leaks of fuel, oil or grease from equipment (including hydraulic hose ruptures and loss of fluid) shall be disposed of as per policies and guidelines. For larger leaks and spills a disposal plan shall be developed and submitted to regu*l*ators for approval*;*

e) The *Used Oil Control Regulations* shall be used to determine requirements for the storage and disposal of used oil;

f) All equipment on the Project site shall use only oils/lubricants[2] that classify as "biodegradable"[3]; unless demonstrated by the contractor and accepted that it is not feasible because of:

   i) technical or performance constraints;

   ii) negative impacts on equipment warranties;

[2] For example: hydraulic oil; multipurpose lubricant; chain oil; form oil; gear oil; transmission fluid; differential fluid; rust proofing; heat transfer fluids; compressor fluid; saw guide oil; electrical insulating fluid; and grease.
[3] i.e. the product must be either "readily biodegradable"; or have inherent, primary biodegradability; or inherent, ultimate biodegradability, as defined by the *OECD 301 B: Ready Biodegradability Test* procedure.

iii) cost constraints; and/or

iv) unavailability of biodegradable oils and lubricants.

g) The Contractor shall document the consideration of this issue providing, as a minimum, the following information:

i) cost differential in using biodegradable and non-biodegradable oils and lubricants;

ii) life cycle cost differential for equipment maintenance and operation;

iii) product specifications indicating the product meets the definition of "biodegradable" when tested in accordance with the OECD 301B Ready Biodegradability Test procedure; or

iv) reasons (e.g. technical, market availability, equipment warranty provisions, etc) for not using biodegradable fluids, should that option be proposed.

h) Empty drums shall be stored and backhauled to nearest receiving community, as per the WMP. Bungs shall be inspected and tightened prior to shipping;

i) Contractors shall at all times maintain in good condition at least one spill kit dedicated to each piece of fuel-powered equipment. Each spill kit shall be located on the equipment and stored in a weather-proof container. Each spill kit shall have an absorption capacity of no less than 23 litres. Examples of acceptable spill kits with various absorption capacities are as follows:

23 Litre Absorption Capacity

- One (1) 10-liter bag Oclansorb®, or equivalent;
- Two (2) 4-mil heavy duty disposal plastic bag 762 mm x 1219.2 mm;
- One (1) steel hand spade;
- Two (2) 100 mm x 1200 mm Sorb Sox®, or equivalent;
- Five (5) sorbent pads 9.5 mm x 431.8 mm x 482.6 mm.

64 Litre Absorption Capacity

- One (1) 13-liter bag Oclansorb®, or equivalent;
- Ten (10) sorbent pads 9.5 mm x 431.8 mm x 482.6 mm or equivalent;
- Two (2) 4-mil yellow heavy duty disposal bag 762 mm x 1.2 m;
- One (1) steel hand spade;
- Two (2) 101.6 mm x 1.2 m Sorb Sox®, or equivalent;
- Two (2) 101.6 mm x 2.4 m Sorb Sox®, or equivalent;

121 liter Absorption Capacity

- Twenty five (25) sorbent pads 9.5 mm x 431.8 mm x 482.6 mm
- Ten (10) 4-mil yellow heavy duty disposal bag, 762 mm x 1219.2 mm:
- One (1) 44-liter bag Oclansorb®, or equivalent;
- Eight (8) Sorb Sox® 101.6 mm x 1.2 m, or equivalent;
- Five (5) Sorb Sox® 101.6 mm x 2.4 m, or equivalent;
- Two (2) Spillows® 50.8 mm x 431.8 mm x 482.6 mm, or equivalent;
- One (1) spark resistant poly-shovel;
- One (1) Sorb Sox® Boom 177.8 mm x 3 m, or equivalent; and
- One (1) Pair of chemical resistant gloves.

In addition to equipment-dedicated spill kits, the Contractor shall at all times maintain in good condition spill response caches that are accessible within 15 minutes travel of all work faces and within the immediate vicinity of fuel/hazardous materials storage areas. Each cache shall have sufficient absorption capacity for one thousand (1000) litres of fuel or hazardous liquids, and shall contain at a minimum the following:

- Forty (40) hazardous material socks 76.2 mm x 1.2 m;
- Twenty four (24) hazardous material socks 76.2 mm x 2.4 m;

- Sixty (60) Sorb Sox® 101.6 mm x 1.2 m, or equivalent;
- Sixteen (16) hazardous material pillows 457.2 mm x 457.2 mm;
- Eight (8) 44-liter bag Oclansorb®, or equivalent;
- Eight (8) 13-liter bag Oclansorb®, or equivalent;
- Four (4) 25-pound Qualisorb Gold #628, or equivalent;
- One hundred (100) hazard material pads 9.5 mm x 431.8 mm x 482.6 mm;
- One hundred twenty (120) Hi-Point Pads (9.5 mm x 431.8 mm x 482.6 mm), or equivalent;
- Four (4) Neoprene drain cover 914.4 mm v 914.4 mm x 3.2 mm;
- Four (4) 1-pound Container Gap Seal plugging compound;
- Four (4) spark resistant poly-shovels;
- Eight (8) pairs chemical resistant gloves;
- Eight (8) pairs splash goggles;
- Eight (8) pairs Tyvek coveralls;
- Fifty (50) 4-mil yellow heavy duty disposal bags 762 mm x 1219.2 mm;
- Two (2) plastic scoop and brush;
- Eight (8) steel hand spades; and
- Eight (8) 4-kg. Vytac ACX powder acid neutralizer with colour indicator and instructions (for battery acid spills), or equivalent;

Only trained, qualified persons shall handle fuels and other hazardous materials. The Workplace Hazardous Materials Information System (WHMIS) shall be implemented to ensure proper handling and storage is achieved. Operators shall be in attendance for the duration of all fuelling operations;

j) The Canadian Transport Emergency Centre (CANUTEC – 613-996-6666) operated by Transport Canada can assist emergency response personnel in handling dangerous goods emergencies.

k) Waste oils, lubricants, and other used oil shall be reused, recycled or disposed of at an approved, licensed waste management facility in accordance with the WMP (as per the *Used Oil Control Regulations, 2002* and the *Air Pollution Control Regulations, 2004)*;

l) Storage areas shall be equipped with firefighting equipment, in accordance with approvals;

m) Smoking shall be prohibited within 50 m of a fuel storage area; and

n) See Section 5.18 for specific information related to buffer zones required for fuel storage, equipment fuelling and fuel transfer activities.

5.13.2 Fuel Storage Requirements

a) Fuel storage tanks shall comply with *GAP Regulations* and shall be equipped with vacuum gauges and vent pipes, as applicable.

b) Waste oil storage tanks shall comply with the *Used Oil Control Regulations, 2002* (see Figure 5-4 for a typical waste oil tank);

c) All bulk fuel and waste oil storage (> 2000 L) shall be in tanks with suitable secondary containment (i.e. double walled, self dyked, lined, earthen dyke etc.);

Figure 5-4: Typical waste oil tank featuring vacuum gauges, vent pipe, etc.

d) Diesel fuel and gasoline to be used for refuelling purposes shall be stored in appropriate 20 L containers (i.e. yellow containers for diesel, red containers for gasoline). Containers shall be clearly identified stating container contents;

e) A letter of consent shall be obtained from designated officials of the Service NL for fuel caches of 10 or more 205 L drums (including helicopter fuel caches). A letter of consent is not required for fuel caches under 10 drums;

f) A marker stake or flag shall be required for a petroleum products storage site of less than 10 x 205 L drums;

g) Boundary poles or posts with colourful flags or a painted marker shall be required for temporary petroleum product sites of 10 to 100 x 205 L drums;

h) Fuels stored inside dykes or self-dyked units shall be clearly marked to ensure they are not damaged by moving vehicles and are visible under all weather conditions. Dykes and barriers shall be designed and constructed in accordance with the *GAP Regulations* (see Figures 5-5 and 5-6 for typical dyked and concrete pad methods for tank installation);

i) Used oil shall be stored in an appropriate storage tank meeting the requirement of Sections 18 and 21 of the *Used Oil Control Regulations*;

j) Used oil can be stored in a 205 L drum as long as the drum is:

   i) clearly marked "used oil";

   ii) made of 18 gauge steel;

   iii) stored in an area providing secondary containment;

   iv) equipped with sufficient size openings to prevent spillage during filling or emptying;

   v) equipped with venting if they are intended to be vacuumed out; and

   vi) in compliance with CAN/GSSB-43.150-95 if they are to be transported by road.

k) All used oil tanks shall be inspected on a regular basis as per Section 24 of the *Used Oil Control Regulation.* All fuel storage tank systems shall be inspected on a regular basis as per Sections 20 and 21 of the *GAP Regulations*. This involves, but is not limited to, gauging or dipping and the keeping of reconciliation records for the duration of the program.

Figure 5-5: Acceptable fuel storage with dykes

Figure 5-6: Fuel storage on concrete pad

5.13.3 Fuel Transfer

The following procedures shall apply to the transfer of fuel or hazardous material:

a) In all cases, a qualified person shall attend the transfer to storage tanks, for the duration of the operation. This person shall be trained in proper fuel handling procedures to minimize the risk of a spill. The attendant shall be trained in the requirements of the fuel suppliers approved Spill Contingency Plan, Master Spill Response Plan (MSRP) and Workplace Hazardous Materials Information System (WHMIS);

b) Hoses or pipes used for fuel transfer shall be equipped with properly functioning and approved check valves, spaced to prevent backflow of fuel in the case of failures;

c) All tanks shall be dipped before and after filling;

d) Fuel transfers between ship and shore or between ships shall be conducted in accordance with the *Canada Shipping Act, Oil Pollution Prevention Regulations;*

e) Exposed pipelines shall be protected from vehicular collision damage by the installation of guardrails; and

f) Exposed "ship to shore" fuel transfer lines shall be clearly flagged from the shoreline to the receiving fuel tank to prevent traffic collision during transfer operations.

5.13.4 Equipment Fuelling and Lubrication

The following procedures shall apply to the fuelling of heavy construction equipment:

a) Fuelling and lubrication of equipment shall occur in such a manner as to minimize the possibility of contamination to soil or water;

b) When refuelling equipment, operators shall:

   i) Use leak-free containers and reinforced rip and puncture-proof hoses and nozzles;

   ii) Be in attendance for the duration of the operation; and

   iii) Seal all storage container outlets except the outlet currently in use.

c) Regular inspections shall be performed on the hydraulic and fuel systems of machinery. Leaks shall be repaired immediately;

d) Fuelling or servicing of mobile equipment on land shall not be allowed within 30 m of watercourses or waterbodies, except in designated areas with dewatering pumps; and

e) Fuelling attendants shall be trained in the requirements under the contractors Spill Contingency Plan in the C-SEPP and the MSRP.

5.13.5 Hazardous Materials

The following procedures shall apply to the use of hazardous materials:

a) Hazardous materials shall be used only by personnel who are trained and qualified in the handling of these materials and only in accordance with manufacturers' instructions and government regulations. WHMIS and the provisions of the *Transportation of Dangerous Goods Act* shall be implemented throughout the job site. All employees involved with hazardous materials shall be appropriately trained;

b) All hazardous wastes shall be stored, removed and disposed of in accordance with the WMP (as per government regulations and applicable permits);

c) Material Safety Data Sheets (MSDS) must be available on-site prior to receipt of any hazardous materials;

d) A hazardous waste storage area shall be constructed and properly marked. A permit may be required for construction of this area; and

e) Hazardous waste shall not be permitted to be poured down drains, oil/water separators, septic systems or discharged into the environment in any form.

5.13.5.1 Wood Treatment

The following standards shall apply to the use of wood preservatives on the site:

a) Creosote shall not be used on the site.

b) In Protected Water Supply Areas:

i. Treated wood products shall not be used in protected water supply areas;

ii. Where written justification for treated wood is presented, for the use in protected water supply areas, for acceptance, the treatment options shall be restricted to chromated copper arsenate (CCA), ammonical copper arsenate (ACA), ammoniacal copper zinc arsenate (ACZA), pentachlorophenol (PCP), or copper naphthenate (CuN);

iii. Table 5-2 below specifies the required buffer zones separating water bodies (within protected water supply areas) from locations where treated wood products, including poles, are to be used;

Table 5-2: Buffer Zones for Placement of Treated Wood within a Water Supply Area

Body of Water	Width of Buffer Zone
Pond/Lake	150 m (for pond/lake intake structures)
River	150 m for a distance of 1 km upstream and 100 m downstream of river intake structures
Main River Channel	75 m
Major Tributaries/Lakes/Ponds	50 m
Other bodies of water	30 m

iv. If structures are required within these specified buffer zones, then only untreated wood, steel or concrete shall be used; and

v. If wood poles are required within the buffer zones outlined in Table 1, but untreated wood poles are not practical or feasible, alternative protective measures may be used however, regulatory approval for such alternative measures shall be required. Specific techniques used to eliminate or minimize environmental disturbance shall be applied as appropriate.

c) Saltwater and Freshwater Areas (other than Protected Water Supply Areas):

i. In areas of low water hardness (i.e., 15-25 mg/L-1 $CaCO_3$), pH 5.5 or less, and elevated background metals levels, or areas where metals-sensitive biota exist, ACA, ACZA and CCA shall not be used;

ii. Pentachlorophenol shall not be used in salt water environments;

iii. For temporary installation of wood structures (i.e. bridge abutments or wood poles) within 15 metres of a water body only untreated timber shall be used;

iv. For permanent installations, non-invasive materials such as concrete or steel shall be used;

v. If use of untreated wood or alternative materials is not feasible or practical, approval by regulators is required prior to use of CCA, ACA, PCP and CuN; and

vi. Protective measures outlined above under Protected Water Supply Areas shall be considered; however, using these alternatives requires preapproval by regulatory agencies.

5.13.6 Spills and Leaks of Fuel and Hazardous Materials

The following procedures shall apply to the Spills of Fuel and Hazardous Materials:

a) All necessary precautions shall be implemented to prevent the spillage and leakage of fuels and other hazardous materials used during the construction phase;

b) All spills of fuel and hazardous materials shall be reported immediately to the On-Site Environmental Monitor. In the event of a spill refer to the Master Spill Response Plan; and

c) A copy of the Master Spill Response Plan shall be present on site and in the event of a spill the outlined procedures shall be followed.

5.14 SEWAGE DISPOSAL

All sewage disposal activities shall comply with Newfoundland and Labrador's *Health and Community Services Act, 1997* and the *Environmental Control Water and Sewage Regulations, 2003* under the *Water Resources Act, 2003.*

Environmental Concerns

The accidental release of untreated sewage is a concern to human health, drinking water quality, and freshwater and marine ecosystems. This applies to effluent from a sewage treatment system that does not meet the limit set in Schedule A of the *Environmental Control Water and Sewage Regulations, 2003.*

Environmental Protection Procedures

a) Development of sewage treatment facilities shall be undertaken in consultation with the relevant regulatory agencies for a temporary or permanent sewage collection system, and a Certificate of Approval shall be obtained from the Service NL and/or the DOEC;

b) The health inspector with the Service NL is the approval authority for sewage flows under 1000 gallons. The general sanitization of the site is under the jurisdiction of the health inspector who shall perform periodic inspections;

c) All sewage disposal activities shall comply with Section 36(3) of the Fisheries Act.

d) For septic systems, the location of a tile field shall be clearly marked and vehicular traffic shall not be permitted to operate within this defined boundary; and

e) Portable washrooms and toilets used at the Lower Churchill Project site shall be routinely inspected and properly maintained by their owners or by the Project as determined by the WMP. Sewage sludge removed from the facilities shall be transported off site for approved treatment and disposal. Companies engaged to perform this work must have approval from the Service NL and/or DOEC. Copies of government approvals must be provided to the On-Site Environmental

Monitor before work can proceed. All human sanitary waste must be contained and disposed in a manner that meets all environmental and health requirements. Any concerns must be brought to the immediate attention of the On-Site Environmental Monitors and H&S Coordinator.

5.15 SOLID WASTE DISPOSAL

Environmental Concerns

Solid waste (e.g. construction waste, domestic waste, paper, cardboard, and wood), if not properly controlled and disposed of, can be unsightly, may cause human safety and health concerns, and could negatively affect wildlife.

Environmental Protection Procedures

a) A Waste Management Plan for Component 1 and 4b is in place to address waste generation, handling, storage and disposal during construction. The WMP includes methods for waste stream separation, collection, storage, transport, disposal and associated schedules. Any procedures or strategies for management of solid waste shall also be in accordance with the Provincial Waste Management Strategy;

b) Waste management at the site shall comply with all provisions of the WMP;

c) Waste material shall not be deposited in a body of water; and

d) Waste material shall not be deposited anywhere except at a facility or site approved to accept that specific type of waste.

5.16 WORKING WITHIN 15 METRES OF A BODY OF WATER

Environmental Concerns

Working close to water bodies poses a risk of introducing contaminants into the aquatic ecosystem, affecting fish, fish habitat, and other receptors, and affecting the natural flow regime of the water body. Contaminants such as sediment, petroleum hydrocarbons, and other deleterious substances may impact fish, wildlife, plants, and human receptors. Proper protection plans are required to minimize or eliminate sedimentation and water pollution and maintain riparian habitat near water bodies.

Environmental Protection Procedures

Mitigation measures provided in various sections (e.g. Section 5.25 - Erosion Prevention and Sediment Control, Section 5.13 - Storage, Handling and Disposal of Fuel and Other Hazardous Material, Section 5.18 - Buffer Zones, etc) shall be consulted to ensure that appropriate measures are understood and implemented during the course of construction. Work within 15m of a body of water requires a permit under section 48 of the *Water Resources Act.*

In addition, the following steps shall be taken to ensure protection of water bodies:

a) A joint engineering and environmental reconnaissance of the site shall be completed in the early planning stages to identify all nearby bodies of water and mitigation and protective measures shall be identified;

b) Where possible, the majority of construction works shall take place during low flow and low rainfall period;

c) Any vehicles or equipment working near a body of water shall be clean and in good condition;

d) Heavy equipment shall be kept outside the high water mark of all bodies of water, where possible; and

e) All equipment on the Project site shall use only oils/lubricants that classify as “biodegradable” where feasible (see Section 5.13 for additional information on the use of biodegradable oils/lubricants).

5.17 WATERCOURSE CROSSINGS – FORDING, CULVERTS AND BRIDGES

Environmental Concerns

The environmental concerns associated with fording, culvert installations, bridge construction and maintenance include direct disturbance to, or mortality of, fish, disturbance to waterfowl, loss of fish habitat caused by sedimentation and removal of substrate, and disturbances to stream bank vegetation.

Environmental Protection Procedures

Erosion stabilization methods and effective sedimentation control practices shall be implemented when required (Section 5.25), and these shall conform to requirements, guidelines, and principles contained in DFO FactSheets, Operational Statements, DOEC Environmental Guidelines, and specific requirements of regulatory permits and approvals.

All watercourse crossings (fording, culvert installation and bridge crossings) shall comply with permits issued by DOEC. In addition, a notification form or a request for project review to DFO are required. If a letter of advice is issued for Works and Undertakings Affecting Fish Habitat from DFO, all conditions shall be followed.

The following measures shall be implemented to minimize negative effects of watercourse crossings:

a) Attention shall be given to scheduling in order to minimize the time the watercourse is disturbed and therefore minimize the sediment entering the watercourse. The ideal time for construction is during low flow and low rainfall period;

b) Any alterations to a body of water which may impact navigation shall require a Navigable Waters Permit Application under *Navigable Waters Protection Act (NWPA)* request for project review under NWPA from Transport Canada (TC). If a NWPA authorization is issued, the conditions shall be adhered to;

c) Any alterations to a body of water which may impact water quality shall require a DOEC permit(s) under the *Water Resources Act;*

d) Watercourse crossing construction activities, in areas of fish habitat, shall be undertaken in accordance with DFO requirements and under the direct guidance of the On-Site Environmental Monitor;

e) All water courses and bodies of water shall be examined by the On-Site Environmental Monitor or sub-contractors on a site-specific basis in order to evaluate each watercourse crossing (including upstream and downstream);

f) Work shall be performed in such a way as to ensure that materials such as sediment, fuel and oil do not enter watercourses and water bodies;

g) The banks and flood plains of watercourses must be adequately protected from erosion using an applicable erosion prevention method as outlined in Section 5.25, Erosion Prevention and Sediment Control;

h) A suitable buffer (Section 5.18) of undisturbed natural vegetation shall be left between the access road and the bank of any adjacent watercourse, unless otherwise specified. The typical buffer width shall be determined in consultation with the On-Site Environmental Monitor according to the following formula:

Buffer width (m) = 20 m + 1.5 x slope (%) (where slope >30%);

i) The buffer width for reservoir clearing shall be 15 m (slope distance); and

j) See Section 5.18 for buffer widths related to temporary fuelling services or washing of equipment near watercourses or waterbodies.

Fording

When fording any watercourse, the DOEC Environmental Guidelines for Fording and the DFO fact sheet for Temporary Fording Sites shall be followed in conjunction with the following:

a) Areas of known or suspected spawning habitat shall be avoided;

b) Where feasible, crossings shall be restricted to a single location and made at right angles to the watercourse;

c) Equipment activity within the watercourse shall be minimized by limiting the number of crossings;

d) All equipment shall be clean and mechanically sound to avoid the introduction of oil, gasoline, and hydraulic fluids to waterbodies;

e) No servicing or washing of heavy equipment shall occur adjacent to a watercourse, waterbody, or ecologically sensitive area. These areas shall be identified on constraint mapping and shall be identified in the field by the On-Site Environmental Monitor;

f) Where the ford area is not natural bedrock or is easily disturbed by fording, the entire fording area shall be stabilized using vegetation mats, corduroy roads or coarse material (125 mm diameter or greater) when such material is available from a reasonably close location within the right-of-way; when the substrate of the ford area is not subject to easy disturbance by fording or coarse material is not easily available within the right-of-way, fording under existing substrate conditions may occur under the guidance of the On-Site Environmental Monitor;

g) Fording activities shall not decrease the depth of the watercourses to less than 20 cm. Where the existing depth is less than 20 cm, that depth shall be maintained;

h) Photographs of all ford sites shall be taken prior to and after the fording has been completed. The On-Site Environmental Monitor shall be responsible for collecting these photographs;

i) Waterbodies shall not be forded during high flow periods;

j) All bank sections which contain erodible materials shall be stabilized or avoided if possible; if banks must be sloped for stabilization, no material shall be deposited within the watercourse; sloping shall be accomplished by back-blading and the material shall be deposited above the high water mark of the watercourse; and

k) Proposed fording activities on waterbodies or water courses visible on 1:50,000 scale maps shall require a permit from DOEC.

Culverts

In those locations where installations or upgrading of existing culverts are required, permits are required from DOEC. In addition a request for project review to DFO may be required. If a letter of advice is issued from DFO, all conditions shall be followed.

The culverts used shall be sized to handle the 1-in-100 year return period flood (however design criteria may vary depending on site-specific conditions and the length of time a culvert will be used (i.e. temporary vs. permanent)) and shall be constructed in accordance with the DOEC Environmental Guidelines for Watercourse Crossings and Culverts and the DFO operational statement for Culvert Maintenance as well as the DFO fact sheets for Culvert Installations. The following measures shall also be implemented:

Installation of Culverts

a) Install culvert(s) in accordance with good engineering and environmental practice. Photographs of culvert installation are shown as Figures 5-7 and 5-8;

b) Proposed culvert installations on water courses visible on a 1:50,000 scale map shall require a permit from DOEC;

c) Unless otherwise indicated, all work shall take place in dry conditions, either by the use of cofferdams or by diverting the stream with pumps and hoses. All work involving major alterations to stream channels shall be carried out at a time of low flow, in a manner that prevents downstream sedimentation;

d) Cylindrical culverts shall be counter sunk when installed in fish habitat (as recommended by DFO) such that the culvert bottom is one-third the diameter below the streambed in the case of culverts less than 750 mm outside diameter; for culverts greater than 750 mm outside diameter, the culvert bottom shall be installed a minimum of 300 mm below the streambed;

e) If two culverts are to be installed at one location, one culvert shall be installed at an elevation lower than the other one. A maximum of two culverts are allowed at one location;

f) The natural low flow regime of the watercourse shall not be altered; culverts shall not disrupt flow of water or cause ponding at the upstream side of the installation;

g) A culvert shall not be installed before site-specific information such as localized stream gradient, fish habitat type and species present have been evaluated, as required;

h) When rock energy dissipaters are utilized at culvert outlets, proper fish passage shall be ensured;

i) Photographs of all culvert installations shall be taken prior to and after the installation has been completed. The On-Site Environmental Monitor shall be responsible for collecting these photographs;

j) Inlet and outlet areas shall be adequately protected from erosion by installing erosion prevention structures as outlined in Section 5.25, Erosion Prevention and Sediment Control;

k) Culverts shall be of sufficient length to extend a short distance beyond the toe of the fill material;

l) Backfill material shall be of texture that shall support the culvert and limit seepage and subsequent washing out;

m) Culverts shall be aligned such that the original direction of stream flow is not significantly altered and the gradient at the culvert follows the stream channel gradient to the extent possible. Infilling or reduction of the natural cross-sectional area of the watercourse shall not be permitted;

n) Fill and construction debris shall be removed from the culvert area to a location above the peak flow level to prevent its entry into the watercourse;

o) Construction activity shall be confined to the immediate area of the culvert;

p) Fill material shall not be removed from streambeds or banks except when removal of material is necessary to ensure a flat foundation for installing a culvert;

q) The use of heavy equipment in watercourses or bodies of water shall not be permitted;

r) Culverts shall be marked to indicate their position under the snow;

s) As required, cofferdams of non-erodible material shall be installed above and below work areas to separate them from the watercourse when excavating for culverts and footings. All sandbags used in construction must be accounted for and removed after work is completed. Where pumping is used to bypass flow, pumps shall have sufficient capacity to prevent washout of the cofferdams. Refer to DFOs fact sheet for Instream Work in the Dry – Cofferdams;

t) Cofferdams shall be removed upon completion of construction and the streambed returned as closely as possible to its original condition;

u) Water pumped from work areas or other runoff must have sediment and turbidity removed by settling ponds, filtration, or other suitable means before discharging to a waterbody;

v) The release of sediment laden water into a waterbody, watercourse or ecologically sensitive area, due to construction activities, shall comply with applicable discharge guidelines as presented in the *Newfoundland and Labrador Environmental Control Water and Sewage Regulations, 2003* under *the Water Resources Act;*

w) With respect to maintenance of water quality within receiving waterbodies on and around the site, the *CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life* shall be used; and

x) Culvert installations shall not require a DFO review when the following conditions are met (unless the culvert installations are within fish habitat):

i) the work does not include realigning the watercourse, installing a culvert liner or support struts, replacing damaged or destroyed bevels ends, or extending/replacing the existing culvert;

ii) explosives are not used to remove debris; and

iii) the work does not include any dredging, infilling (e.g., filling scour pools) or excavation of the channel upstream or downstream of the culvert.

Culvert Upgrading/Maintenance

Culvert maintenance includes the removal of accumulated debris (e.g., logs, boulders, garbage, ice build-up) that prevents the efficient passage of water and fish through the structure and well as reinforcement of eroding inlets and outlets. The following measures shall be implemented when upgrading/maintaining culverts:

a) In locations where upgrading and/or alterations are required for existing culvert at the site, the mitigation measures listed above for installation of a culvert shall be reviewed and followed, as applicable;

b) Culverts shall be inspected regularly so that immediate action can be taken to clear blockages caused by ice or debris and to identify any apparent problems, such as erosion, which may require remedial action;

c) An inspection of culverts shall be made during and after major floods to observe the culvert operation and record high water marks. Conditions which require corrective maintenance shall be noted including debris accumulations, sedimentation, erosion, piping, scour, and structural damage and reported if applicable;

d) Culverts which have been damaged by ice or debris, by improper installation or construction procedures, or are in a condition which could impair their proper functioning shall be replaced immediately to prevent overtopping, erosion, or flooding;

e) Access for maintenance shall be provided, especially where debris control structures are installed. Such access shall not disrupt the site rehabilitation efforts; and

f) During rehabilitation activities following the end of construction, culverts within the flood zone (below LSL) may be left in place and flooded during reservoir impoundment. Culverts above the LSL shall be removed.

Figure 5-7: Example of well installed culvert

Figure 5-8: Example of culvert installation

Bridges

a) Environmental protection measures outlined above which are applicable to bridge construction and maintenance shall be adhered to;

b) Any proposed bridge installations require a permit from DOEC. In addition, a request for project review or project notification to DFO is required. If a letter of advice is issued from DFO, all conditions shall be followed;

c) Photographs of all bridge installations shall be taken prior to and after the installation has been completed. The On-Site Environmental Monitor shall be responsible for collecting these photographs;

d) During bridge construction all applicable guidelines shall be adhered to including but not limited to: DOEC Environmental Guidelines for Bridges and Watercourse

Crossings, DFO Clear Span Bridges Operational Statement, DFO Fact Sheet for Temporary Bridges, and DFO Fact Sheet for Bridge Construction/Demolition;

e) To safely convey peak flows, permanent bridges shall be designed for a 100-year return period stream flow;

f) Temporary bridges shall consider the following basic design criteria:

   i) Hydraulic design shall be based on the 1:2 year storm event;

   ii) Abutment logs shall be placed a minimum of 1 meter from the top of the bank;

   iii) Deck height shall be a minimum of 250 cm above the bank height; and

   iv) Deck height shall be a minimum of 450 cm above the water surface at the time of installation.

g) Each installation shall take into consideration site-specific conditions and appropriate criteria shall be accepted by the On-Site Environmental Monitor;

h) The upstream and downstream sides of abutments must be protected with erosion prevention structures as outlined in Section 5.25, Erosion Prevention and Sediment Control, to prevent erosion and scouring;

i) Roadside embankments near the watercourse shall be adequately protected from erosion by installing applicable erosion prevention structures as outlined in Section 5.25;

j) Adequate erosion protection as per Section 5.25 Erosion Prevention and Sediment Control shall be provided where roadside ditches discharge into the watercourse near the bridge;

k) Abutments and piers shall be constructed in the dry and where possible during times of low flow;

l) During construction of concrete components, formwork shall be constructed to prevent any fresh concrete from entering bodies of water. Dumping of concrete or washing of tools and equipment in any body of water is prohibited;

m) Periodic maintenance such as painting, resurfacing, clearing of debris, or minor repairs, shall be carried out without causing any physical disruption of the watercourse. Care shall be taken to prevent spillage of pollutants into the water;

n) All waste materials shall be disposed of in accordance with the WMP;

o) All areas affected shall be returned to a state that resembles local natural conditions; and

p) During rehabilitation activities following the end of construction, all temporary bridges shall be removed.

5.18 BUFFER ZONES

Environmental Concerns

The potential for erosion/sedimentation, spills, etc. and resulting effects on water quality, fish and fish habitat is a key environmental concern associated with construction activities. In addition, sensitive and rare environmental receptors (e.g. Osprey nesting sites, archaeological/historic resources, etc) require protection from activities associated with construction.

Buffer zones of natural vegetation or undisturbed areas that separate these environmental receptors from construction activities are needed to mitigate adverse environmental effects. These undisturbed areas may also provide wildlife habitat and/or travel corridors near work areas and Project features.

Due to the many buffer zones referenced in various government documents and others that may be stated in regulatory permits yet to be obtained, the appropriate buffer zone to use in a specific area may vary over time. Therefore, the On-Site Environmental Monitor shall be the only site-based personnel to determine which buffer is applicable, and contractors shall be required to consult with these individuals prior to establishing buffers. For general guidance, however, the following procedures shall define the minimum requirements during construction.

Environmental Protection Procedures

a) DFO recommends buffer zones to separate areas of land disturbance/roadways from water bodies shall be calculated by the following formula:

Buffer Width (m) = 20 m + 1.5 x slope (%) (where slope >30%);

b) A minimum 15 m (slope distance) vegetation buffer shall be maintained for reservoir clearing;

c) A minimum buffer zone of natural vegetation 20 m from the high water mark of waterbodies, watercourses and ecologically sensitive areas shall be maintained around work areas where available space poses a constraint, except where

specified otherwise. If the available space allows, then wider buffer zones of 100 m shall be maintained between construction areas and watercourses, waterbodies and ecologically sensitive areas (Figure 5-9 shows a typical buffer zone being protected by tarp fencing);

Figure 5-9: Tarp fence outlining a vegetation buffer zone

d) Sediment control devices shall be constructed outside buffer zones as required. This is required to control runoff from areas of exposed soils and prevent transport of sediments towards water bodies. Section 5.25, Erosion Prevention and Sediment Control outlines all acceptable sediment control measures;

e) All aircraft must maintain a 300 m vertical and horizontal buffer from known active raptor nests between May 15 to August 15;

f) No clearing shall take place within 800 m of an active raptor nest between the months of May 15 to August 15;

g) For all work activities other than clearing, a 200 m buffer shall be respected for active raptor nests from May 15 to August 15. Within this 200 m buffer zone the following applies, after consultation with the provincial government:

   i) Only essential vehicular activity shall be permitted;

   ii) Work shall only be permitted in the presence of the On-Site Environmental

Monitor; and

iii) Crews shall cease work if there is a disturbance at a nest until activity at the nest has returned to normal; work shall not commence again until approval from the On-Site Environmental Monitor.

h) Crews shall not establish a permanent or temporary camp within 800 m of a known raptor nest;

i) Locations along the Churchill River are known as spring and fall staging areas for waterfowl and harlequin ducks. Helicopters moving through these areas during this time (typically May or September) shall maintain a minimum altitude of 500 m from concentrations of waterfowl and harlequin ducks;

j) For known harlequin duck nesting areas, a 100 m buffer of natural vegetation shall be maintained along the river's edge during their breeding, nesting and staging times (May through September). A 30 m buffer shall be maintained outside the sensitive nesting season. Clearing and construction within these buffers during this time shall not occur unless otherwise authorized;

k) Buffer zones for other bird species not indicated in this document are outlined in the Avifauna Management Plan and shall be respected;

l) A minimum buffer zone of 100 m shall be maintained from the high water mark of waterbodies, watercourses and ecologically sensitive areas around any bulk fuel storage activities;

m) The typical buffer zone for quarries and borrow pits in relation to a water body is 100 m. In some instances the development of quarries and borrow pits shall be allowed within this 100 m buffer zone, however applicable permits from regulators shall be required, as well as consultation with the On-Site Environmental Co-ordinator;

n) A minimum buffer zone of 50 m shall be maintained around any archaeological site. The size of buffer zones may increase or decrease depending on the type of site and the buffer zone may be revised based on direction from the Provincial

Archaeology Office (PAO). Where the site has been designated for recovery and/or recording the buffer zone shall be maintained until it has been cleared by the On-Site Environmental Monitor. Where available space poses constraints, this width may be reduced and supplemented by other protective measures. Site-specific mitigative measures for known historic resources in the Project area are addressed within Section 5.32.1; and

o) Buffers for working around caribou are outlined in Section 5.32.3.

Figure 5-10 provides a summary of recommended buffer zones for the handling and storage of fuels and other hazardous products. Table 5-3 provides a summary of all buffer zones.

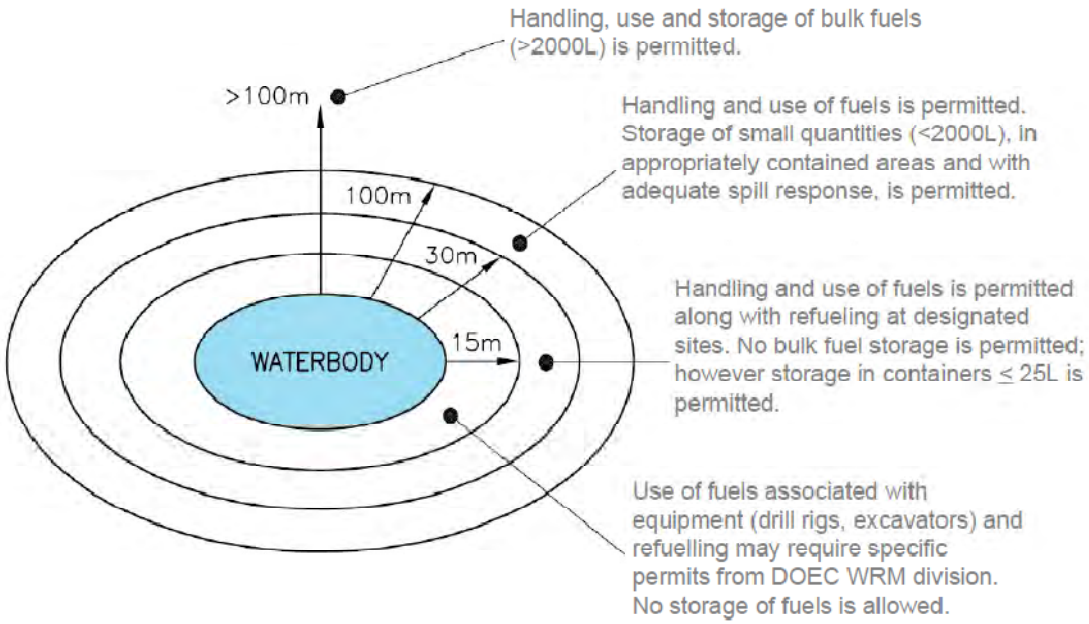

Figure 5-10: Required Buffer Zones from a water body (for fuel activities)

Table 5-3: Recommended Buffer Strips for Various Activities

Activity	Environmental Receptor	Recommended Width (m) of Buffer Strip
Handling, use and storage of bulk fuels (> 2000 L)	Waterbody	100 m
Storage and handling of small quantities (<2000 L) of fuel in appropriately contained areas and with adequate spill response	Water body	30 m
Handling and use of fuels (including transfer and fuelling of equipment). Storage of fuel in containers ≤25 L	Waterbody	15 m
Linear Developments/ Clearing of Vegetation	Waterbody	20 m (+1.5 x slope (%) where >30%) 15 m buffer for reservoir clearing
	Active Raptor Nests	800 m (between May 15 – August 15)
Other Work Activities	Active Raptor Nests	200 m (between May 15 – August 15)
Aircrafts	Active Raptor Nests	300 m (vertical and horizontal)
	Waterfowl and Harlequin Duck Concentrations	500 m vertical distance
Quarrying and Aggregate Removal from Borrow Areas	Waterbody	100 m
All Activities	Archaeological sites	50 m
Cutting	Scheduled Salmon Rivers	50 m*

Activity	Environmental Receptor	Recommended Width (m) of Buffer Strip
Cutting	Black Bear Denning Sites (Late October – Late April)	50 m*
Cutting/Construction	Harlequin Duck	100 m* during nesting, breeding and molting seasons (Early May through September) 30 m* outside the sensitive time
Cutting/Construction	Active waterfowl/waterbird nests (species not of management concern)	100 m
Cutting/Construction	Active passerine nests (species not of management concern)	30 m
Cutting	Waterbody occupied by a beaver	30 m*

*** Buffer zone widths may vary once cutting permits are obtained.**

5.19 ALTERATIONS TO A BODY OF WATER/ INSTREAM WORKS

Environmental Concerns

The environmental concerns associated with alterations to a body of water include direct disturbance to, or mortality of, fish, disturbance to waterfowl, loss of fish habitat caused by sedimentation and removal of substrate, and disturbance to stream bank vegetation. Typical alterations to a body of water include fording, bridges and culverts however other less common alterations include cofferdams, pumping and stream diversions. Fording, bridges and culverts have been discussed in subsequent sections therefore this section shall concentrate on cofferdams, pumping and stream diversions.

Environmental Protection Procedures

a) Any work within 15 m of a water body visible on a 1:50,000 scale map shall require a permit from DOEC. A request for project review shall be submitted to DFO. If a letter of advice is issued by DFO, the conditions of the letter shall be adhered to;

b) Erosion stabilization methods and effective sedimentation control practices shall be implemented when required, and these shall conform to requirements, guidelines, and principles contained in DFO FactSheets, Operational Statements, DOEC Environmental Guidelines and specific requirements of regulatory permits and approvals;

c) Two cofferdams or a square type structure shall be used for best results. The first cofferdam shall be upstream of the construction area and shall keep the construction area dry and provide a basin for water to be pumped. The second cofferdam shall be downstream of the construction area and shall prevent any sediment laden water that may have accumulated in the construction area from discharging directly into the watercourse;

d) Pumping the water shall commence prior to starting intrusive work to prevent the river from being silted as water passes the work area. When a watercourse is too large to divert by other measures, part of the river may be blocked off to allow work to take place in dry conditions. One third the width of the watercourse or less shall be blocked at any time in order to ensure efficient remaining capacity in the channel to safely accommodate flow without causing excessive high velocity, erosion or overtopping of banks. A dewatering plan shall be developed prior to dewatering activities;

e) An alternative means of isolating the work area shall be to construct a temporary diversion channel lined with plastic sheeting or an impermeable material. The channel shall be designed to handle the predicted flows of the watercourse. Figure 5-11 shows typical cofferdam usage in a river and Figure 5-12 illustrates the usage of a stream diversion coupled with cofferdams;

Figure 5-11: Cofferdams surrounding work area

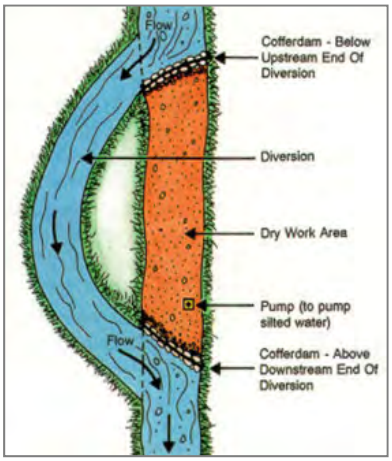

Figure 5-12: Illustration of stream diversion and cofferdams

f) Floating silt curtains or suitable alternative shall be used to contain and control the dispersion of turbidity and sediment when working in or near a waterbody;

g) The curtain shall be located beyond the lateral limits of the construction site; the alignment shall be as close as possible to the activities but not so close as to be disturbed by the construction equipment;

h) The curtain shall be firmly anchored in place by posts; and

i) The contractor shall remove built up sediment and debris as required; if the fabric becomes clogged it shall be replaced.

Fish Habitat and Relocation

a) A license to conduct fish sampling/collection permits shall be obtained from DFO prior to any sampling, collection or relocation activities;

b) The waterbody shall be de-watered using a screened pump which shall be deployed on a floating structure near the deepest portion of the pond/river. The pump shall be monitored during all de-watering. The water shall be directed to a vegetated area so that any sediment carried by the pump shall be further filtered through vegetation before reaching another water body. The pumped water and the screen shall be monitored for fish during all pumping. Optimally, the isolated section of river shall be reduced to a small containment area capable of being electrofished/ seined by boat;

c) If soft sediment moves toward the deeper part of the area during draw-down, this will effectively reduce the size of the area and shall require careful monitoring of water levels so that too much water is not removed hence trapping all fish in a thick layer of sediment;

d) Electrofishing inside the small containment area left after de-watering shall be conducted by a small boat so as to reduce the amount of sediment disturbance. Other techniques shall be available should electrofishing become inefficient due to increased sediment disturbance (e.g. seining and/or casting net). The boat shall be of a non-conducting material so that the electrofisher will not short out (e.g. zodiac, fibreglass/plastic canoe). A second small boat shall be used to transport any captured fish to shore so that disturbance of bottom sediment is

minimized. This boat shall be moved between the shore and collection boat by ropes. This may be modified in the field as necessary;

e) Water temperature will be another critical factor in successful relocation of all fish, as the reduced pond will warm relatively quickly. Optimally, it would be desirable to begin collection of fish in the early morning hours. Coordination of the draw-down shall be conducted to ensure this can occur. Water temperature shall be monitored continually and any exceedance of the Experimental License requirement shall mean a stop in collection, is required. However, this may be a field-call as pausing once the isolated section of river is reduced may cause more harm than completing the relocation. This situation shall be avoided;

f) Monitoring shall include recording water temperatures, dissolved oxygen levels, pH, and visual observations of stress and/or overcrowding. If signs of stress and/or overcrowding are observed, additional measures may be required that will be developed and followed by Nalcor. These additional measures will be provided to DFO in a Fish Stranding/Relocation Plan for their review, prior to the initiation of any dewatering activities (including infilling of the Diversion Head Pond).

g) Once the isolated section of river has been de-watered, the small containment area shall be electrofished, seined, and/or netted to remove any remaining fish;

h) All fish shall be contained in 20 litre buckets for transport to the release point. Each bucket shall be relocated once five fish are exceeded or thirty minutes have passed so that stress is avoided;

i) All fish shall be acclimatized prior to release. Each bucket shall be laid into the receiving water so that water temperatures between both are equal (measured using thermometers). Once acclimated, fish shall be released;

j) An estimate of the length of each fish shall be obtained in order to calculate the total weight of the fish;

k) Experienced personnel shall be responsible for capture and release of the fish. The person responsible for capture shall be familiar with all equipment and shall be able to adjust the voltage on the electrofisher as water levels and conductivities change. They shall also be able to detect signs of fish stress. The person responsible for fish release shall be experienced in acclimating fish and monitoring their health. They shall also be able to estimate fish species and lengths; and

l) If dewatering is required as part of the execution of work, a dewatering plan shall be developed as part of the C-SEPP.

5.20 WORK IN/AROUND MARINE ENVIRONMENT

Environmental Concern

The principle environmental concerns from marine construction include the release of fines, hazardous liquids, and toxic substances to the water and substrate, and disturbance to fish and fish habitat. Marine construction activities can also disturb nearshore terrestrial habitat and cause seabirds, waterfowl and marine mammals to avoid the area.

Environmental Protection Procedures

a) Work in and around the marine environment shall require a permit for the Alteration of a Waterbody under the *Newfoundland and Labrador Water Resources Act*, and the *Federal Navigable Waters Protection Act.* In addition a request for project review to DFO may be required for infilling. If a letter of advice is issued from DFO, all conditions shall be followed;

b) Clean blasted rock shall be used for infilling. Armour stone protection shall be placed progressively to minimize erosion and to prevent the loss of infill material. All blasted material shall be taken from an approved quarry site;

c) The operation of heavy equipment shall be confined to dry, stable areas or approved barges;

d) Infilling shall be done in compliance with the *Navigable Waters Protection Act* authorization;

e) Any timber cribbing used for construction of temporary or permanent structures shall consist of untreated wood (or preservatives safe for the marine environment);

f) Sedimentation prevention methods as outlined in Section 5.25, Erosion Prevention and Sediment Control shall be used where appropriate to control sedimentation into the marine environment during infilling;

g) Refer to Section 5.19 for silt control procedures in water works;

h) All equipment shall have muffled exhausts to minimize noise;

i) Fuelling of equipment shall follow the buffers outlined in the Buffer Zone section (Section 5.18);

j) All vehicles shall be clean and in good repairs. Regular mechanical inspections for leaks on all equipment shall be made and repairs undertaken immediately; and

k) The Master Spill Response Plan and appropriate spill kits for equipment shall be available on-site (see Section 5.13).

5.21 GRUBBING AND DISPOSAL OF RELATED DEBRIS

Environmental Concerns

The principal concerns associated with grubbing and disposal of related debris are the potential effects of erosion and sedimentation on marine and freshwater ecosystems and water quality.

Environmental Protection Procedures

All grubbing and disposal of related debris near watercourses shall adhere to relevant regulatory requirements, including the permits from DOEC and the formal "Letters of Advice", "Operational Statements", and/or Authorizations for Works or Undertakings Affecting Fish Habitat from the Fisheries and Oceans Canada.

Other specific measures to be undertaken to minimize potential effects on aquatic habitat and resources are as follows:

a) Grubbing activities shall be limited to only those areas that are required for Project development;

b) Grubbing of the organic vegetation mat and/or the upper soil horizons shall be minimized. These shall be left in place where possible. Limits of stripping and/or grubbing shall be shown on all drawings issued for construction;

c) The organic vegetation mat and upper soil horizon material, which has been grubbed, shall be spread in a manner that attempts to cover exposed areas. Any surplus material shall be stored or stockpiled for site rehabilitation and revegetation purposes elsewhere in the Project area. Topsoil and peat shall be stockpiled separately from the overburden and separated by a buffer zone (Section 5.18) from any waterbodies, watercourse or ecologically sensitive areas. The location of the stockpiles shall be shown on drawings issued for construction and accessible for future rehabilitation purposes;

d) A minimum of 5 metres should separate stockpiles of grubbed material from standing timber;

e) Grubbed material and/or topsoil shall be stored in low piles to decrease the effect of compaction on structure. Stockpiles of topsoil should be seeded or otherwise protected using erosion control methods as outlined in Section 5.25, Erosion Prevention and Sediment Control to prevent erosion and loss of nutrients. This is especially important if stockpiles are to remain in place for periods of a year or more;

f) Overburden and topsoil from grubbing activities shall be stored, and stabilized, for the purpose of future rehabilitation;

g) Erosion prevention and sediment control measures shall be installed to minimize and control runoff soil erosion and transport of sediment laden water during grubbing and the re-spreading and stockpiling of grubbed materials. Section 5.25, Erosion Prevention and Sediment Control outlines all acceptable prevention and control methods (i.e. use of sediment ponds);

h) Where grubbed materials are re-spread or stockpiled; as many stumps and roots as possible shall be left in place to maintain soil cohesion, to dissipate the energy of runoff, and promote natural re-vegetation;

i) The length of time that grubbed areas are left exposed to the natural elements shall be minimized to prevent unnecessary erosion. These areas shall be monitored for erosion and such findings shall be reported to the On-Site Environmental Monitor;

j) During grubbing, care shall be taken to ensure that grubbed material shall not be pushed into areas that are to be left undisturbed (Figures 5-14 and 5-15 show examples of grubbing activities and a grubbed right-of-way);

k) Grubbing shall be avoided on steep slopes near watercourses. A buffer zone shall be maintained between grubbed areas and watercourses, waterbodies and ecologically sensitive areas (Section 5.18). Grubbing limits adjacent to watercourses shall be flagged in the field prior to undertaking grubbing/stripping activities;

l) Grubbing and other debris shall not be permitted to enter any watercourse;

m) Bog and other wet material that is excavated from the site shall be piled and graded on well drained ground in low piles. The piles shall be seeded or otherwise protected using erosion control methods as outlined in Section 5.25, Erosion Prevention and Sediment Control; and

n) Where the piles are in the transmission line right-of-way they shall not impede access to the line for future maintenance or access.

Figure 5-13: Example of grubbing activities

Figure 5-14: Example of grubbed and cleared path

5.22 QUARRYING AND AGGREGATE REMOVAL FROM BORROW AREAS

Environmental Concerns

The principle concerns for quarry development and associated aggregate removal include the potential for impacts on aquatic systems, loss of terrestrial habitat and historic resources, potential quarry development/rehabilitation plans.

Environmental Protection Procedures

The following measures shall be implemented to minimize these effects:

a) Permits to quarry shall be obtained from the NL Department of Natural Resources before quarries are established. Quarry activity shall be undertaken in compliance with these quarry permits and shall comply with all other relevant regulations;

b) Quarries shall be located 100 m from a water body unless otherwise approved by the Department of Natural Resources. If approved, additional mitigative measures may be required;

c) The development of quarry sites and rock excavations shall require monitoring to determine the absence or presence of sulphide bearing rock. For environmental protection against Acid Rock Drainage (ARD), the On-Site Environmental Monitor shall visually inspect bedrock before, during, and after excavation work on a periodic basis. Previous surveys have indicated that materials at the site are Not Potentially Acid Generating (NPAG), however in the event that visible evidence of ARD is noted, the On-Site Environmental Monitor shall be notified immediately. Visible evidence of ARD is typically a yellowish colour of water or sediment called yellow boy or evidence or sulphides in rock. Photographs of yellow boy and sulphides (Figures 5-16 – 5-19) are shown below;

Figure 5-15: Photograph of Yellow Boy water run-off

Figure 5-16: Photograph of Yellow Boy water run-off

Figure 5-17: Typical sulphides in rock

Figure 5-18: Typical sulphides in rock

d) Quarry areas shall be developed in a controlled manner so as to minimize potential environmental effects and quarry locations shall consider sensitive wildlife areas. The following protection procedures shall be implemented to minimize disturbance and facilitate rehabilitation:

   i) A buffer zone of undisturbed vegetation shall be maintained between borrow areas/quarries and watercourses, waterbodies and ecologically sensitive areas (see Section 5.18);

ii) The quarry area, stockpile area and limits of clearing shall be staked and/or flagged to prevent over-extension of the development, (corner posts at least 1 metre high above ground shall be installed to mark the quarry area);

iii) The area to be excavated shall be clear cut of all vegetation prior to grubbing, excavation or removal of any material. Only the area necessary for one year's production shall be cleared;

iv) All stumps, organic matter and topsoil shall be stripped from the area to be excavated and stockpiled at least 5 m from uncleared areas; stockpiles shall be kept at least 10 m from the area of excavation; separate overburden piles shall be developed where this material is present; topsoil and the underlying overburden shall not be mixed (Section 5.21);

v) Stockpile areas are to be confirmed by the On-Site Environmental Monitor, prior to stripping;

vi) Upon completion of excavation of a quarry, no cliff faces or benches shall be left at a height of greater than 5 m. Available material left over from quarrying and stockpiled overburden shall be used to minimize slopes and face heights and to rehabilitate the area (Section 5.35);

vii) Each quarry shall be evaluated by the On-Site Environmental Monitor on a site-specific basis to determine whether the cliff faces shall be converted to rubble slopes; and

viii) Following sloping, the topsoil and any organic materials shall be re-spread over the disturbed area to promote natural re-vegetation by adjacent seed sources (5.35).

e) In order to prevent sedimentation of waterbodies, watercourses and ecologically sensitive areas, sediment control measures (basins and traps) shall be established, if required, and cleaned on a regular basis, as required, to ensure

that the retention capacity is maintained at all times. Section 5.25, Erosion Prevention and Sediment Control outlines all acceptable sediment control measures;

f) The Total Suspended Solid (TSS) content of construction-altered water that is released into a natural waterbody shall not exceed 30 milligrams per litre[4] and be in compliance with *Environmental Control Water and Sewage Regulations, 2003;*

g) With respect to maintenance of water quality within receiving waterbodies on and around the site, the *CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life* shall be used;

h) The pH level of construction-altered water that is released into a natural waterbody shall be between 5.5 and 9 pH units and be in compliance with *Environmental Control Water and Sewage Regulations, 2003*;

i) Dust from aggregate processing, storage and handling shall be controlled with water as required during times when temperatures are above freezing. A water use license must be obtained from DOEC; and

j) If crushing activities in the quarry require a water source, A water use license is also required from the Water Resources Management Division; Quarry operations shall consider sensitive wildlife periods as outlined in Section 5.1.

[4] If water is being abstracted from a water course, used, treated and subsequently returned to the same water course, these solids data mean that the effluent should not contain more than 30 milligrams per litre more than was in the water originally abstracted.

5.23 TRENCHING

Environmental Concerns

Where linear excavations for the construction of water lines or any other infrastructure is undertaken, potential runoff of sediment-laden water could result in effects on marine or freshwater fish and fish habitat, water quality and historic resources.

Environmental Protection Procedures

The following measures shall be implemented to minimize the potential effects of trenching:

a) Topsoil and excavated overburden and bedrock shall be stored in separate stockpiles for later use during rehabilitation;

b) Any unsuitable material shall be disposed of in a disposal area to be confirmed by the On-Site Environmental Monitor;

c) Dewatering of trenches, as outlined in Section 5.27 shall make use of measures to minimize and control the release of sediment laden water through the use of acceptable sediment control measures as outlined in Section 5.25, Erosion Prevention and Sediment Control; and

d) Backfilling of linear trenches shall allow for settlement to ensure that the finished grade of the trench is level with the surrounding surface.

5.24 EXCAVATION, BACKFILLING AND GRADING

Excavation, backfilling and grading of common rock and other materials may be required at various locations within the Project site.

Environmental Concerns

The principal environmental concerns associated with excavation, backfilling and grading are potential effects on water quality and fish and fish habitat due to run-off of sediment laden water. Potential disturbance to rare species and habitat and archaeological resources must also be taken into account.

Environmental Protection Procedures

All work shall be conducted in a manner that ensures the minimum amount of disturbance necessary and controls potential sedimentation of watercourses and waterbodies in or adjacent to the work areas as outlined in the following procedures:

a) Excavation, backfilling and grading shall be done only after grubbing and stripping is completed. Where engineering requirements do not require grubbing and stripping (e.g., within the buffer zone of a stream crossing), filling shall occur without any disturbance of the vegetation mat or the upper soil horizons;

b) Excavation, backfilling and grading in the vicinity of stream crossings shall be done in a manner that minimizes erosion and sedimentation of watercourses and water bodies; and

c) A buffer zone of undisturbed vegetation shall be maintained between construction areas and all watercourses, waterbodies and ecologically sensitive areas (Section 5.18).

5.25 EROSION PREVENTION AND SEDIMENT CONTROL

Environmental Concerns

The potential for erosion and resulting effects to water quality and fish and fish habitat is a key environmental concern associated with construction activities. Figures 5-20 and 5-21 show sediment run-off situations that can be avoided by following the environmental protective measures herein.

Figure 5-19. Sediment plume in water

Figure 5-20. Sedimentation on land

Environmental Protection Procedures

Erosion prevention and sedimentation control shall be a main objective in all work areas where soil may be transported by water, wind, or ice. An Erosion and Sedimentation Control Plan shall be prepared and submitted by the Contractor as part of the C-SEPP, prior to the start of site activities.

Storm water discharge into any water body showing on 1:50,000 mapping shall require a DOEC permit under the Water Resources Act.

5.25.1 Site-Specific Erosion and Sedimentation Control Plan

The following outlines the requirements of the Erosion and Sedimentation Control Plan:

a) A brief description of the proposed land disturbing activities, existing site conditions and adjacent areas;

b) A description of the critical areas on the site (i.e. areas that have a potential for serious erosion problems);

c) Construction schedule that includes the date stripping and grading will begin and the expected date of stabilization;

d) A brief description of the measures that shall be used to minimize erosion and control sedimentation on the site including types, options, when they shall be installed and where they shall be located;

e) An inspection and maintenance program including frequency of inspection and repair, clean out and disposal of trapped sediment, duration and final rehabilitation when site work is complete;

f) Shut down plans where construction plans are delayed for an extended period of time;

g) An emergency response plan that identified available short term resources in terms of personnel, equipment and erosion and sedimentation control measures and reporting steps;

h) Name of person preparing plan and professional stamp/designation;

i) Site plan including the following features:

   i) Existing and final site contours at an interval and scale sufficient to identify runoff patterns before and after disturbance;

   ii) Existing vegetation and buffers;

   iii) Limits of clearing and grading;

   iv) Critical areas; and

   v) Location and type of erosion and sedimentation control measures with dimensions.

j) Detailed drawings of all erosion and sedimentation control structures and measures showing dimensions, material and other important details;

k) The following calculations:

i) Design calculations for erosion and sedimentation control measures (culverts, channels, sediment traps, etc.) such as particle size, flow rates and peak discharge;

ii) Calculations to demonstrate the design of sediment removal efficiency; and

iii) Any other calculations, as required.

l) Contingency measures shall be implemented to deal with storm events and high run-off in order to minimize adverse environmental effects from these events. Erosion prevention and sediment containment measures and required equipment shall be available to address contingency/emergency situations.

5.25.2 Erosion Prevention

The primary way to control erosion is to prevent activities that can contribute to it. However, specific erosion control measures may be required to be designed for the site to minimize the effects of construction activities on the environment. Options for erosion prevention are discussed in the following sections.

5.25.2.1 Discussion of Erosion Control Options

Slope Treatments

Several slope treatments can be used to reduce erosion. Slope treatments are used prior to seeding for vegetation growth. Roughening a slope with horizontal depressions helps control erosion by creating safe seeding sites therefore increasing vegetation, reducing runoff velocity, and increasing infiltration. The depressions also trap sediment on the face of the slope. The amount of roughening required depends on the steepness of the slope and the type of soil. Stable, sloping rocky faces may not require roughening or stabilization, while erodible slopes require special surface

roughening. Roughening methods include stair-step grading, grooving, and tracking. All three methods are shown in Figures 5-22 to 5-24.

Figure 5-21: Photograph of grooving slope treatment method

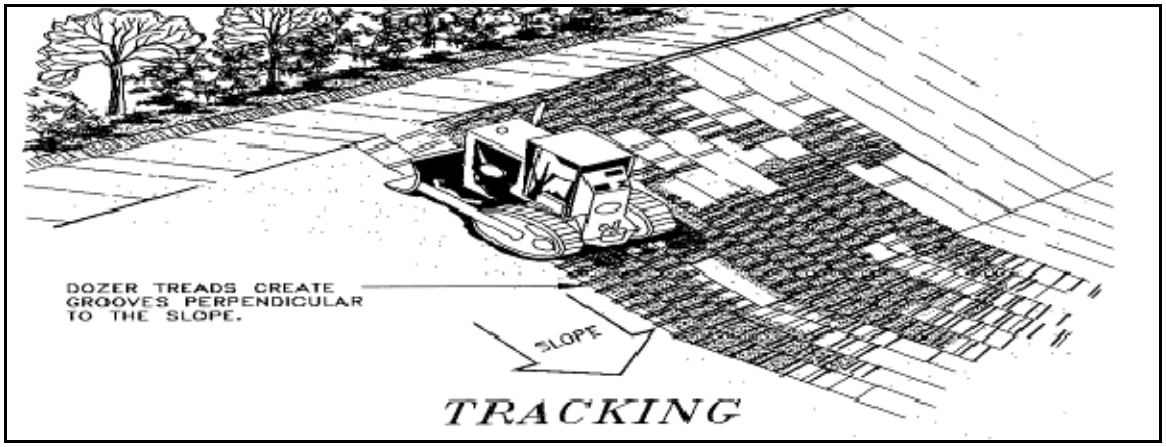

Figure 5-22: Illustration of tracking slope treatment method

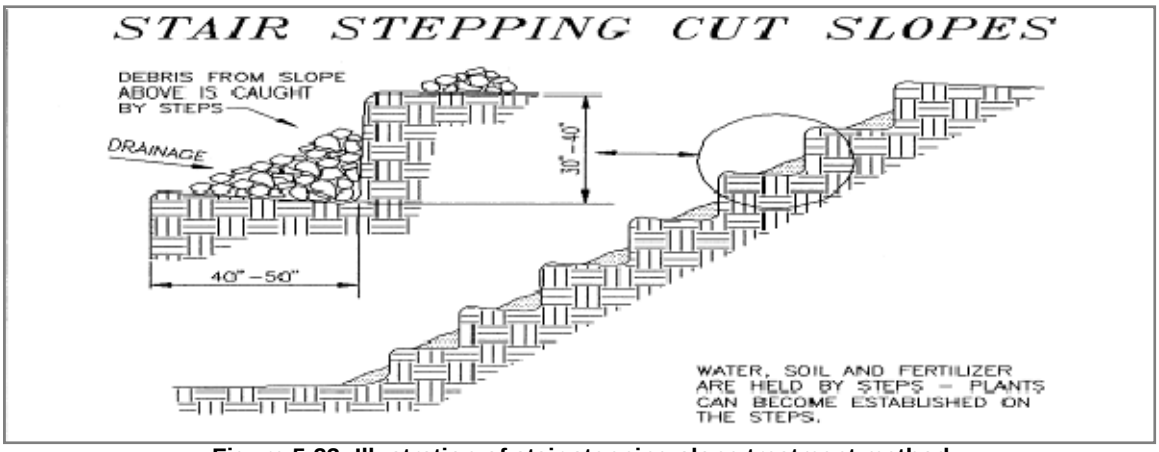

Figure 5-23: Illustration of stair stepping slope treatment method

Erosion Control Nets/Mats/Blankets/Fibrous Rolls

Erosion control blankets are temporary protective barriers laid on top of bare soil vulnerable to erosion, commonly made of mulch, wood fibre, straw or synthetics. They are typically used on short steep slopes where there is a high erosion potential and slow vegetation establishment. Rolled Erosion Control Products (RECPs) are manufactured mulch blankets (see Figure 5-25) that protect soil from erosion and Turf Reinforcement Mats (TRMs) are used to help establish vegetation in channels.

Figure 5-24: Photograph of Erosion Control Blanket used on a slope

Erosion control nets are typically synthetic textiles or nets that degrade over time. The nets are woven to permit plants to take root through the holes in them. They also act as a medium to retain water for longer period of time. Different grade of nets are used based on the topography of the ground. The more closely knit nets can be used to curtail erosion in high slope areas, while the more loosely knit nets can be used in flatter terrain. Installation of erosion control mats and blankets shall take into consideration the criteria listed in Section 5.25.2.2.

Fibre rolls serve as barriers between up gradient construction and downgradient water bodies. Fibre rolls are installed on slopes in line with one another with one at the base of the slope. The space between each row of fibre roll is dependent on the steepness of the slope. The steeper the slope, the more rows of evenly spaced horizontal rows of rolls is needed. Fibre rolls are fastened to the ground with wooden stakes. Figures 5-26 and 5-27 show some of the methods of erosion control.

Figure 5-25: Photograph of Fibre Rolls used to stabilize

Figure 5-26: Photograph shows erosion control blanket on slope and erosion control mat in channel

Rip Rap

Rip rap can be used as an erosion-resistant ground cover and when installed properly it reduces the velocity of runoff and increases infiltration. Rip rap typically works well on river banks and/or bottoms, roadside ditches and tops of slopes. A non-woven geo-textile liner should be used at the top of the channel to prevent migration of fines. Rip rap placement shall follow criteria listed in Section 5.25.2.2 and applicable construction specifications and drawings. Figure 5-28 shows properly placed rip rap while Figure 5-29 shows poorly placed rip rap with geotextile exposed.

Figure 5-27: Photograph of Rip Rap placed along a slope

Figure 5-28: Photograph of failed Rip Rap Protection

Check Dams and Dikes

Check dams and dikes are temporary barriers that are typically constructed of rocks, gravel bags, sandbags or fibre rolls that are installed across a constructed swale or drainage ditch to reduce the velocity of water. They are placed in areas where runoff erosion has occurred or where runoff needs to be diverted or channelled. They are not designed to stop the water, but to slow it down. Check dam and dyke installation shall follow the criteria listed in Section 5.25.2.2 and applicable construction specifications and drawings.

Check dams shall be maintained and inspected periodically as well as unscheduled inspections prior to, and after, a significant rainfall event, anticipated heavy precipitation or runoff event (e.g. snow melt). Removal of sediment from check dams shall be conducted as required, in order that the check dam continues to perform its function of reducing the amount of sediment present in the run-off. Photographs of rock constructed check dams are shown below in Figures 5-30 and 5-31.

Figure 5-29: Photograph of Rock Constructed Check Dam

Figure 5-30: Photograph of a Rock Constructed Dike

Energy Dissipaters

Energy dissipaters (or outlet protection devices) are devices that are installed on the downstream end of a culvert or outlet and are used to reduce the velocity of the water flow. Energy dissipaters are typically made of rocks (rip rap apron); however they can be man-made devices such as concrete blocks or metal prongs. Energy dissipaters required for fish bearing waters shall be of natural means (not man-made). Energy dissipaters require engineering design to accommodate the velocity and volume of flow and shall follow the criteria listed in Section 5.25.2.2 and applicable construction specifications and drawings. Figure 5-32 shows properly constructed or placed energy dissipaters while Figure 5-33 shows improperly placed rocks as energy dissipaters.

Figure 5-31: Correct Construction of Rock Energy Dissipaters

Figure 5-32: Incorrect Construction of Rock Energy Dissipaters

5.25.2.2 Design Criteria and Installation Procedures for Erosion Control Measures

Design criteria and installation procedures for applicable options discussed above are listed below. Reference shall be made to these criteria if either of these options is deemed suitable for site-specific conditions.

Straw Mats

a) Straw mats shall be applied at a rate of 3000 to 8000 lb/acre;

b) Soil shall be visible through the straw mat (not too heavily applied);

c) Straw shall be applied by blower or by hand; and

d) Straw shall be anchored to prevent it from blowing away.

Wood Fibre Mulch

a) Preferable on steep cut slopes of 2H:1V or steeper; and

b) Wood fibre mulch shall be applied at a rate of at least 1000 lb/acre (increasing the rate of application will increase effectiveness).

Rolled Erosion Control Products (RECPs)

a) May be used for gradients of 2.5H:1V or steeper;

b) Shall be installed on unfrozen ground;

c) Slopes shall be top soiled and seeded prior to placing RECP;

d) Blankets shall be in full contact with the soil by properly grading soil, removing rocks or deleterious materials, prior to placing blanket;

e) In channels, blankets shall extend above the anticipated flow height, with a minimum 0.5 m of free board;

f) For turf reinforcement mat (TRM), blanket shall be placed immediately after top soiling;

g) Blanket shall be anchored by using wire staples, metal geotextile stake pins, or triangular wooden stakes; and

h) Blankets shall be placed longitudinal to direction of flow, with fabric not stretched but maintaining contact with underlying soil.

Rolled Erosion Control Products (RECPs) on Slopes

General Installation Methods for RECPs on slopes are listed below however all installation shall be designed on a site-specific basis and products shall be installed according to manufacturers procedures.

a) Prepare surface and place topsoil and seed (surface should be smooth and free of rocks, debris, or other deleterious materials);

b) Blanket shall be anchored at top of slope in a minimum 0.15 m by 0.15 m trench for the entire width of the blanket;

c) The blanket shall be rolled out downslope;

d) Where the blanket roll is not long enough to cover the entire length of the slope, a minimum 0.15 m by 0.15 m check slot shall be excavated at the location of the

lap, and the downslope segment of blanket anchored in the check slot, similar to the method used for the top of the slope, or (2) when blankets, must be spliced down the slope, place blanket end over end (shingle style) with approximately 0.10 m overlap. Staple through overlapped area at 0.3 m intervals;

e) The upslope portion of blanket shall overlap the downslope portion of blanket, shingle style, at least 0.15 m with staple anchors placed a maximum 0.3 m apart;

f) Adjacent rolls of blanket shall overlap a minimum 0.1 m;

g) Anchors shall be placed along central portion of blanket spaced at 4/m2 minimum (0.5 m spacing) for slopes steeper than 2H:1V and 1/m² (1 m spacing) for slopes flatter than 2H:1V; and

h) Anchors along splices between adjacent rolls shall be placed 0.9 m apart.

Rolled Erosion Control Products (RECPs) in Channels

General Installation Methods for RECPs in channels are listed below however all installation shall be designed on a site-specific basis and products shall be installed according to manufacturers procedures.

a) Prepare surface and place topsoil and seed (surface should be smooth and free of large rocks, debris, or other deleterious materials);

b) Excavate a minimum 0.15 m deep and 0.15 m wide trench at the upstream end of channel and place end of RECP into trench;

c) Use a double row of staggered anchors approximately 0.1 m apart (i.e. 0.2 m linear spacing) to secure RECP to soil in base of trench;

d) Backfill and compact soil over RECP in trench;

e) Roll centre RECP in direction of water flow on base of channel;

f) Place RECP end over end (shingle style) with a minimum 0.15 m overlap downgrade;

g) Use a double row of staggered anchors approximately 0.1 m apart to secure RECP to soil;

h) Full length edge of RECP at top of sideslopes shall be anchored in a minimum 0.15 m deep and 0.15 m wide trench;

i) Use a double row of staggered staple anchors a maximum of 0.1 m apart (i.e. 0.2 m linear spacing) to secure RECP to soil in base of trench;

j) Backfill and compact soil over RECP in trench;

k) Overlap RECP on side slopes (shingle style down channel) a minimum of 0.1 m over the centre RECP and secure RECP to soil with anchors spaced a maximum of 0.2 m apart;

l) In high flow channels, a check slot across the width of the channel is recommended at a maximum spacing of 10 m to anchor the ends of the RECP to the underlying soil;

m) Use a double row of staggered staple anchors a maximum of 0.1 m apart (0.2 m linear spacing) to secure RECP to soil in base of check slot; and

n) Backfill and compact soil over RECP in check slot.

Rip Rap

The following criteria shall be considered when installing a check dam:

a) Used for grades 5-15%;

b) It shall be constructed of durable, large, loose stone;

c) A non-woven geo-textile liner shall be used at the top of the channel to prevent migration of fines;

d) Side slopes of rip rap must be a slope of IV:3H or less;

e) Rip rap shall be of angular stone; and

f) Rip rap depth shall be at least 300mm and 1.5x the maximum stone diameter.

Check Dams and Dikes

The following criteria are to be considered when installing a check dam:

a) Check dams shall not be used in live streams or in channels with extended base flows, as this may have a detrimental effect on fish or fish habitats;

b) The check dam sediment trap shall consist of rock fill with filter fabric on the upstream face held in place with small shot rock;

c) Accumulated sediment shall be cleaned out of the filter fabric at regular intervals as required and the material shall be disposed of so that it cannot subsequently run into any waterbodies containing fish;

d) Any damaged section(s) of filter fabric as well as any undercut or end flow areas where water flows freely around the filter fabrics shall be repaired or replaced;

e) Drainage area shall be less than 4 ha;

f) The filter fabric shall be of a weight of at least 200g/m^2;

g) The rock fill shall be clean rock, with rock fragments sized between 100 and 150mm;

h) The small shot rock shall be clean rock, with fragments no larger than 120mm;

i) When used in series, the top of the downstream check dam shall be level with the bottom of the next dam upstream;

j) The check dam shall extend beyond the top of the ditch banks and the centerline elevation shall be low enough that flow does not go around the structure; and

k) Check dams shall be maintained and inspected periodically as well as unscheduled inspections prior to, and after, a significant rainfall event, anticipated heavy precipitation or runoff event (e.g. snow melt). The following maintenance shall be completed, as required:

    i) remove any accumulations of sediment; and

ii) add or remove rock as necessary to maintain design height, cross-section and flow through characteristics.

Energy Dissipaters

The following criteria are to be considered when installing energy dissipaters:

a) Energy dissipaters are preferably constructed on level grade for a distance which is related to the outlet flow rate and the tail water level;

b) The sill or transition to the natural channel shall be level with and at the same slope as the receiving channel;

c) Energy dissipaters are applicable for small and medium size culverts of any cross section where the depth of flow at the outlet is less than the culvert height;

d) For rip rap aprons, the apron width at the pipe end shall be 3x the pipe diameter;

e) Energy dissipaters shall drain by gravity when not in operation; and

f) Energy dissipaters shall be self cleaning and require minimum maintenance.

5.25.3 Sedimentation Prevention

5.25.3.1 Silt Fences/Sediment Barriers

Sediment barriers are temporary sediment control devices that are used to protect water quality of down gradient rivers, streams and other water bodies from sediment in water run-off. The most common barriers are silt fences; however other options include straw or hay bales or a berm of erosion control mix. Silt fences are typically used in combination with other site water control measures including sediment traps and basins. Engineering requirements may vary depending on the locations of the silt fence and shall take such factors into consideration as drainage/surface area of exposed soils and time of year the silt fence is employed.

Silt fences typically consist of a piece of synthetic filter fabric stretched between a series of wooden stakes. The stakes are installed on the downhill side of the fence, and the bottom edge of the fabric is trenched into the soil and backfilled on the uphill

side. The storm water passes through the fence and sediment is deposited on the uphill side of the fence.

Silt fences are suitable for sheet runoff from exposed areas of soil with grades less than 5% as a result of construction activities. The following criteria shall be taken into consideration when installing silt fences:

a) The silt fence shall consist of a filter fabric fence held in place by posts;

b) The woven filter fabric shall be of a weight of at least 200 g/m^2;

c) No single run of silt fence shall exceed 100 m in length;

d) The drainage area behind the silt fence shall not exceed 0.1 ha per 30 meters of fence;

e) Silt fences shall not be installed on a slope, and be located no nearer than 1 m from the toe of slope;

f) Silt fences shall not be used when the overland flow exceeds 0.03 m^3/sec;

g) The fabric shall be at least 900mm wide/high;

h) The fence posts shall be of sufficient length to support the fabric, be sturdy and be of dimensions of at least 50mm square;

i) The staples shall be sufficiently sturdy to support the fabric for the required life of the fence;

j) The posts shall be secured at 3m intervals on the immediate down slope side of the trench;

k) The filter fabric shall be taken from a continuous roll, and cut to the required length. The maximum length of the filter fabric shall be stapled to the upstream side of the stakes, with 200mm of fabric extending into the trench and spread over the trench bottom;

l) When installing a silt fence in frozen earth or rock, metals posts shall be used and wire ties shall be used to attach the filter fabric (Figure 5-36);

m) When a fence is installed in frozen earth it shall be checked and potentially replaced during spring melt as the posts may have shifted with the melting earth; and

n) Silt fences shall be removed when the site has been stabilized, or re-vegetated

Silt fences shall be inspected and maintained on a regular basis as well as before any anticipated heavy precipitation or runoff event (e.g. snow melt). Accumulation of sediment shall be periodically removed and disposed of in an area where it shall not re-enter any waterbody.

Also, repairs and replacement of damaged silt fences shall be addressed immediately. Figures 5-34 to 5-36 show proper construction of silt fences and Figures 5-37 and 5-38 show poorly constructed silt fences that have failed and allowed silt or silty water to pass through.

Figure 5-33: A well constructed silt fence

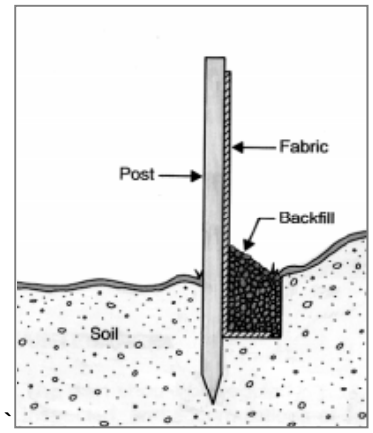

Figure 5-34: Properly constructed silt fence

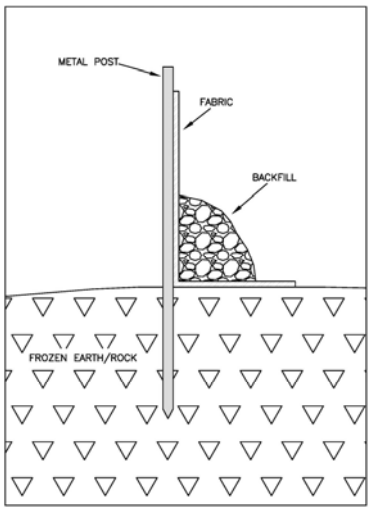

Figure 5-35: Properly Constructed Silt Fence for Frozen Earth or Rock

Figure 5-36: Examples of poorly installed silt fences

Figure 5-37: Examples of poorly installed silt fences

5.26 SITE WATER MANAGEMENT

Environmental Concerns

For a large-scale, earth-moving construction projects such as the Lower Churchill Project, a major consideration in the protection of water quality and aquatic resources is the management of site water run-off and associated suspended solids. The protection of water quality and aquatic resources shall focus on prevention, containment and treatment of water and wastewater associated with the site. Site water management can be divided into three main categories: Surface Water Interception, Containment and Treatment.

Environmental Protection Procedures

The main focus of measures to protect water quality and aquatic resources is prevention. Preventative measures shall include measures to reduce the volume of water entering the work sites (thereby reducing the volume of water that requires subsequent containment and treatment). Site water management systems shall be installed as per technical specifications and/or the C-SEPPs. See references such as DFO's Fact Sheets on Ditching, Filter Fabric, Rock Check Dams and Temporary Settling Basins for more information related to erosion prevention and sedimentation control.

Storm water discharge into any water body showing on 1:50,000 mapping shall require a DOEC permit under the *Section 48 of the Water Resources Act*. Effluent monitoring locations, frequency, sampling and reporting shall comply with the conditions of the permit.

5.26.1 Description of Site Water Management Methods

Surface Water Interception

Reducing the amount of water entering the work sites through surface water runoff, infiltration through the cofferdams and groundwater seepage may be required. At the main work sites ditches shall be incorporated into the site layout to intercept surface

water and divert it around the work areas. Infiltration through the cofferdams and groundwater seepage shall be reduced by the installation of a properly designed sump and pump well systems that shall draw down the water table.

Containment

Once in the work areas, water shall be contained until the water can be treated and released. A system of ditches and drains, incorporated with sump and pump systems, may be required to handle water that enters all excavations. Where required, ditches, drains and sumps shall be located along the lower boundaries of the construction sites to intercept and contain silty or sediment laden water. Measures to contain water from excavations and other construction works shall include but not be limited to:

a) The containment of water from concrete production and placement, including the cutting of concrete, washing of forms or water otherwise contaminated by concrete components or admixtures;

b) The containment of wash water from the cleaning of mixers and mixer trucks;

c) The control of sediment and run-off from aggregate washing areas. This may include, but shall not be limited to, use of a closed system washing operation or a multiple tiered settling basin system; and

d) Testing and treatment for elevated levels of TSS or other contaminants related to blasting (such as Ammonium Nitrate and fuel oil).

Treatment (Sediment Ponds/Traps)

Once contained, water shall undergo testing and if necessary treatment prior to release. The goal of site water management is to release water within regulatory limits for all parameters. Water shall be tested for oil and grease, TSS, ammonium nitrates and/or any other parameters outlined by the monitoring plan in the C-SEPP based on usage of equipment and site chemicals as required to meet the *Environmental Control Water and Sewage Regulations, 2003.*

For open excavations, a system of properly designed and constructed settling basins is the preferred method of sediment removal. A sediment basin (also called a sediment pond – See Figure 5-39) is a temporary pond built on a construction site to capture eroded or disturbed soil that is transported due to water run-off. The sediment basin protects the water quality of down gradient water bodies. The sediment suspended in the water settles in the pond before the runoff is discharged. Sediment basins are typically used on larger construction sites (>5 acres). Use of sediment basins is usually in conjunction with other sediment and erosion controls. Reference the DFO Fact Sheet for Temporary Settling (Detention) Basins for more information.

Figure 5-38: Sediment Basin

A sediment trap is similar to a sediment basin and is basically an embankment built along a waterway or low-lying area on the site. Sediment traps should be installed prior to construction and earth moving activities and are commonly used on smaller construction sites, where a sediment basin is not practical. Use of sediment traps is usually in conjunction with other sediment and erosion controls. The size of sediment traps and basins shall depend on the size of the site, location and rainfall runoff for the area. See Figure 5-40 for a photograph of a sediment trap.

Both sediment ponds and sediment traps require periodic inspection and maintenance. Inspections shall occur following each significant rainfall to ensure proper drainage and to determine if structure repairs are required. Maintenance

shall include removal and disposal of accumulated sediment from the settling basins in order to maintain their operating capacity. Sediment shall be disposed of in area that would preclude the sediment from entering waterbodies downstream.

Figure 5-39: Sediment Trap

Water leaving sediment traps and basins shall be tested for applicable parameters (Schedule A of the *Environmental Control Water and Sewage Regulations, 2003* under the *Water Resources Act)*. Following testing, the addition of chemicals or the use of mechanical processes may be required to treat the water in conjunction with settling and filtration.

Contaminated or silted water pumped from excavations or work areas, or any runoff or effluent shall have sediment removed by applicable sediment control measures as outlined in Section 5.25, before discharging to a watercourse, waterbody or other ecological sensitive area. In addition, any effluent directed out of the Project site shall be tested for TSS and hydrocarbons (if there are any indications of hydrocarbon contamination, such as a sheen or odour) before being discharged to any watercourse, waterbody or other ecological sensitive area. Effluent discharge shall comply with the provincial *Environmental Control Water and Sewage Regulations, 2003* under the provincial *Water Resources Act.*

With respect to maintenance of water quality within receiving waterbodies on and around the site, the *CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life* shall be used.

5.26.2 Design Criteria and Construction Considerations

The design of the structures shall consider the following:

a) The loading of suspended solids in the water;

b) Particle size and gradation;

c) The volume of water to be treated;

d) The rate of inflow;

e) Rate of outflow; and

f) The contributing surface area.

Specific design criteria is provided below:

a) Design storm shall be the precipitation of the 24 hour rainfall intensity from a 1:20 year storm;

b) Drainage area for each sediment retention structure shall not exceed 2 ha;

c) Ponds shall be located in low lying areas where they will not contribute to high groundwater conditions and where the system can return the water to a body of water or recharge the water table;

d) The Contractor may also use other low-lying areas or wetlands for treating lightly silted water or smaller quantities of water;

e) Sedimentation ponds shall be accessible by heavy equipment for removal of accumulated silt;

f) Pond designs shall include an overflow discharge in case of flooding. The overflow section shall have a minimum width of 1.5 m for every 250 m^2 of pond area;

g) Provide 1 to 2 % elevation drop between inlet and outlet grades; and

h) Maintain a minimum pond depth of 1 m. A minimum length to bottom width ratio of 4:1. The size shall be determined to ensure discharge water meets the *Environmental Control Water and Sewage Regulations, 2003.*

5.27 DEWATERING WORK AREAS

Environmental Concerns

The major concerns associated with dewatering are sedimentation, direct fish mortality, and/or habitat destruction for freshwater and marine fish species.

Environmental Protection Procedures

a) Filtration or other suitable measures, such as settling ponds, silt fences and dikes, shall be implemented for sediment removal and turbidity reduction in water pumped from work areas before discharging;

b) Where possible, clean water meeting the *Environmental Control Water and Sewage Regulations, 2003* shall be discharged to vegetated areas to further reduce any potential effects on watercourses. Additionally, mechanisms to prevent scouring and erosion of the discharge location shall be installed as outlined in Section 5.25;

c) The size of sedimentation ponds shall be designed to accommodate the anticipated volume of collected water and meet discharge criteria for water quality as outlined in Section 5.26;

d) Discharged water shall be encouraged to follow natural surface drainage patterns;

e) Harmful alteration, disruption and destruction of fish habitat shall not be permitted unless a formal HADD Authorization has been obtained from DFO; and

f) See Fish Habitat and Relocation in Section 5.19 Alterations to a Body of Water/Instream Works

5.28 BLASTING AND WASTE ROCK DISPOSAL

Environmental Concerns

The general environmental concerns associated with on-land blasting include:

a) Destruction of vegetation outside excavation limits;

b) Noise disturbances to wildlife;

c) Disturbance of archaeological resources;

d) Release of chemicals (i.e. ammonia) to the environment (explosive mixtures and products); and

e) Dust generation.

Blasting in or near water bodies can affect organisms with swim bladders (fish) but may also affect a variety of aquatic animals including shellfish, marine mammals, otters, seabirds and waterfowl. The introduction of sediment into the water column is also a concern for marine/freshwater water quality and related effects on aquatic life.

Environmental Protection Procedures

The handling, transportation, storage and use of explosives and all other hazardous materials shall be conducted in compliance with all applicable laws, regulations, orders of the DOEC and the Service NL, the *Explosives Act*, and the *Transportation of Dangerous Goods Act*. The following measures shall be implemented to minimize the effect of the use of explosives and blasting:

a) Explosives shall be used in a manner that shall minimize damage or defacement of landscape features, trees, ecologically sensitive areas such as wetlands, and other surrounding objects by controlling through standard best practice (including precisely calculated explosive loads and adequate stemming), the scatter of blasted material beyond the limits of activity. Outside of cleared areas, inadvertently damaged trees shall be cut, removed, and salvaged if merchantable (Section 5.8). Fly rock that inadvertently enters a waterbody

watercourse or any ecologically sensitive area, and that can be recovered without further damage to the environment shall be removed. Instances where larger fly rock (boulders) enters theses areas or deep waterbodies, recovery of this shall be discussed with the On-Site Environmental monitor;

b) Blasting patterns and procedures shall be used which minimize shock or instantaneous peak noise levels;

c) Time delay blasting cycles or blasting mats shall be used, if necessary, to control the scatter of blasted material;

d) Blasting shall not occur in the vicinity of fuel storage facilities;

e) All blasters shall have a Blasters' Safety Certificate from the NL Department of Labour. This certificate and a Temporary Magazine License shall be obtained prior to drilling and blasting;

f) Use of explosives shall be restricted to authorized personnel who have been trained in their use;

g) There shall be separate magazines on site for explosives and for dynamite blasting caps. All temporary magazines for explosive storage shall have appropriate approvals;

h) The immediate area of the blast site shall be surveyed within one hour prior to a blast and operations shall be curtailed if wildlife (e.g. black bears, water fowl, raptors, etc.) is observed within 500 m. Environmental personnel and On-Site Environmental Monitors shall conduct pre-blast monitoring to see and identify species of concern. Additionally, any individual animal sightings by other personnel shall be reported to the On-Site Environmental Monitor. Blasting may be delayed in such circumstances until wildlife have been allowed to leave the area of their own accord;

i) All blasting associated debris, such as explosive boxes and used blasting wire, must be collected for proper disposal as soon as possible following blasting activity;

j) If blasting is necessary within the vicinity of an archaeological site, precautions shall be taken to ensure that blasted material and shock waves do not disturb any part of the site. If necessary, protective covering shall be applied to the site under the supervision of an approved archaeologist. Blasting shall not be undertaken in these areas without first notifying the On-Site Environmental Monitor;

k) Waste rock that is suitable for usage at the site shall be set aside for subsequent use. Waste rock not suitable for site use shall be deposited in the designated stockpile area;

l) Previous testing on selected samples of bedrock has shown the samples to be Non-Potentially Acid Generating (NPAG). As a precautionary measure the On-Site Environmental Monitor shall inspect all areas of blasted rock and rock stockpiles to ensure no evidence of PAG material exists; and

m) If possible, blasting shall be done outside of sensitive time periods for important wildlife areas (See Table 5-1).

Blasting in Close Proximity to or In a Body of Water

Seismic geophysical methods may require in-water blasting. This may include the use of small sources of energy (explosives, air gun, weight drop, etc.) in the water column.

The following measures shall be implemented to minimize the effect of the use of explosives and blasting in or near water:

a) When blasting operations are within 200m of a waterbody occupied by fish, the operations shall be carried out in accordance with DFO guidelines;

b) Downstream areas shall be monitored after each blast for evidence of fish kills and if any are evident, blasting operations shall cease and the incident shall be reported to the On-Site Environmental Monitor;

c) Three hours prior to any blasting activities near water bodies, a visual reconnaissance of the area shall be undertaken to establish the presence of water fowl or aquatic mammals;

d) If blasting is necessary within 15 m of a waterbody, it shall be undertaken in compliance with the required Water Resources permits from the DOEC, and DFO Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters, 1998. A copy of this reference shall be kept at the Project site and made available to all contractors;

e) Underwater blasting activities shall require review and authorization from DFO, the On-Site Environmental Monitor shall confirm that the DFO Area Habitat Biologist has been notified 24 hours before the start of blasting operations;

f) Drilling and blasting activities shall be undertaken in a manner that ensures the magnitude of explosions is limited to that which is absolutely necessary. A blasting plan shall be reviewed with the On-Site Environmental Monitor in advance of work in close proximity to water bodies;

g) For multiple charges, time delay detonators shall be used to reduce the overall detonation to a series of single explosions separated by minimum delay;

h) Large charges shall be subdivided into a series of smaller charges with minimum delay detonation;

i) The on land set-back distance from the blast site to the waterbody or the set-back distance around the blast site in the waterbody shall be based on the maximum weight of charge to be detonated at one instant in time, the substrate, and the type of fish or fish habitat in the area of the blast. These set-back distances are outlined in the Guidelines for Use of Explosives In or Near

Canadian Fisheries Waters, 1998 and the DFO Fact Sheet for Blasting – Fish and Fish Habitat Protection; and

j) Blast holes shall be stemmed with sand or gravel to grade or to streambed/water interface to confine the blast.

Waste Rock Disposal

For environmental protection against ARD and other leaching of heavy metals the On-Site Environmental Monitor shall visually inspect rock before, during, and after blasting work and on a periodic basis. Previous surveys have indicated that materials at the site are Not Potentially Acid Generating (NPAG), however in the event that visible evidence of ARD is noted, the On-Site Environmental Monitor shall be notified immediately. Visible evidence of ARD is typically a yellowish color of water or sediment called yellow boy or evidence or sulphides in rock. Photographs of yellow boy and sulphides are shown in Section 5.22 in Figures 5-16 to 5-19).

Stockpiling shall be completed in a manner that will reduce the potential for acid rock drainage and metal leaching. All stockpiles shall be placed in an area where drainage can be collected, tested and treated, if required. Consideration shall be given to installing a settling pond for runoff to deal with suspended solids. Stockpile areas and limits of clearing shall be staked and/or flagged to prevent overextension of the development, thereby minimizing the extent of the operation.

Treatment shall be site-specific based on analytical results, however typical treatment shall include settling ponds, the addition of chemicals or the use of mechanical processes to aid in settling or filtration. Treatment options shall be confirmed by the On-Site Environmental Monitor and approved by DOEC.

The release of water from blasting activities and waste rock drainage shall meet Schedule A of the *Environmental Control Water and Sewage Regulations,2003* before it shall be permitted to be discharged directly or indirectly into a storm sewer, body of water or onto the ground.

5.29 CONCRETE PRODUCTION

Environmental Concerns

The major concern relating to concrete production is the effects of effluent released to the environment. Liquid wastes may contain hazardous materials such as cement, concrete additives, and form oil.

Cement is very alkaline and washwater from spoiled concrete or from the cleaning of the batch plant mixers and mixer trucks, conveyors and pipe delivery systems can have pH levels outside the acceptable range. Similarly, spoiled concrete or washwater would contain concrete additives and agents, some of which are toxic to aquatic species. Aggregates, particularly the finer sand fractions may be washed from spoiled concrete or discharged in washwater. Uncontrolled release of such washwater, chemicals and sediments could adversely affect aquatic life and aquatic habitat.

Environmental Protection Procedures

a) Approval from DOEC shall be obtained to establish the required concrete batch plants at each site. Plant operations shall comply with the conditions outlined in the approvals and requirements under air pollution control regulations;

b) Prior to the release of effluent to the environment it shall be tested for appropriate parameters (as outlined in Schedule A of the *Environmental Control Water and Sewage Regulations, 2003*) to ensure effluent quality standards are met. The specific criteria for concrete production are a pH level between 5.5 and 9 and TSS less than 30 mg/L. Release shall be in accordance with runoff control procedures;

c) With respect to maintenance of water quality in receiving waterbodies on and around the site the *CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life* shall be used;

d) If water to be released does not meet discharge criteria, it shall be further treated until these discharge criteria have been met;

e) Treatment shall be site-specific as it depends on analytical results, however typical treatment may include the addition of chemicals or the use of mechanical processes to aid in filtration or settling. Treatment options shall be confirmed by the On-Site Environmental Monitor and approved by DOEC;

f) The *Environmental Code of Practice for Concrete Batch Plant and Rock Washing Operations, 1992* shall be adhered to during concrete production activities, as applicable;

g) When concrete is to be placed within 15m of a waterbody, provisions of all required permits shall be followed. Under no circumstances shall fresh concrete come into contact with a waterbody, before the concrete has cured;

h) Washwater from the cleaning of mixers, mixer trucks and concrete delivery systems shall be handled using the procedures outlined in Section 3.0 of the *Environmental Code of Practice for Concrete Batch Plant and Rock Washing Operations.* The following outlines important steps to take; however the code of practice shall be reviewed thoroughly:

   i) All rinsing activities shall be carried out at the site of the concrete batch plant, except rinsing of the chute;

   ii) The rinsing of the chute may be carried out at the delivery site but care and caution shall be taken before any concrete is rinsed from a chute at the delivery site. It is permissible to rinse onto the ground or soil but under no circumstances into a pond or stream or onto a surface that leads directly to a water body, such as a storm sewer;

   iii) All rinsing activities at the site of the batch plant shall be done over a containment pond (approximately 12.2 m x 4.57 m and less than 0.91 m deep). The material used to form the bottom and sides of the pond can be compacted clay or a synthetic liner, however the DOEC shall approve

any installation of a synthetic liner. The pond shall be self contained with no water inlets or outlets and no possibility of surface drainage into or out of the pond;

iv) Any trucks returning with unused concrete shall dispose of this concrete into an approved area able to contain it while still in liquid form before the trucks can be washed. Once the concrete has hardened it may be used as fill material. Liquid concrete shall not be permitted to run freely over the ground;

v) Once all concrete has been removed from the truck, the truck may be brought over to the containment pond where washing can take place. Any water that is used to wash the truck shall be directed into the pond;

vi) When the water level in the pond reaches a height that necessitates discharge, water can be discharged following the procedure outlined in b) and c) above otherwise it shall be removed by pumper truck or undergo additional treatment; and

vii) Water shall not be discharged in an area where it would cause erosion or be able to pick up solids from the surface.

5.30 DUST CONTROL

Environmental Concerns

The environmental concerns associated with dust include effects on human health and aquatic ecosystems, waterfowl and vegetation.

Environmental Protection Procedures

The following measures shall be taken to mitigate potential effects of dust:

a) Dust from construction activities shall be controlled where possible by using frequent applications of water. Waste oil shall not be used for dust control but other agents such as wood chips, calcium chloride, matting and re-vegetation shall be considered on a site-specific or as needed basis and shall require the approval of appropriate regulators;

b) Environment Canada's Best Practices for the Use and Storage of Chloride-Based Dust Suppressants, (February, 2007) shall be followed for the application of chloride based dust suppressants. This includes but is not limited to:

   i) Chloride based dust suppressants shall not be applied prior to a heavy rainfall or if rain is threatening for at least 36 hours;

   ii) Dust suppressants shall be applied after a rainfall event to aid in mixing.

   iii) Suppressants shall be applied during early morning or evening times to reduce evaporation; and

   iv) Chloride suppressants shall not be applied to a bridge deck or paved surface.

c) Dust control agents (wood chips, calcium chloride, matting, etc.) shall be stored at suitable distances from all watercourse, water body, or ecologically sensitive areas using proper Buffer Zones (Section 5.18).

5.31 NOISE CONTROL

Environmental Concerns

A variety of noises associated with construction and operation activity can negatively affect wildlife and fish and can affect human safety and health. Noises associated with blasting are temporary in nature and noises associated with drilling are considered long-term, but localized.

Environmental Protection Procedures

Measures shall be implemented wherever possible to minimize potential effects arising from a variety of noise sources, including:

a) Wildlife surveillance shall be conducted prior to and post noisy activities. Activities may be delayed until wildlife have been allowed to leave the area as directed by the On-Site Environmental Monitor;

b) Adherence to all applicable permits and approvals;

c) All equipment shall have exhaust systems regularly inspected and mufflers shall be operating properly in accordance with the manufacturers recommendations; and

d) Low level flying of aircraft shall be avoided in areas where wildlife, particularly sensitive wildlife are present (i.e. caribou, osprey, harlequin duck and other waterfowl).

5.32 RESOURCE SPECIFIC MITIGATIONS

Environmental Concerns

Construction activities have the potential to impact a number of specific resources in the Lower Churchill Region. The resources are historical and archaeological resources, species at risk, forestry resources, land use, etc.

5.32.1 Historic and Archaeological Resources

Sites of historic or archaeological significance have been identified at the Muskrat Falls generation site, the reservoir impoundment area (Component 1) and the HVac transmission line (Component 4b). When working in areas of high potential for historic or archaeological sites, site-specific work measures shall be developed.

To date, fifty-nine (59) sites have been identified in the area of the generation facility, reservoir and the HVac transmission line. Sites are a combination of archaeological sites and sites that are of cultural and spiritual importance to the Innu.

Sixteen (16) sites were recovered through fieldwork during 2012, and the remainder of sites will be either protected during Construction or recovered prior to Construction. See Table 5-4 for information about the known sites within the project boundaries including proposed mitigation measures and contributing project activity.

Table 5-4: Historical and Archaeological Resources in the Lower Churchill Region

Archaeological Registration Number/Name	Project Feature	Environmental Mitigation	Contributing Project Activity
FhCe-01	Muskrat Falls Generation Facility	To be recovered	Several Project Activities
FhCe-02	Muskrat Falls Generation Facility	Protected/To be recovered	Construction of Generation Components
FhCe-03	Muskrat Falls Reservoir/ Generation Facility	Protected/To be recovered	Several Project Activities
FhCe-04	Muskrat Falls Reservoir/ Generation Facility	Recovered	Several Project Activities
FhCe-05	Muskrat Falls Reservoir/ Generation Facility	Recovered	Several Project Activities
FhCe-06	Muskrat Falls Reservoir/ Generation Facility	To be recovered	Several Project Activities
FhCe-07	Muskrat Falls Reservoir/ Generation Facility	Recovered	Several Project Activities
FhCe-08	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding

Archaeological Registration Number/Name	Project Feature	Environmental Mitigation	Contributing Project Activity
FhCe-09	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FhCe-10	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FhCe-11	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FhCe-12	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FhCf-01	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FhCf-02	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FhCf-03	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCg-02	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCg-03	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCg-08	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCg-01	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCg-04	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCg-07	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCg-05	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCg-06	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCh-01	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
Ff-Ci-01	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FfCi-02	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FfCi-05	Muskrat Falls Reservoir/Generation Facility	To be recovered	Construction of Access Road or Bridge
FgCh-05	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCh-06	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FfCh-02	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCh-04	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCh-02	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FgCh-03	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FfCh-01	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding
FiCt-01	Proposed AC Transmission Line	To be recovered	Construction and/or Increased Access
Manitu-utshu 1 (FhCe-13)	Muskrat Falls Reservoir/Generation Facility	Protected	Site Access
Manitu-utshu 2 (FhCe-14)	Muskrat Falls Reservoir/Generation Facility	Protected	Site Access
Manitu-utshu 3 (FhCe-15)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction
Manitu-utshu 4 (FhCe-16)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction
Manitu-utshu 5 (FhCe-17)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction
Manitu-utshu 6 (FhCe-18)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction
Manitu-utshu 7 (FhCe-19)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction
Manitu-utshu 8 (FhCe-20)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction

Archaeological Registration Number/Name	Project Feature	Environmental Mitigation	Contributing Project Activity
Manitu-utshu 9 (FhCe-21)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction
Manitu-utshu 10 (FhCe-22)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction
Manitu-utshu 11 (FhCe-23)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction
Manitu-utshu 12 (FhCe-24)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction
Manitu-utshu 13 (FhCe-25)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction
Manitu-utshu 14 (FhCe-26)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction
Manitu-utshu 15 (FhCe-27)	Muskrat Falls Reservoir/Generation Facility	Recovered	Dam Construction
Manitu-utshu 16 (FhCe-28)	Muskrat Falls Reservoir/Generation Facility	Protected	Reservoir Preparation; Impounding
Manitu-utshu 17 (FhCe-29)	Muskrat Falls Reservoir/Generation Facility	Protected	Reservoir Preparation; Impounding
Manitu-utshu 18 (FhCe-30)	Muskrat Falls Reservoir/Generation Facility	Protected	Reservoir Preparation; Impounding
Manitu-utshu 19 (FhCe-31)	Muskrat Falls Reservoir/Generation Facility	Protected	Reservoir Preparation; Impounding
Manitu-utshu 20 (FhCe-32)	Muskrat Falls Reservoir/Generation Facility	Protected	Reservoir Preparation; Impounding
Manitu-utshu 21 (FhCe-33)	Muskrat Falls Reservoir/Generation Facility	Protected	Reservoir Preparation; Impounding
Manitu-utshu 22 (FhCe-34)	Muskrat Falls Reservoir/Generation Facility	Protected	Reservoir Preparation; Impounding
Manitu-utshu 23 (FhCe-35)	Muskrat Falls Reservoir/Generation Facility	Protected	Reservoir Preparation; Impounding
Ushkan-shipiss	Muskrat Falls Reservoir	To be recovered	Reservoir Preparation; Impounding

As per the requirements of the PAO, a historic and archaeological resources impact assessment shall be conducted at sites where historic and archaeological resources may be unearthed. For low potential sites a desktop review may be adequate. For higher potential sites, field assessment may be required.

Existing information shall be provided where available, and where activity will take place in an area that has not been previously reviewed a historic resources overview assessment may be required.

The following mitigations shall be implemented with respect to historic and archaeological resources:

a) All persons on site shall be informed of the historic resources potential of the area, of their responsibility to report any unusual findings, and to leave such findings undisturbed;

b) A site orientation to be attended by all staff and contractors this shall identify areas of high historic resources potential;

c) The On-Site Environmental Monitor shall report to the PAO if any potential archaeological resources are uncovered during excavation (Martha Drake, Provincial Archaeologist, 709-729-2462);

d) Where possible known sites shall be avoided by modifying design (i.e. road and transmission line alignment adjustment) to ensure a 50 m minimum buffer (actual size may be revised based on direction from the PAO). Where the site cannot be avoided, the site shall be recorded/recovered to the satisfaction of the PAO before work can proceed as per Historic Resources Management Plan developed by NE-LCP;

e) The onsite environmental monitor shall be immediately contacted if any historical resources are discovered during the course of the work. All work within 50 m of the discovery location shall stop and contingency plan procedures implemented; and

f) Regular monitoring shall be conducted by the On-Site Environmental Monitor to ensure that site protection measures are adequate and that the terms and intent of the P-WEPP requirements are being met. Sites registered with the PAO outside the immediate Project area shall be visited annually by the On-Site

Environmental Monitor during periods when the sites are not snow covered to ensure they have been left undisturbed.

5.32.2 Species at Risk

Many wildlife species (including plants, animals and birds) and their habitat are protected under provincial and federal regulations such as the *National Species at Risk Act*, *Migratory Birds Convention Act* and the *NL Endangered Species Act*. Of primary concern are disturbances, destruction or degradation of critical habitat, recovery habitat and disturbance during critical life periods (i.e. nesting and spawning) Displacement of species due to construction activities (i.e. blasting) or encounters with construction equipment and personnel is also a concern.

Six species have been identified through the Environmental Assessment process as being of concern in the Lower Churchill River Area and the HVac transmission line right-of-way. They are as follows:

a) Common Nighthawk;

b) Olive Sided Flycatcher;

c) Woodland Caribou;

d) Grey Cheeked Thrush;

e) Rusty Blackbird; and

f) Harlequin Duck;

Reference should be made to the fact sheets for species listed on the SARA list and the Endangered Species Act to find further information about these species.

A research permit for work around SARA listed species may be required from the Wildlife Division, Dept. of Env. and Conservation, Gov NL.

The following mitigations shall be implemented with respect to endangered, threatened or vulnerable wildlife at the site:

a) Critical habitats shall be identified on site plans or plan profiles for roads and transmission lines for C-SEPP*;*

b) All site personnel shall receive training to recognize any endangered, threatened or vulnerable species of plant or animal and its habitat prior to the start of clearing and any other site activities;

c) Through site surveys, existing potential rare plants habitat shall be identified and mapped prior to the commencement of any site work. Based on this mapping, travel routes and “no-go” zones shall be established to avoid sensitive areas. Animals and animal habitats such as active nesting sites and beaver dams, shall also be identified and mapped;

d) Work plans shall be submitted in advance and shall be reviewed for potential conflicts, including rare plants, endangered species, critical habitat and other areas of concern (i.e. beaver dams and nesting sites);

e) Where required (i.e. as per the Avifauna Management Plan or associated EEM Plans), prior to commencement of work, an on-site wildlife biologist shall be on-site to survey for areas of concern (critical breeding habitat, rare plants, nest sites, etc.) and to provide input on work methods, lay out approved travel routes and work areas and associated buffer zones;

f) In areas where concerns have been identified, the On-Site Environmental Monitor shall ensure work crews are aware of concerns identified and work methods to be used;

g) There shall be no intrusion into “no-go” zones without prior permission of the On-Site Environmental Monitor;

h) Crews shall not travel outside of marked work areas and trails. If markers are not clear or are missing, the On-Site Environmental Monitor shall be consulted prior to commencing or continuing with the work;

i) The On-Site Environmental Monitor shall monitor work activity in sensitive sites at all times and provide advice on access and travel requirements;

j) The Environmental Coordinator shall be informed of activities near sensitive areas so that they may notify any regulators;

k) Notice of potential impacts to rare or protected species and their habitat at the job site shall be given to the On-Site Environmental Monitor for evaluation;

l) Prior to construction during nesting season (May 15 to August 15) the area shall be surveyed for active nests including raptor and other SARA listed species listed in Section 5.30.2;

m) No clearing shall take place within 800 m of an active raptor nest between the months of May 15 to August 15. If a nest is encountered during clearing activities, all work shall stop until the site is cleared by the On-Site Environmental Monitor, in consultation with the appropriate regulatory agencies.

n) For all work activities other than clearing, a 200 m buffer shall be respected for active raptor nests from May 15 to August 15. Within this 200 m buffer zone the following applies, after consultation with the provincial government:

o) Only essential vehicular activity shall be permitted;

p) Work shall only be permitted in the presence of the On-Site Environmental Monitor;

q) Crews shall cease work if there is a disturbance at a nest until activity at the nest has returned to normal; work shall not commence again until approval from the On-Site Environmental Monitor.

r) Crews shall not establish a permanent or temporary camp within 800 m of a known raptor nest;

s) If a tree containing an inactive nest is encountered during reservoir and site clearing, the nest shall be assessed for viability and if the nest is deemed viable a platform shall be established as approved by the provincial government; and

t) If a tree containing an inactive nest is encountered during the transmission line right-of-way clearing a platform may not be required as the transmission line tower will provide an alternative nesting site.

5.32.3 Wildlife Protection

The following mitigative measure shall be implemented for the protection of wildlife at the site:

a) Construction activities shall be scheduled considering any sensitive areas of fish and wildlife habitat and critical periods in fish and wildlife cycles, and considering additional mitigation measures that may be required. Annual timing of migration, spawning and calving in the vicinity of the site shall be considered at all times;

b) Personal pets shall not be brought to the construction site;

c) Buffer zones shall be implemented to protect wildlife at the site, see Section 5.7 for the buffer zones for helicopter traffic at the site;

d) Fishing and hunting are prohibited at or near the construction site. All project participants shall be prohibited from fishing and hunting at or near the construction site while working on the project;

e) Under no circumstances are wildlife to be fed and all measures shall be taken to avoid inadvertent feeding;

f) Wildlife shall not be chased, caught, diverted, followed or otherwise harassed by project participants;

g) All Wildlife sightings and nuisance wildlife shall be reported to the On-Site Environmental Monitor;

h) The forestry branch shall be contacted and updated with regards to nuisance wildlife and wildlife encounters;

i) Equipment and vehicles shall yield the right-of-way to wildlife and adhere to construction site speed limits;

j) Environmental awareness training, with regular briefings, shall be implemented for all personnel;

k) All persons on site shall be made aware of the potential for encounters with black bears and instructed to report all sightings to the On-Site Environmental Monitor;

l) Black bear deterrent measures such as bear bangers and bear spray may be used, and translocation of bears shall be undertaken before any lethal means are considered. A research permit for relocation of bears may be required from the Wildlife Division, Department of Environment and Conservation, Government of Newfoundland and Labrador;

m) Fire arms shall not be permitted on site, with exception of approved bear monitors;

n) Black bear protection permits shall be obtained for each black bear monitor. Permits shall be signed by the individual that the permit is issued to;

o) An Avifauna Management Plan has been developed by NE-LCP. This Plan includes:

    i) Surveying for migratory bird nests prior to cutting during the nesting season;

    ii) Surveying for sensitive habitat that typically supports nest;

    iii) Information regarding avoiding identified nests until fledged;

    iv) Information regarding cutting in sensitive habitats during nesting season; and

    v) Employing on-site support of qualified biologists during construction, as required.

p) Clearing activities between May 1 and July 31 shall be in compliance with the Avifauna Management Plan; and

q) No one shall disturb, move or destroy migratory bird nests. If a nest or young birds are encountered, work shall cease in the immediate area of the nest. Work shall not continue in the area until the nest is no longer occupied, otherwise the work plan shall be modified to avoid nest sites by a minimum of 30 m (100m for the Rusty Blackbird).

Caribou

During the calving (May 28 – July 1) and post calving seasons (July 2 – September 20) if caribou approach the Project, it is proposed there be a progressive level of heightened awareness by Project personnel AND increased interaction with the Wildlife Division. Project personnel shall follow the following mitigation and monitoring measures (as outlined in the Caribou Management Plan):

a) The Wildlife Division of the NLDEC shall notify the Project Manager should data from satellite collars indicate that caribou are within 20 km of the Project site;

b) Upon notification of caribou within 20 km of the Project site, surveys will be instituted within this radius. The most appropriate form of surveying will be evaluated during the first two years of construction. Initially a preference will be given to observations from fixed points along the high ground adjacent to Project activities. As an adaptive management measure, if ground-based surveys prove not to be useful or feasible, aerial surveys will be implemented at the Muskrat Falls Generating Facility construction site;

c) Sightings or reports of caribou, within 20 km of Project infrastructure and activities will be described in a one-page update of wildlife observations associated with the Environmental Protection Plan (EPP). This update will normally be sent by Nalcor Energy to the Wildlife Division in Goose Bay and Corner Brook on a bi-weekly basis (whenever Project activities are ongoing). Such updates will also be presented during environmental awareness training and regular briefings for all personnel;

d) When caribou are known to occur within 20 km, a 5 km buffer around each area of activity will be monitored on a weekly basis by scanning for tracks or animals from road-accessible vantage points within this radius. Observations reported by personnel or others will also be recorded and investigated within this area. Reporting to the Wildlife Division would be increased to a weekly basis in this scenario. Note that if caribou are not seen within the 20 km radius, the 5 km buffer would be monitored on a bi-weekly basis (from road-accessible vantage points) over the course of the calving and post-calving period. If caribou are observed at a distance of less than 5 km from Project infrastructure and activities, Nalcor Energy will issue an advisory of their proximity to personnel to be alert, The monitoring from road accessible vantage points will increase in frequency to a daily basis by the on-site environmental monitor;

e) While caribou are within 5 km of Project infrastructure and activities, all sightings of caribou will be reported to the on-site Environment Monitor, and will be immediately communicated to all vehicle operators. Caribou will not be blocked from crossing access roads or work areas. If caribou are crossing or attempting to cross the site roads, then traffic will stop and wait for them to cross;

f) Prior to primary blasting at the main site a wildlife survey will be conducted. If caribou are within 3 km of the site the blasting will be delayed until the caribou have left the area. Methods to encourage the caribou to leave the area will be utilized as agreed to and in consultation with the Wildlife Division. The 3km radius may be reduced based sound monitoring surveys, as agreed to by the Wildlife Division;

g) For all other activities (vegetation clearing, grubbing, grading and leveling, laydown and storage of equipment and material in existing areas, generators to support the activity, vehicle and heavy equipment use, handling and transfer of fuel and other hazardous material, waste disposal, sewage disposal and hazardous waste disposal) which would not be audible beyond a short distance, if caribou approach to within site of the work area (up to maximum buffer of 500

m), the On-Site Environmental Monitor will determine if activities will need to be delayed or curtailed to allow the animals to proceed onwards beyond the work site. Such interactions will be included in the weekly reports to the Wildlife Department; and

h) For activities related to transmission line construction (localized and low intensity blasting, tower erection and conductor stringing) which would not be audible beyond a short distance, if caribou approach to within site of the work area (up to maximum buffer of 500 m), the On-Site Environmental Monitor will determine if activities will need to be delayed or curtailed to allow the animals to proceed onwards beyond the work site. Such interactions will be included in the weekly reports to the Wildlife Department;

Throughout the construction of the Project, Nalcor Energy will maintain communications with the provincial Wildlife Division, and other stakeholders and officials regarding the movements of the George River Herd and/or possible woodland caribou (e.g., Red Wine Mountains Caribou Herd) sightings in the Project area.

5.32.4 Muskrat Falls Rock Knoll

Construction activities conducted to reduce interaction with rock knoll to extent practical, in consultation with the Innu Nation through the EMC.

5.33 COMMISSIONING

Environmental Concerns

Commissioning will occur after installation and prior to release for commercial operation; it is a means of verifying and documenting that each component, system and assembly of a facility is built, installed and tested as planned and designed to meet Project requirements.

It will take about three months to commission each turbine at the generation facility. This includes physical inspections, comparing as-built components to the original design drawings and specifications, testing in a de-energized state and energized state, in isolation, and connected to the transmission line grid, for various operating conditions. Commissioning the proposed transmission line is related to mechanical acceptance so that all hardware is in place and properly installed.

Environmental concerns related to commissioning relate to unintended release of hydrocarbons into the environment.

Environmental Protection Procedures

a) All equipment containing fluids shall be checked for leaks by the supplier and/or manufacturer and shall be tested according to the manufacturer's directions prior to commissioning activities;

b) There shall be monitoring during commissioning for spills and/or leaks;

c) Appropriate spill kits shall be on hand to respond to a spill or leak (see Section 5.13);

d) In the event that a spill or leak is detected, the Master Spill Response Plan shall be referred to for response to any incidents; and

e) All other requirements of this P-WEPP shall be adhered to during commissioning.

5.34 DIVERSION HEAD POND FORMATION AND RESERVOIR IMPOUNDMENT

Construction of the north and south dams will result in the formation of a 59 km long reservoir. At Full Supply Level (FSL), the area of inundation will be 41 km², resulting in a reservoir with a total surface area of 101 km². During the impoundment of the reservoir the downstream flow will be significantly reduced (30% of normal flows will be maintained during impoundment. It is estimated that it will take approximately 10 to 12 days to fill the reservoir to FSL, at which time normal downstream flows will re-commence in the river. A detailed plan outlining the schedule and duration of diversion head pond formation and impoundment will be provided to DFO in advance of these activities, for their review and acceptance/approval.

Prior to full impoundment, a diversion head pond will be created when the riverside cofferdam is complete and the river is diverted through one spillway during construction of the hydroelectric facilities. Prior to winter freeze up the flow through the spillway will be controlled and a diversion head pond will be formed to facilitate the development of a stable ice cover for the remainder of the construction period. The diversion head pond will be maintained at an elevation of 24 m during the spring, summer and fall seasons with a total reservoir surface area of 74 km². In winter, the head pond will be maintained at an elevation of 25 m with a total reservoir surface area of 76 km². During diversion, the total outflows will be equal to the total inflows.

Environmental Concerns

Environmental concerns associated with formation of the diversion head pond and reservoir impoundment include:

a) Previously dry soils will become hydrated. This may change the cohesive properties of the soil and may lead to slumping; and

b) Nesting/mating of terrestrial wildlife in the impoundment/head pond zone may be flooded and spawning and habitat of aquatic species in the impoundment/head pond zone and downstream may be affected.

Environmental Protection Procedures

The flooding of habitat for terrestrial and aquatic species is date sensitive due to the timing of reproduction and rearing in a variety of species. See Table 5-1 in Section 5.1 for information related to sensitive life stages for aquatic and terrestrial fauna in Labrador. As construction progresses and more certainty is gained regarding the timing of head pond formation/impoundment, a filling plan shall be developed in consultation with the Nalcor Environmental Assessment Coordinator and relevant regulatory authorities.

The filling plan shall include timing of activities, sequencing and execution plans and relevant mitigations depending on the timing/season of impoundment/head pond formation.

5.35 SITE REHABILITATION

Environmental Concerns

The primary concern with environmental rehabilitation is site stabilization and erosion prevention. This is particularly pertinent in regards to temporary structures such as roads, quarries, cofferdams, etc.

Environmental Protection Procedures

Environmental rehabilitation shall be consistent with all applicable standards, codes, acts and regulations and the conditions of EA release.

General rehabilitation approaches are provided in this section however specific rehabilitation approaches shall also be developed in compliance with regulatory requirements and industry best practice and shall be completed on a site by site basis and included in the C-SEPP. An outline of the requirements of the site-specific rehabilitation plan is provided below.

5.35.1 Site-Specific Rehabilitation Plan

The following outlines the requirements of the Site-Specific Rehabilitation Plan:

a) Removing and stockpiling overburden and organic material for re-use;

b) Re-grading areas to control erosion and establish suitable drainage;

c) Replacing the overburden and organic material to produce conditions for re-growth; and

d) Encouraging natural re-vegetation, or re-planting with suitable vegetation.

On some sites there may be limited overburden and organic matter. Nutrient poor soils and a shorter growing season may also slow down and reduce the rate of vegetation re-establishment. In these cases it may be necessary to import seed, mulch or geotextiles to artificially improve revegetation for key areas. Measures to prevent the invasion of disturbed sites by non-native plant species shall be considered. Acceptable approaches include, but are not limited to:

a) Use of native plant and soil material for rehabilitation and re-vegetation;

b) Use of only species that are non-aggressive and non-persistent (where local plants are not available or shall not meet the rehabilitation objectives).

c) Implementation of measures to ensure that additional materials (required to limit erosion, reduce sedimentation or enhance establishment) are weed and disease free; and

d) Equipment coming from other regions or provinces shall be clean and free of potential seed sources of invasive plants.

All areas of the construction sites shall require careful consideration of the landscape within which the work is taking place, to ensure that the correct approach is taken. Areas shall be prioritized in terms of need and importance and the level of rehabilitation shall be modified accordingly. Factors that shall be considered in determining the rehabilitation approach include, but are not limited to:

a) Site and public safety (including future access requirements);

b) Sedimentation concerns and proximity to water bodies;

c) The natural habitat of the area (i.e. vegetation, soil, hydrology, etc.);

d) Wildlife habitat considerations;

e) Riparian habitat considerations;

f) The productivity of the site (i.e. moisture, content and nutrient regime) and its effect on re-vegetation;

g) The availability of materials and implications of importing unnatural material;

h) Land use and their effect on success of rehabilitation techniques; and

i) Overall cost of rehabilitation measures.

Once the schedule of work at each construction area has been developed, a detailed schedule for carrying out rehabilitation work shall be developed in accordance with

regulatory requirements and shall also consider industry best practice for implementation of site rehabilitation. The site-specific rehabilitation plan shall indicate timing of the rehabilitation works for each area to be rehabilitated. Consideration shall be given to progressive rehabilitation throughout the construction period, as opposed to waiting for the end of construction before starting with rehabilitation.

5.35.2 General Measures

a) Rehabilitation shall be required for all temporary works including roads, stream crossings, camps and quarry and borrow areas;

b) No temporary buildings or structures associated with the work shall be left on site upon completion of the work;

c) All solid waste, including petroleum, oil and lubricant containers shall be removed from site;

d) Pre/Post occupation inspection shall be completed; and

e) The On-Site Environmental Monitor shall prepare a report for all sites documenting site conditions prior to disturbance and upon site abandonment and rehabilitation. Each report shall include a description of the condition of vegetation and other aspects of natural environment.

Quarry/Borrow Areas

The following measures are specific to quarry and borrow areas and shall be considered in rehabilitation plans for those areas:

a) Any organic material or overburden removed during development of the borrow pits and quarries shall be stockpiled near the pit or quarry area for future use during rehabilitation of the borrow pit or quarry. Overburden (and non-PAG rock) that is not suitable for rehabilitation purposes shall be stockpiled for temporary use or permanent disposal. Stockpiling shall be in stable configurations and contoured to match the surrounding landscape. For temporary stockpiling it shall

be and returned to the borrow pit or quarry opening once extraction from the pit or quarry is complete;

b) As site conditions dictate, vegetation or other cover materials may be established on slopes to control erosion and dust (as outlined in Section 5.25, Erosion Prevention and Sediment Control). Quarries and pits reclaimed during operations may be used as test plots to evaluate suitable re-vegetation techniques to be used for the rehabilitation of other work areas in the future;

c) Arrangements shall be made with the representatives of the Department of Natural Resources for an inspection to be conducted prior to abandonment of the site;

d) All equipment and material shall be removed from the site;

e) All pit and quarry slopes shall be graded to slopes less than 20%, or to a slope conforming to that existing prior to quarrying;

f) Excess overburden may be used for sloping but topsoil or organic material may not be used for sloping. Following sloping, topsoil or organic material may be spread over the entire quarry area to promote vegetation; and

g) Quarry conditions, including slope on rock walls, shall be determined through the Rehabilitation Plan. Each quarry shall be evaluated on a site-specific basis to determine if cliff faces should be converted to rubble slopes.

Roads/Stream Crossings

The following measures are specific to road and culvert/bridge rehabilitation and shall be considered in rehabilitation plans for those areas:

a) The contractor shall submit a plan for controlling erosion during rehabilitation activities. This plan would address construction activities that have the potential for stream sedimentation;

b) When working in a stream or water body, remove all fill around pipes before water bypass installation and pipe removal;

c) The stream shall be dewatered at the site using a non-eroding, water tight diversion during excavation. Settling basins shall be used to ensure that muddy water does not enter the water body;

d) Fill material that requires temporary placement shall be placed in stable areas outside of stream channels and flood plains;

e) Channel banks shall be armoured with large rock, woody debris and vegetation when needed;

f) Channel and vegetation rehabilitation shall be required if there are disturbances upstream and downstream of the stream crossing site;

g) Stream channels shall be restored to natural grade and dimensions and re-vegetation may be required;

h) Culverts within the flood zone (below LSL) may be left in place and flooded during reservoir impoundment/head pond formation. Culverts above the LSL shall be removed;

i) Temporary bridges in all areas of the site shall be removed; and

j) Removed culverts and other structural materials shall be disposed of as per the WMP.

6 ENVIRONMENTAL MONITORING AND FOLLOW UP

6.1 ENVIRONMENTAL COMPLIANCE MONITORING

To ensure that appropriate and effective environmental mitigation measures are employed during construction, the project shall have full-time On-Site Environmental Monitors at various construction sites. These individuals shall inspect worksites and activities for conformance with the P-WEPP, C-SEPPs, engineered mitigation measures required by design; and compliance with government regulations and permits.

This P-WEPP establishes the basis for environmental compliance monitoring at the Project site, i.e. monitoring for regulatory compliance to verify that conditions of all permits and approvals are satisfied, and that all environmental regulatory requirements are met. Refer to the Regulatory Compliance Plan (RCP) for further information on regulatory compliance for the Lower Churchill Project.

Non-conformance with this P-WEPP and/or non-compliance with permits, approvals, and regulatory requirements shall be documented, as indicated in the following paragraphs and in the RCP, and addressed with the contractor responsible for mitigation measures. Corrective action shall be identified, target dates shall be agreed upon, and responsibilities shall be assigned to appropriate personnel. This documentation shall be distributed to other members of the Project's environmental management team and written notice of agreed corrective action shall be forwarded to the contractor so that issues are resolved to the satisfaction of the Project's environmental management team.

If non-conformance items are noted that require immediate attention, or if agreed corrective action is not implemented in a timely and effective manner, then appropriate resources shall be contracted by the project to immediately undertake the required action.

Daily field reports shall be prepared by the On-Site Environmental Monitor/Coordinator and distributed to the Construction Manager, the Environmental Manager, the Environmental Coordinators, NE-LCP, and the Contractor. These reports shall describe the work being undertaken by the Contractor, and document incidents of non-conformance with environmental requirements. An example of the Daily Field Report checklist is located in Section 8.

The Environmental Coordinators, in consultation with project staff and the Contractor, shall prepare quarterly Environmental Compliance Audit Reports (i.e. 1 audit report/quarter for the Hydro component, and 1 audit report/quarter for the Transmission Line components). The reports shall document all incidents of non-compliance and their causes. The Environmental Coordinators shall distribute the Environmental Compliance Audit Reports to relevant Project participants. The Environmental Coordinators shall be responsible for managing the Non-Conformance Registry, including updating it regularly, and incorporating all conditions into the Registry to ensure that these are complied with in a timely manner.

The contractor shall be responsible for developing a site-specific Compliance Monitoring Plan to be included in the C-SEPP. This shall include such things as frequency of monitoring, parameters, locations and media to be monitored, etc.

All analysis conducted to support compliance monitoring shall be subject to the Accredited Laboratory Policy.

6.2 ENVIRONMENTAL EFFECTS MONITORING

The intent of Environmental Effects Monitoring (EEM) is to confirm predictions made as part of the environmental assessment.

EEM monitoring shall be carried out by NE-LCP. The EEM program results shall be communicated to SLI's Environmental Manager by Nalcor's Environmental and Regulatory Compliance Lead.

Should effects deviate from predicted, NE-LCP shall determine the cause and appropriate action. Should this information be linked to work practices, the P-WEPP shall be revised and updates shall be provided to contractors and staff.

It is noted that there may be additional requirements for approvals and communication with the regulators related to the EEM Plan.

6.3 ANNUAL ENVIRONMENTAL PERFORMANCE REVIEW

At the end of each construction year the project shall convene an environmental performance workshop to review all work activities that relate to environmental concerns, issues and/or mitigations. This workshop will include a review of environmental audits carried out by project staff during the year. The review process shall give all parties a chance to evaluate overall environmental performance and compliance with government regulations, permits, this P-WEPP, and C-SEPPs.

7 CONTINGENCY PLANS

Contingency plans to address unplanned occurrences and emergency situations are provided in the following sections. The following unplanned occurrences and emergencies have been addressed under contingency plans:

- Fuel and Hazardous Material Spills (Master Spill Response Plan)
- Wildlife Encounters (including nesting and denning sites)
- Historic and Archaeological Resources
- Forest Fires (ERP)

7.1 FUEL AND HAZARDOUS MATERIALS SPILLS

Spills of fuel and/or hazardous materials can potentially be harmful to human health and safety, vegetation, soil, surface water, ground water, wildlife, aquatic organisms, historic resources and human health and safety.

In case of a fuel or hazardous material spill project staff shall refer to the Master Spill Response Plan for detailed contingency measures. A site-specific fuel and hazardous materials response plan shall form part of the C-SEPP.

To mitigate environmental effects of fuel and hazardous material spills and leaks, Contractors shall at all times maintain in good condition at least one spill kit dedicated to each piece of fuel-powered equipment. Each spill kit shall be located on the equipment and stored in a weather-proof container. Each spill kit shall have an absorption capacity of no less than 23 litres. In addition to equipment-dedicated spill kits, the Contractor shall at all times maintain in good condition spill response caches that are accessible within 15 minutes travel of all work faces and in the immediate vicinity of fuel/hazardous materials storage areas. Each cache shall have sufficient absorption capacity for one thousand (1000) litres of fuel or hazardous liquids (see Section 5.13 for more details on spill kits).

7.2 WILDLIFE ENCOUNTER

Wildlife encounters pose a potential risk for stress or injury to both the wildlife and site personnel. To reduce the risk and stress, control measures and environmental protection procedures have been put in place and are shown below. As a protection measure, hunting, trapping or fishing by Project personnel is not permitted on site.

The following procedures shall be implemented on site to prevent the attraction of wildlife to the Site:

a) Site and working areas shall be kept clean of food scraps and garbage;

b) Animal proof disposal containers shall be used and will be regularly emptied and transferred to an approved waste disposal site (as per WMP); and

c) No personal pets, domestic or wild, shall be allowed on the site.

In the case of wildlife encounters the following shall be implemented:

a) No attempt shall be made by any worker at the project site to chase, catch, divert, follow or otherwise harass wildlife by vehicle or on foot;

b) Equipment and vehicles shall yield the right-of-way to wildlife;

c) Any wildlife sightings or encounters shall be reported to the On-Site Environmental Monitor;

d) The On-Site Environmental Monitor shall be responsible for all actions in response to nuisance animals, including the use of firearms by bear monitors in the project area. A research permit for relocation of nuisance animals may be required from the Wildlife Division, Department of Environment and Conservation, Government of Newfoundland and Labrador;

e) If the nest of any bird is encountered during construction and operation activities, work around the nest shall be stalled until the Wildlife Division has assessed the situation and appropriate mitigation is applied;

f) Any incidents that result in the displacement or killing of wildlife shall be reported to the On-Site Environmental Monitor complete with details on the incident and the names (and contact information) of the persons involved; and

g) In the event of a bear encounter project personnel shall follow the procedures as outlined in the Bear Awareness Training.

7.3 HISTORIC AND ARCHAEOLOGICAL RESOURCES

Historic resource material that is disturbed, destroyed or improperly removed from a site represents a potential cultural loss of information and history that could otherwise be handled and interpreted in an efficient and appropriate manner.

In case of a suspected discovery of an archaeological site or artefact the following procedures shall apply:

a) Archaeological materials encountered shall be reported initially to the On-Site Environmental Monitor. The On-Site Environmental Monitor shall then immediately report this to the On-Site Environmental Coordinator, SLI's Environmental Coordinator (Hydro or Transmission), and Construction Manager. The latter shall report to Nalcor's Site Manager. The Provincial Archaeologist at PAO (Martha Drake, Provincial Archaeologist, 709-729-2462) shall be informed of the discovery by Nalcor's Environmental and Regulatory Compliance Coordinator with the following information:

   i) Nature of activity;

   ii) Nature of the material discovered; and

   iii) Precise location of the find.

b) Under the Historic Resources Act, RSNL 1990, c.H-4, all archaeological sites and artefacts are the property of the Crown, and shall not be disturbed. The project shall take all reasonable precautions to prevent employees or other persons from removing or damaging any such objects or sites. Persons in

contravention and may be held liable for prosecution under Section 35.1 and 35.2 of the *Historic Resources Act* (*RSNL 1990, c. H-4*) for all contravention. Personnel working in the vicinity shall be advised of the find, including the On-Site Environmental Monitor. The site area shall be flagged for protection and avoidance;

c) All work shall cease within 50 m of the discovery until NE-LCP advises the PAO of the discovery. The PAO, in consultation with NE-LCP shall provide direction regarding the discovery and may authorize a resumption of the work. If required, a full archaeological assessment shall be conducted of the site and immediate area; and

d) The PAO shall assess the significance of the discovery and determine if mitigation is required. NE-LCP in consultation with the PAO shall develop mitigation measures and advise the PAO of any such measures.

7.4 FOREST FIRES

Construction for the development of the Lower Churchill may have activities that increase the risk of fire in the natural environment. Fires on site could spread to the surrounding area and forest. The main concerns include human health, damage to vegetation, wildlife and air and water quality. In case of a forest fire project personnel shall refer to the Emergency Response Plan for detailed contingency measures.

The operator shall take all precautions necessary to prevent fire hazards when working at the site. These include but are not limited to:

a) An Operating Permit shall be required during the forest fire season;

b) All flammable materials shall be stored and handled properly; and

c) All flammable waste shall be appropriately disposed of on a regular basis;

In the case of a fire being encountered the following shall be implemented:

a) The Site Manager shall appoint a supervisory staff member as "On Scene Commander" for fighting any forest fires;

b) Immediate steps shall be taken by the operator and contractors on site to contain or extinguish the fire. Applicable personnel shall be trained in fire fighting and the use of such equipment. Equipment shall be provided in proper operating condition to suit the labour force and shall comply with manufacturer's standards;

c) Fires shall be immediately reported to the Site Manager who will in turn report it to the applicable authorities (1-866-709-3473). The following information is required when reporting a fire: name and telephone number, time of detection of fire, size of fire, location of fire, weather conditions (rain, sun, wind direction and speed, etc.);

d) Sufficient firefighting equipment to suit the labour force and fire hazards shall be provided by the contractor. Equipment shall be provided as specified in the forest fire regulations and Operating Permit and shall include shovels, back tanks and axes. Such equipment shall comply with and be maintained to the manufacturer's standards. Project personnel shall be trained in the use of such equipment;

e) During the fire season, ATV's shall be equipped with a fire extinguisher or suitable equivalent containing a minimum of 227 grams of ABC dry chemical. Other machinery and equipment shall be equipped with a fire extinguisher containing a minimum of 4.5 kilograms of ABC dry chemical;

f) The forest fire suppression equipment referred to in the Operating Permit shall be provided at the operating site in the following ratio:

Table 7-1: Forest Fire Suppression Equipment Requirements

Employees	Back Tank Pumps	Axes or Pulaski Tools	Grubbers or Shovels
5 or less	1	1	1
6-10	2	2	2
11-15	3	3	3
16-20	4	4	4
>20	Add 1 back tank pump, 1 axe or Pulaski tool and 2 grubbers or shovels to the above figure for each group of 5 additional employees or fraction of that number of employees. The back tank pump must have a capacity of 20 litres and be of a type approved by the forest service.		

g) The contractor is required to ensure all fire pumps are approved by forest services, and all approvals shall be documented;

h) When the number of employees reaches 20 or over, one fully functional forest fire pump, such as the Wajax Mk3, shall be available at the site. Pump accessories shall include: a gated “Y” valve, hose strangler and two nozzles for each unit, additionally, 610 meters of forest fire hose shall be available for each unit. If there are greater than 40 employees, two of these systems are required;

i) The forestry official issuing the operating permit may specify deviations from the equipment requirements should local operating conditions warrant deviations;

j) The actual location of the forest fire suppression equipment in relation to the operating site may be designated by the forestry official issuing the permit;

k) A copy of the operating permit shall be on the operating site and shall be shown when requested by a forestry official;

l) The operating permit may be temporarily suspended by a forestry official if the fire weather index for that locality rises to high or extreme;

m) Where a forest fire occurs on forest land in an area where logging or industrial operations are being carried out the person/s carrying out the operations shall immediately notify the nearest forest management district office or ranger station and commence fighting the fire with all labour, materials, equipment and facilities

at his or her disposal until relieved of this responsibility by a forestry official or the fire is extinguished; and

n) For additional information regarding forest fire contingency planning, refer to the ERP.

8 FORMS

Form 1: Daily Environmental Inspection Report

Form 2: Fuel Reconciliation Form

Form 3: Water Withdrawal Form

Form 4: Revision Request Form

Form 5: Revision Control Record

Form 6: Receipt of Revision Acknowledgment Form

DAILY ENVIRONMENTAL INSPECTION REPORT

Report Number:

Client: Nalcor Energy
Project: Lower Churchill Project

Contract No.:

Date:

Section 1: Description

Temperature:

 •  •  •  •

Project Component:

Contractor(s):

Contractors Environmental Representative(s):

Daily Site Activities:

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DAILY ENVIRONMENTAL INSPECTION REPORT

Section 2: Project-Wide Environmental Protection Procedures (See P-WEPP)

	C	N/C	O/I	N/A
1) Scheduling and Timing of Construction Activities 2) Construction Entrance 3) Linear Developments				
4) Winter Construction				
5) Equipment Operation and Movement				
6) Vessel Operations (Barge/Boat) 7) Helicopter Traffic 8) Clearing of Vegetation 9) Pumps and Generators				
10) Surveying				
11) Drilling				
12) Surface Water and Groundwater Use 13) Storage Handling Use and Disposal of Hazardous Materials 14) Sewage Disposal 15) Solid Waste Disposal				
16) Working Within 15 Metres of a Body of Water				
17) Watercourse Crossings				
18) Buffer Zones 19) Alterations to a Body of Water/Instream Works 20) Work in/Around Marine Environment 21) Grubbing and Disposal of Related Debris				
22) Quarrying and Aggregate Removal from Borrow Areas				
23) Trenching				
24) Excavation Backfilling and Grading 25) Erosion Prevention and Sedimentation Control 26) Site Water Management 27) Dewatering Work Areas				
28) Blasting and Waste Rock Disposal				
29) Concrete Production				
30) Dust Control 31) Noise Control 32) Resource Specific Mitigations 33) Commissioning 34) Diversion Head Pond Formation and Reservoir Impoundment				
35) Site Rehabilitation				

C: Compliance *O/I: Opportunities for Improvement (Compete Section 4)*
N/C: Non Compliance (Compete Section 5) *N/A: Non-applicable*

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DAILY ENVIRONMENTAL INSPECTION REPORT

Section 3: Permit Condition Compliance (insert permit # in shaded area below)

	C	N/C	O/I
1)			
2) 3) 4)			
5)			
6) 7) 8)			
9)			
10) 11) 12)			
13) 14) 15)			

Section 4: Opportunities for Improvement

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DAILY ENVIRONMENTAL INSPECTION REPORT

Section 5: N/C Table

#	Description of Non-Compliance (Include Photographs)	Corrective Action Taken (Yes/No)	CAR Form Completed (Yes/No)	Date

DAILY ENVIRONMENTAL INSPECTION REPORT

Section 6: Photographs

On-Site Environmental Monitor

Construction Manager

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DAILY ENVIRONMENTAL INSPECTION REPORT

CORRECTIVE ACTION REQUEST FORM

Lower Churchill Project	ENVIRONMENTAL CORRECTIVE ACTION REQUEST	N° _____
To Be Filled Out by SLI (OSEM or OSEC):		
Contract Number:	Contract Name: Lower Churchill Project	
Description of Environmental Concern:		
Suggested Corrective Action:		
Requested By: ..... Signature:	Date:	
To Be Filled Out by Contractor:		
Received By: ..... Signature:	Date:	
Proposed Corrective Action:		
Forecast Impact on Project:		
Cost Estimate Attached: Yes/No		
To Be Filled Out by SLI:		
Accepted By OSEM or OSEC: ..... Signature:	Date:	
Accepted By SLI Construction Manager: ..... Signature:	Date:	
Office Use: To Be Filled Out by SLI Contract Administrator (if Impact on Project scope, schedule or cost)		
Accepted By (Contract Administrator): ..... Signature:	Date:	

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FUEL RECONCILIATION FORM

Tank #: Type of product in tank:

Date	Opening Dipstick Inventory	Meter Delivery (gallons)	Fuel in Tank	Closing Dipstick (Inches)	Closing Dipstick (gallons)	Removed from UST	Meter Sales	Loss or Gain	Water Reading

Weekly Reconciliation:_____

Signature: _____ Date: _____

Part C - Further Calculations that must be Performed

Enter the total number of gallons pumped _____ Total gallons over or short _____

Or

Enter the total volumetric capacity of UST System (if greater) _____ Compare these ↕ numbers

Enter the leak check: _____ x .005 = _____ gallons (total gallons pumped)

If leak suspected or observed contact the spill report line 1-800-563-9089.

WATER WITHDRAWAL FORM

DATE:	**NAME:** **TELEPHONE #:**
WATER SOURCE:	
IF GROUDWATER WELL, DISTANCE FROM AND IDENTIFICATION OF NEAREST SURFACE WATER BODY:	
GPS CO-ORDINATES: **LAT/LONG:**	**UTM:** **NORTHING/EASTING:**
LOCATION OF POINT DISCHARGE (IF ANY):	**RATION OF WITHDRAWAL VOLUME TO POINT DISCHARGE VOLUME:**
SIGNATURE:	**TITLE:**

Attach to this form a location map with water withdrawal location (and point discharge if any) clearly marked.

REVISION REQUEST FORM

Section to be Reviewed:	
Nature of Revision:	
Rationale for Revision: **(i.e., environmental/worker safety, etc.)**	
Submitted by:	**Submission Date:**

Please submit request to EEP Document Control Coordinator

REVISION CONTROL RECORD

EPP SECTION	REVISION DATE	EPP HOLDER'S SIGNATURE

RECEIPT OF REVISION ACKNOWLEDGMENT FORM

I _____ acknowledge receipt of revised pages ____ to ____ of the Project-Wide Environmental Protection Plan, SLI Document Number 505573-0000-68RA-I-0005.

_____ _____

Signature Date

9 REFERENCE DOCUMENTS

Information and documents referenced in this P-WEPP can be found at the NE-LCP Project Office in St. John's and are all publically available documents. DFO Operational Statements and Factsheets as well as DOEC Environmental Guidelines and Federal Government Regulations are included in a reference material document (document # GV-0003-01). A listing of the key reference material is provided below:

Provincial Government Guidelines (Water Resources Division, DOEC):

- *Environmental Guidelines for Watercourse Crossings;*
- *Environmental Guidelines for Stream Crossings by All-Terrain Vehicles;*
- *Environmental Guidelines for Bridges;*
- *Environmental Guidelines for Culverts;*
- *Environmental Guidelines for Fording;*
- *Environmental Guidelines for Diversions, New Channels, Major Alterations;*
- *Environmental Guidelines for Pipe Crossings; and*
- *Environmental Guidelines for General Construction Practices.*

DFO Operational Statements:

- *Aquatic Vegetation Removal in Freshwater Systems Operational Statement;*
- *Beaver Dam Removal Operational Statement;*
- *Bridge Maintenance Operational Statement;*
- *Clear Span Bridges Operational Statement;*
- *Culvert Maintenance Operational Statement;*
- *Dock and Boathouse Construction Operational Statement;*
- *High Pressure Directional Drilling Statement;*
- *Ice Bridges and Snow fills Operational Statement;*
- *Isolated Pond Construction Operational Statement;*

- *Maintenance of Riparian Vegetation in Existing Right-of-ways Operational Statement;*
- *Overhead Line Construction Operational Statement;*
- *Punch and Bore Crossings Operational Statement;*
- *Routine Maintenance Dredging Operational Statement; and*
- *Underwater Cables Operational Statement.*

DFO Fact Sheets:

- Fact Sheet on Effects of Silt on Fish and Fish Habitat;
- Fact Sheet on Blasting – Fish and Fish Habitat Protection;
- Fact Sheet on Ditching;
- Fact Sheet on Temporary Fording Sites;
- Fact Sheet on Forwarder Trails;
- Fact Sheet on Filter Fabric;
- Fact Sheet on Rock Check Dam;
- Fact Sheet on Temporary Bridges;
- Fact Sheet on Resource Road Construction;
- Fact Sheet on Instream Work in the Dry – Cofferdams;
- Fact Sheet on Streambank Stabilization;
- Fact Sheet on Instream Work in the Dry – Temporary Diversion;
- Fact Sheet on Instream Work in the Dry – Elevated Pipes;
- Fact Sheet on Culvert Stabilization;
- Fact Sheet on Storm Drain Outlets;
- Fact Sheet on Temporary Settling Basins;
- Fact Sheet on Bridge Construction/Demolition;
- Fact Sheet on Freshwater Salmonid Habitat Requirements;
- Fact Sheet on Highway Construction/Upgrading – Infilling, Stabilization and No-Grub Zones;
- Fact Sheet on Freshwater Intake End-of-Pipe Fish Screen;

- Fact Sheet on Stream Clean-up;
- Fact Sheet on Timber Crib;
- Fact Sheet on Water and Sewer Installation – Stream Crossings;
- Fact Sheet on Culvert Installation; and
- Fact Sheet on AVTs, Fish Habitat and You

Other Pertinent Federal Documents

- Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters, Wright and Hopky, 1998;
- Freshwater Intake End-of-Pipe Fish Screen Guidelines, Fisheries and Oceans Canada, 1995;
- Guidelines for Protection of Freshwater Fish Habitat in Newfoundland and Labrador. Fisheries and Oceans Canada, St. John's, NF, Gosse, M.M., et. al. 1998;
- Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador, Bradbury C., et. Al. 2001;
- Forestry Guidelines for the Protection of Fish Habitat in Newfoundland and Labrador, Scruton, D.A., et. al. 1997; and
- Standard Methods Guide for Freshwater Fish and Fish Habitat Surveys in Newfoundland and Labrador Rivers & Streams, Sooley, Darrin R. 1998.

Other Pertinent Provincial Documents

- Environmental Policy for Infilling Bodies of Water W.R. 91-1(*Water Resources Act*, DOEC);
- Environmental Policy for Land and Water Developments W.R. 95-01 (*Water Resources Act*, DOEC);
- Environmental Policy for Development in Shore Water Zones W.R. 97-1 (*Water Resources Act*, DOEC);
- Environmental Policy for Development in Wetlands W.R. 97-2 (*Water Resources Act*, DOEC);

- Environmental Code of Practice for Concrete Batch Plant & Rock Washing Operations (Department of Environment and Lands);
- Newfoundland and Labrador Species at Risk Data Sheets; and
- *Motorized Snow Vehicles and All-Terrain Vehicles Regulations* (NL Department of Natural Resources).
- NL Water Resources Act;
- Accredited Laboratory Policy (PD:PP 2001-01.02)

Nalcor's References

Nalcor's Project reports provide information in support of the P-WEPP. Such information is a useful and key source of information for the overall documentation of environmental performance throughout the life of the Project. The documentation is listed below:

- Nalcor Energy's Environmental Policy and Guiding Principles;
- Lower Churchill Hydroelectric Generation Project - Environmental Impact Statement, Nalcor Energy, 2009;
- Information Responses, Lower Churchill Project, 2009;
- Information Responses, Lower Churchill Project, 2010;
- Standard Operating Procedures, AMEC Earth & Environmental Ltd., Large River/Waterbody De-Watering and Fish Relocation;
- Standard Operating Procedures, AMEC Earth & Environmental Ltd., Pond De-Watering and Fish Relocation; and
- Labrador-Island Transmission Line, Environmental Assessment, Historic and Heritage Resources Component Study, May 2011.

10 REGULATORY CONTACT LIST

NE-LCP General Information:

1-888-576-5454

lowerchurchill@nalcorenergy.com

DOEC Water Resources – St. John's:

(709) 729-5713

DOEC Crown Lands - Happy Valley/Goose Bay:

(709) 896-2488

DOEC Wildlife Division:

(709) 637-2029

DFO: Habitat Management – Labrador:

709-896-6193

DNR Forestry Division:

(709) 497-8479

DNR Mines Division:

(709) 729-6447

Service NL, GSC - Happy Valley/Goose Bay:

(709) 896-5471

Provincial Archaeology Office:

709-729-2462

Environment Canada Environmental Emergency Report Line:

709-772-2083 or 1-800-563-9089.

Town of Happy Valley Goose Bay

709 896 3321

Supplier/Contractor Document Requirements

Nalcor Doc. No. LCP-PT-MD-0000-IM-PR-0015-01

Comments:	Total # of Pages: (Including Cover):
This document supersedes LCP-SN-CD-0000-IM-PR-0002-01, Rev C3 (SLI No. 505573-0000-37AG-I-0015)	24

Status / Revision	Date	Reason for Issue	Prepared by	Functional Manager Approval	Quality Assurance Approval	Project Manager (Generation + Island Link) Approval
C1	16-Dec-2013	Issued for Construction	N. Collins	D. Green	D. Green	R. Power

SUPPLIER/CONTRACTOR DOCUMENT REQUIREMENTS		
Nalcor Doc. No.	**Revision**	**Page**
LCP-PT-MD-0000-IM-PR-0015-01	**C1**	**1**

INTER-DEPARTMENT/DISCIPLINE APPROVAL (where required)

	Department Manager Approval	Date
RFO	B. Barnes	28-Oct-2013

0 SUMMARY OF CHANGES

General Update throughout document	Document number superseded from contractor document to LCP PT number
	Removal of SLI and EPCM contractor to reflect organizational integration.
	General formatting and use of current template
Appendix A – Supplier Document Front Sheet – (LCP-SN-CD-0000-IM-PR-0002-01 Appendix A)	Removed from procedure. New reference to the Document Front Sheet for Suppliers/Contractors LCP-PT-MD-0000-IM-FR-0001-01.
Appendix B – Drawing Templates	Removed from procedure. New reference to the Drawing Templates for Suppliers/Contractors LCP-PT-MD-0000-IM-FR-0002-01.
Appendix C – Document Control Aconex User Guide	Removed. Now part of the Starter KIT.
Appendix D – Final Documentation Chart	Removed.
Appendix E – Binder Cover	Removed from procedure. New reference to the Binder Cover Pages for Final Documentation LCP-PT-MD-0000-IM-FR-0009-01.
Appendix F – Major equipment list and supply chain information	Removed from procedure
Appendix G – Table of Contents for Installation, Commissioning, Operations and Maintenace Manual and Manufacturer's Record Book	Removed from procedure. New reference to the: Installation, Commissioning, Operations and Maintenace Manual Table of Contents - LCP-PT-MD-0000-IM-FR-0004-01, Manufacturer's Record Book Table of Contents - LCP-PT-MD-0000-IM-FR-0006-01 Dispatch Dossier - LCP-PT-MD-0000-IM-FR-0008-01
Appendix H – Example of the Binder Spine Templates	Removed from procedure. New reference to the Binder Spines for Final Documentation LCP-PT-MD-0000-IM-FR-0005-01.
Accessing Aconex	Added

TABLE of CONTENTS

1 PURPOSE

The purpose of this procedure is to define the responsibilities and methodology required to control the submission of Supplier/Contractor technical documents identified in the Supplier/Contractor Documents Requirements List (SDRL) as required for the Lower Churchill Project (LCP). This includes coding of technical documents and submission process for documentation being reviewed through to final handover.

2 SCOPE

This procedure applies to all Supplier/Contractors that provide goods or services for the Lower Churchill Project. The Supplier/Contractor shall transmit all documentation to LCP Document Control (LCPDCC) using LCP Aconex transmittal.

This procedure will provide all the details and submission requirements for Supplier/Contractor technical (revision controlled) document and drawing deliverables as listed on the approved SDRL defined for the project scope of work.

3 DEFINITIONS

Aconex	Electronic Document Management System which is a secure on-line platform for storing, managing and distributing project information for the Lower Churchil Project.
As-Built Documentation	Technical (Revision Controlled) Documentation where mark-up information has been formally incorporated into a new revision of the original document.
CA	Contract Administrator is responsible for managing the Agreement and Contract Administration from Award through to Completion.
Documentation	Documentation is any communicable material that is used to describe, explain or instruct regarding some attributes of an object, system or procedure, such as its parts, assembly, installation, maintenance and use.
Supplier/Contractor	Firm, corporation, organization, company, etc. with a scope of work under a purchase order, contract or agreement for the LCP.
SDRL	Supplier/Contractor Document Requirements List indicates the document and data requirements, timing of submissions, types of review, as-built requirements, handover deliverables and any requirements for inclusion in final documents/manuals.

SDRL Code	A 3-character alpha-numeric code representing document types. e.g.: B01 = General Arrangement and Layouts.
SDR (A01)	Supplier Document Register (A01) - documents list identifying individual document deliverables by purchase order. This register will capture deliverable requirements as agreed by Contractor/Supplier and Company. Contractor/Supplier is responsible to create and approve this document as a revision controlled document.
OCR	Optical Character Recognition is text recognition software (Adobe Standard) that is used to convert electronic files to PDF format.
Portable Document Format (PDF)	Portable Document Format (PDF) is a file format used to represent documents in a manner independent of application software, hardware, and operating systems. Each PDF file encapsulates a complete description of a fixed-layout flat document, including the text, fonts, graphics, and other information needed to display it.
Supplier/Contractor Documents	Documents that a Supplier/Contractor issue to LCPDCC for Review and Acceptance by LCP Project Team such as drawings, parts list, calculations, procedures, reports and manuals pertaining to the contract, purchase order or agreement.
Red-line drawing	A red-line drawing is essentially an intermediate drawing that shows corrections or changes to a previous drawing. The term red line literally comes from the (typically) red pen used to amend the drawings by hand. These mark-ups show changes made to the drawing subject matter during the manufactuer or construction of the product. Red-lines are used to then develop record drawings. Record drawings, also called "as-builts" accurately reflect what was constructed and are used for future work and/or reference.
Retained Documentation	Documents/Drawings which are designated to be held by the Supplier/Contractor for a designated period of time.
Responsible Lead / Package Engineer (PE)	The person who is responsible for the package awarded to Supplier/Contractor and Interdisciplinary Coordination (IDC) Review of Supplier/Contractor Documents.
Revision Controlled Documents	A document deliverable resulting from a service related contractual relationship or a Supplier/Contractor document created in support of engineering, construction, procurement, manufacture, preservation, installation, commissioning and operation.

LCPDCC	Lower Churchill Project Document Control Centre.	
Starter Kit Templates	LCP-PT-MD-0000-IM-FR-0001-01	Document Front Sheet for Suppliers/Contractors
	LCP-PT-MD-0000-IM-FR-0002-01	Drawing Templates for Suppliers/Contractors
	LCP-PT-MD-0000-IM-FR-0003-01	SDR Template (A01)
	LCP-PT-MD-0000-IM-FR-0004-01	Installation, Commissioning, Operations and Maintenance Table of Contents Template
	LCP-PT-MD-0000-IM-FR-0005-01	Manual Binder Spine Templates for Final Documentation
	LCP-PT-MD-0000-IM-FR-0006-01	Manufacturing Record Book Table of Contents Template
	LCP-PT-MD-0000-IM-FR-0008-01	Dispatch Dossier Table of Contents Template
	LCP-PT-MD-0000-IM-FR-0009-01	Manual Binder Cover Pages for Final Documentation
	LCP-PT-MD-0000-IM-FR-0010-01	Major Equipment and Supply Chain Information
Superseded	The information from a document that is now to be found on another document. Contractors/Suppliers are to make the appropriate cross-references both on the superseded document and the Supplier Document Register.	
Transmittal	Tracks and establishes a history of documentation transfer to and from Suppliers/Contractors through Aconex.	
Void	The information on the document/drawing is no longer valid and/or in use.	

ICOM (R01)	Installation, Commissioning, Operating and Maintenance Manual – an organized compilation of documents and data as per the following sections: 1. Installation section shall include all erection/assembly drawings, instructions as to the use of special tools provided, tolerances allowed on setting dimension, handling and unpacking instructions. Also includes quantities of preservatives and fluids required for shipment. 2. Commissioning section shall include list of spare parts, special tools and utilities required, pre-commissioning checks to be performed, sequenced procedure for dynamic commissioning and start-up and fault finding guidelines. Copies of all relevant drawings shall be included. 3. Operating section shall include description of equipment, operating procedures for start-up, steady state, shutdown, emergency and fault conditions, operating parameters, function of protective devices and controls, copies of all relevant cause and effect charts and block diagrams, and fault finding guidelines. 4. Maintenance section shall include instructions for maintenance disassembly, repair/overhaul and reassemble, schedule of preventative maintenance/maintenance frequencies.
MRB (R02)	Manufacturing Record Book is an organized compilation of construction, manufacturing, installation, testing, reporting and certification documentation required to demonstrate that constructions, equipment materials and fabricated systems and units are in compliance with the statutory regulations and specified requirements.
DISPATCH DOSSIER (R05)	Dispatch Dossier shall mean all those documents required, as a minimum to accompany goods released to site from Contractors/Suppliers and Fabricators. Procured goods shall not be dispatched without Dispatch Dossier. Also includes quantities of preservatives and fluids required for shipment.
TRAINING MANUAL (R06)	Operator and Maintenance training manual shall be a separate document that contains detailed training information developed by the Supplier/Contractor from the documents prepared for the project (e.g.: drawings, manuals, spare parts, BOM's etc).

4 RESPONSIBILITIES

Contractors/Suppliers – Are responsible to be completely aware of and follow the requirements herein. Supplier/Contractor shall have a designated Document Control contact person responsible for Aconex setup and coordinate contractual submissions to LCPDCC. Supplier/Contractor shall create and submit all required documentation as per the stipulations of this document.

LCP Document Control (LCPDCC) Team – Is responsible for clarifying the requirements where necessary as well as the receipt, standard Document Control quality checking and management of the documentation submitted to LCP by the Supplier/Contractor.

LCP Document Control (LCPDCC) Centre – is responsible to manage and process Supplier/Contractor document submittals in accordance with this document. Email LCPDCC@lowerchurchillproject.ca

LCP Responsible Lead/Package Engineer – is responsible for coordinating and identifying the distribution, review/approval cycles, and providing guidance for the management of technical documents including:

- Establish and Control of Review and Distribution Matrices
- Control the Inter Discipline Coordination (IDC) review of documents for assigned work package(s) on the project.
- Resolve the issues that may occur internally during the IDC review of Supplier/Contractor documents.
- Incorporate the comments and assign review status from the IDC review of Supplier/Contractor documents.
- Sign off the Supplier/Contractor documents.
- Submit the Supplier/Contractor documents to LCP Document Control Center (LCPDCC), who will issue them to the Supplier/Contractor.

LCP Contract Administrator - Responsible for managing the contract requirements and obligations with the Supplier/Contractor.

5 REFERENCES

LCP-PT-MD-0000-IM-FR-0001-01	Document Front Sheet for Suppliers/Contractors
LCP-PT-MD-0000-IM-FR-0002-01	Drawing Templates for Suppliers/Contractors
LCP-PT-MD-0000-IM-FR-0003-01	SDR Template (A01)
LCP-PT-MD-0000-IM-FR-0004-01	Installation, Commissioning, Operations and Maintenance Table of Contents Template
LCP-PT-MD-0000-IM-FR-0005-01	Manual Binder Spine Templates for Final Documentation
LCP-PT-MD-0000-IM-FR-0006-01	Manufacturing Record Book Table of Contents Template
LCP-PT-MD-0000-IM-FR-0008-01	Dispatch Dossier Table of Contents Template
LCP-PT-MD-0000-IM-FR-0009-01	Manual Binder Cover Pages for Final Documentation
LCP-PT-MD-0000-IM-FR-0010-01	Major Equipment and Supply Chain Information
LCP-SN-CD-0000-EN-PR-0002-01	Engineering - Service Codes and Equipment Tagging
LCP-PT-MD-0000-IM-PR-0009-01	Procedure for Issuance of Revision Controlled Documents for Internal Review & Acceptance
LCP-PT-MD-0000-IM-SD-0001-01	Coding Standard

6.0 INTRODUCTION

The objective of this document is to define the requirements for Suppliers/Contractors to submit documentation and drawing to the LCP project team from creation to completion/turnover.

6.1 SUPPLIER/CONTRACTOR DOCUMENT REQUIREMENTS LIST (SDRL) AND DOCUMENT REGISTER (SDR)

All potential Suppliers/Contractors will be provided a project specific SDRL and associated templates as part of the initial Bid Package. This SDRL forms the basis of the contractually required document deliverables. The SDRL is necessary to produce the SDR also known as the A01 on the SDRL.
Upon award, the SDR (A01) document should be completed by the Supplier/Contractor to include a complete list of required document deliverables as agreed in the SDRL. Each listed deliverable should have an associated forcasted submission date, etc. The SDR is to be submitted as defined on the SDRL.

Supplier/Contractor shall submit a completed SDR (A01) form (LCP-PT-MD-0000-IM-FR-0003-01) indicating the document deliverables to be supplied per the Purchase order/Agreement's specific SDRL.

The SDR (A01) shall always be the first document produced and delivered within two weeks after award of contact or purchase order. This document register is subject to review and acceptance by LCP and identified as SDRL code A01.

Once the SDR (A01) has been agreed with the LCP Responsible Lead/Package Engineer, the Supplier/Contractor shall maintain the SDR (A01) until contract closeout and issue in Aconex on a monthly basis with any and all updates.

The SDR (A01) shall be completed as follows:

1. The Document/Drawing numbers shall be assigned in accordance with Section 6.2.
2. Document Title.
3. If at the time of the initial submission of the SDR (A01) specific titles cannot be identified, the Supplier/Contractor shall contact the LCP Responsible Lead/Package Engineer for clarification.
4. In conjunction with LCP document coding, the Supplier/Contractors may reference their own document number and revision sequence (where applicable).
5. Include the planned submission date per the SDRL requirements.

Once a document has been submitted per the SDR (A01), the document number shall not be re-used. If a document is superseded or made void, this shall be stated clearly in the SDR (A01). Same if the placeholder is cancelled, it shall be clearly stated on the SDR.

6.2 DOCUMENT/DRAWING CREATION

All Supplier/Contractor document/drawing numbers will be reserved by LCPDCC after approval of SDR (A01), in accordance with the Coding Standard, LCP-PT-MD-0000-IM-SD-0001-01 for the Lower Churchill Project. All reserved document/drawing numbers or place holders will be transmitted via Aconex.

Electronic documentation submitted by the Supplier/Contractor for review must be in the text searchable PDF format OCR (Adobe Standard Software).

Electronic documentation may also be required in native format for integration into design development. Specific requirements and exceptions will be outlined in the package specific Supplier/Contractor Documents Requirements List (SDRL).

All documents in letter (size 8-1/2 in x 11 in) and legal (size 8-1/2 in x14 in) shall include the Document approved LCP Front Sheet for Suppliers/Contractors - LCP-PT-MD-0000-IM-FR-0001-01 as the first page of each document.

Electronic files shall be limited to one file per document/drawing. Where there are multiple files, a unique and logical reference would need to be applied. Please note: a document with multiple pages submitted as a single document is reviewed as one document. Any revisions to a particular page or sheet of the document shall require the complete document to be resubmitted with the next revision. Partial submissions will not be accepted.

All drawings shall be created and delivered on standard paper sheets. All drawings should also be defined with a border and no markings shall be permitted outside the border. Drawing notes shall be positioned in a column at the right hand side of the drawing.

Drafting standards shall be in compliance with the project symbol requirements.

The following tables describe the accepted drawing formats and scales to be used on the Lower Churchill Project.

Table 1 – Acceptable Drawing Sizes

STANDARD		DIMENSIONS		PROJECT REQUIREMENTS
ISO 216 (Metric)	A0		841 mm x 1189 mm	X
	A1		594 mm x 841 mm	X
	A2		420 mm x 594 mm	X
	A3		297 mm x 420 mm	X
	A4		210 mm x 297 mm	X
ANSI Y14.1 (Imperial)	E	34 in x 44 in		X
	D	22 in x 34 in		X
	C	17 in x 22 in		X
	B	11 in x 17 in		X
	A	8.5 in x 11 in		X

Table 2 – Accepted Drawing Scales

Type of Drawing	Metric Scales
Topography	
General, Hydrology, Topography	1:20 000 1:10 000 1:5 000 1:2 000 1:1 000
Plans and Profiles	1: 500 1:200 1:100
Building Drawings	
Location Plan, Key Plan	1:10 000 1:5 000
Site Plan, Layout Plan	1:2 000 1:1 000 1: 500
General Layout Drawing, Plot Plan	1:500 1:200 1:100
Layout Drawing (general or partial)	1:100 1:50
Detail and Assembly Drawings	1:30 1:20 1:10 1:5 1:2 1:1

6.2.1 REVISION STATUS

All documents and drawings require a revision status upon submission. The first submission will be submitted as revision status of A1 – Issued for Review, unless otherwise ageed to by the LCP Responsible Lead/Package Engineer. All A1 documents are to be resubmitted at revision B or higher **and** achieve a Review Code 01 to be considered ready for use.

All drawing revisions shall be shown by a “cloud” surrounding the area with revision symbol. The revision symbol shall be a triangle with revision letter/number inside. Note of the revision are to be made in the title block of the drawing. Clouds are not to cover portions of the drawing which has not been revised.

Previous revision symbols and clouds are to be removed and only current revision shall be shown when a drawing is re-issued.

Revision Status are as follows:

A – IDC – Issued for review
B – Approved for Use/Implementation/Bid
C – Approved for Purchase/Construction/Fabrication
D – Approved for Design
L – As-Built/Final
N – Cancelled
S – Superceded
V – Void

If a drawing or document is to required to be voided, it must be VOIDED in its entirety and then issued at the next submission as a V status. VOID shall be written within parallel lines across the full drawing or the first page of a document and authorized by the LCP Responsible Lead/Package Engineer.

If a document or drawing is required to be superseded meaning the information on the existing document/drawing has been re-located to another document/drawing, the Contractor/Supplier is to make the appropriate cross-references on the superseded document and show a revision status of S to represent that the information has been superseded and issued S1.

All changes in revision statuses must be reflected on the SDR upon the next monthly submission.

6.2.2 TAG NUMBERS

The purposes of tagging and numbering are for the work protection code process, for asset management by identifying individual equipment in the different project facilities, and for the procurement of equipment and material, including bulk material. Reference Engineering - Service Codes and Equipment Tagging - LCP-SN-CD-0000-EN-PR-0002-01.

Tag numbers shall be used and clearly identified on all Supplier/Contractor documents to facilitate rapid and efficient identification of the equipment throughout LCP.

For equipment items with tag numbers, the tag number must be placed on the drawing and in proximity to the item so there is no confusion which tag belongs to which item.

6.3 DOCUMENT AUTHORIZATION

The Supplier/Contractor shall be responsible to ensure that:

1. All necessary checking, authorization and acceptance of their documents is performed prior to submittal to LCPDCC;
2. All the Supplier/Contractor documents are submitted via the LCP Aconex System to LCPDCC and never sent directly to the LCP Responsible Lead/Package Engineer or LCP Contract Administrator; and
3. The Sub-Supplier/Sub-Contractor documents are to be complete and integrated in a logical manner with those being provided by the Supplier/Contractor and shall be accepted by supplier/contractor prior to submission to LCP team.
4. All documentation/drawings are of good quality.

6.4 SUBMISSION OF SUPPLIER/CONTRACTOR DRAWINGS AND DOCUMENTATION

Upon award of the contract/purchase order, the LCP Contracts Administrator/Buyer will request the contact name, email address and phone number of the Supplier/Contractor's Document Control representative. An email will be sent to the representative by LCPDCC advising of the required steps to creating an Aconex user account(s). This includes:

1. Setting up their organization with Aconex directly.

2. Providing accounts to your internal team members

3. Contacting the LCPDCC representative to add you and your company participants to the applicable LCP databases in Aconex and submit the required Aconex presentation, online tutorial, forms and any other relevant information.

4. Participating in project specific training with your Document Control representative. Example: Uploading Documents to Aconex.

All document/drawing numbers must be reserved prior to submission, which will be developed and approved from the Supplier/Contractors SDR (A01). The assigned document/drawing numbers shall be processed electronically via Aconex approved metadata placeholder and issued by LCPDCC to the Supplier/Contractor by Aconex transmittal. Any document or drawing received without an assigned number will not be processed.

The dates shown for documents to be submitted on the SDR (A01) shall be the forecasted date of arrival at the LCPDCC via the electronic document management system (Aconex). The forcasted date shall be in accordance with the expected dates as defined in the SDRL.

If hardcopies of documents are required to be submitted in addition to the electronic submission via Aconex a copy of the transmittal to be submitted with the hardcopy and sent to LCPDCC team as follows:

Nalcor Energy
Project Delivery Team
Lower Churchill Project
350 Torbay Road, Suite 2
St. John's, Newfoundland
A1A 4E1
Attention: LCP Document Control

6.4.1 QUALITY OF DOCUMENTS UPON SUBMITTAL

Typically, all documents are issued electronically as searchable Optical Character Recognition (OCR) PDF documents. All pages of documents and drawings shall be of correct orientation, legable, with all required content, numbered correctly as requested through the SDR and assigned by Aconex. Both documents and drawings should include the correct revision, dates, signatures and stamps (if required). All pages of a document should be numbered correctly and consecutively with no blank pages. All documents/drawings shall be in the English language.
All dates referenced shall be in the format dd-mmm-yyyy (eg: 17-May-2013)

6.4.2 REVIEW OF DOCUMENT AND DATA

Review and comment by the LCP Responsible Lead/Package Engineer/LCP Contract Administrator or conversely, the failure to review, shall not imply acceptance or relieve the Supplier/Contractor of any responsibility or liability for dimensional or functional accuracy or completeness of such data, or the equipment being supplied.

The LCP Responsible Lead/Package Engineer/LCP Contract Administrator shall review in accordance with the Procedure for Issuance of Revision Controlled Documents for Internal Review & Acceptance - LCP-PT-MD-0000-IM-PR-0009-01 and returned to the Supplier/Contractor within the terms of the Purchase Order/Agreement.

6.4.3 RETURN OF SUPPLIER/CONTRACTOR DOCUMENTS

The LCP Responsible Lead/Package Engineer shall assign to each of the Supplier/Contractor document submitted, one of the Review Codes as as listed below:

Code 01 - Reviewed and Accepted – No Comments
Code 02 - Reviewed – Incorporate Comments, Revise and Resubmit
Code 03 - Reviewed – Not Accepted
Code 04 - Information Only
Code 05 - Not Reviewed

6.4.4 RESUBMISSION OF SUPPLIER/CONTRACTOR DOCUMENTS.

All documents submitted/resubmitted for review shall have achieved Review Status Code 1 or 5 or have been made void/cancelled at Purchase/Agreement closeout.

Once code 01 has been received, LCP Package Engineer will request a B1 or C1 to be issued by Supplier/Contractor. Resubmission of document assigned Return Code 02 and 03 is required before being considered suitable to proceed with the work. The Supplier/Contractor has 14 calendar days or unless otherwise specified in the contract from receipt of comments to resubmit the document

Any documents modified after acceptance at Code 01 or 05 must be resubmitted for review/acceptance.

On each subsequent submission of same documentation previously reviewed by LCP, the Supplier/Contractor shall use the applied same unique number but different revision as per LCP Coding Standard. If on the next submittal of a document where the previous submittal has not yet been returned then the Supplier/Contractor shall consult with LCP Responsible Lead/Package Engineer prior to issuing the revised document.

All drawing revisions shall be shown by a “cloud” surrounding the area with revision symbol. The revision symbol shall be a triangle with revision letter/number inside. Note of the revision are to be made in the title block of the drawing. Clouds are not to cover portions of the drawing which has not been revised. Previous revision symbols and clouds are to be removed and only current revision shall be shown when a drawing is re-issued.

6.4.5 RED-LINES

Red-Lines will be required as directed by the LCP Responsible Lead/Package Engineer. This may include all or none of the company supplied documents.

6.4.6 AS-BUILT/FINAL DOCUMENTS

The SDRL template provides the LCP Responsible Lead/Package Engineer identification of the As-Built requirements. The Supplier/Contractor shall ensure that the final status of the documents reflects only those documents that need updating to reflect their accurate final status, need to be submitted:

a) The "As-Built/Final" status shall be provided for materials/equipment/construction.
b) Where subsequent modifications have been undertaken to materials/equipment/construction provided these are reflected in the final documents.
c) Shall be issued at a revision status of “L”

At the completion of the Purchase/Contract, all documents shall reflect the "As-Built/Final" status of the service, and the Supplier/Contractor shall include the following paragraph in the Final Stage Payment Certificate:

"We the Supplier/Contractor certify that all documents supplied in association with the above Purchase/Contract fulfill our contractual requirements and reflects the "As-Built/Final" status.”

“As built” drawings, shop drawings and material lists shall be forwarded no later than 14 calendar days or unless otherwise specified in the contract after the end of fabrication.

6.5 MANUALS

6.5.1 PRELIMINARY ISSUE

The templates provided are for guidance with the final content being agreed with the LCP Responsible Lead/Package Engineer.

Installation, Commissioning, Operations and Maintenace Manual (ICOM) Table of Content - LCP-PT-MD-0000-IM-FR-0004-01
Manufacturer’s Record Book (MRB) Table of Content - LCP-PT-MD-0000-IM-FR-0006-01
Dispatch Dossier Table of Content - LCP-PT-MD-0000-IM-FR-0008-01

<u>Preliminary Submittal</u>

After approval of the Table of Contents, the Supplier/Contractor must submit electronically and in one file, the first submittal of the complete manual in an OCR enabled PDF format for review.

Note: Adobe OCR Documents preserve the fidelity of the original files and are more reliable and easier to use because they retain the fonts, images, graphics, and layout of any source file regardless of the application and platform used to create them. Adobe OCR Documents can lock down content to create

easily searchable, auditable documents of record. Bookmarking shall also be applied based on the Table of Content.

6.5.2 FORMAT FOR MANUALS

The Supplier/Contractor shall submit all manuals in English.

Material shall not be submitted in loose form but shall be completely fastened together and bound in a rigid binder. Binder size maximum of 4" D- size to be used ensuring ½" of space is available so not to restrict the turning of pages. Document to be printed double sided where possible to reduce the number of binders required.

Professional-quality presentation binder that has 3 secure locking rings and a clear view cover that folds back for easy insertion of the Manual Binder Cover Page for Final Documentation - LCP-PT-MD-0000-IM-FR-0009-01 and spine label holder for the Manual Binder Spine Templates for Final Documentation LCP-PT-MD-0000-IM-FR-0005-01. Binders must have 2 inside pockets for filing CD or DVD and a D-Ring mechanism, complete with triggers, for easy access.

The number of hardcopies per manual are as follows:

- R01 - ICOM - three (3) hard bound copies upon handover.
- R02 – MRB - electronic version and the supplier/contractor to keep original hardcopies for traceability and auditing purposes – three (3) hard bound copies upon handover.
- R05 – Dispatch Dossier – three (3) hard bound copies – one to be delivered to site with the equipment/goods and the other 2 to be sent to LCPDCC Document Control Centre.
- R06 – Training Manual – three (3) hard bound copies upon handover.

6.5.3 ELECTRONIC COPY

Electronic copy shall be submitted using Aconex transmittal process.
Special Note: Electronic and hard copy must be identical

The final submission of the manuals shall include;

- Two (2) copies of each DVD (Master and Backup)
- All drawings submitted with final manuals shall be As-Built and original drawing along with the .dwg electronic native format or other Company approved formats as applicable.
- Electronic versions of all manuals shall be provided in PDF File Format and in their original Native Electronic File Format. There shall be one PDF file for each manual and multiple PDF files for one Manual will not be accepted.
- PDF File formats shall be in one OCR file using Adobe Acrobat software

- Native electronic files shall be submitted in Microsoft 2000 or higher electronic format (with each electronic file clearly identified according to its proper location in the manual based on the table of contents).

Upon confirmed approval by the LCP Responsible Lead/Package Engineer on the final version of Manuals, the Supplier/Contractor shall prepare the final version of Manuals in DVD Format, the procedure for which is described below. The Supplier/Contractor shall submit two (2) copies of each DVD, one marked “MASTER”, and the other marked “BACKUP”. Each DVD shall have a label with details including and not limited to “Project Document Number”, “Project Title” & “Agreement/PO Number”. Each DVD shall be of good quality and shall be virus checked before submission to the LCP Responsible Lead/Package Engineer for final acceptance.
The Manuals in DVD format shall be created in a format known as “Portable Document Format” (PDF) using Adobe Acrobat Writer 8.0 or latest software for Windows XP. The DVD shall be self-executing and the software for the operation of the DVD is Adobe Acrobat Reader for Windows XP which shall be delivered as part of the DVD Operating System. Adobe Acrobat Reader allows the PDF files to be viewed, printed and navigated.

DVD format requirements shall be:

- Electronic documents shall be converted from the native file to PDF image files using Adobe Acrobat Writer 8.0 or higher.
- Non-electronic documents shall be scanned to minimum 300 dpi (Dots per Inch) and converted from the original format to PDF using Adobe Acrobat Writer 8.0 or higher.
- Create the folders to match the table of contents
- Create bookmarks to identify chapters and sections and thumbnail for pictures and images.

6.5.4 TRAINING MANUAL (R06)

Operator and Maintenance training manual shall be a separate document that contains detailed training information, developed by the Supplier/Contractor from the documents prepared for the project (eg: drawings, manuals, spare parts, BOM’s etc).

Manual Front Page and Spines
Document Front Sheet for Suppliers/Contractors
Title of the Project- Lower Churchill Project
Project Contract Number and description of Work
Manual Nalcor Document Number and Revision
Name and Address of Main Supplier/Contractor and Sub-Supplier/Contractor
Volume No. of Manual

6.5.5 FINAL SUBMISSION OF MANUALS

The Supplier/Contractor shall submit to the Lower Churchill Project a complete electronic PDF version as well as hard copy(s) of the complete set of manuals to the following address:

Nalcor Energy
Project Delivery Team
Lower Churchill Project
350 Torbay Road, Suite 2
St. John's, Newfoundland
A1A 4E1
Attention: LCP Document Control Centre

One electronic PDF version must be uploaded and submitted via transmittal using the Lower Churchill Project Aconex System.

Prior to final issue of the ICOM it is recommended that the LCP Responsible Lead/Package Engineer meet the Supplier/Contractor to review the manual to prevent repetitive issues and the requirements described below have been met. All other manuals are to be submitted for acceptance via Aconex for approval prior to submitting final version.

6.6 COMPONENT SPECIFIC REQUIREMENTS

6.6.1 HYDRO – GENERATION – COMPONENT 1 - 3D MODEL CATIA

As part of the scope of the Lower Churchill Project the Hydro Generation Component 1 will be developing a 3D Model. CATIA by Dassault System is the software used to develop this model.

To meet this requirement, equipment Supplier/Contractor are required to provide a 3D representation of the facilities and equipment that are being provided in CAT.PART format or STEP or IGES compatible with CATIA.

3D models provided in formats other than the above require validation and approval from the company prior to submission.

Electronic Copy drawings shall be provided in DWG (AutoCAD), CAD Drawing and PDF format.

6.6.2 TRANSMISSION LINES, TOWERS AND FOUNDATIONS – COMPONENT 4 - 3D MODEL PLS

Transmission lines

The transmission line designs are completed with the use of the PLS-CADD software (PLS Systems Inc.)

All sag/tension reports, stringing charts and plan and profile sheets are produced with PLS-CADD. All vector loads for each loading cases and line angle are produced with the PLS-CADD/LITE software

Towers

The tower designs are completed with the PLS-TOWER software. The supply of tower shall include the updated PLS-TOWER models, compatible with the PLS-CADD software. The PLS-TOWER backup file shall be supplied. Each tower type will be supplied with the full set of PLS-TOWER models. For each tower type, a PLS-TOWER model shall be supplied for each of the tower height, at each 1.5m increment, from minimum tower height to maximum tower height.

Foundations

The steel grillage foundation designs are completed with the SAP2000 software. The supply of the grillage foundation type shall be supplied with the updates SAP2000 models, including the tower foundation loads as defined by the PLS-TOWER software.

7.0 PROJECT SPECIFIC INSTRUCTIONS

To ensure efficient handling of drawings and other documents, Supplier/Contractor shall abide by the following rules:

- All drawings to be produced using the LCP Drawing Templates for Suppliers/Contractors - LCP-PT-MD-0000-IM-FR-0002-01. It is acceptable for the Supplier/Contractor to place its complete drawing within the LCP drawing frame.
- A document with multiple pages submitted as a single document will be reviewed as one document. Any revisions to a particular page or sheet of the document shall require the complete document to be resubmitted with the next revision assigned.
- When a Section is shown on a separate drawing sheet, the Plan drawing number shall be included in the Section identification.

- Reference drawings shall be tabulated in the “Reference Drawing” section at the bottom of the drawing. Equipment/nozzle tabulation on General Arrangements (GA) shall be on the right side of the drawing.
- Drawings produced must be submitted as a complete drawing file. This means all drawing files must be bound to include all relevant information. This is necessary to properly access/view and use the drawing.
- Documents identified as requiring the Engineer’s Seal and Signature will be in accordance with the Newfoundland and Labrador Professional Engineers and Geoscientists Act. Refer to www.pegnl.ca.
- Supplier/Contractors shall ensure that all documents involved in the provision of architectural services, when issued, shall bear the signature and seal of the architect who prepared or approved them as per The Architects Act of the province of Newfoundland and Labrador.

8.0 RECORDS

N/A

9.0 ATTACHMENTS

N/A

SNC·LAVALIN

nalcor energy

Lower Churchill Project

WASTE MANAGEMENT PLAN
Component 1 and 4b

SLI Document No. 505573-0000-68RA-I-0008-02

Nalcor Reference No. LCP-SN-CD-0000-EV-PL-0005-01-B3

Date: 30-Sep-2012

Prepared by: _____
Lesley Reid
Environmental Coordinator Transmission Lines and DC Specialties

Check by: _____
David Haley
Environmental Manager

Approved by: _____
Normand Bechard
Project Manager

Revision					
N°	By	Check	Appr.	Date	Remarks
02	LR	DH	NB	30-Sep-2012	Issued to be aligned with other management documents
01	MW	KD	NB	09-Apr-2012	Issued for Client review and acceptance
00	MW	KD	NB	08-Mar-2012	Issued for Client approval
PC	MW	KD	NB	19-Jan-2012	Issued for Review
PB	MS	KD	NB	28-Oct-2011	Issued for Review

MAINTENANCE OF THE WASTE MANAGEMENT PLAN (WMP)

This *WMP* will at times require updating in response to changes in the Project, Contractor work methods, group structure, or technological advancements that provide a higher level of environmental protection. The subsections below indicate the process with respect to maintenance and implementation of the *WMP.*

Initiating Revisions

This *WMP* is a controlled document and revisions may only be processed by SNC Lavalin's (SLI's) Environmental Manager. It is anticipated that most of the revisions to this *WMP* will be initiated by the environmental management team at the site or at the Lower Churchill Project office in St. John's.

Nalcor staff shall request revisions through document control. *WMP* holders and readers/reviewers (within SLI, government agencies, contracting firms, other stakeholders, etc) may request revisions by forwarding a completed Revision Request Form (RRF), provided in Section 12, to SLI's Environmental Manager. These revision requests will be screened and reviewed by SLI in conjunction with Nalcor staff, and forwarded to SLI's Project Manager for approval.

Compliance Instructions

Revision requests that have been accepted by SLI's Project Manager will be sent to SLI's Environmental Manager for distribution to key Project participants as "Compliance Instructions" These instructions shall be signed off by key holders of the WMP and returned within two days of receipt. A log of compliance instructions shall be maintained by SLI's Environmental Coordinator (Hydro), and these will be incorporated periodically into a revised edition of the WMP

Revision Procedures

Revisions to the Waste Management Plan shall be made annually, or as required, in accordance with SLI's document control procedures. SLI's Environmental Manager

will issue the accepted revisions of the Waste Management Plan to key holders, Contractors, and readers/reviewers. Each revision will be accompanied by a Revision Control Record (provided in Section 12) that:

a) identifies all compliance instructions that have been issued since the last revision; and

b) Lists the sections being superseded.

Within two working days of receiving a revised Plan, *WMP* holders shall:

a) Familiarise themselves with revised sections of the *WMP*;

b) Incorporate all revisions into their areas of responsibility, as appropriate;

c) Ensure that all personnel are familiar with the revisions; and

d) Acknowledge receipt of the revised *WMP* by forwarding via fax, email, or mail a signed and dated acknowledgement form to SLI's Environmental Manager. The receipt of revision acknowledgement form is located in Section 12.

TABLE OF CONTENTS

Page No.

List of Figures

List of Tables

1 INTRODUCTION

This *Waste Management Plan (WMP)* is developed to establish safe, efficient and environmentally compliant waste management during construction and commissioning activities of the Lower Churchill Project (LCP). This plan outlines the roles and responsibilities that all Project participants must follow to ensure that the collection, storage, transportation and disposal of all wastes generated during construction and commissioning activities of the LCP is managed in an environmentally sound manner.

1.1 PURPOSE

Specifically the purposes of this *WMP* are to:

a) comply with the conditions and requirements of Environmental Assessment (EA) release;

b) outline the Lower Churchill Project's commitments to minimize potential environmental effects - including commitments made in the Environmental Impact Statement (Nalcor, 2009) and during the regulatory review process under the joint review panel;

c) manage potentially adverse impacts on the environment and protect the health and safety of site personnel (including Contractors, Subcontractors/vendors and visitors);

d) provide a reference to applicable legislative requirements and guidelines;

e) provide a reference document for Lower Churchill Project participants to use when planning and/or conducting specific procurement, construction and commissioning activities with respect to waste management;

f) provide a detailed summary of waste management issues and measures to be implemented during construction and commissioning;

g) provide direction for environmental orientation programs for Lower Churchill Project participants; and

h) communicate changes to the *WMP* through an interactive revision process;

The intent is to afford a high degree of control over the handling of waste and to implement the ideals of the three R's namely reduction, recovery/reuse and recycling of wastes. Ultimately this plan will help to minimize potential adverse environmental effects and provide a framework for those involved in the Project.

This document will be reviewed on an annual basis (or as deemed necessary by SLI or Nalcor) throughout the construction phase and updated as necessary to accommodate the dynamics of design and construction as it progresses.

1.2 SCOPE AND APPLICATION

The scope of this *WMP* covers the engineering, procurement, construction, and commissioning phase of the Lower Churchill Project for Components 1 and 4b. The focus of this plan is on construction and commissioning activities for the site access roads, reservoir preparation, accommodations and administrations complex, laydown areas, AC line from Muskrat Fall to Churchill Falls, and the Muskrat Falls hydroelectric generating facility. Section 2 describes the Project in more detail. Note that the cable crossing at the Strait of Belle Isle and the Labrador Island Transmission Link are not within the scope of this WMP.

This WMP is one component of the Lower Churchill Project's *Environmental Management Plan (SLI Document # 505573-0000-68RA-I-0004, NE-LCP Document # MFA-SN-CD-0000-EV-PL-0001)*. Other subordinate documents of the Environmental Management Plan include the following:

a) *Contract-Specific Environmental Protection Plan (*C-SEPP*) Template (SLI Document # 505573-0000-68RA-I-0011, NE-LCP Document # LCP-SN-CD-0000-EV-PL-0006-01)*

b) *Rehabilitation Plan (RP) (SLI Document # 505573-0000-68RA-I-0007, NE-LCP Document # LCP-SN-CD-0000-EV-PL-0004-01);*

c) *Regulatory Compliance Plan (RCP) (SLI Document # 505573-0000-68RA-I-0003, NE-LCP Document # LCP-SN-CD-0000-RT-PL-0001-01); and*

d) *Project-Wide Environmental Protection Plan - Component 1 and 4b (SLI Document # 505573-0000-68RA-I-0005, NE-LCP Document # LCP-SN-CD-0000-EV-PL-0002-01)*;

Nalcor's Emergency Response Plan is a companion document to the Environmental Management Plan. It contains a Master Spill Response Plan, which shall be used by contractors as a basis for preparing their own spill response plans.

This *WMP* applies to all Project participants, including Nalcor, SLI, Contractors, Subcontractors, suppliers, service providers, and all employees of these organizations.

Given the Lower Churchill Project's magnitude, accepted *Contract-Specific Environmental Protection Plans (C-SEPPs)* shall be required. C-SEPP*s* shall be prepared by all contractors for all construction contracts to ensure that effects on the environment are minimized to the extent practical. These C-SEPP*s* shall provide sufficient detail on the Contractor's:

a) Scope of work;

b) Methods of construction;

c) Sequence of activities;

d) List of resources (i.e. equipment and site workforce);

e) Temporary and permanent installations;

f) Environmental protection procedures and alternative procedures, if required; and

g) Environmental contingency measures.

One aspect of the C-SEPP will be how the Contractor proposes to handle the waste from their activities.

This *WMP* will serve as a resource to Contractors as they prepare their own *C-SEPPs.* Contract packages shall include the C-SEPP template, with specific instructions on how these templates are to be properly completed. All C-SEPPs shall require approval by both SLI and NE-LCP prior to the contractor's mobilization to site.

2 PROJECT DESCRIPTION

2.1 MUSKRAT FALLS HYDROELECTRIC DEVELOPMENT AND AC TRANSMISSION LINE (COMPONENT 1 AND 4B)

Muskrat Falls is one of two hydroelectric developments being planned for the lower Churchill River. The remotely controlled nominal 824 MW Muskrat Falls Hydroelectric Development will be composed of the following sub-components and associated ac connector lines to an ac switchyard:

a) 16 km of permanent access roads, including upgrading of existing roads and new construction;

b) Reservoir, approximately 60 km long and 101.4 km^2 in total area;

c) Replacement fish habitat;

d) A north roller compacted concrete (RCC) overflow dam;

e) Gated spillway including:

   i) Approach and discharge channels; and

   ii) Vertical lift gates.

f) A close coupled intake and powerhouse including:

   i) intakes with gates and trash racks;

   ii) concrete lined water passages;

   iii) turbine/generator units at approximately 206 MW each with associated ancillary electrical/mechanical control equipment;

   iv) power transformers (includes 1 spare), located on the draft tube deck of the powerhouse; and

   v) 2 overhead cranes;

g) A south dam;

h) Component diversion works (i.e. cofferdam and spillway for diversion channel);

i) Stabilized north spur;

j) ac switchyard at Muskrat Falls; and

k) Churchill Falls switchyard extension.

Figure 2-1 shows the current concept for the generating facility.

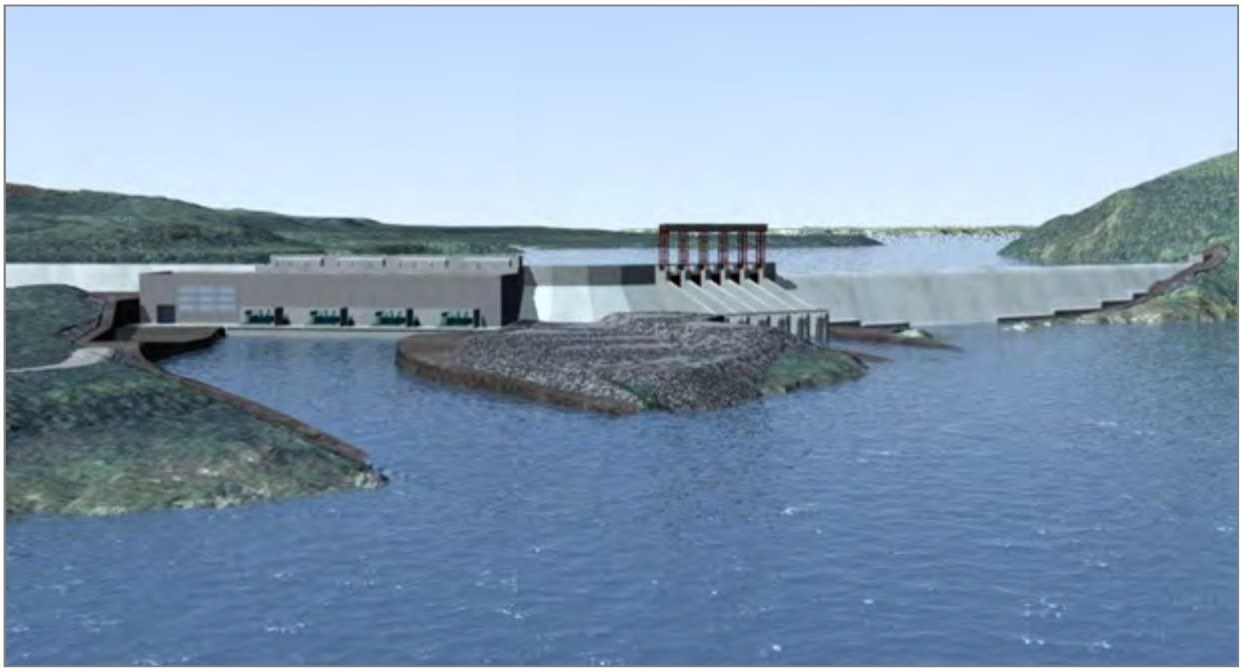


Figure 2-1: Muskrat Falls Generating Facility (Component 1)

2.2 SUB-COMPONENT 4B: HVAC OVERHEAD TRANSMISSION LINE MUSKRAT FALLS TO CHURCHILL FALLS

a) Transmission lines from Muskrat Falls to Churchill Falls:

   i) 2-315 kV ac, 3 phase lines, double bundle conductor;

   ii) Single circuit galvanized lattice steel guyed suspension and rigid angle towers; and

   iii) 250 km long.

2.3 CONSTRUCTION RELATED INFRASTRUCTURE

Construction related infrastructure will be established to support construction activity for components 1 and 4b. Some of this infrastructure is temporary and shall be decommissioned before the end of the construction phase. It is anticipated that the following infrastructure will be required:

a) A 1,500 person accommodations and administration complex (for construction period);

b) Access roads associated with the main dam structure, the accommodations complex and reservoir;

c) Diversion facilities (i.e. upstream and downstream coffer dams, the latter of which is to be removed prior to tailrace flooding);

d) Borrow pits and quarries;

e) Construction bridge;

f) Concrete and crushing plants;

g) Construction power and site communications infrastructure;

h) Reservoir clearing camps and wood storage yards;

i) Material storage and laydown areas including the potential use of port facilities (if upgrades are required to port facilities they shall be completed by the responsible party);

j) Fuelling and fuel storage facilities;

k) Spoil areas;

l) Muskrat Falls 25 kV construction power line & construction power terminal substation;

m) HVac transmission line construction camps; and

n) Trash and debris collection boom, associated roads and debris storage areas.

3 RELEVANT LEGISLATION

There are federal, provincial and municipal regulatory requirements that apply to the waste management needs of the Project. The Project will fully comply with all applicable regulatory requirements. Copies of all permits and licenses shall be obtained and kept on file and a copy provided to SLI by all Contractors, Subcontractors and facilities for all aspects of their work related to waste disposal. Compliance will be facilitated through a program of environmental compliance monitoring, primarily implemented by the On-Site Environmental Monitors.

3.1 FEDERAL

The following federal acts apply to waste management at the Project:

a) *Transportation of Dangerous Goods Act (TDGA);*

b) *Canadian Environmental Protection Act (CEPA); and*

c) *Hazardous Materials Information Review Act.*

3.2 PROVINCIAL

The following provincial acts and regulations apply to waste management at the Project:

a) *Waste Management Regulations;*

b) *Waste Diversion Regulations*

c) *Dangerous Goods Transportation Act;*

d) *Storage and Handling of Gasoline and Associated Products Regulations;*

e) *Used Oil Control Regulations;*

f) *Environmental Control Water and Sewage Regulations;*

g) *Newfoundland and Labrador Environmental Protection Act* (NLEPA); and

h) *Water Resources Act.*

3.3 MUNICIPAL

Should any construction activities take place within any municipal boundaries, local bylaws will need to be complied with and permits obtained.

Note: The above legislation listed in Sections 3.1, 3.2 and 3.3 is not considered exhaustive. The waste generator is responsible to ensure all relevant legislation is followed prior to waste generation and disposal on the LCP.

4 STAGED APPROACH TO WASTE MANAGEMENT

The following subsections describe waste management responsibilities before and after the start of the Garbage Removal and Disposal Contractor's (GRDC's) mandate, and Figure 4-1 shows the anticipated workforce during the approximate 6 year construction period.

4.1 PRE-GRDC IMPLEMENTATION

The Early Works contracts are the first to be awarded for the Project. The purpose of these contracts is to develop access and infrastructure to facilitate construction of the Muskrat Falls hydroelectric generating facility. These Early Works construction contracts are as follows:

- Main Site Access Road South Side (including clearing);
- Accommodations Complex Site Utilities
- Accommodations Complex Buildings;
- Administrative Buildings; and
- Construction Power.

During initial stages of Accommodations Complex development, a starter camp will be constructed. This camp will house the Bulk Excavation Contractor's workforce until the Accommodations Complex is fully developed.

After this starter camp is completed, the GRDC will begin its work, and provide service primarily to those housed at this camp.

It is anticipated that the total workforce on site will start at 125 to a maximum 490 people during the Early Works construction period.

4.2 POST-GRDC IMPLEMENTATION

Post-GRDC work includes all construction contracts that begin after the start of all Early Works contracts. During this time it is expected the site workforce will increase substantially from about 630 people initially and reaching 1,500 workers in the 4th year of construction.

As described above, the GRDC will remove and dispose of domestic wastes and sewage from holding tanks in facilities provided by SLI (e.g. wash-cars, trailers), sewage sludge from septic tanks for the starter camp, and sludge from the Accommodations Complex sewage treatment plant. All wastes generated in facilities established by Contractors (e.g. portable toilets, lunchroom/office trailers, etc) shall be the responsibility of the Contractor.

Excluded from the GRDC's mandate are construction & demolition wastes, all wastes generated by Contractors working in remote locations (e.g. Reservoir Clearing, ac Transmission Line), hazardous wastes other than sewage and sewage sludge as mentioned above and biomedical wastes.

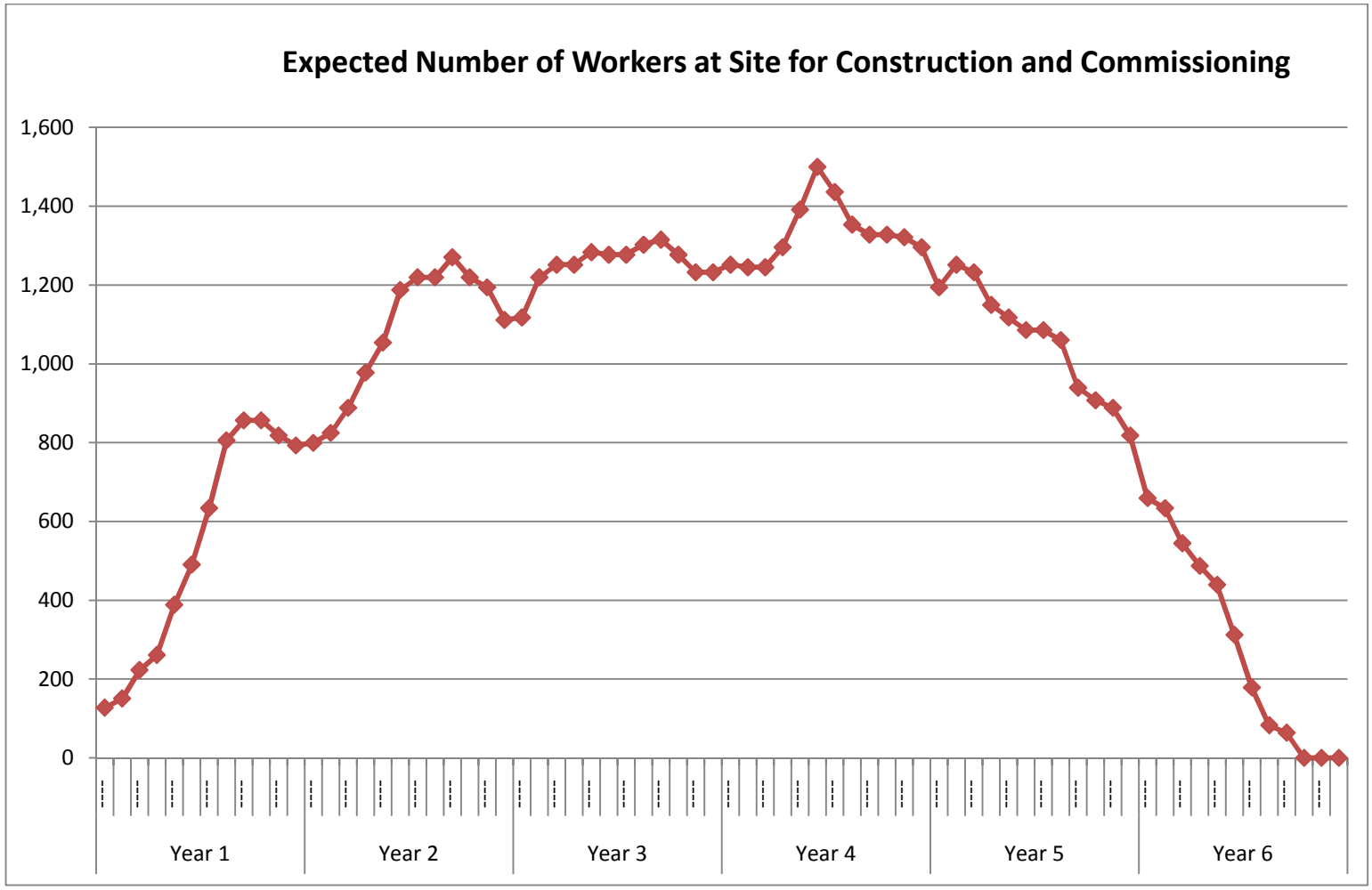


Figure 4-1: Expected Workforce from Year 1 to Year 6

5 ROLES AND RESPONSIBILTIES

The Lower Churchill Project environmental management team is comprised of NE-LCP and SLI environmental, engineering, and construction management staff. A Responsibility Matrix is provided in Figure 5-1. Figure 5-2 illustrates the team structure. Roles and responsibilities of team members are further defined in the sections that follow.

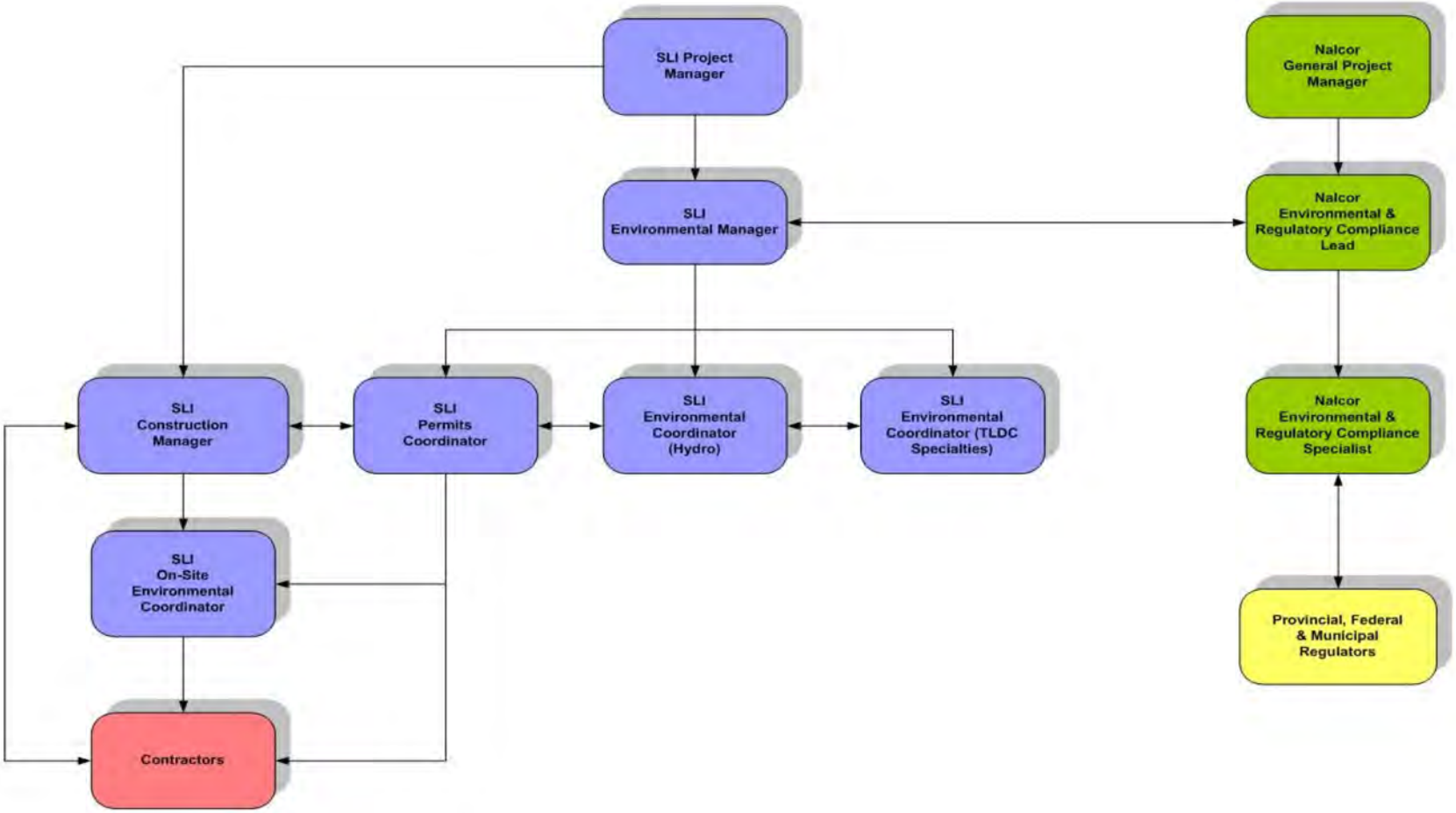


Figure 5-1: Lower Churchill Project Hydroelectric Generation Facility Project: Environmental Management Team

Activity	SNC-Lavalin Inc	Project Manager	Environmental Manager	Environmental Co-ordinator (Hydro)	Environmental Co-ordinator (TL/DC Specialties)	Permits Co-ordinator	Component Manager	Construction Managers	Interface Manager	Area Manager	On-Site Environmental Monitors	SLI Staff	Nalcor Energy	Garbage Removal and Disposal Contractor	Medical Services Contractor	Roads Contractor	Other Contractors
Administration Activities																	
Development of the WMP		A	R	S	S	S	S	S	I	I		S	I	I	I	I	I
Review of WMP		A	R	S	S	S	S	S	I	I		I	A/R	I	I	I	I
Approval of WMP (SLI/Nalcor)		A	R	I	I	I	I	I	I	I		I	R	I	I	I	I
Implementation of the WMP		A	R	R	R	R	R	R	I	I	S	I	C	R	R	R	R
Management/Revisions of the WMP		A	R	R	S	S	I	C	I	I	S	S	C	I	I	I	I
Contractor Orientation		A	C	I	I	I	I	R	I	I	S	I	I	R	R	R	R
WMP Compliance Monitoring (Contractors and Site Services)		A	R	R	S	S	I	C	I	I	R	I	C	C	C	C	C
Corrective Actions		A	R	C	C	C	I	R	I	I	S	I	I	R	R	R	R
Managing Compliance Tracking Registry		A	R	R	R	R	I	C	I	I	I	S	C	I	I	I	I
Waste Management Activities																	
Early Works																	
Sewage Disposal		A	R	S	S	C	I	R	I	I	R	I	I	I	I	R	R
Domestic Waste Disposal		A	R	S	S	C	I	R	I	I	R	I	I	I	I	R	R
Construction Waste Disposal		A	R	S	S	C	I	R	I	I	R	I	I	I	I	R	R
Hazardous Waste Disposal		A	R	S	S	C	I	R	I	I	R	I	I	I	I	R	R
Biomedical Waste Disposal		A	R	S	S	C	I	R	I	I	R	I	I	I	R	S	S
Work after first 6 months																	
Sewage Disposal		A	R	S	S	C	I	R	I	I	R	I	I	R	I	R	R/S
Domestic Waste Disposal		A	R	S	S	C	I	R	I	I	R	I	I	R	I	R	R/S
Construction Waste Disposal		A	R	S	S	C	I	R	I	I	R	I	I	I	I	R	R
Hazardous Waste Disposal*		A	R	S	S	C	I	R	I	I	R	I	I	I	I	R	R
Biomedical Waste Disposal		A	R	S	S	C	I	R	I	I	R	I	I	I	R	S	S

Accountable, **R**esponsible, **S**upports, **C**onsulted, **I**nformed

Figure 5-2: Responsibility Matrix

5.1 NALCOR

5.1.1 Individual Responsibilities

Nalcor's *Project Manager* shall be accountable for the review and acceptance of the *WMP*. As part of this process Nalcor shall be responsible for making sure that the plan as prepared is consistent with its environmental policy, and commitments made during the Environmental Assessment process to various aboriginal groups and stakeholders are honoured.

Nalcor's *Project Manager* shall be consulted on the various aspects of *WMP* management and will provide information to SLI's Environmental Management Team as required to manage and update the *WMP* and process applications for selected permits, as identified by Nalcor.

Nalcor's *Environmental and Regulatory Compliance Lead* and Nalcor's *Environmental and Regulatory Compliance Specialist* will support the *Project Manager* in his/her responsibilities. Communication and liaison with local municipalities and federal/provincial regulators will be the responsibility of the *Environmental and Regulatory Compliance Specialist.*

5.1.2 Nalcor Auditing Function

Nalcor will periodically perform audits on SLI's performance as it relates to the *WMP* to ensure compliance with commitments in the EIS and regulatory requirements.

5.2 SLI

Waste management support will fall under the guidance of the SLI Environmental Management Team (as shown in Figure 5-1). SLI shall provide onsite direction and monitoring of all waste management activities throughout the life of the Project. In addition, once the Garbage Removal and Disposal Contractor are engaged, SLI will:

- Provide a Hazardous Waste Storage Area for Contractor use; however construction and maintenance of storage facilities (i.e. used oil tanks) and final

disposal and removal of equipment will be the responsibility of the Contractor and he/she will abide by applicable regulations;

- Provide common collection locations for domestic waste and removal and disposal of this waste periodically through the GRDC[1];
- Provide services for the removal of sewage sludge through the GRDC[1];
- SLI/GRDC will not provide domestic waste collection services or sewage sludge removal services for Contractors operating during this phase in remote locations, nor for the road construction Contractor, reservoir clearing Contractor, ac Transmission Line Contractor, or for any construction camps used by them.

Administration type responsibilities are defined further in the following section of individual responsibilities.

5.2.1 Individual Responsibilities

SLI Project Manager

This individual shall be:

- Accountable for developing, implementing, managing and approving the *WMP;*
- Accountable for approving *WMP* revision requests;
- Accountable for all SLI staff actions including waste management compliance monitoring, tracking and potential corrective actions;
- Informed of Nalcor's review and acceptance of the *WMP*;
- Accountable for Contractor waste management actions and enforcing compliance related to the *WMP;* and
- Accountable for ensuring the Contractor receives the applicable site orientation related to waste management.

[1] Note the GRDC will remove and dispose of these wastes collected from only the hydroelectric generating facility site, Nalcor and Contractor laydown areas, and accommodations complex site.

SLI Environmental Manager

This individual shall be:

- responsible for all processes involved in developing, implementing and managing the *WMP*;
- Responsible for managing all *WMP* revision requests, including receiving such requests, coordinating the screening of these by appropriate members of SLI's and Nalcor's environmental management teams, and preparing/distributing waste management "Compliance Instructions" to key Project participants;
- Responsible for all SLI staff actions including waste management compliance monitoring and tracking, and enforcing corrective actions;
- Informed of Nalcor's review and acceptance of the *WMP*;
- Responsible for oversight of the Contractor's waste management activities such as storage and disposal;
- Responsible for distributing accepted *WMP* revisions to key Project participants, and receiving acknowledgement of receipt; and
- Responsible for ensuring that an annual performance review of the *WMP* is conducted.

SLI Environmental Coordinators (Hydro and Transmission)

This individuals shall be:

- Responsible for managing and implementing the *WMP* and waste management environmental compliance monitoring;
- Informed of Nalcor's review and acceptance of the *WMP* and the Contractor's orientation;
- Supportive to SLI's Environmental Manager in overseeing the Contractor's waste management activities;

- Responsible for maintaining a log of waste management "Compliance Instructions";
- Responsible to ensure all waste streams generated by the Contractors are identified in the Waste Management Plan; and
- Responsible for undertaking quarterly compliance audits for applicable components.

SLI Permits Coordinator:

This individual shall be:

- Responsible for managing the Permit Registry in conjunction with the *SLI Environmental Coordinator (Hydro)* and the *SLI Environmental Coordinator (Transmission);*
- Supportive to SLI's *Environmental Coordinators* with implementing and managing the *WMP* as well as waste management compliance monitoring;
- Informed of Nalcor's review and acceptance of the *WMP* and the Contractor's orientation;
- Consulted by the Contractors regarding disposal practices and requirements of permits; and
- Responsible for maintaining copies of permits/licenses, and track and communicate permit requirements for waste management.

SLI Component Managers:

These individuals shall be:

- Responsible for ensuring the *WMP* is included in procurement packages;
- Supportive for the development of the *WMP;*
- Consulted during waste management compliance monitoring; and
- Informed about all other aspects of the *WMP.*

SLI Construction Managers:

These individuals shall be:

- Responsible for overseeing construction including management of on-site waste management activities through implementation of the *WMP;*
- Responsible for reporting directly to SLI's *Project Manager* in St. John's;
- Consulted on all aspects of management of the *WMP*, waste management compliance monitoring, and compliance tracking;
- Responsible for ensuring Contractors receive the appropriate orientation and training required related to waste management; and
- Responsible for overseeing waste management activities by the Contractors at the Project Site, and reporting any non-compliance and enforce corrective actions.

SLI Area Managers:

These individuals shall be:

- Informed on all aspects of the *WMP;*

SLI On-Site Environmental Monitors:

These individuals shall be:

- Responsible for monitoring on-site Project activities;
- Responsible for evaluating the Contractors' environmental performance with respect to requirements established in the *WMP;*
- Responsible for tracking on-site compliance with regulatory requirements and conditions of all permits and approvals as they relate to waste management.
- Responsible for reporting directly to the OSEC, Construction Manager and SLI's Environmental Coordinators;
- Responsible for interacting with the Contractors on waste management matters;

- Responsible for preparing and submitting daily reports to SLI's Construction Managers, Environmental Manager, and Environmental Coordinators;
- Supportive to SLI's Construction Managers with ensuring Contractors receive the appropriate waste management orientation before working on site; and
- Responsible for ensuring that the Contractor's waste streams are all properly characterized.

SLI On-Site Environmental Coordinators:

These individuals shall be:

- Responsible for coordinating all activities and monitoring effort by the On-Site Environmental Monitors to ensure the WMP is complied with.
- Responsible for evaluating the Contractors' environmental performance with respect to requirements established in the *WMP;*
- Responsible for reporting directly to the Construction Manager and liaising with SLI's Environmental Coordinators;
- Responsible for interacting with the Contractors on waste management matters; and
- Supportive to SLI's Construction Managers with ensuring Contractors receive the appropriate waste management orientation before working on site.

5.2.2 SLI Auditing Function

The purpose of SLI's auditing function will be to evaluate the performance of the *WMP* and to identify opportunities for continual improvement.

SLI auditing will consist of daily field reports, quarterly environmental compliance audit reports, initiating corrective action and annual performance reviews.

Daily reports will be completed by the On-Site Environmental Monitor. These reports will focus on the Contractors' environmental performance, including a summary of their waste management activities.

A quarterly environmental compliance audit reports will be completed by SLI Environmental Coordinators for the Transmission and Hydro components. These reports will review all aspects of the Contractor's performance and will have a section focusing on incidents of non-compliance with the *WMP*. SLI's Environmental Coordinators shall distribute the Environmental Compliance Audit Reports to relevant Project participants.

An annual performance review will be completed by key members of the Environmental and Construction teams. This audit will review all aspects of the Contractor's performance, including activities that relate to waste management and disposal. The review process will give all parties a chance to evaluate overall environmental performance and compliance with government regulations, permits and all Plans, including the *WMP*.

5.3 CONTRACTORS

In all cases, Contractors must communicate clearly to SLI the types and volumes of waste they produce. In addition, they must regularly monitor their waste management activities to ensure that all required approvals are always in place and that facilities are appropriately licensed to accept their wastes.

5.3.1 Pre-GRDC Implementation

Contractors shall be responsible for the management of waste in their working areas in accordance with this *WMP*. Responsibilities include the safe collection and containment of all hazardous and non-hazardous waste. Contractors will also be responsible for the offsite transportation and final disposal of waste to a facility or site licensed to accept it. All waste will be the responsibility of the Contractor.

Biomedical waste will be the responsibility of the Medical Services Contractor. Contractors will support the Medical Services Contractor through approved temporary disposal of biomedical items.

5.3.2 Post-GRDC Implementation

The GRDC shall be responsible for collection of domestic waste and sewage removal at the camp facility post contract award. Contractors shall support the GRDC in the task of domestic waste disposal by management of domestic waste in their specific working areas in accordance with this *WMP*, including the transportation of waste to the provided containers or designated storage areas.

In certain cases in remote areas or areas that are difficult to access, Contractors (including the Roads Contractor, Reservoir Preparation Contractor and ac Transmission Line construction) will be responsible for managing their own domestic waste and sewage removal. Contractors will be responsible for the offsite transportation and final disposal of the domestic waste and also for engaging a licensed Sewage Removal Contractor.

All Contractors are responsible for their own construction and demolition material and all hazardous waste generated as a result of their activities. This material shall be transported to a facility or site licensed to accept it. A temporary storage area will be identified by SLI for temporary placement of hazardous materials, until such time that it can be transported to the appropriate facility or disposed of by a Hazardous Materials Sub-contractor (as engaged by the Contractor). This storage area is only a location to be provided by SLI, and the construction, maintenance and eventual removal of all hazardous material is the responsibility of the Contractor.

Biomedical waste will be the responsibility of the Medical Services Contractor. Contractors will support the Medical Services Contractor through approved temporary disposal of biomedical items.

6 MANAGEMENT PLAN

This *WMP* has been prepared, with considerations for current waste management practices in the province, for Component 1 and 4B of the Lower Churchill Project. That being said, waste management within the Province is changing, under the direction of the Provincial Waste Management Strategy. It can be expected that waste management requirements for the Project may need to be revised and revisited in the future as more local and regional modern waste management facilities and programs are established. Currently the Happy-Valley Goose Bay region contains a municipal landfill that accepts domestic waste along with a privately owned soil treatment facility licensed to accept hydrocarbon impacted soil. There is no licensed hazardous waste facility in the region. In addition, initiatives and programs for waste segregation are limited in the region at this time. As a result of the limited facilities and waste programs in the region, it is anticipated that most hazardous wastes will require transportation and disposal outside of the region or Province. In the event local waste initiatives and new waste facilities are established, the *WMP* will be revised to reflect these changes. Revisions to this plan shall be made as identified in the Preface.

This *WMP* addresses all wastes expected to be generated onsite during Component 1 and 4B work, classifies waste into streams and outlines the handling and disposal options for each type of waste. A summary of potential waste treatment and disposal options is included in Table 6-1.

All construction activities and their associated waste streams (outlined in the subsections below) are subject to appropriate regulations. Section 3 of this document provides a list of relevant legislation that applies to waste management on the LCP.

Contractors shall provide the Engineer with two (2) copies of all permit documentation and licenses immediately on receipt from regulatory agencies. Any subcontracted facility accepting any type of waste and recyclable materials shall provide documentation to the Contractor, and copies of this documentation shall be kept on file for inspection by the Engineer.

6.1 WASTE CLASSIFICATION

Contractors on site are responsible for the handling, sorting and in some cases storage and disposal of the waste they generate at the site (See Section 5, Roles and Responsibilities for Contractors responsibilities at different stages of the Project).

There are a number of strategies that Contractors can use to handle wastes expected at the site. These strategies are as follows:

- **Waste segregation:** All site Contractors, Subcontractors and the GRDC will be required to implement category-wise segregation of waste streams (i.e. liquid wastes, solid wastes, recyclable, hazardous, etc.) in accordance with local disposal requirements. All waste categories will be analyzed and the principals of the following three R's will be applied:
- **Reduction initiatives:** Reducing the raw material consumption is the first step to reduce waste generation. To practice this principle all processes and material used will be evaluated on the basis of possible reduction in raw material usage.
- **Recovery/reuse initiatives:** Recovery of usable material or energy as a by-product is an important part of the waste minimization process. All opportunities for onsite reuse of waste materials will be highly encouraged.
- **Recycling initiatives:** Recycling is the next option considered for the successful management of the waste streams. Wherever possible, recycling of used oil, beverage containers, tires, copper and aluminum, etc. and reuse of the material in other applications will be encouraged. A site orientation on recycling will be provided by SLI's Representative to all Contractors, Subcontractors and employees regarding recycling responsibilities.
- **Disposal:** Disposal becomes the final option when other options are not technically or economically feasible. All waste shall be disposed of according to relevant guidelines and regulations, as detailed in the following sections.

Hazardous vs. Non-Hazardous Wastes

The types of solid wastes considered include inert or non-hazardous wastes of various kinds (i.e. containers, filters, belts, scrap metals, domestic garbage, etc.) or hazardous wastes (i.e. used oils, solvents, paints, used/unused chemicals, old batteries, chemical based sludge etc.).

Both hazardous and non-hazardous wastes will be generated at the site. A general description of such wastes is illustrated in Figures 6-1 and Figure 6-2. A description of the prescribed handling and disposal methods of the anticipated materials generated at the site is provided in the following sections.

A Hazardous Waste Storage Area (HWSA) will be provided by the Project; however the Contractors will be responsible for construction and maintenance of any storage facilities (i.e. used oil tanks) that they place at the site. Contractors shall arrange for transportation to a licensed hazardous waste facility for possible recovery, treatment and disposal as required. All storage, handling and disposal activities will follow applicable regulations.

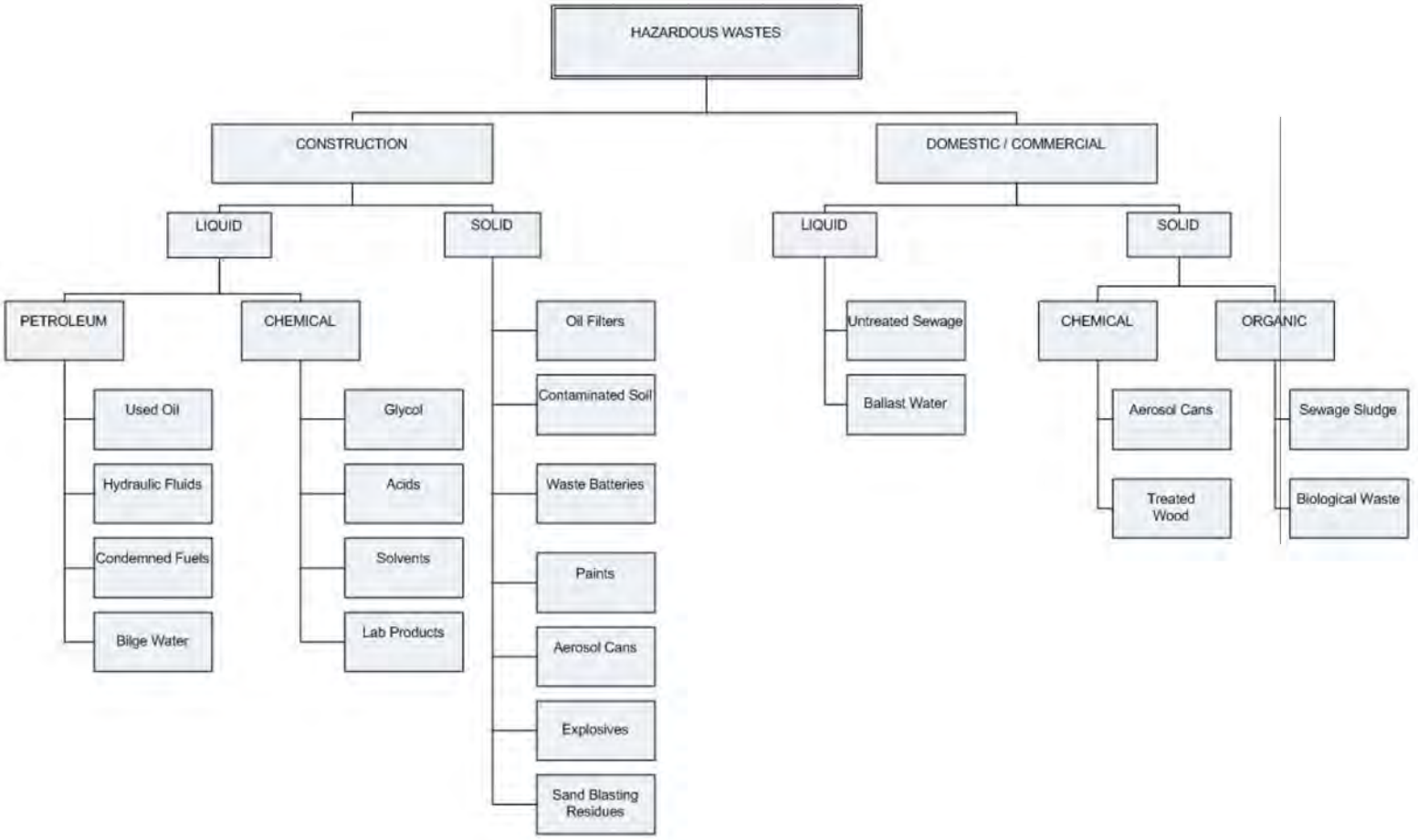


Figure 6-1: Potential Hazardous Waste Generate

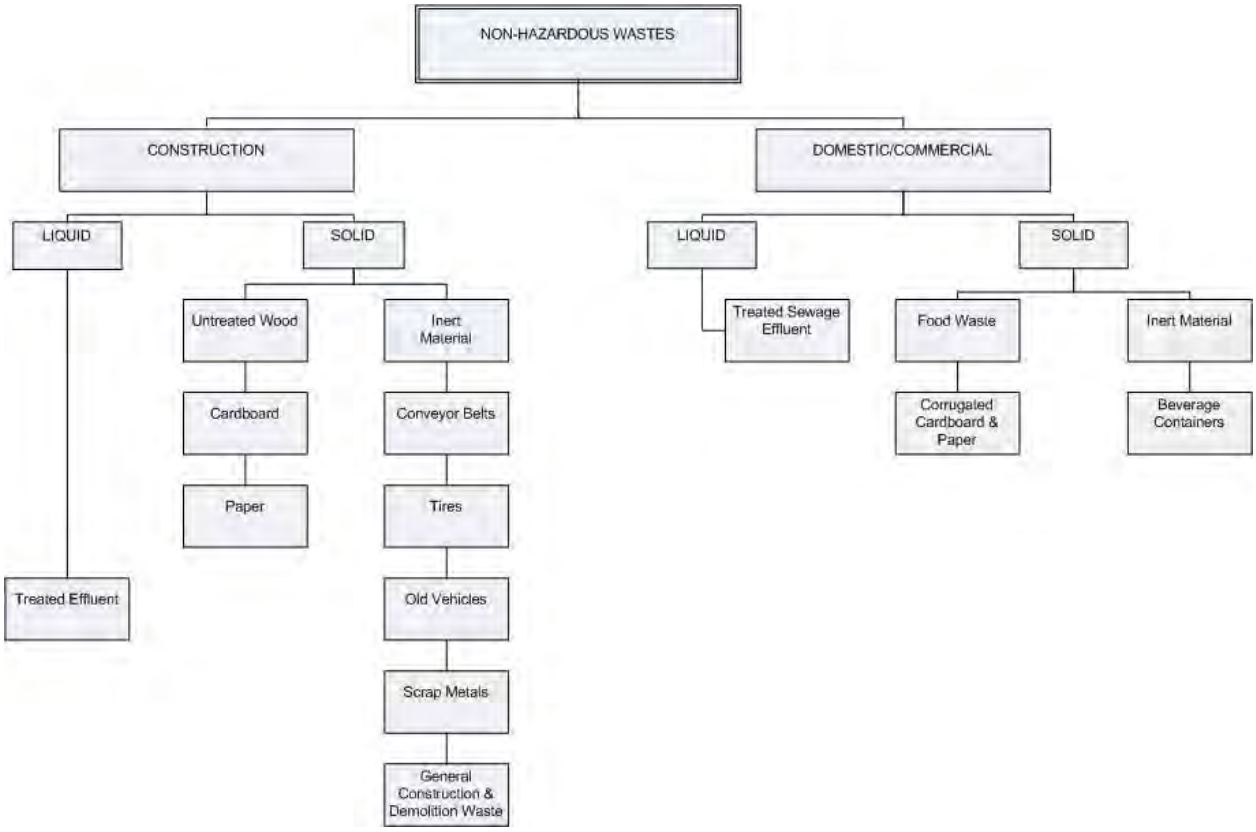


Figure 6-2: Potential Non-Hazardous Wastes Generated

6.2 HAZARDOUS WASTES

It is expected that hazardous wastes will be generated during construction activities. Hazardous wastes include such materials as used batteries, paint, cleaning fluids and petroleum based wastes.

Special precautions shall be exercised when handling these materials since the improper release or disposal could adversely affect the environment. Personnel handling wastes will be required to have specific training and utilize PPE to ensure safe handling and disposal.

A HWSA will be provided by the Project, however the Contractor will be responsible for construction and maintenance of any storage facilities (i.e. used oil tanks).

Contractors shall arrange for transportation to a licensed hazardous waste facility for possible recovery, treatment and disposal as required.

All chemical and hazardous wastes generated in remote areas will be managed under all applicable guidelines and regulatory requirements and brought to a licensed hazardous waste facility on a regular basis. Processing of the various anticipated chemical wastes are described below. Approved containers for hazardous wastes stored on site and transported to licensed disposal/recycling facilities shall meet requirements of the *Transportation of Dangerous Goods Regulations (see http://www.tc.gc.ca/eng/tdg/moc-menu-202.htm).*

Note: Contractors are responsible for disposal of their Hazardous waste including preparation, suitable shipping containers and transportation of the hazardous waste to an offsite licensed disposal facility. Regular checks will be made by the On-Site Environmental Monitors.

6.2.1 Hazardous Construction Wastes

6.2.1.1 Hazardous Construction Liquid Petroleum Wastes

Petroleum-based wastes generated at the site will primarily be used engine and hydraulic oil. In addition there may be rear end/differential gear lubricants, oil from site electricity generators, used degreasing solvents, contaminated or expired diesel. These wastes shall be segregated as necessary in order to render the individual waste streams easier to reuse for other purposes, recycle or permit recovery of by-products.

Used Oil and Hydraulic Fluids

The Contractor is encouraged to initiate acceptable recycling options for used oil, either onsite or offsite, wherever practical. For example, used oil could be reused or combined (with new oil) where low-grade fuels may be used such as kerosene heaters, waste oil burners for shops and warehouses (with DOEC approval) or it could be sent offsite for recycling.

The Contractor shall deposit used oil in a secondary containment tank located at the HWSA. The Contractor is responsible for installing and maintaining these tanks. The waste oil shall be regularly collected by a qualified and experienced Hazardous Waste Contractor. The Hazardous Waste Contractor shall be engaged by the Contractor.

The tanks will have double-containment and roof-vent connection for oil removal as defined in the *Used Oil Regulations*. All connecting pipes will be above ground, making it easier to inspect for leaks. The tank fill ports will normally be locked and the keys made accessible to designated employees only as per the *Provincial Used Oil Control Regulations*.

Note: Waste oil may be contaminated with small amounts of diesel fuel, heating fuel and water, while still retaining its recycling properties. Contamination with gasoline, glycol, solvents, or solids will render waste oil unfit for recycling into usable engine oil at any offsite facility and create a large increase in disposal unit costs.

Regular monitoring will be carried out as per “Design, Construction, Operation, Maintenance and Inspection of Terminal and Tank Facilities Guidelines”, API-2610 and any additional provincial registration requirements and *Provincial Used Oil Control Regulations* under the *Environmental Protection Act*. The Contractor shall provide the Engineer with two (2) copies of all permit documentation immediately on receipt from regulatory agencies. This includes the permit from the disposal facility permitted to accept the used oil.

The Contractor is required to maintain an active inventory of all petroleum products on site. This will ensure that reasonable balance is maintained between the amount of oil used/recovered versus amounts unused and in inventory.

Condemned Fuels

Diesel fuel is sometimes condemned when the water content is too high. These fuels can be stored in drums at the HWSA by the Contractor and transported offsite to be used by others as low-grade fuels through a waste exchange program or sent to a licensed offsite facility for destruction.

Bilge Water

The word is typically used to describe the water that collects in the bilge compartment of a marine vessel. Water that does not drain off the side of the deck drains down through the ship into the bilge. This water may be from rough seas, rain, minor leaks in the hull, other interior spillage, etc. The water that collects in the bilge must be pumped out to prevent the bilge from becoming too full and threatening to sink the ship.

Bilge water can be found aboard almost every vessel. Depending on the ship's design and function, bilge water may contain water, oil, urine, detergents, solvents, chemicals, pitch, particles, and so forth.

By housing water in a compartment, the bilge keeps these liquids below decks, making it safer for the crew to operate the vessel and for people to move around in strong weather.

Under no circumstances shall bilge water be discharged into the ocean. This water shall be collected by an approved waste management firm, and treated and/or disposed of at an approved hazardous waste facility.

6.2.1.2 Hazardous Construction Liquid Chemical Wastes

Solvents

During construction, solvents will be used as a degreasing agent in the maintenance shops, Generator enclosures and utility services buildings. These degreasing solvents are toxic petroleum based chemicals; however, non-toxic citrus-based alternatives shall be encouraged as substitutes where only moderate degreasing or

cleaning is required. Detergents and steam jets shall be used where feasible to minimize the use of solvents. Solvents shall not be allowed to drain onto the ground; they shall be collected in drip pans for reuse or disposal.

Residual or used solvents shall be stored in leak-proof containers. The containers will be shipped offsite to a licensed recycling/disposal facility. Industrial part washers/solvent recyclers are available and Contractors are encouraged to use them to reduce the amount of waste solvent generated.

Lab Products

During construction, materials testing may be established on site. These sites will predominantly perform physical tests; chemical waste generation will be minimal. The personnel working in these facilities will be trained to identify and segregate the hazardous components from their waste streams. The chemical wastes shall be stored in containers (as outlined in Material Safety Data Sheets (MSDSs) required by Workplace Hazardous Materials Information System regulations and other relevant legislation, as shown in Table 6-1) and shall be collected by a qualified and experienced Hazardous Waste Contractor.

6.2.1.3 Hazardous Construction Solid Wastes

Used Filters

Used oil filters will be generated with ongoing heavy equipment maintenance. Used filters drained of oil will be stored in separate lined drums established at the HWSA by the Contractor for pickup by a qualified and experienced Hazardous Waste Contractor. A final record of disposal from the licensed hazardous waste facility should be provided by the Contractor to the Engineer.

Contaminated Soil

Effective implementation of this *WMP* should lead to a reduction of soil contamination via on-going inspection and scheduled maintenance of equipment, use of trays for draining, lining of loading and unloading zones and using secondary

containment, for example secondary containment of hazardous materials storage tank areas. In spite of these measures, spills, leaks and ruptures may occur and hydrocarbon contamination of soil is a possibility. All spills and leaks shall be reported to the On-Site Environmental Monitors and immediate corrective action shall be taken. Refer to the Master Spill Response Plan and the P-WEPP for contingency and response plans in the case of a petroleum spill. Contaminated soil shall be transported to a licensed Soil Treatment Facility.

Note: Contaminated soil should be substantially reduced through education programs, equipment maintenance, operational techniques and manual "pick and shovel" excavation of land based spills wherever possible. The On-Site Environmental Monitors will be provided with a progressive and final record of disposal from the offsite licensed soil treatment facility.

Waste Batteries

It is expected that the bulk of used batteries generated will be primarily the lead acid type.

Used batteries shall be stored at the designated HWSA. The Contractor shall be responsible for storage/disposal/recycling of used lead/acid batteries, including draining and provision of shipping pallets, and transportation of the waste batteries to an off-site licensed disposal or recycling facility. The following procedures should be used for lead acid type batteries, such as those used by vehicles and industrial equipment:

- protect battery terminals with electrical tape to prevent short circuits;
- wrap battery with cloth, tape, and place in a polyethylene (garbage) bag;
- place in sturdy cardboard box, again packed with tape;
- place packaged batteries on a pallet, ensure all batteries are covered, and wrapped in shipping wrap or strapped. Do not ship batteries in a drum.
- Batteries must be shipped in accordance with the TDG Regulations.

Paints

Waste paint will be recycled or reused if possible. Water-based paint will replace oil-based paint, alkyd, or epoxy wherever technically and economically feasible. Waste paint will be stored in drums at the designated HWSA and shipped to a licensed recycle/disposal facility. Paint cans that do not contain residual paint can be placed with general waste for disposal at a landfill approved to accept such waste. Paint and paint cans generated by Contractors, will be their sole responsibility, along with handling, shipping and disposal as applicable.

Aerosol Cans

The use of aerosol cans on site will be discouraged, however; where unavoidable, aerosol cans with residual product shall be collected separately in marked containers at the various work areas. Contractors, employees and other site personnel will be advised to separate these cans from the general waste stream. The cans shall be transported off site by a certified Hazardous Waste Contractor. Aerosol cans that do not contain residual product can be placed with general waste for disposal at a landfill approved to accept such waste.

It is recommended that the Contractor follow the waste minimization policy, as aerosols should be substituted wherever possible with refillable type pump/spray bottles.

Explosives

The Contractor will deal solely and expediently with any contaminated or expired explosive material in accordance with all licensing and regulatory requirements, standards and best practices. If any explosives are to be destroyed or shipped off-site, the Contractor will acquire approval from the On-site Environmental Monitors prior to taking action.

Explosives packaging may be burned at a site designated to do so. The Contractor shall get approval from the On-Site Environmental Monitor prior to taking action.

Sandblasting Residues

During construction, sandblasting operations will be carried out in order to prepare some metal surfaces for coatings. During sandblasting activities, the surrounding areas shall be shrouded for dust control and all residual materials resulting from the sandblasting shall be collected by Contractor and temporarily stored in drums for analytical testing consistent with DOEC's Pollution Prevention Division's guidance document entitled *Leachable Toxic Waste, Testing and Disposal*. The sandblasting residues, if determined through analysis as hazardous, shall be shipped offsite in accordance with all regulatory requirements, including those of the *Transportation of Dangerous Goods Regulations,* for final disposal at a facility licensed to accept hazardous materials. As previously discussed, hazardous material shall be temporarily stored in the Project provided storage location (HWSA). If the sandblasting residue is deemed non-hazardous, it will be transferred to a landfill approved to accept such waste.

6.2.2 Hazardous Domestic/Commercial Wastes

6.2.2.1 Hazardous Domestic/Commercial Liquid Wastes

Untreated Sewage

Toilet and wash facilities will be located throughout the site. For early works packages, port-a-potties or holding tanks will likely be used. Subsequent to the Early Works program septic systems with tile fields will be utilized for the starter camp, a full water and sewer/sewage treatment plant will thereafter be used for Accommodations Complex, sewage holding tanks and portable toilets will be used at remote locations. See Section 5, Roles and Responsibilities for information on sewage waste throughout the life of the Project.

In the case of toilet facilities not connected to any form of treatment, human waste shall be collected using a licensed septic removal service and sent to a licensed disposal facility. This will be required in cases where the responsibility does not rest with the GRDC (e.g. construction camps and work sites used by the Reservoir

Clearing and ac Transmission Line Contractors, or any of the Early Works Contractors). The Contractor shall provide the Engineer with two (2) copies of all permit documentation and licenses for this service immediately on receipt from regulatory agencies. These services are available within the Town of Happy Valley-Goose Bay.

Ballast Water

The Ballast Water Control and Management Regulations, under the *Canada Shipping Act,* identifies the procedures to be used for release of Ballast Waters in Canadian Waters. Provisions of these regulations shall be strictly followed by all vessels involved in transporting goods, equipment, and materials involved on the Project.

6.2.2.2 Hazardous Domestic/Commercial Solid Wastes

Organic - Biomedical Waste

Small amounts of biomedical wastes will most likely be generated during construction. For the purpose of this Waste Management Plan, biomedical wastes regarded as hazardous include:

- All waste sharps (e.g. waste needles), wherever they are generated;
- All waste material generated in on-site medical clinics and mobile treatment centres that have become contaminated with bodily fluids;
- All wastes deposited in receptacles that are labelled “Biomedical Wastes Only” and which are strategically located within Company provided facilities; and
- All similar wastes collected and stored by Contractors in their own facilities.

Note that all soft waste materials contaminated with “significant amounts” of bodily fluids shall be immediately double bagged in plastic. These shall be placed in a “Biomedical Waste Only” receptacle provided by the Company or Contractor. All other materials and surfaces that have come in contact with such fluids shall be immediately cleaned with a disinfectant, such as bleach.

Persons using needles to administer their own medication (e.g., diabetics) shall place their used needles in the approved sharps containers provided throughout the site.

Sharps generated in remote locations shall be collected and stored in approved sharps containers.

Biomedical wastes collected from filled sharps containers and “Biomedical Waste Only” receptacles shall be removed from the work site and transported to a licensed facility for destruction and disposal.

Disposal of biomedical waste collected at Company supplied facilities is the responsibility of the Medical Services Contractor. There is an existing bio-medical waste collection service that collects waste from Happy Valley - Goose Bay. The Medical Services Contractor shall organize a pickup/drop off schedule with for this service.

Off-site removal and disposal of biomedical wastes collected by Contractors and stored at their facilities shall be the Contractor’s responsibility.

Organic - Sewage Sludge

Sewage sludge generated by sewage treatment systems shall be removed from site by the GRDC and disposed of at a licensed waste disposal site.

Chemical - Treated Wood

During construction, pieces of unusable lumber treated with wood preservation chemicals shall be collected and disposed of in a licensed waste disposal site.

Chemical - Aerosol Cans

Aerosol cans shall be collected and disposed of in a licensed waste disposal site.

6.3 NON-HAZARDOUS WASTES

The handling, storage and disposal of waste materials that are classed as Non-Hazardous and generated at the site is generally the sole responsibility of the

Contractor and shall be managed under all applicable guidelines and regulatory requirements.

An exception to this would be food wastes generated at the permanent Accommodations Complex. These wastes will be collected, hauled, and disposed of by the GRDC in accordance with a services contract.

6.3.1 Non-Hazardous Construction Wastes

6.3.1.1 Non-Hazardous Construction Liquid Wastes

Treated Effluent

Treated effluent (including effluent discharging into a water body from settling ponds, sewage treatment plants, and concrete batch plants) shall be released to the environment in accordance with SLI's approval.

Prerequisites for this approval are that all applicable regulatory permits and approvals be provided to SLI, and that the effluent quality is shown to meet all regulatory requirements (e.g. *Environmental Control (Water and Sewer) Regulations* and Section 36(3) of the *Fisheries Act)*, and permit conditions.

All concrete trucks and associated equipment shall be cleaned in a manner that conveys all wash water to an approved settling pond to ensure its treatment prior to release to the environment. Washing of this equipment should preferentially take place at the concrete batch plant; however, minor washing of concrete truck chutes and hand tools may take place at the delivery location, provided that all wash water is contained and directed to an approved settling pond for treatment.

6.3.1.2 Non-Hazardous Construction Solid Wastes

The discussion below focuses on solid non-hazardous waste destined to approved waste disposal sites. Written copies of the site operators' permission shall be provided to the Engineer prior to disposal.

Inert Material

SLI is committed to reducing the volume of the overall waste to the greatest extent practicable by reusing and recycling. Inert waste, such as waste concrete from the cleaning of cement trucks and pumps, off-spec and/or surplus production shall be reused rather than dumped whenever practicable.

If required, disposal of small amounts of waste concrete shall be done at a designated disposal site, which shall be accepted by the On-Site Environmental Monitors. The concrete shall be discharged into one or more "cow patties" not more than 6 feet in diameter and allowed to cure completely before being incorporated into the site fill.

Where possible, off spec or waste concrete shall be utilized to manufacture items such as barriers, retaining structures, etc; disposal shall be considered a last resort. If disposal is required, construction and demolition (C&D) waste shall be taken to a landfill approved to accept such waste.

Conveyor Belts and Tires

Conveyor belts and tires have limited life and, when no longer usable, contribute to construction waste generation.

Contractors must pursue a tire and conveyor belt exchange program with the vendors; and an investigation of alternative uses for old conveyor belts and tires shall be ongoing. Some suitable alternate uses for tires are dock protection and road protection in turning areas. However, for the most part, used conveyor belts and those tires not included under the MMSB tire recycling program (i.e. heavy equipment and industrial tires, etc.) shall be removed from the site and transported to a licensed waste disposal area. Tires included under the MMSB program, shall be taken to a MMSB authorized collection point by the Contractor for disposal.

Old Vehicles

Vehicles and equipment shall be shipped offsite for reuse/recycle when they are no longer useable. While awaiting back shipping, each Contractor shall store unusable

vehicles and/or their metallic parts in areas designated by the Engineer. These shall be collected and hauled to a licensed metals recycling facility for processing.

All fluids shall be drained/collected and stored in a manner acceptable to SLI (in Project provided storage location previously mentioned) where they shall be collected and/or transported to a licensed Hazardous Waste Facility.

Scrap Metals

This waste stream consists of ferrous and nonferrous scrap metals of various types. Metal scraps may be generated from cut-off parts of reinforced steel bar, wire, ends of piping and other similar items. Scraps shall be deposited in a metals storage bin and collected by a licensed metals recycler.

Bulky scrap metals such as unusable vehicles or large appliances shall be shipped offsite for salvaging and disposal. Reusable scrap metals such as sheeting and used drums will be reused as a part of an effective waste reduction program. Recoverable/recyclable scrap metals shall be sent to the recycling facilities directly by the Contractor. Scrap metals that cannot be recycled will be sent to a landfill approved to accept such waste.

General Construction and Demolition Waste

Waste generated during construction activities may include salvageable materials such as electrical cables and reels, cladding, piping and insulation, where possible, these shall be removed from site for potential reuse. Alternatively, any useable excess materials, which might be required for maintenance and/or repairs, will be stored neatly in a warehouse or designated laydown area. Innovative use of excess materials, such as using electrical reels for stacking supports or portable bollards, will be encouraged where practical. Materials that cannot be recycled or reused will be transported directly to a landfill approved to accept such waste.

Untreated Wood

During the construction phase, pieces of broken untreated lumber shall be collected and disposed of in a landfill authorized to accept such waste. .

Larger pieces of untreated lumber shall be stored at an SLI approved temporary storage area for potential reuse. Site personnel shall be informed to reuse this lumber material as much as possible or wherever feasible. When no longer usable at the site, untreated wood waste shall be shipped offsite for reuse.

Cardboard and Paper

Cardboard and paper wastes shall be recycled collected and sent to a local recycling facility, if available, or disposed of at an approved waste disposal site.

6.3.2 Non-Hazardous Domestic/Commercial Wastes

6.3.2.1 Non-Hazardous Domestic/Commercial Liquid Wastes

Effluent from a sewage treatment system that meets all regulatory requirements and permit conditions for discharge to the environment shall be released in accordance with the Engineers approval.

6.3.2.2 Non-Hazardous Domestic/Commercial Solid Wastes

Inert Material

The solid domestic waste stream consists of food waste, recyclable containers (cans, bottles), inert non-combustible domestic waste, packaging, corrugated cardboard, plastics, and paper and paper products.

The disposal of solid domestic waste is the sole responsibility of the Contractor for all Early Works contracts. For all other contracts, a GRDC is expected to be in place and this waste disposal Contractor shall assume responsibility for this waste stream.

All solid wastes generated in remote locations (including the Roads Contractor) will be managed by individual Contractors and transported to a licensed waste disposal site on a regular basis.

Food Waste

The majority of the food wastes will be generated in the lunchroom areas of the construction site and accommodations complex. All food waste shall be collected and disposed of in an enclosed and covered wildlife-proof bin to minimize the attraction of wildlife.

Bag lunch wastes generated in various work areas shall be collected in plastic bags and taken directly to wildlife-proof bins. This will then be placed in a storage bin and taken to a landfill for disposal or compost. Appendix A includes a supplier's brochure of bear resistant containers that are acceptable for use as wildlife-proof bins.

Where possible, purchasing bulk food packages shall be encouraged at the site to minimize waste production, through the reduction of packaging materials.

Beverage Containers

Although plastic waste will be included in the garbage stream, bulk purchases and, where possible, reusable containers should be utilized to reduce the overall generation of plastic waste.

Where reuse of beverage containers at the site is not possible, and where practical, arrangements shall be made to transport those beverage containers to a local recycling depot.

Corrugated Cardboard and Paper

Fibre waste will be included in the garbage stream; however, where possible, paper reduction strategies should be exercised to reduce the overall generation of fibre waste. Examples of reduction strategies may include workplace initiatives promoting double-sided printing, employee training, procurement policies with respect to packaging, etc.

All cardboard and paper shall stored in a bin and be shipped off site to a licensed recycling facility, when required.

Reduction in cardboard waste will be achieved by encouraging Contractors and suppliers to avoid extensive packaging.

6.4 OTHER WASTES

6.4.1 International Waste

Due to the possibility of shipment of supplies by water at the Happy Valley - Goose Bay and Cartwright Ports, international waste may be off-loaded from an international source, upon inspection and approval of the Canadian Border Services Agency (CBSA). The On-Site Environmental Monitors will be responsible to contact CBSA prior to off loading, however under a contractual arrangement, responsibility will rest with the Contractor and all associated documentation and records will be made available to the On-Site Environmental Monitors upon request.

Table 6-1: Treatment and Disposal Plan

Waste Type	Site Handling/Shipping Methodology	Treatment or Disposal Strategy	Applicable Regulations/Permits/Information	Primary Responsibility
Petroleum Waste Stream				
Used Oil including used Hydraulic Fluids	Collect in trays and drums. Transfer to ULC storage tanks. Ship offsite.	Ship Offsite to a Licensed Facility for recycling or destruction	*Used Oil Control Regulations, EPA* *GAP Regulations, EPA* *TDG Regulations* *Reference Material for the WHMIS Requirements of the Hazardous Products Act and Controlled Products Regulations* *Fire Prevention Flammable and Combustible Liquids Regulations under the Fire Prevention Act, 1991*	Contractor
Condemned Fuels	Collect and store in drums at the Hazardous Waste Storage Area (HWSA). Ship offsite.	Ship Offsite to a Licensed Facility for recycling or destruction	*GAP Regulations, EPA* *TDG Regulations* *Reference Material for the WHMIS Requirements of the Hazardous Products Act and Controlled Products Regulations* *Fire Prevention Flammable and Combustible Liquids Regulations under the Fire Prevention Act, 1991*	
Used Oil Filters	Store canisters in separate drums at the HWSA. Ship offsite.	Recovery/Landfill at Licensed Offsite Facility	*Used Oil Control Regulations, EPA* *TDG Regulations* *Reference Material for the WHMIS Requirements of the Hazardous Products Act and Controlled Products Regulations*	
Contaminated Soils	Analyse Samples. Consult Regulations. Ship offsite.	Ship to Licensed Offsite Facility for Destruction or Bioremediation	*NL Guidance Document for the Management of Impacted Sites*	

Waste Type	Site Handling/Shipping Methodology	Treatment or Disposal Strategy	Applicable Regulations/Permits/Information	Primary Responsibility
Chemicals				
Acids	Store in approved containers at the designated HWSA. Ship to offsite disposal facility.	Reduce / Dispose offsite.	*TDG Regulations* *Reference Material for the WHMIS Requirements of the Hazardous Products Act and Controlled Products Regulations*	Contractor
Solvents	Use non-toxic solvents when feasible. Store in approved containers at the designated HWSA. Ship to disposal facility offsite.	Reduce / Dispose offsite.	*TDG Regulations* *Reference Material for the WHMIS Requirements of the Hazardous Products Act and Controlled Products Regulations* *Fire Prevention Flammable and Combustible Liquids Regulations under the Fire Prevention Act*	
Waste Batteries	Store at the designated HWSA. Ship offsite by a qualified and experienced Hazardous Waste Contractor as per TDG requirements.	Ship to Licensed Offsite Facility for recycling or disposal.	*TDG Regulations* *Reference Material for the WHMIS Requirements of the Hazardous Products Act and Controlled Products Regulations*	Contractor
Aerosol Cans	Collect cans separately in marked drums. Store at the HWSA. Ship offsite by a qualified and experienced Hazardous Waste Contractor.	Reduce / Ship contents to Licensed Offsite Facility Offsite for disposal.	*TDG Regulations* *Reference Material for the WHMIS Requirements of the Hazardous Products Act and Controlled Products Regulations*	
Solvents, Paints, epoxies and adhesives.	Collect cans with residual product in drums. Store at the designated HWSA. Ship offsite. Empty containers can be collected	Dispose offsite at an offsite Licensed facility.	*Fire Prevention Flammable and Combustible Liquids Regulations under the Fire Prevention Act, 1991*	

Waste Type	Site Handling/Shipping Methodology	Treatment or Disposal Strategy	Applicable Regulations/Permits/Information	Primary Responsibility
	and shipped with regular waste for disposal in Regional Landfill.			
Laboratory Products	Store at source. Dispose offsite.	Dispose offsite at an offsite Licensed facility.	*TDG Regulations* *Reference Material for the WHMIS Requirements of the Hazardous Products Act and Controlled Products Regulations*	
Explosives (expired or contaminated)	In accordance with all regulatory standards, protocols, good practices.	Reduce, destroy, ship off-site	*TDG Regulations*	Contractor
Other Wastes				
Fluorescent bulbs/tubes	Store at the designated HWSA. Ship offsite by a qualified and experienced Hazardous Waste Contractor.	Recovery/Landfill at Licensed Offsite Facility	*TDG Regulations* *Reference Material for the WHMIS Requirements of the Hazardous Products Act and Controlled Products Regulations*	Contractor
Tyvek Suits/Rags	Store at the designated HWSA. Ship offsite by a qualified and experienced Hazardous Waste Contractor.	Recovery/Landfill at Licensed Offsite Facility		
Printer and Toner Cartridges	Store and send back to supplier or manufacturer.	Recycle	*Discuss with equipment supplier.*	
Domestic Wastes				
Food	Collect in plastic bags.	Landfill/Compost		

Waste Type	Site Handling/Shipping Methodology	Treatment or Disposal Strategy	Applicable Regulations/Permits/Information	Primary Responsibility
	Take directly to storage bin. Do not store outside.	at Regional Waste Management Facility or approved landfill site.	*Waste Diversion Regulations, EPA* *Provincial Waste Management Strategy* *Waste Management Regulations, EPA*	Contractor during early works. GRDC upon implementation of contract (exception: road Contractor, reservoir clearing, ac transmission line Contractors).
Paper and Cardboard	Contractors store dry materials for collection. Place in storage bin and ship offsite to a licensed recycling facility or Regional Waste Management Facility, when required.	Landfill when applicable/ Recycle		
Plastics	Plastics of non-toxic materials to be included with regular waste and transported to landfill.	Recycle/Landfill	*Waste Diversion Regulations, EPA* *Waste Management Regulations, EPA*	
Beverage Containers	Collect beverage containers accepted under the MMSB Beverage Container Recycling Program and make available to charitable organizations.	Recycle	*Waste Diversion Regulations, EPA* *Waste Management Regulations, EPA* *Multi-Materials Stewardship Board (MMSB) – Beverage Container Recycling Program and School Program*	
Tin Cans	Contractors store dry materials for collection by GRDC. Collect and store with recyclable plastics and	Recycle	*Waste Diversion Regulations, EPA* *Waste Management Regulations, EPA*	

Waste Type	Site Handling/Shipping Methodology	Treatment or Disposal Strategy	Applicable Regulations/Permits/Information	Primary Responsibility
	ship offsite to Regional Waste Management Facility.			
General Wastes	Collect and store in compactor bin. Ship offsite to a licensed facility.	Landfill		
Inert Bulk Wastes				
Passenger and light truck tires	Remove from site and transport to a licensed tire storage/disposal area. Work within the MMSB's Used Tire Recycling Program	Re-use / Recycle / Dispose offsite	*Waste Management Regulations, EPA* *MMSB – Used Tire Recycling Program*	Contractor
Vehicles	Drain and collect residual fluids and store in laydown area. Ship offsite via licensed metals recycler.	Recycle	*Waste Diversion Regulations, EPA* *Waste Management Regulations, EPA*	
Bulk Construction Debris	Stockpile in designated laydown area. Reuse/Recycle where possible. Ship offsite to Regional Landfill Site.	Reuse / Recycle / Dispose offsite	*Waste Diversion Regulations, EPA*	
Scrap Steel / Wire / Aluminum	Store recyclable wire or aluminum in metal bins at storage area. Store bulk steel at laydown area and ship offsite.	Recycle offsite	*Waste Management Regulations, EPA*	

Waste Type	Site Handling/Shipping Methodology	Treatment or Disposal Strategy	Applicable Regulations/Permits/Information	Primary Responsibility
Sandblast Residue	Collect at source. Store in drums at the storage area. Ship offsite or transfer to landfill.	Landfill		
Concrete	Disposal of "cow patties" at designated site. Once cured can be used in site fill material	Reuse as fill		
Special Wastes				
International Waste	Contact Canadian Border Services Agency for inspection and approval prior to off loading.	Landfill	*Health of Animals Act , Section 17* *Health of Animals Regulations, Section 47 and 105 (3)* *Plant Protection Act* *Plan Protection Regulations*	Contractor
Biomedical Wastes	Store in special waste receptacles Ship offsite.	Dispose offsite		
Asbestos Waste	Requires removal at source by a licensed Asbestos Abatement Contractor.	Landfill	*Environment Protection Act* *Asbestos Abatement Regulations, 1998* *The Occupational Health and Safety Act* *Highway Traffic Act*	
Human Waste	Collected at source and removed by a licensed Septic Removal Contractor.	Treatment and Disposal	*Public Health Act, Sanitation Regulations*	Contractor during early works. GRDC upon implementation of contract (exception: road

Waste Type	Site Handling/Shipping Methodology	Treatment or Disposal Strategy	Applicable Regulations/Permits/Information	Primary Responsibility
				Contractor, reservoir clearing, ac transmission line Contractors).

7 ESTIMATED VOLUMES OF SPECIFIC WASTE STREAMS

Potential waste streams were identified in previous sections however the primary waste streams identified at the planning stage that are expected to be generated at the Project site include domestic, sewage and construction waste. As such, waste volumes for these three waste streams have been calculated for early works and work following the start of the GRDC's mandate. In addition, two other significant wastes that have been identified include used oil and explosive boxes. The volumes of all items are calculated and shown in the sections below.

7.1 EARLY WORKS

7.1.1 Domestic Waste (Early Works)

The estimated amount of domestic waste to be generated during the first 6 months is approximately 50 tonnes. A generation rate of 1 kg/person/day was utilized to calculate this number as domestic waste directly corresponds to population or in this case the number of workers located on site.

The estimated tonnage is expected to fill approximately five, 37 yd^3 compactor trucks, based on 10 tonnes per load. Figure 7-1 provides the breakdown of domestic waste volume per month.

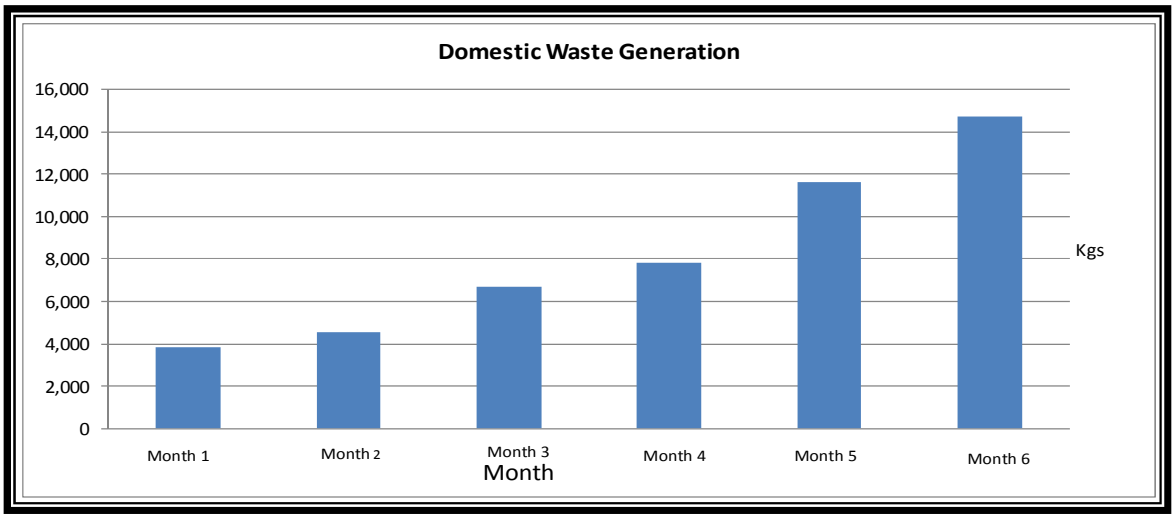


Figure 7-1: Domestic Waste Generation (pre-GDRC implementation)

7.1.2 Sewage Waste (Pre-GDRC Implementation)

During the majority of the early works, more notably during the construction of the access road, the site will be serviced with portable toilets. Based on an estimated sewage generation rate of 10 L/person/day, the total estimated amount of sewage waste to be generated prior to the start of GDRC's mandate is about 500,000 L. Figure 7-2 provides the breakdown of sewage waste volume per month. More information about sewage disposal is located in Section 6.2.

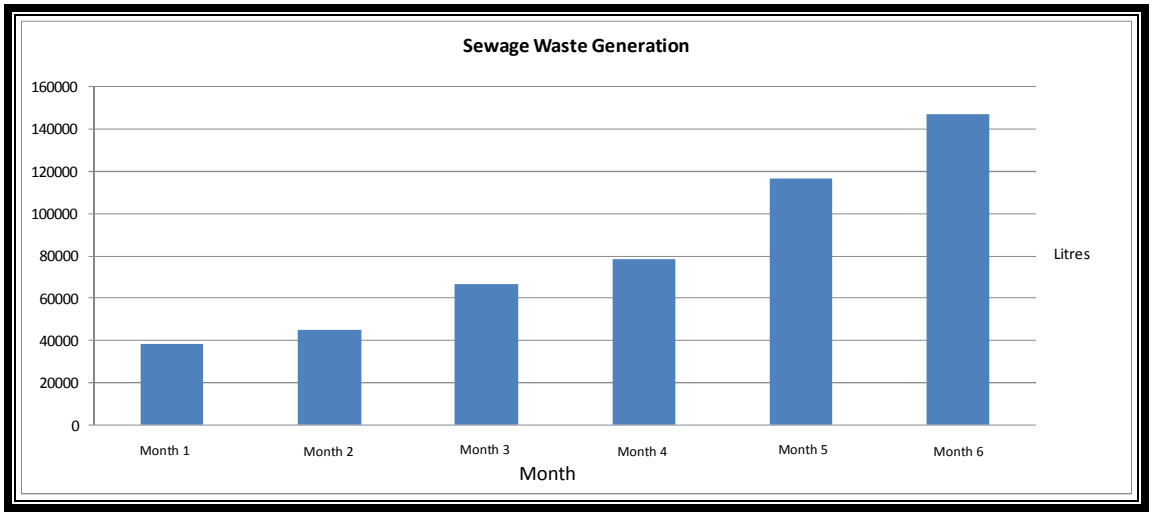


Figure 7-2: Sewage Generation (pre-GDRC implementation)

7.1.3 Construction Waste (Early Works)

7.1.3.1 Access Road

It is assumed that the amount of construction waste generated during the construction of the Access Road will be minimal, however only a small amount of formwork is expected to be needed for culvert installation. This is estimated to be approximately 500 kg or 0.5 tonnes.

In addition, the use of silt fencing will be required for protection to surrounding environment. This waste is type is estimated to be approximately 0.25 tonnes. An additional, 1 tonne is carried to account for miscellaneous construction waste items.

Therefore, based on the information above, the total amount of waste generated during the construction of the access road is estimated to be approximately 1.75 tonnes.

7.1.3.2 Accommodation Complex and Site Services Infrastructure

As with the construction of the access road, the construction of the accommodation complexes will also generate very little construction waste. Due to the

accommodations units arriving prefabricated, the estimated amount of waste generated is low, and is made up mostly of wood cuttings generated from wooden foundation cribbing and some plastic and plywood waste. It is assumed that 225 kg of wood waste would be produced per trailer. Current estimates are that 26 trailers will be needed for an approximate total of 6000 kg or 6 tonnes.

Piping for site services will be manufactured of HDPE and will be cut and fused to the desired length. Based on an estimated overall length of 4.6 km of HDPE pipe, and an assumption of 0.1 m of wastage per 15 m of pipe, with a weight of 120 kg/15 m, the total tonnage of waste generated from piping activities is .25 tonnes.

7.1.4 Used Oil (Early Works)

A considerable amount of heavy equipment will be utilized during the early phases of the Project. In keeping with necessary maintenance schedules, Contractors are required to maintain equipment and equipment fluids. During this phase, it is estimated that nearly 16,500 litres of waste oil will be generated. More information on used oil is provided in Section 6.2.1.1.

7.1.5 Explosive Boxes (Early Works)

During the early phase of this Project, the use of explosives will be necessary for excavation of the access roads. An estimated total of 1,300 cases of explosives will be required for road construction activities. Once the explosives are removed and used during construction, the cases will be destroyed as identified in Section 6.

Table 7-1: Estimated Waste Volumes (Early Works)

Waste Type	Estimated Volume
Domestic Waste	50 Tonnes
Sewage Waste	492,000 Litres
Construction Waste (includes Access Road, Accommodations Complex and Site Services	8 Tonnes
Used Oil	16,500 Litres
Explosive Boxes	1,300 Cases

7.2 WORK POST GRDC AWARD

7.2.1 Domestic Waste

The total estimated amount of domestic waste to be generated from year 1 to year 6 is 1,900 tonnes. This equates to approximately, one hundred and ninety 37 yd^3 compactor truck loads. Figure 7-3 provides the breakdown of domestic waste volume per year.

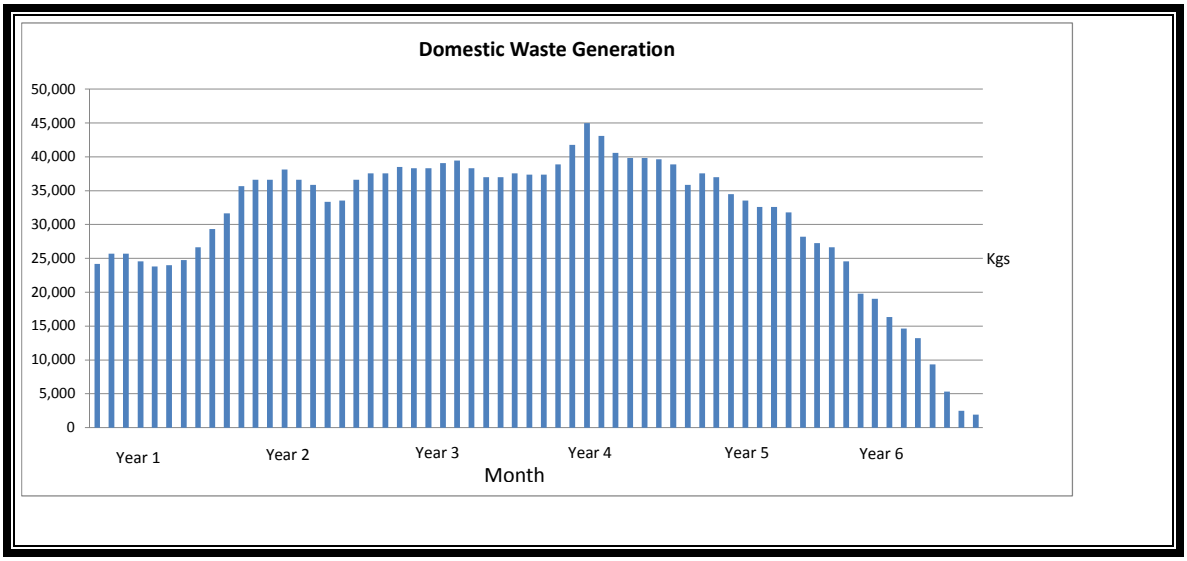


Figure 7-3: Domestic Waste Generation Year 1 to Year 6

7.2.2 Sewage Waste

Based on the assumption that the average worker generates approximately 270 L/day of sewage, the total estimated amount of sewage waste to be generated after year 1 to year 6 is estimated at 525,000,000 Litres. Although, this volume represents the total amount generated, it is expected that only 10,000 litres of sludge would be removed from the sewage treatment plant per year for a total of 50,000 litres over the life of the Project. Figure 7-4 provides the breakdown of sewage waste volume per year. More information about sewage disposal is located in Section 6.

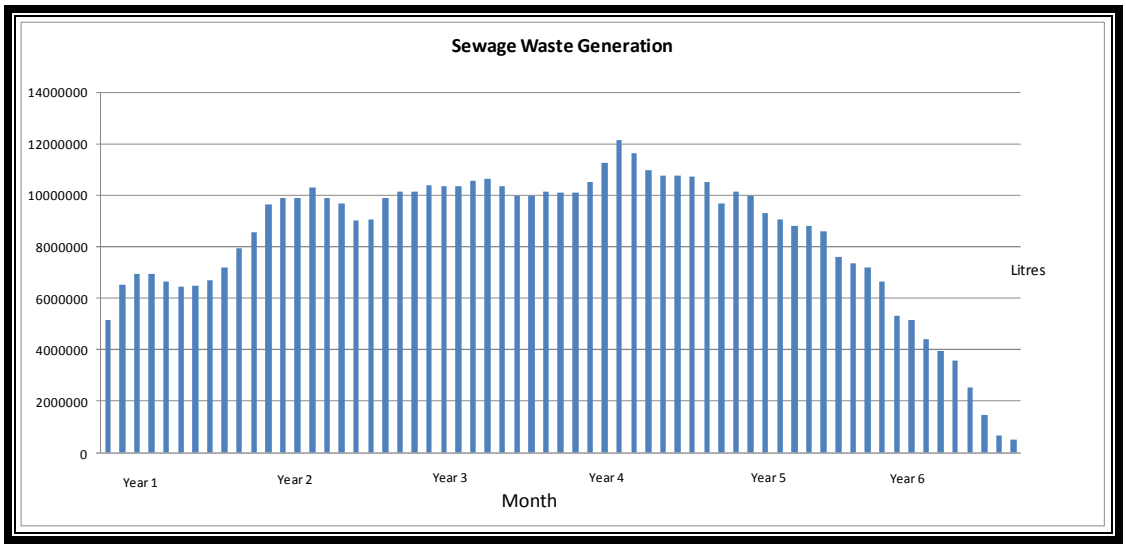


Figure 7-4: Sewage Generation Year 1 to Year 6

7.2.3 Construction Waste

Based on waste information obtained from the Bull Arm Construction Site during fabrication of the Hibernia Gravity Base Structure, the reported waste tonnage for the construction debris waste stream was 8,400 t/yr. Based on this information we can estimate a total of 42,000 tonnes over the life of this Project. Of that tonnage approximately 23,000 t is expected to be recyclable metals, including scrap rebar and with an additional 4,800 t in recyclable wood.

It is assumed that although different in scope, the LCP will likely see similar types of waste tonnages after GRDC implementation.

7.2.4 Used Oil

Similar to the section above, an estimate for waste oil is based on data obtained during fabrication of the Hibernia Gravity Base Structure. The volume of waste oil generated on site was reported to be 936,000 L/yr. This volume can be considered

comparable based on the length of the Project and types of equipment used for a total of 4.7 million litres. More information on used oil is provided in Section 6.

7.2.5 Explosive Boxes

During the later phase of this Project, the use of explosives will be necessary during bulk excavation. An estimated total of 13,000 cases of explosives will be needed to complete this work leaving 13,000 empty cases once the explosives have been utilized. More information on explosive boxes is provided in Section 6.

Table 7-2: Estimated Waste Volumes (Year 1 to Year 6)

Waste Type	Estimated Volume
Domestic Waste	1,900 Tonnes
Sewage Waste Generated to Treatment Plant Sewage Sludge Removed from Treatment Plant	525,000,000 Litres 50,000 Litres
Construction Waste	42,000 Tonnes
Used Oil	4,700,000 Litres
Explosive Boxes	13,000 Cases

8 WASTE MANAGEMENT REQUIREMENTS

As part of the overall waste management plan, the LCP is committed to ensuring that every person on site is provided with the opportunity and direction to practice responsible waste management. Waste receptacles, such as recycling and waste bins, will be strategically placed throughout the site and will be clearly labelled as to what should be placed in them. Recycling bins will be placed in heavy traffic areas, common work areas, and, most importantly, in locations where recyclables are typically generated.

The details of the waste collection/disposal requirements will be finalized with the GRDC, however the following sections discusses the anticipated requirements.

8.1 STORAGE

8.1.1 Beverage Containers

Most empty beverage containers will be generated in dining halls of the starter camp and Accommodations Complex, and at construction sites frequented by a large number of people. Empty containers at remote locations shall be collected and contained by the Contractor and transported to a designated area for storage for future recycling or directly to the licensed recycling depot.

Blue bin recycling containers are recommended for use for the collection of beverage containers due to their high visibility. The use of dedicated recycling containers will serve as a reminder for personnel to use the recycling containers instead of throwing containers into the general refuse containers. The blue bin containers will be clearly labelled BEVERAGE CONTAINERS ONLY and be placed in the following areas around the site:

- Lunch Facilities
- General Office
- Maintenance Areas

8.1.2 Residual Waste Containers

Waste receptacles shall be placed within all buildings and work areas for the collection of residual waste.

8.1.3 Roll Off/On and Front Load Containers

At minimum, it is anticipated that three wildlife proof 20' (40 yd) roll on/off containers will be needed on site to accept waste transferred from the smaller bins once they are removed from the site buildings. Two containers could be utilized for the residual waste stream, and a third will be required for substitution, when filled bins area being transported to the waste disposal site.

At least, one 7 cubic meter Front Load Container shall be placed on site to collected beverage containers. Once this bin is filled, it will be hauled to a licensed recycling depot for processing.

8.1.4 Construction and Demolition Waste Storage

During construction, individual Contractors will be responsible for collecting their wastes in acceptable containers within their workshops or laydown areas. Containers containing construction waste or large construction waste materials may be temporarily stored within the construction area upon approval on the On-site Environmental Monitor and must be stored according to applicable regulations.

Recyclable metals shall be placed in an onsite location suitable for pick up by a licensed metals recycler. Special arrangements shall be made with the recycler for large items.

8.1.5 Hazardous Waste Storage

A Hazardous Waste Storage Area will be provided for Contractors to utilize. The storage area will be designated by SLI to a Contractor for storage of hazardous waste. The Contractor shall be responsible for constructing and maintaining the site

in compliance with applicable regulations and is ultimately responsible for disposal and removal of any waste management infrastructure and equipment.

Individual Contractors will be responsible for providing acceptable leak proof containers within their work areas. Containers for on-site hazardous waste storage shall, as a minimum, meet requirements of the *Transportation of Dangerous Goods Regulations*, as provided in http://www.tc.gc.ca/eng/tdg/moc-menu-202.htm.

The Contractor shall provide SLI with records of type and amount of waste deposited in and removed from site. SLI will monitor the storage area to ensure that Contractors store waste in a safe manner. The Contractor shall ensure that containers are removed from site on an as needed basis to a licensed hazardous waste facility for disposal.

Storage shall comply with provisions of the National Fire Code to ensure that incompatible wastes are not stored together.

All Contractors that generate handle, store, and/or transport hazardous materials and hazardous wastes shall each be required to meet all regulatory requirements that pertain to their involvement with these materials/wastes. These Contractors shall have all resources (including employees who have completed training programs acceptable to the Engineer), meet all licensing/permitting requirements of applicable federal and provincial regulations, and provide spill response resources and capabilities consistent with the Project's Master Spill Response Plan.

8.2 FUTURE WASTE MANAGEMENT REQUIREMENTS

Future provincial waste management requirements may dictate the separation of various waste streams at source. In the event that a regional plan is implemented, this Waste Management Plan will require revisions and operation changes will be needed.

These changes may result in the use of additional source separation techniques and equipment.

8.3 CONTINGENCY PLANS

An adverse event is one that can result in potential negative effects on the health and safety of site personnel, Contractors, the public, or the environment. The following sections describe potential adverse events and appropriate responses to deal effectively with them.

Note that the federal *Transportation of Dangerous Goods Regulations* requires an approved *Emergency Response Assistance Plan* for those who transport explosives. Such a plan, when implemented effectively in response to an incident involving explosives, helps mitigate environmental effects.

The Project's *Master Spill Response Plan* is another document intended to facilitate an effective response to a spill incident aimed at mitigating effects of spills of oil, fuels, and other hazardous materials.

Proactive measures to anticipate and prepare for adverse events are expected of all Project participants, particularly those tasked with waste management.

8.3.1 Improper Disposal

Any instances of improperly disposed of materials identified by onsite Environmental Monitors or other Project participants shall be reported immediately to SLI's Construction Manager and Environmental Coordinator (Hydro), and investigated. The responsible Contractor shall be required to remove the waste and dispose of it in a manner acceptable to the Engineer. This will include waste characterization, as directed by the Engineer, to identify the nature of the improperly disposed of material so that acceptable storage, transport, and disposal options can be identified. If a responsible party cannot be identified, arrangements will be made by the onsite Environmental Monitor to have the waste removed and transferred for disposal. For example, recyclable material will be removed from the non-recyclable waste stream.

If hazardous wastes are suspected to be improperly disposed of, then this material will be characterized. If safe and practical to do so, the material will then be placed in

dedicated storage containers separate from other waste types that have not come into contact with the hazardous materials, and transported to and disposed of at a licensed hazardous waste disposal facility.

8.3.2 Fire

In the event of fire associated with wastes, the onsite Environmental Monitors shall be notified and the emergency response unit shall be dispatched immediately in accordance with the procedures outlined in the Project's Emergency Response Plan.

Because even small fires can quickly escalate into a dangerous situation, particularly when hazardous materials (fuels, chemicals, etc) and wastes are involved, it is imperative that the emergency response unit be dispatched immediately.

As a pro-active measure aimed at preventing fires, Contractors shall use approved storage containers and waste handlers shall be familiar with hazardous waste compatibility profiles. Non-compatible wastes will be segregated.

8.3.3 Extreme Weather Conditions

At times when forecasts call for extreme weather events (e.g. snow, rain, wind, etc), the Construction Manager at his/her discretion shall issue instructions with respect to waste management activities on site. This may include a temporary suspension of waste collection and transportation until the weather improves. In addition, the Construction Manager may also issue instructions to inspect and secure waste containers and storage sites to reduce potential for uncontrolled releases of waste to the environment.

Provisions will be made to allow at least two days of waste storage on site to allow for such adverse weather conditions.

8.3.4 Vehicular Accidents

In the event of a vehicular accident that results in a spill of a waste material, the Contractor shall notify a SLI Onsite Environmental Monitor of the incident and the emergency response unit will be dispatched immediately in accordance with procedures outlined in the Project's Emergency Response Plan and Master Spill Response Plan, as required.

Depending on the waste type, the Contractor may be required additional notifications. In the case of accidents involving transport of explosives, the *Emergency Response Assistance Plan* shall be implemented, in accordance with provisions of the *Transportation of Dangerous Goods Regulations.*

8.3.5 Contingency Planning

Each Contractor shall address several key elements associated with managing an adverse event through the development of a contingency plan which shall be included in the contract specific EPP. The plan shall include the following:

- Location and nature of the work;
- Types of waste being transported;
- Identification of the types of emergencies that maybe reasonably expected to occur and the potential effect involving public health and safety, environment and property;
- Resources including personnel and/or sub-contractors accountable for waste management procedures;
- Roles and Responsibilities of all key personnel, responders, organizations and other agencies who have specific responsibilities under the event.
- Description of how the plan shall be implemented and who it shall be reported to, including;

  - Government assistance contacts
  - Response equipment and material suppliers
  - Clean up Contractors
  - Fire and Emergency Authorities
  - Hospitals
  - SLI Contact
- Remediation Procedures
- Disposal procedures
- Reporting procedure, including:
  - Date and time of release;
  - Weather conditions;
  - Cause of the release;
  - Substance and quantity involved;
  - Affected environment;
  - Identification of all parties and individuals involved in the incident and response;
  - Identification of all those affected;
  - Containment procedure;
  - Clean up techniques;
  - Short and long term impacts
  - Measures to be implemented to prevent any re-occurrence.
- Validation, updating and maintenance procedure of the plan

9 TRAINING

All operations personnel involved in the handling of hazardous and non-hazardous wastes will be fully trained for 'Personal Safety and Protection'. They will also be trained in emergency response and environmental protection. Contractors will be required to provide trained, qualified and experienced personnel for waste management duties. In addition, all personnel entering the site will be given basic instructions for complying with the Site Waste Management and Recycling Policy.

10 SURVEILLANCE AND MONITORING

The onsite Environmental Monitors will proactively identify any requirements for maintenance work and report the need for repairs. Routine inspection schedules will be maintained to minimize the potential for leaks or pollution and a record will be kept of the maintenance needs and servicing performed. During construction, weekly inspections of the various waste collection and disposal points, the inventory of bulk wastes, the waste management data sheets, the status of the protective equipment and the spill kits will take place. Any non-conformance will be tracked and recorded and necessary corrective action identified.

11 REFERENCES

Title
DOEC Guidance Documents for Municipal Solid Waste Transfer Stations
DOEC Guidance Documents for Construction and Demolition Waste Disposal Sites
DOEC Guidance Documents for Permanent Household Hazardous Waste Depots
Guidelines for Establishment and Operation of Facilities for the Outdoor Storage of Tires
DOEC Guidance Document for the Management of Impacted Sites

12 FORMS

REVISION REQUEST FORM

Section to be Reviewed:	
Nature of Revision:	
Rationale for Revision: **(i.e., environmental/worker safety, etc.)**	
Submitted by:	**Submission Date:**

REVISION CONTROL RECORD

WMP SECTION	REVISION DATE	COMPLIANCE INSTRUCTIONS	NATURE OF REVISION

RECEIPT OF REVISION ACKNOWLEDGMENT FORM

I _____ acknowledge receipt of revision _____ of the Waste Management Plan, SLI Document Number 505573-0000-68RA-I-0008.

_____ _____

Signature Date

APPENDIX A

Examples of Acceptable Wildlife - Proof Disposal Bins


BearSaver
Bear Resistant Refuse, Recycling
and Food Storage Solutions

BE Series Trash/Recycling Container

Manufactured by the North American leaders in bear-resistant containers.

Available in single and double configurations, the large capacity Model BE Series containers are equally suited for refuse or recycling. Incredible quality and durability makes these all-weather containers great for any application.

- Tilt Out Bag Rack
- Bear-Resistant and Accessible to Persons with Disabilities
- 70 Gallon Single Models and 140 Gallon Double Models Available
- Rear Service Door
- Optional Custom Laser Cut Designs
- Refuse, Recycling, or Combo Configurations
- Corrosion Resistant Materials and Powder Coated Finishes
- Standard Colors are Forest Brown, Fir Green, Olive Green, Blue and Black

CE Series Trash/Recycling Container

Available in single and double configurations, the CE Series trash and recycling containers are used widely by the NPS and USFS with great success. These heavy-duty, ADA approved products are a good choice where accessibility compliance is required. The top-loading pull down chutes make these models operable even with a closed fist. Uses a standard 32 gallon trash can inside.

- User Friendly Loading Chutes for Trash and Tubes for Recycling
- Bear Resistant and ADA Compliant
- Front Service Door
- Trash, Recycling, or Combo Configurations
- Corrosion Resistant Materials and Powder Coated Finishes
- Standard Colors are Forest Brown, Fir Green, Olive Green, Blue and Black

HA Series Trash/Recycling Container

Manufactured by the North American leaders in bear-resistant containers.

Available in single and double configurations, the Model HA Series containers are equally suited for trash or recycling. Incredible quality and durability makes these all-weather containers great for any application. The stylish design allows placement in locations like visitor centers and downtown city streets where aesthetics are important.

- Bear-Resistant and ADA Compliant
- Front Service Door
- Optional Recycled Plastic Wood Siding or Custom Laser Cut Designs
- Trash, Recycling, or Combo Configurations
- Corrosion Resistant Materials and Powder Coated Finishes
- Standard Colors are Forest Brown, Fir Green, Olive Green, Blue and Black

HID-A-BAG Trash/Recycling Container

Available in four sizes with trash, recycle or combination options.

Also available in single or double configurations, some models are even ADA Compliant! The Hid-A-Bag is a well known, widely used line of products with a long standing track record of exceptional durability.

- Tilt Out Bag Rack
- Bear-Resistant
- Options that are Accessible to Persons with Disabilities
- 32, 64, 70 and 140 Gallon Models Available
- Rear Service Door
- Refuse, Recycling, or Combo Configurations
- Corrosion Resistant Materials and Powder Coated Finishes
- Standard Colors are Forest Brown, Fir Green, Olive Green, Blue and Black

Food Storage Lockers

Manufactured by the North American leaders in bear-resistant containers.

BearSaver Bear-Resistant Food Storage Lockers are rugged, high quality metal enclosures designed for safe and convenient food storage in campgrounds, picnic areas and trailheads. Our intermediate sized lockers are 15 (FS15) and 20 cubic feet, which are perfect for smaller campsites and trailheads. The 24 (FS24) and 30 (FS30) cu/ft lockers are large enough to hold an entire family's food supply including two large ice chests.

The **BearSaver** latching system uses a pocket style touch latch with double spring bolt actuation on its standard enclosures. Our pocket style, self-closing touch latch is composed of zinc plated steel components and hardware. A child safety release handle on the inside of the enclosure is provided. The design is very simple for users to operate but is beyond the capabilities of bears. It has a clean, attractive appearance and is ADA compliant in terms of height, reach and required pounds of operating force.

Model FS15
15 Cubic Foot Capacity Food Storage Locker
This small to intermediate sized food storage locker is perfect for trailheads, day use areas, tent cabin areas and small campsites. There is a center shelf built in to take advantage of the 15 cubic foot capacity. With provisions to bolt side-by-side, these lockers can easily be lined up for group usage.

Model FS20
20 Cubic Foot Capacity Food Storage Locker
This is an economically priced, intermediate sized food storage locker with enough capacity (20 cubic feet) for a regular sized cooler and room left over for a few dry goods. Primarily used in campsites, the FS20 can also be used at trailheads and public use areas.

Model FS24
24 Cubic Foot Capacity Food Storage Locker
One of most popular models, the FS24 has enough capacity (24 cubic feet) for a family who is camping for a week. There is room for two regular sized coolers and plenty of space left over for dry goods. Always paying attention to detail we have added hooks on the ceiling of the locker for hanging bags of dry goods. These heavy-duty enclosures with easy to use, selflatching doors will provide years of reliable services in all weather conditions.

Model FS30
30 Cubic Foot Capacity Food Storage Locker
Our largest and best selling food storage locker, the FS30 has a full 30 cubic feet of interior space to accommodate large families on extended stays. With the capacity to hold the largest of coolers and lots of dry provisions, this big locker removes the worries associated with keeping food in your car overnight.

Models FS24RCE and FS26G
These new style food storage lockers are unique in design and made for large families. The sloped roofs are great for heavy snow loads with all the quality and durability you would expect from BearSaver.

RCE Series Residential Waste Enclosures

Manufactured by the North American leaders in bear-resistant containers.

Our line of residential waste enclosures keeps with the BearSaver tradition of producing tough, functional, long lasting outdoor equipment. The RCE Series enclosures are manufactured using the same materials and finishes as our line of commercial trash enclosures, which are used widely throughout the U.S. and Canada. Our proven, field tested outdoor enclosures will provide years of trouble-free service in all weather conditions. If you are looking to keep hungry bears out of your trash, BearSaver has the solution you need.

Available in 3 Sizes

- **RCE130F** Holds (1) 30-gallon Rubbermaid can (included with purchase). This model has a slim profile and can be easily bolted side-by-side for added capacity.
- **RCE230F or RCE230G** Holds (2) 30-gallon Rubbermaid cans (included with purchase) and has a large top-loading lid. Available with sloped or gabled roof.
- **RCE132F** Holds (1) standard 32-gallon can (not included) and can be bolted side-by-side for added capacity.
- **RCE330G** Holds (3) cans 30-gallon Rubbermaid cans (included with purchase) and has a gabled roof.

All models have provisions to either bolt down to a slab or use the BearSaver pole mount installation method. See website for details.

Mini Depot Trash/Recycling Container

Designed to hold three different recyclables, the Mini Depot can be configured just by changing the decals. Standard openings are 5" x 5" but a 5" x 10" opening can be ordered in the center position for trash input. Heavy steel construction insures years of service in the most demanding environments. With a baffle plate installed on the inside beneath the loading holes, bears (or people) cannot remove the contents.

- **Easy Loading and Unloading**
- **Bear Resistant and ADA Compliant**
- **Lockable Front Service Doors, 90 Gallon Capacity**
- **Trash, Recycling, or Combo Configurations**
- **Corrosion Resistant Materials and Powder Coated Finishes**
- **Standard Colors are Forest Brown, Fir Green, Olive Green, Blue and Black**

Commercial Containers

Manufactured by the North American leaders in bear-resistant containers.

Standard dumpsters with two loading doors are available in front load 2, 3, and 4 yard sizes. Counter-balance lid dumpsters are available in front load 2, 3, 4, 5 and 6 yard sizes. The standard dumpsters have front loading, swing-open doors so getting trash or recyclables inside is easy and clean. The counter-balance lid dumpsters use a creative latching system that requires only one finger to open. The counter-balance effect makes the tops light and easy to open. On either model, dumping is made easy by gravity latches releasing the unloading lid during the emptying process. Clip-down lids are also available as an option.

- **2, 3 and 4 Yard Front Load Styles for Trash**
- **Pole Mounting Options to Avoid Tipping**
- **Gravity Latches or Clip-Down Lids**
- **Bear-Resistant and Rodent Proof**
- **Corrosion Resistant Materials and Powder Coated Finishes**
- **Standard Colors are Forest Brown, Fir Green, Olive Green, Blue and Black**

Bear Resistant Poly Cart

The BearSaver™ bear-resistant carts are available in 32, 65 and 95 gallon sizes as well as three (3) levels of protection: basic, moderate and high.

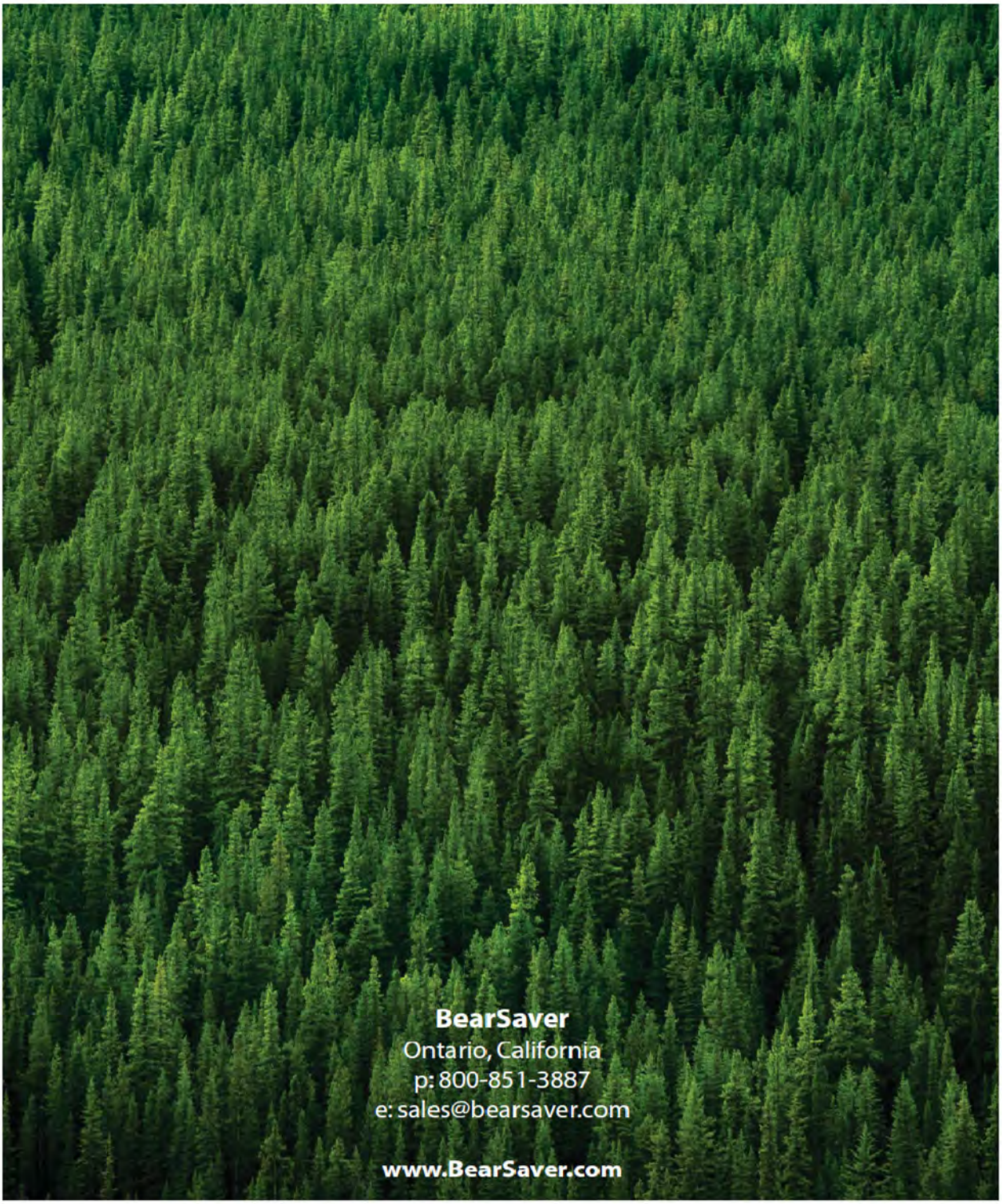
- Special latch box under the bib prevents animal entry
- Snap shut lid means no manual relatching is required
- Designed for manual and semi-automated collection systems

Cart Options

The Grizzly Model A fully secured cart offering the maximum level of protection. Bear resistant latch, steel reinforced side rails, lid, back corners, back stiffener and handle area. Perfect for heavy bears like grizzlies.

The Black Bear Model A tough black bear resistant cart offering a medium level of protection. Bear resistant latch, steel reinforced side rails, back corners and lid.

The Varmint Model The economy version of our rolling cart family. Great protection from raccoons, squirrels, coyotes, pets and all other small animals. A bear resistant latch and steel reinforced lid offers "lock down" protection at an affordable price.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www.BearSaver.com

Nalcor Energy – Lower Churchill Project

Security Management Plan

LCP-PT-MD-0000-HS-PL-0005-01

Comments:	Total # of Pages (Including Cover): 30

B1	27-Feb-2013	Issue for Use	D. Riffe	S. Lee	G. Fleming	R. Power	P. Harrington
A1	25 Sept 12	Issue for Review	D. Riffe				
Status/ Revision	Date	Reason For Issue	Prepared By	Checked By:	Project Manager (Marine Crossings) Approval	Project Manager (Generation + Island Link) Approval	Project Director Approval

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Inter-Departmental / Discipline Approval (where required)

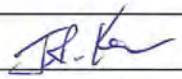
Department	Department Manager Approval	Date
Deputy General Manager	 **J. Kean**	
Muskrat Falls Site Manager	**M. Dykeman**	
	Name	
	Name	

TABLE of CONTENTS

1.0 Purpose

This Security Management Plan will define the methods used to determine the level of threats and security preparedness required to effectively address these identified threats at all construction sites for the Lower Churchill Project (hereafter referred to as LCP or the Project). The operational basis of this plan has been developed in accordance with information generated from an initial project threat assessment conducted by an independent third party consultant in December of 2011.

The physical environment of infrastructure of the Muskrat Falls construction camp and support systems will be designed and managed to reduce the potential of security related incidents/unwanted events. A risk assessment has been conducted to define those areas or zones where the security threats are and how these can be adequately mitigated any known or perceived risk. The Security Management Plan must remain an "evergreen" document to allow for changes in focus, site conditions, threats/risks and mitigating actions. Any changes to this document will be forwarded to all responsible individuals via document processing/document control/Aconex. The Security Management Plan is an integral component of the overall LCP Security Management strategy.

2.0 Scope

The scope of the LCP Security Management Plan consists of the following construction work sites and auxiliary support sites to be effectively managed from a Security perspective:

- Muskrat Falls Generation Facility
- Labrador Island Transmission Link (LITL)
- Labrador Transmission Asset (LTA)
- Miscellaneous Lay Down Areas
- Project Office (s)- Torbay Road/Hydro Place/Happy Valley-Goose Bay Office

Refer to **Attachment #1** for the LCP Project Schematic for additional information.

Other areas that have been considered and included in this plan, as and when applicable, are:

- Public access buildings

- Marine ports

3.0 Definitions

Access Control System - A system having several features which enable a designated authority to control access to physical areas or information and resources within a given facility. This often consists of physical barriers (static and automated) and access interfaced to a computer-based information system.

Authorized Worker – Any worker who has fully met all training and testing requirements stipulated by the NALCOR / SLI and deemed to be fully competent to work within his/her defined work scope on the project. Additionally, this definition shall include those individuals who, over time, remain in good standing with all training and site access requirements.

Authorized Escort – A contractor or subcontractor representative who has completed site orientation, is fully aware of the site's emergency response and evacuation procedures, and has the authority to accompany visitors.

EPCM – Engineering, Procurement, and Construction Management Consultant- Refers to a contracted company providing technical support services under the direction and management of Nalcor. For the Lower Churchill Project the EPCM Consultant is SNC-Lavalin.

Host – A contractor or subcontractor representative who has been authorized to invite non-project personnel to the project site and receives prior clearance from the Muskrat Falls Site Management or Transmission Line Management beforehand.

Visitor – Any non-project person(s) visiting the project construction site including, but not be limited to vendors, couriers, delivery personnel, regulatory personnel, consultants, engineering representatives, stakeholders and other personnel not assigned to the site.

Badges – Purpose-specific credentials or devices which identify the bearer by electronic signature and photographic confirmation of the bearer. Badges also act as an access tool that interface with a computer based system which activates gates, turnstiles or other physical barriers designed to restrict access.

Temporary Badges – A temporary credential issued to individuals who have been authorized to access the LCP on a limited or temporary basis. Temporary badges are intended to be used in conjunction with Authorized Escorts, and shall be returned to security when visit is completed and/or permanent badge is issued.

Qualified and Competent Security Personnel – Security personnel who, as a minimum, have met all work scope criteria and job stipulations and successfully completed a nationally or provincially recognized security training, supplemented by a minimum of 2 years security work experience in a construction type environment.

4.0 Responsibilities

4.1 Project Component Manager(s)

The Project Component Manager(s) shall ensure all Contractors are fully informed of the security stipulations and requirements defined within this plan, as well as any changes or modifications made to the plan during the course of the Project. Additionally, the Project Component Manager(s) shall ensure all necessary resources; personnel and training, etc. are provided to adequately meet the requirements as defined by this Plan.

4.2 LCP Project Health and Safety Manager

The LCP Project Health and Safety Manager shall be responsible for the overall implementation and management of this Project Security Management Plan. The LCP Project Health and Safety Manager for will also provide oversight and on-going management through direct interface with:

- EPCM Health and Safety Personnel
- Muskrat Falls Site Manager and Site Management Team
- LCP Component Managers
- Telecommunications
- Security Service Provider
- Nalcor Corporate Management Team
- SOBI Crossing Project Manager/Project Team

The SOBI Crossing Project Manager and SOBI Health and Safety Advisor shall be accountable for ensuring that Management of Security is implemented and maintained for the SOBI operations/activities. The Contractor's responsibility for Site/Vessel Security will be clearly defined contractual agreements and verified by the SOBI Health and Safety Advisor.

4.3 Muskrat Falls Site Health and Safety Manager; Site Health and Safety Coordinator/Advisor

The Muskrat Falls Site Health and Safety Manager and Site Health and Safety Coordinator shall also coordinate and consult on incident investigations, secure required documentation and facilitate, through the security contractor, the site badging and induction process for all contractor and subcontractor personnel entering the project site. The Site Health and Safety Coordinator shall also collect and report all metrics and documentation as established by the Muskrat Falls Site Manager and LCP Health and Safety Manager

The Site Health and Safety Manager shall liaise with all Contractor supervision to address issues that arise concerning the security of LCP, tools and equipment.

For SOBI Operations, The SOBI Health and Safety Advisor shall monitor and observe the implementation and maintenance of Security Practices and Principles on SOBI Sites and Contracted Vessels during the execution of the scope of work.

4.4 Field Emergency Response and Security Coordinator

The Site Emergency Response and Security Coordinator shall:

- Supervise and serve as the primary day-to-day point of contact for the Security services provider in relation to establishing processes and systems needed to adequately secure the project site. Ensure the full implementation, enforcement and general application of the Security Management Plan.

- Reviews and recommends (for approval) any request for resources by Security Provider.

- Functions as the key point of contact for the Security Provider. Additionally, this position oversees and monitors the third party Security Provider to ensure all requirements and commitments outlined in the written contract are adhered to and/or effectively executed.

- Conduct periodic site inspections from a site security perspective,

- Prepare loss and incident reports and liaise with subcontractor supervision in relation to property losses and./or investigations and ensure all personnel under their authority fully comply with all provisions and stipulations within the Security Management Plan.

- Monitor the plan's performance and assess the security contractor on a regular basis to ensure suitability and overall effectiveness.

- Identify areas that require further threat assessment as the project develops and/or changes. This shall include a security assessment for marine ports and the transmission line construction areas, as and when required.

- Coordinate and assist, as required, local law enforcement in the investigation, collection of evidence and resolution of criminal activity on the LCP Construction Site.

- Participate in all supervisory safety meetings and report all required security metrics and data to the Site Health and Safety Coordinator for correlation and report to the Muskrat Falls Site Manager. The security coordinator must be responsive to project management to report on relevant security issues as required.

4.5 Contractor Security Personnel

Qualified and competent Security personnel will be responsive to the needs and requirements as outlined in the "**Authorization Protocol for Access to Project Construction Sites (LCP-PT-MD-0000-HS-PR-0001-01)**", as well as the directions of the Security and Emergency Response Coordinator and Site Health and Safety Manager. Security Officers will visually check all worker's ID presented for access to the Muskrat Falls jobsite and resolve any discrepancies before the badge bearer is permitted entry into the project site. Security officers will continue to monitor the workforce through the audit process to ensure that all personnel on site have the appropriate level of access prior to entry.

A security gate will be positioned at the entrance to the forestry access road from the Trans-Labrador Highway. During active construction, the gate will be manned on a 24 hours per day, 7 days per week. Initially, a temporary facility will be installed at the location (small trailer with generator to provide power, washroom facilities, cellular and satellite phone as well as VHF radio with the clearing and road construction contractors' frequencies). A list of personnel and vehicles involved with the road clearing and construction will be provided to the security personnel for site access. All vehicles approaching the entrance to the gate will be checked to ensure that the personnel and vehicles are authorized to enter. The lift gate can be left open when there are security personnel at the control position. The gate will be closed and locked when security personnel are not present at the control position.

The purpose of the security presence at this gate is to limit/control access to Muskrat Falls site. The following risks have been identified as Moderate to High level Risks.:

- Transportation of illegal contraband (drugs and alcohol) to/or from the construction site, which could have an adverse impact on personnel and activities. Impacts may include equipment damage, vehicle accidents and personnel injury. (Risk: Moderate)
- Theft/unauthorized transport of contractor/contractor property from the construction site. Impacts may include project delays, as well as financial impacts to contractor/company. (Risk: Moderate)
- Unauthorized access of on-lookers/curiosity seekers onto the site. Impacts may include endangerment of site personnel and/or unauthorized personnel due to the inherent dangers of the work activity combined with the distractions that may be caused by unauthorized personnel, as well as increased risk of unauthorized vehicles impacting construction site transportation patterns which could results in vehicle accidents and potential liability for Nalcor. Although the site will be sign posted advising all personnel that it is company premises and authorization is not allowed, access via snowmobiles, four wheelers, etc. is quite possible. (Risk: Moderate)
- Unauthorized demonstrations/protestors at the site entrance. Impacts may include hampered access, work stoppage and potential sabotage incidents endangering personnel, equipment which could result in work delay and/or work stoppage. (Risk: Major)

As a result of the aforementioned risks, the following protocols will be instituted:

- A Security Guard Station will be constructed a safe distance from the Trans-Labrador highway so as not to impede routine traffic on the highway at any time. Provisions will be made to direct oncoming traffic to a staging area (along the side of the access road) in the event of high traffic volume.
- The Security Guard Station will have a full time lockable gate to control access and will be manned by two Site Security Personnel at all times. One of the guards will be checking documentation and authorizations for site entry, while the other guard will be unlocking the gate, checking the vehicle for contraband or suspicious behaviour.
- The Security Guard Station will be manned and operational on a full time (24 hour) basis.

- If a security guard suspects an individual(s) to be transporting illegal contraband to the site or demonstrating irregular behaviour, the guard should contact the Muskrat Falls Site Manager to advise the situation and detain the individual until contract is made. Any personnel found to be transporting illegal contraband or demonstrating irregular behaviour will be asked to leave the site immediately and will not be allowed to return to the site.
- If the Security Guard suspects and unauthorized removal of equipment/property has taken place, he must advise the Muskrat Falls Site Manager and have him address the issue with the individual in question.
- In the event that unauthorized personnel are found to be trespassing on the site, they will be asked to leave immediately. In the event they refuse to leave, the RCMP will be contacted by Security to remove these personnel from the site.

In the case that members of the public arrive at the security gate with questions related to the road construction they will be politely directed to contact the Happy Valley/Goose Bay Nalcor Office. In the event protestors/demonstrators are at the site entrance of on the site. Site Security will notify the Muskrat Falls Site Manager and advise him of the situation. The Muskrat Falls Site Manager will contract the RCMP, particularly if the situation escalates. If protestor/ demonstrator actions are inhibiting work activity, Nalcor operations may be shut down and Nalcor Project Management (through the Muskrat Falls Site Manager) may elect to file an injunction to have these personnel removed from the site, which would be private property.

The project office located at the Muskrat Falls Construction Site Area is currently only accessible to authorized project personnel though the main gate clear security. All visitors to the site are required to complete a "Remote Site Access Request Form, which must be approved by the Muskrat Falls Site Manager, the LCP Safety and Health Manager, as well as the Project Manager. Refer to Section 11 of this document for more information pertaining to Visitor Access. Once access is gained into the site, the electronic swiping process is further supplemented by a sign in/sign out requirement at the main gate Visitors cannot enter the site until Site Security verifies the visit has been pre-approved as per the Remote Site Access Procedure. As per the visitor policy, visitors are required to sign in and sign out at the main gate and are to remain in the Main Gate Area until the appropriate project person arrives to meet the visitor. Visitors are to be escorted full time by the respective project representative for the duration of the visit to the office.

Security personnel will be involved as a key point of contact in emergency response activities, journey management and other general communications on site 24 hours per

day / 7 days a week. Additionally, security officers will be required to conduct the following:

- Periodic site inspections of the jobsite to determine if the perimeter is secure,
- Periodic inspections of all bags and packages entering the worksite;
- Periodic examination of all lunchboxes and personal packages leaving the Muskrat Falls site;
- Inspection of camp rooms as a result of reasonable suspicion (as defined under the Muskrat Falls Camp Rules) for drug and/or alcohol use.
- Inspections of all vehicles entering and leaving the Muskrat Falls site;
- Oversite and enforcement of site speed limits and conduct regular checks of their assigned area for security violations or activities of a suspicious or undesirable nature and report them to the Security Supervisor.
- Security officers shall also assist in all incident investigations, as required, relevant to health and safety observations and associated security matters.

For sites other than Muskrat Falls, Site Contractors may be required to provide Security Officers responsible for carrying out security duties. The Security Officers will be responsible for interfacing with contractors and assisting, as required, on supporting contractor's security plan. Coordination of joint security planning with contractors will require the overall communication and coordination with the site Health and Safety Coordinator for this scope of work. Should gated facilities be erected at Sub Station construction sites, security officers will be responsible for controlling and managing access and egress from these sites

4.6 Contract Workers, Visitors and Other Personnel

All workers, visitors and other personnel having reason to physically enter the Muskrat Falls site shall adhere to the requirements of this plan by attending all required training, providing required personal information, submitting to applicable drug and alcohol testing protocols and inspection, and meeting all other requirements as defined under the plan.

5.0 Security Threat Assessment

The level of security protection will vary for each area of the LCP based on risk exposure and probability of incident occurrence.

A Security Threat Assessment is the process that is used to determine the security threat (s) to the project, and is in line with the risk assessment process. The Threat

Assessments noted below utilize the LCP Risk Matrix for evaluating security related threats: The security threat assessment is normally used in areas such as:

Muskrat Falls Generation Site (North Spur and South side) Security Threats may include the following:

- Unauthorized entry into the site; **(Risk- Moderate)**
- NGO Protest Groups blocking site access (materials, equipment, personnel, emergency access); **(Risk- Major)**
- Theft of computers, proprietary information, equipment, supplies, fuel, materials- including explosive or flammable materials, tools; **(Risk- Moderate)**
- Vandalism of company or contractor property, structures, equipment, materials; **(Risk- Moderate)**
- Sabatoge of company/contractor equipment, materials, supplies, fuel; **(Risk-Moderate)**
- Bomb threat event at the construction site or accomodations. **(Risk- Moderate)**
- Emergency evacation of the site (due to wild fire, flooding, hazardous weather conditions or other unforeseen weather related and natural disaster event) leaving equipment, materials, computers, etc. exposed for theft. **(Risk-Moderate)**
- Hunting/trapping on designated company property endangering site personnel; **(Risk-Moderate)**
- Unauthorized personnel at site locations while hazardous operations/tasks are underway (blasting, heavy lifts, excavation/trenching, loading, heavy equipment operations, high voltage work activities). **(Risk-Moderate)**
- Personnel operating equipment/vehicles or working on site while under the influence of alcohol or drugs. **(Risk-Moderate)**
- Driving on site at unsafe speeds, without seatbelts, while using cell phones or in an otherwise wreckless manner. **(Risk-Moderate)**
- Violence at the site/camp (fighting, weapons, firearms, other violent behaviour/action) **(Risk-Moderate)**

Soldier's Pond and Churchill Falls Security Threats may include the following:

- Unauthorized entry into the site; **(Risk- Moderate)**
- Protest/aboriginal groups blocking site access (materials, equipment, personnel, emergency access); **(Risk- Moderate)**
- Theft of computers, proprietary information, equipment, supplies. **(Risk- Minor)**
- Vandalism of company or contractor property, structures, equipment, materials; **(Risk- Moderate)**
- Sabatoge of company/contractor equipment, materials, supplies, fuel; **(Risk-Minor)**
- Bomb threat event at the construction site or accomodations. **(Risk-Minor)**
- Emergency evacation of the site (due to wild fire, flooding, hazardous weather conditions or other unforeseen weather related and natural disaster event) leaving equipment, materials, computers, etc. exposed for theft. **(Risk-Moderate)**
- Hunting/trapping on designated company property endangering personnel working on site; **(Risk-Moderate)**
- Unauthorized personnel at site locations while hazardous operations/tasks are underway (heavy lifts, high voltage work activities). **(Risk-Moderate)**
- Personnel operating equipment/vehicles or working on site while under the influence of alcohol or drugs. **(Risk-Moderate)**
- Driving on site at unsafe speeds, without seatbelts, while using cell phones or in an otherwise wreckless manner. **(Risk-Moderate)**
- Violence at the site (fighting, weapons, firearms, domestic violence). **(Risk-Minor)**

Security Threats for **Transmission Lines** may include the following:

- Unauthorized entry into the transmission line temporary site; **(Risk-Moderate)**
- Protest/aboriginal groups blocking site access (materials, equipment, personnel, emergency access); **(Risk-Moderate)**

- Theft of computers, proprietary information, equipment, supplies, fuel, materials- including flammable materials, tools; **(Risk-Moderate)**
- Vandalism of company or contractor property, structures, equipment, materials; **(Risk-Moderate)**
- Sabatoge of company/contractor equipment, materials, supplies, fuel; **(Risk-Moderate)**
- Bomb threat event at the temporary site or accomodations. **(Risk-Moderate)**
- Emergency evacation of the site (due to wild fire, flooding, hazardous weather conditions or other unforeseen weather related and natural disaster event) leaving equipment, materials, computers, etc. exposed for theft. **(Risk-Moderate)**
- Hunting/trapping on designated company property endangering site personnel; **(Risk- Moderate)**
- Unauthorized personnel at site locations while hazardous operations/tasks are underway (heavy lifts, loading, heavy equipment operations, high voltage work activities). **(Risk-Moderate)**
- Persons camping on the Right-Of-Way. **(Risk-Moderate)**
- Personnel operating equipment/vehicles or working on site while under the influence of alcohol or drugs. **(Risk- Moderate)**
- Driving on site at unsafe speeds, without seatbelts, while using cell phones or in an otherwise wreckless manner**. (Risk-Moderate)**
- Violence at the site/camp (fighting, weapons, firearms, other violent behavior/action.) **(Risk- Minor)**

Security Threats for **Marshalling Yards** may include the following:

- Theft of equipment, supplies, fuel, materials- including explosive or flammable materials, tools; **(Risk- Major)**
- Unauthorized entry into the site; **(Risk-Moderate)**
- Protest/aboriginal groups blocking site access (materials, equipment, personnel); **(Risk-Moderate)**
- Vandalism of company or contractor property, equipment, materials; **(Risk-Moderate)**

- Sabatoge of company/contractor equipment, materials, supplies, fuel; **(Risk-Moderate)**
- Emergency evacation of the site (due to wild fire, flooding, hazardous weather conditions or other unforeseen weather related and natural disaster event) leaving equipment, materials, etc. exposed for theft and/or damage. **(Risk-Minor)**
- Unauthorized personnel at site locations while hazardous operations/tasks are underway (heavy lifts, loading, heavy equipment operations). **(Risk-Minor)**
- Personnel operating equipment/vehicles or working on site while under the influence of alcohol or drugs. **(Risk- Moderate)**

Security Threats for the two **Electrode Sites** may include the following:

- Unauthorized entry into the site. **(Risk-Moderate)**
- Theft of equipment, materials (primarily copper). **(Risk-Moderate)**
- Individuals going into the water (without authorization) **(Risk-Minor)**
- Sabatoge of any accessible equipment, supplies, materials on site. **(Risk-Moderate)**

Security Threats for the **Transition Compounds** may include the following:

- Unauthorized entry into the compound. **(Risk-Moderate)**
- Theft of equipment, materials. **(Risk-Moderate)**
- Sabatoge of any switchgear, connections, etc. at the site. **(Risk-Moderate)**
- Unauthorized operation or tampering of switchgear, connections, etc. at the compound. **(Risk-Moderate)**
- Vandalism of any equipment or materials within the compound. **(Risk-Moderate)**
- Unauthorized personnel at site locations while hazardous operations/tasks are underway (hook-up, commissioning and energization) **(Risk-Moderate)**

Security Threats for **Laydown Areas** include the following:

- Unauthorized entry onto the laydown areas **(Risk-Moderate)**

- Theft of equipment, supplies, materials, tools. **(Risk-Moderate)**
- Vandalism of company property, equipment, materials. **(Risk-Moderate)**
- Sabatoge of company equipment, materials, supplies stored in the laydown areas. **(Risk-Moderate)**
- Unauthorized entry into the site while hazardous operations/tasks are underway. **(Risk- Minor)**
- Personnel operating equipment/vehicles or working in the laydown area while under the influence of alcohol or drugs. **(Risk-Moderate)**
- Driving on in the laydown area at unsafe speeds, without seatbelts, while using cell phones or in an otherwise wreckless manner**. (Risk-Moderate)**

Security Threats for the **Project Offices (Happy Valley/Goose Bay and Torbay Road Office)** include the following:

- Unauthorized entry into the Project Offices. **(Risk-Moderate)**
- NGO Protest Groups blocking office access (proprietary information/ reference materials/documentation/reference materials, equipment, personnel, emergency access, Emergency Operations Centre); **(Risk-Moderate)**
- Theft of equipment, supplies, computers, printers, proprietary information **(Risk-Moderate)**
- Vandalism/Sabatoge of company or contractor property, structures, equipment, materials; **(Risk-Minor)**
- Bomb threat event at the Project Office. **(Risk-Moderate)**
- Emergency evacation of the Office(due to fire, flooding, hazardous weather conditions or other unforeseen weather related and natural disaster event) leaving equipment, materials, computers, etc. exposed for theft. **(Risk-Moderate)**
- Violence at the office (fighting, weapons, firearms, other violent behaviour/action) **(Risk-Minor)**

Other areas that may be included in this plan are:

- **Public access buildings** (Security Treats may include theft, vandalism, sabatoge, NGO Protests) **(Risk-Moderate)**
- **Marine ports** (Security Treats may include theft, vandalism, sabatoge, NGO Protests) **(Risk-Moderate)**
- **Highways** (Security Threats may include blockades by NGO Protest Groups, significant weather conditions or serious vehicle incidents limiting or prohibiting site access, emergency response) **(Risk-Moderate)**
- **Airports** (Security Threats may include serious aircraft (fixed wing or helicopter) incidents adversely impacting company personnel and site operations). **(Risk-Moderate)**

In general terms, it can be expected that periodic disruptions from the NGO's at or near the construction site gates will occur. The scope and depth of any civil disobedience on their behalf will vary depending on personnel involved, but it is believed that this threat potential will exist throughout the duration of the project and could have an adverse impact upon construction deadlines, occupational health and safety issues and community support and relationships.

Many of the proponents have expressed concern that illegal organized criminal activity will flourish in the community. There are some indications that some organized criminal groups are making efforts to entrench themselves in the community. As a result, there will likely be an increase in the distribution, sale and use of illegal drugs, the primary focus being the construction workforce which will reach 1500 at peak stages of the project. Ongoing police intelligence indicates that there is a significant amount of hard drugs, i.e., cocaine, crack cocaine, coming into the area from Montreal and Toronto. This will have a knock-off effect and potential impact upon health and safety at the camp and worksites. As a result, the **LCP Drug and Alcohol Standard (*LCP-PT-MD-0000-LR-SD-0001-01)*** has been approved and in place for LCP Construction Sites, to mitigate risk. Drug and Alcohol testing will be carried out for pre-access and post incidents. Additionally all personnel are requested to be viligant – i.e, drug and alcohol pre-access and post incident testing, as well as vigilant monitoring of personnel to identify unusual or abnormal behaviour.

A network of information has been established and intelligence will flow as the project moves forward. A continual scan of conditions in the area under the auspices of a proactive intelligence gathering mechanism will be required.

Future Project security threat assessments shall be conducted periodically using a competent individual with a recognized security background to ensure potential threats and mitigating actions are undertaken, as appropriate.

6.0 Security Methodology/Approach

6.1 Muskrat Falls Generation Site

The Security Contractor's Execution Plan addresses site security methodology and approach and should be referred to for additional detail on methodology and approach. In general terms, Site Security Methodology and Approach are defined in the following sections.

6.1.1 24 Hour Patrols

Contractor employed security personnel will undertake 24 hour / 7 days a week security patrols of the site, with particular focus on conducting such patrols after normal working hours. Such patrols will be conducted by 2 person teams that will visually inspect areas containing equipment and materials, and those site support areas susceptible to unauthorized entry. Security personnel will report any unauthorized entries and persons demonstrating suspicious behaviour to project management utilizing the project reporting protocol. Additionally, Security personnel will be monitoring vehicle speed and driving activity and reporting any violations to the Emergency Response and Security Coordinator for handling..

6.1.2 Site Access and Random Checks

All authorized site personnel and contractors will be issued a readable identifcation badge which is scanned at the entry gate by site security upon entry and exit from the site. Personnel entering the site via bus or van will also be required to have their identification badges scanned prior to entry and exit from the site. The identification badge will allow for an accurate accounting of all personnel on the Muskrat Falls site at any given time during the day or night. Personnel arriving at the site without their badge may be issued a temporary identification badge after presenting appropriate identification. The temporary badgemust be returned to security upon leaving the site.

On a random basis, security checks of personnel entering and leaving the site will be conducted by the Security Contractor. Individuals who possess an unauthorized badge;

or no badge, shall be denied access to the Muskrat Falls site. An unauthorized badge may include, but is not limited to the following:

- Photograph of bearer does not match the individual trying to gain site access.
- Scan indicates expired training and/or other credentials
- Attempted access by authorized person at wrong gate
- Unauthorized contractor to the LCP
- Other circumstances- to be determined

Random checks of vehicles, knapsacks, plastic bags, luggage, tool boxes, lunch boxes, and other containers will be completed to verify that personnel are in possession of only personal property. All materials, tools or equipment may also be checked by serurity personnel. Submission to random security checks are a condition of employment on the LCP.

Reasonable suspicion of security breaches may lead to a search of an individual's site accommodations, breaches may include, but not limited to, the following:

- Theft
- Property Damage
- Suspicion of Drugs and Alcohol Possession or use/intoxication/impairment.

6.1.3 Signage

The following signage shall be posted in and around the entrances to each site:
"No Trespassing" signs, installed at all perimeter access points.

- Signs having a 24 hour emergency phone number for a person who can respond to the site. It should also be posted at each of the on-site trailers and camp facilities.
- All Signs must be posted a minimum of five feet off the ground level to prevent vandalism, sabatoge or theft.

6.1.4 Video Surveillance

Video Surveillance equipment will be strategically placed on the Muskrat Fall Generation site to continuously monitor site access points and other key areas that require continuous visual monitoring. These areas will include, but not limited to, parking areas, exterior and interior of camp facilities, and areas that contain high value equipment. Video monitoring and surveillance will be overseen and managed by contractor security personnel.

At the Accommodations Complex, twelve security cameras will be located in and around the Accommodations Complex. In addition to the security cameras, extra wiring will be provided throughout the Complex buildings area to allow for quick installation of additional security cameras as the situation dictates during occupancy. The twelve cameras noted will be located in the following areas:

- Two exterior and one interior cameras will be located in the Accommodations Complex Security Building;
- One camera will be mounted on a light standard at the Emergency Power/Fuel Storage Area;
- Two cameras will be mounted on light standards (One on north side and one on the south side of the vehicle parking area near the Accommodations Complex;
- One camera will be mounted on a light standard (along the east side) for the Bus Depot;
- One interior camera will be located in the Communications Building;
- One exterior camera will be located in the main entrance of the Accommodations Core Complex;
- One exterior camera will be located in the Transit Waiting Area of the Accommodations Core Complex;
- One interior camera will be located in the Receiving and Shipping Area of the Accommodations Core Complex;
- One interior camera will be located in the warehouse area of the Accommodations Core Complex.

(Note: These cameras will be monitored at the Main Security Building at the Accomodation Core Complex)

In addition to the above, the following exterior cameras will be located at the Security Gate near the Trans-Labrador Highway:

- Two exterior and one interior camera will be located at the Security Gate Trailer;
- Two cameras will be mounted on light standards (one on the north side with the other on the south side) for the vehicle inspection area.

(Note: These cameras will be monitored at the Security Gate Trailer)

Security cameras are also planned in the following areas:

- One security camera will be mounted on a light standard at the tapping station located on the North Spur.
- One security camera will be mounted on a light standard at the Owner's Laydown Fueling Area depot.

(Note: These cameras will be monitored at the Main Security Building at the Accomodation Core Complex)

6.1.5 Drug and Alcohol Screening Process

In accordance with the **LCP Drug and Alcohol Standard (LCP-PT-MD-0000-LR-SD-0001-01),** all project personnel and contractors will be required to undergo pre-access drug and alcohol screening. This requirement will exclude authorized visitors.

In addition to pre-acccess screening, personnel involved in an safety or operational related incident are required to undergo a post event screening to verify whether or not drug/alcohol consumption were a causal factor in the incident.

6.1.6 Vehicle Authorization

All vehicles coming to the site must meet applicable safety standards. All work related vehicles must:

- Be in a safe operating condition.
- Have funtional seatbelts that are work by all occupants of the vehicle.
- Be equipped with a 20 pound dry chemical fire extinquisher.
- Must have an adequate first aid kit.
- Must have an amber flashing beacon clearly visible and operational.
- Must have a workable and audible back-up alarm.
- Must have a flagged buggy whip
- Have no more than three people riding in the front seat.
- Not carry any personnel in the back/box.
- Be insured to Nalcor requirements.
- Have licensing and proper insurance for public roadways or will not be allowed on site.

All vehicles not meeting these requirements will not be allowed on site.

6.1.7 Public Intervention

Security personnel may be required to interact with the public at various times

Security personnel will be instructed not to respond to any questions or interact with members of the public who may arrive at the security gate. In the case that members of the public arrive at the security gate with questions related to the Project, they will be politely directed to contact the Nalcor Informatonal Office in St. John's, NL.

In the event of NGO protestors arriving at the security gate the security incident reporting protocol will be followed:

- Security, Site Personnel and/or contractor personnel will not engage with or make contact with the protesting group,
- If practical and safe and the NGO protestors are outside of the secured area the security gate will be closed and locked,
- The Nalcor/SLI Communications/Information Flow established for Incident Reporting will be utilized for and incident relating to NGO Protests, etc. In the event the condition becomes more deliberate, hazardous or personnel are endangered, all operations on the site will stop immediately and personnel will evacuate the area if it is safe to do so.
- No further actions will be taken by the site personnel without explicit instructions from either Nalcor or SLI Site management.

At no time will security personnel enter into any type of physical contact or confrontational behaviour with members of the general public. Their role is strictly to advise, observe, and report.

Should activity outside the gate (via protests or otherwise) occur, the Security Guard at the Main Gate shall contact the Muskrat Falls Site Manager immediately. The Muskrat Falls Site Manager will make contact with the RCMP (Happy Valley- Goose Bay) to respond to the site to initiate action to remove individuals from company property as the situation dictates, particularly if the intent is to cause harm, disrupt or stop work activity. As required, The Muskrat Falls Site Manager may be required to file an injunction or other legal instrument with the provincial court in order for initiate RCMP action, as and when required.

6.2 AC/DC Transmission Lines, Soldier's Pond/Churchill Falls Convertor Stations and Switchyards, Transition Compounds and Electrodes.

It is anticipated that there will be several remotely located work areas during the construction of the transmission and distribution lines. Contractor shall ensure that adequate control measures are implemented to control access to such work sites during work and after work hours. Adequate control measures shall eliminate sabotage / theft and include protection of public safety during and after work hours.

Sub Station construction at the Muskrat Falls Generation Site shall be controlled by contractor provided security personnel with project specific access control protocols followed for access and egress to the substation construction area.

Construction of sub stations at both Churchill Falls and Soldiers Pond are considered isolated work site with security and access to be controlled by the contractor. Adequate control measures shall be implemented to control access to the site during and after construction work areas. Security provisions are required to be implemented by the contractor that will include controlling public access/safety and preventing the sabotage and theft and equipment from these sites. Such provisions include, but are not limited to:

- Planned/periodic patrols around the site by sercurity services contractor personnel, particularly after work hours
- Utilization of barricading and signage at vehicle/equipment entrance points that will control access and egress to the site. Such controls will allow contractor personnel to control (i.e. screening, sign in, etc) unauthorized access to the site.

6.3 Marshalling Yards

There will be several designated Marshalling Yards for various types of equipment and materials found both on the project sites and external to the main project sites. Marshalling Yards will consist of both Contractor and Project controlled lay down areas.

Project controlled lay down areas will be adequately secured and monitored to prevent the sabotage and theft of materials and equipment. Project controlled lay downs will consist of both on site and off site areas. On site lay down areas will be afforded the security systems implied for the overall main site (i.e. gated access, security patrols, etc.). Off site project lay downs will require more detailed security planning that will require such sites to be:

- Barricaded to prevent theft and sabotage and protect public safety. Such barricading might potentially consist of fencing or some other physical means of barricading, supplemented by highly visibility signage;
- Subject to planned patrols by contract security personnel, supplemented by video surveillance & signage;
- Manned by qualified security personnel 24 hour / 7 days a week.
  Storage Containers (having at least 64 square feet of storage area) shall be equipped with the following:

- Doors shall be secured using a hasp or slide bolt with a protective device to prohibit cutting of the padlock, and attached with non-removable bolts from the exterior.
- Padlocks shall have a minimum ½ inch thick shackle with heel and toe locking.
- Exterior hinge pins shall be rendered non-removable by design or welding.

Contractor designated lay down areas shall be directly under the management and control of the contractor. The contractor shall be responsible to ensure that all necessary control measures are implemented to prevent sabotage and theft and to ensure public safety is protected.

6.4 Project Offices

Project Offices currently consist of offices in St. Johns, NL, and the Muskrat Falls Construction Site Area. All personnel working in any project office has the responsibility to understand, respect and enforce building security on a daily basis. Opportunistic theves and unsrupulous individuals often pray on those who are trusting and unaware of the security risks.

The Project Office located on Torbay Road in St. John's, NL is currently only accessible to authorized project personnel who are required to utilize an electronic swipe card for access to the building. To facilitate visitors, an administrator is positioned at the main entrance during working hours. Visitors cannot enter the building until the administrator verifies the intention of the visitor (s). As per the visitor policy, visitors are required to sign in and sign out and are to remain in the Main Entrance area until the appropriate project person arrives to meet the visitor. Visitors are to be accompanied by the respective project representative for the duration of the visit to the office.

Everyone who works in the office has the responsibility to understand, respect and enforce building security daily. Opportunistic thieves and unscrupulous individuals often pray on those who are trusting and unaware of the risks. All personnel are requested to take the following steps to maintain building security practices:

General Office Security

- All personnel are requested to visible display their ID badge for identification purposes.

- Ensure guests/visitors are checked in at the receptionist and issued a visitor's badge. If you see any individual without a badge, ask them if they can produce their badge and escort them to the receptionist if they are unable to do so.
- It is extremely important to report any suspicious unescorted person/stranger in the office at once to your manager/supervisor.
- All personnel are requested to display their Identification Badge on their person at all times. Identification Badges must not be loaned to anyone in the office. Any lost or missing ID badge must be reported to the receptionist.
- All exterior doors are provided with an alarm feature and should never be propped open at any time.
- The practices of "tailgating" (unauthorized person following closely behind an authorized ID holder) and "piggybacking" (authorized person gaining access to the building and allowing others to follow by holding open a secure door) will no longer be permitted. Signs will be posted at each door this week to remind personnel of this
- Third party visitors should sign-in with receptionist, be assigned a visitor badge and be escorted to employee contact. Visitors should be escorted back to reception, return visitor badge and sign out when finished for the day.

Personal Belongings:

- Always keep your purse, wallet, cash, credit cards or cell phone on your person or in a locked drawer at all times.
- Don't leave packages or other valuables around your desk or work area. Leave them at home or lock them up in the trunk of your car.
- Immediately report any theft or other criminal activity in the office to your supervisor.

Computer Data and Computer Generated Documents:

- Never leave confidential documents at printers or the fax machine.
- Always try to avoid leaving confidential documents in plain sight on your desktop.
- Store DVDs, USB drives and other mobile equipment under lock and key when not in use or you are away from your desk. Please be advised that USB drives used are to be the encrypted type as per Nalcor standards.
- Dispose of documents in accordance with the organization policies. Always shred confidential documents you wish to dispose of.

- It is important to Lock the keyboard (Ctrl-Alt-Del) or Windows Logo + L as soon as you leave your workstation to ensure that others cannot access your information while you are away.
- Attach and lock laptops computers with the Kensington lock at all times. If you have any questions or problems with attaching or using these locks please contact the Helpdesk for assistance.

7.0 Emergency/Incident Response

Security personnel will be involved as a key point of contact in emergency response activities, journey management and other general communications on site 24 hours per day. During evening hours, the Security Office will be the contact point for reporting any incident/ emergency. The on-duty Security Officer will be responsible for making contact with the Muskrat Falls Site Manager to initiate Emergency Response as prescribed in the ***Emergency Response Plan*****. *(LCP-PT-MD-0000-HS-PL-0004-01)*** Coordinating with the Project Security Coordinator, security personnel will potentially be required to interface with local law enforcement. Security personnel will also assist in with the incident investigation process that might include, but not limited to; securing incident scenes, accompanying and escorting personnel from the project property, etc.

8.0 Contractor Access

8.1 Site Access Control

Nalcor reserves the right to refuse access and/or entry to its premises which includes all land, property, structures and installations, vehicles and equipment owned, leased, operated or otherwise directly controlled by Nalcor, including the LCP. The construction management team will maintain control over the movements of their construction contractor and subcontractor personnel within the project work site. These measures include, but are not limited to:

- Ensuring compliance to the site specific mandatory use of personal protective Equipment.
- The construction management team shall make provisions for the transport of all construction personnel between offsite vehicle parking areas and the project site.
- Project specific badging intended to identify and allow access to authorized personnel to Muskrat Falls (see section 5.3 for specific information).

- Fences and other physical barriers around the perimeter of the project site with appropriate signage and guard stations limiting authorized/unauthorized access.
- Video cameras shall be installed at key locations throughout the site and at areas considered to be high potential for security threats.
- Limitations on the number of vehicles on project property (see section 6.12 for more specific information). Ensure that all contractor vehicles are in compliance with site requirements for obeying site speed limit requirements and backing into parking spaces.
- Random security checks on personnel and vehicles entering and leaving the Muskrat Falls Site.
- Controlled access to Sub Station Construction Sites. Access to be controlled by contractor personnel through designated access and egress points, supplemented by signage and planned security patrols
- Controlled access to designated transmission and distribution construction work areas. Physical barriers supplemented by signage to implied as control measures and be responsibility of contractor.

8.2 Public or Other Access Buildings

There will be occasions that construction activities will require workers to perform tasks that are adjacent to or directly in current operating facilities (i.e. the sub-station at Churchill Falls). Local security protocols shall be followed by all construction site personnel.

9.0 Control of Tools, Equipment & Materials

Individual contractors will be responsible for controlling and managing their equipment as it is brought onto and off the project site locations. Should overall project theft become a problem, the project will, at its discretion, implement a materials pass that will be required to remove tools and equipment from project sites.

10.0 Camera Pass

The use of cameras on site to collect personal photographs is not permitted at any Project Construction Site. Only project personnel requiring the use of a camera for project related matters are permitted to use cameras on site and must have formal

approval of the Muskrat Falls Site Manager prior to taking the pictures. If client determines that propriety or sensitive information is at risk for public disclosure, the utilization of a permitting process will be implemented.

11.0 Visitor Access

For site construction activity, the number of personnel on the construction site will generally be restricted to only those required to execute the work and manage the site. However, Visitor Access may be required on the site for business related reasons. As a result of various risks associated with Site Construction at the Muskrat Falls Site, site access will be restricted . Requirements for Construction Site Access are defined in the following document: ***Authorization Protocol for Access to Project Construction Sites.(LCP-PT-MD-0000-HS-PR-0001-01.) All personnel going to site must be familiar with this protocol prior to site entry.***

12.0 International Travel

All LCP employees travelling outside of Canada on Project related business shall comply with the requirements of the International Travel Policy. As a minimum, travellers shall:

- Complete the Security Plan Template from the International Travel Program
- Ensure travel authorization is obtained and travel is communicated to the appropriate supervisory personnel;
- Ensure that passport is current and in good, legible condition; with your number memorized and supporting documentation packed should your passport become lost or stolen;
- Ensure that all necessary health precautions are taken specific to the area you are travelling (i.e. immunizations/vaccinations) and that an adequate quantity of medication is taken with you (if applicable).
- Register with the Canadian Abroad Service, as applicable.
- Develop and keep on persons at all times, pertinent emergency numbers to call should an emergency situation arise.

13.0 Exclusions

This plan does not include supplier fabrication facilities and marine ports. Prior to the selection of other facilities and marine ports a security threat / risk assessment shall be conducted to define the level of security controls required Construction on the Transition and Electrode Sites is currently excluded from this plan. Prior to the commencement of construction at these sites a security evaluation will be facilitated by the Security Coordinator to determine the appropriate level of security services to provide and how these services will be executed.

General public areas such as airports, highways, government medical facilities shall be excluded from this plan.

Nalcor Energy – Lower Churchill Project

Standard for Drug and Alcohol

LCP-PT-MD-0000-LR-SD-0001-01

Comments:	Total # of Pages (Including Cover): 30

B1	10-Aug-2012	Issued for Use	C. Rowsell	L. Clarke	G. Fleming	R. Power	P. Harrington
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Status/ Revision	Date	Reason For Issue	Prepared By	Functional Manager Approval	Project Manager (Marine Crossings) Approval	Project Manager (Generation + Island Link) Approval	Project Director Approval
CONFIDENTIALITY NOTE:	This document contains intellectual property of the Nalcor Energy – Lower Churchill Project and shall not be copied, used or distributed in whole or in part without the prior written consent from the Nalcor Energy – Lower Churchill Project.						

Inter-Departmental / Discipline Approval (where required)

Department	Department Manager Approval	Date
HROE	G. McDonald	May 31/2012
HROE	J. Hollohan	May 31/12
Health & Safety	D. Riffe	May 18, 2012
VP, LCP	G. Bennett	June 28, 2012

TABLE of CONTENTS

1.0 PURPOSE

Nalcor Energy ("Nalcor") is the proponent of the Lower Churchill Hydroelectric Project which includes the construction of the Muskrat Falls generating facility, Muskrat Falls reservoir clearing, Muskrat Falls transmission line construction, other ancillary sites and staging areas (collectively referred to as "the Sites"). Nalcor is committed to providing a safe workplace for its employees and contractors. Industrial construction projects of this size and complexity are inherently hazardous places to work. While on the various sites, personnel will often be working in conditions and around equipment and materials that, if handled without proper care and attention, can pose a threat to the safety of those personnel and the surrounding workforce. The use of illicit drugs, inappropriate use of alcohol and the misuse of medications and other substances can have serious affects on workers' health, job safety and overall job performance through erratic behaviours and irresponsible actions. For these reasons, this Comprehensive Drug and Alcohol Standard ("Standard") has been established. This Standard recognizes the importance of an accommodation process for those persons who may have a drug or alcohol problem.

Guiding Principles

The Alcohol and Drug Standard has been developed based the following Guiding Principles:

- Nalcor is committed to providing a safe workplace for its employees and contractors;
- Recognizing the importance of an accommodation process for those persons who may have a drug or alcohol problem;
- The standard applies to all Nalcor employees, contractors, subcontractors, and their respective employees ("Workers");
- Ensuring that Workers are treated fairly and with respect;
- Workers accept responsibility for their own safety and the safety of others;
- Requiring alignment and commitment on the part of all levels of project management; and
- Zero tolerance for possession and/or use of drugs and alcohol.

2.0 SCOPE

This Standard applies to all Nalcor employees, contractors, subcontractors, and their respective employees ("Workers") working on the Sites and persons seeking a site pass required to access the various Sites ("Site Access"). The primary objectives of the Standard are to:

a) Provide safe work Sites for all Workers and personnel whose safety may be adversely affected by the conduct of other Workers; and

b) Ensure Workers are treated fairly and with respect.

We all share the responsibility to ensure that we, and the Workers around us, are all able to safely and reliably perform work duties and that everyone remains fit for duty throughout their work shift. In order to support this responsibility, Nalcor requires all contractors and subcontractors ("Contractors") to establish and fully implement their own Drug and Alcohol programs. All Contractors must commit to taking appropriate and responsible actions required maintaining a safe work place. This requires commitment on the part of all levels of project management, Contractor management, and all Workers to accept responsibility for their own safety and the safety of others. This commitment includes recognizing that conduct or behaviour off Site may adversely affect the ability to safely and reliably perform duties on the Sites. In developing this Standard, Nalcor has adopted the guidelines of the Canadian Model for Providing a Safe Workplace, Alcohol and Drug Guidelines and Rules (2010), or the most current version ("the Canadian Model"). The Canadian Model establishes a minimum industry standard for a safe workplace, is a part of an overall approach to employee health and safety. The standard provides a specific policy with respect to alcohol and drugs in the workplace and strives to establish a consistent industry practice.

As a condition of continued employment or contracting with Nalcor, employees, Contractors, and Workers must accept the terms of this Standard and comply with this Standard in their own drug and alcohol policy, which must also be at least equivalent to the requirements set out in the Canadian Model and this Standard.

This standard shall come into effect at the discretion of the Project Director, at a date no later than the commencement of work at the site.

3.0 DEFINITIONS

3.01 Zero Tolerance

Nalcor is committed to providing a safe workplace for Contractors, Workers, and persons seeking Site Access. In the interest of the safety of those persons or Workers on Site, there is zero tolerance for possession and/or use of drugs and alcohol.

a) Persons or Workers on any Nalcor Site who use or are in the possession of alcohol, illegal drugs, or illegal drug paraphernalia shall be removed from the

Sites, Site Access shall be revoked, and such persons or Workers shall be prohibited from obtaining Site Access indefinitely;

b) Persons or Workers on Sites found to be under the influence of alcohol or illegal drugs will be removed from Sites, Site Access shall be revoked, and such persons or Workers shall be prohibited from obtaining Site Access indefinitely;

c) Persons on any Site who distribute, sell, or attempt to sell drugs or illegal drug paraphernalia, or engage in unauthorized distribution, offering, or sale of prescription medications, shall be removed from such site. Site Access shall be revoked and such person or Workers shall be prohibited from obtaining Site Access indefinitely;

d) Persons or Workers on any Site under the influence of legal drugs or non-prescription medication which interfere with their judgment, coordination, or concentration are not to attend at any of the Sites and will be removed from such site. Site Access shall be revoked and such person or persons shall be prohibited from obtaining Site Access indefinitely; (in accordance with Appendix C)

e) Every person, Worker, or Contractor working on any of the Sites is required to report to the EPC/EPCM site safety personnel, EPCM site labour relations representative, the contractor, any other EPCM management person, or Nalcor, any breach of this Standard which they have observed or have been made aware of immediately, and failure to report any breach of this Standard may result in revocation of Site Access; and

f) Nalcor and/or the EPCM will not grant Site Access to any person who has tested non-negative for illegal or illicit drugs, alcohol, or any medication found to be causing impairment, as per this Standard.

3.02 Workplace Substance Abuse and Effects

Work site substance abuse is defined as:

The use of potentially impairing substances, to the point at which it has the potential to adversely affect performance and/or safety on any of the Sites.

The impairment may either be directly through intoxication and/or residual affects, or indirectly through social and/or health problems. Substance abuse is considered to occur when a drug is taken without medical reasons, or if a substance impairs and/or jeopardizes the health or safety of oneself or others. Abuse can occur by using a

substance too much, too often, for the wrong reasons, at the wrong time, or at the wrong place.

The range of substances that are abused is wide and can include (but is not limited to) alcohol, cocaine (including crack), marijuana, other illicit drugs, solvents, and misuse of prescription drugs or over-the-counter medications.

Category	Examples	Examples of General Effects
Alcohol	beer, wine, spirits	impaired judgment, slowed reflexes, impaired motor function, fatigue or drowsiness, coma, overdose may be fatal
Cannabis	marijuana, hashish	distorted sense of time, impaired memory, impaired coordination
Depressants	sleeping pills, sedatives, some tranquilizers	inattention, slowed reflexes, depression, impaired balance, drowsiness, coma, overdose may be fatal
Hallucinogens	Lysergic acid diethylamide (LSD), phencyclidine (PCP), mescaline	inattention, sensory illusions, hallucinations, disorientation, psychosis
Inhalants	hydrocarbons, solvents, gasoline	intoxication similar to alcohol, dizziness, headache
Opiates	morphine, heroin, codeine, some prescription pain medications	loss of interest, "nodding", overdose may be fatal. If used by injection, the sharing of needles may spread Hepatitis B or C and HIV/AIDS
Stimulants	cocaine, amphetamines	elevated mood, over activity, tension/anxiety, rapid heartbeat, constriction of blood vessels

3.03 Safety Sensitive Positions

The Canadian Human Rights Commission defines a Safety Sensitive Position as:

One in which incapacity due to drug or alcohol impairment could result in direct and significant risk of injury to a Worker, others, or the environment.

Whether a job can be categorized as safety sensitive must be considered within the context of the industry and the particular workplace.

All persons seeking Site Access, if granted, will be working in a safety sensitive position and accordingly, such person will submit to a drug and alcohol testing procedure.

All workers working on the Sites are considered to be working in safety sensitive positions and will submit to a drug and alcohol testing procedure, which meets this Standard in the following circumstances:

a. Where there is reasonable grounds as per this Standard; and

b. Post-incident as per this Standard.

Construction industry sites, particularly sites with this magnitude of construction work, are particularly high-risk areas. In keeping with this definition, Nalcor has identified specific duties and accountabilities as safety sensitive within the Sites, which includes, but is not limited to, the following:

a. Where the duty requires operating or working with moving machinery, equipment, tools, or mobile equipment;

b. Where the duty requires the Worker to handle hazardous chemicals (As identified by the WHMIS legislation), hazardous materials, dangerous materials, and any other materials identified as hazardous through WHMIS.

c. Where the duty requires the Worker to work in an area where blasting activities may occur;

d. Where the duty requires working knowledge of the lock-out procedures, confined space procedures, procedures for working at heights, or any other procedures required on the Sites;

e. Where the duty requires a Worker to work periodically in an area where mobile equipment or other equipment is operating, or construction activities are occurring;

f. Where the duty requires a Worker to travel in, on, or around the Sites;

g. Where the duty requires the Worker to wear personal protective equipment (e.g. hard hat, protective eyewear, safety boots, respirator, etc.);

h. Where the duty requires the Worker to work alone;

i. Where the duty requires the Worker to work above normal elevation (e.g. use of fall protection, step ladder, scaffolding, step stool, etc.);

j. Where the duty requires more than normal physical effort (e.g. lift more than 10 kg);

k. Where the Worker is responsible for the welfare and safety of others;

l. Where the Worker puts themselves or others at risk of injury or death;

m. Where the Worker can put the environment at risk placing the employer at significant liability risk; and

n. Where the duties require supervision or support of any of the above activities.

Delivery companies should be required to have alcohol and drug policies under Transportation Regulations. Any Executive personnel and other short term visitors will be made aware of the alcohol and drug policy prior to arrival at site. These personnel may, in fact, be subject to testing should circumstances dictate as referred to in this standard.

4.0 CAMP

At such time as camp rules are established, they shall be adhered to at all times.

5.0 ABBREVIATIONS AND ACRONYMS

Term	Definition
AMP	Amphetamines
BAT	Breath alcohol technician
Canadian Model	Canadian Model for providing a safe workplace, alcohol and drug guideline and rules (2010)
Certified Lab	A Lab certified by the Substance Abuse and Mental Health Services Administration

	under the National Laboratory Certification Program
COC	Cocaine
Contractors	Nalcor contractors and their subcontractors
DCR	Designated Contractor Representative
DNR	Designated Nalcor Representative
EPC	Engineering, Procurement, Construction
EPCM	Engineering, Procurement, Construction Management
MRO	Medical Review Officer
Nalcor	Nalcor Energy
NHTSA	National Highway Traffic Safety Administration
OPI	Opiates
PCP	Phencyclidine
POCT	A point of care testing procedure
Site Access	A Site pass required to access the Sites
SLI	SNC Lavalin Inc.
Standard	Comprehensive Drug and Alcohol Standard
STT	Screening test technician
THC	Marijuana
The Sites	Lower Churchill Hydro Electric Project including the construction of Muskrat Falls

	Generating Facility, Muskrat Falls Reservoir clearing, Muskrat Falls transmission line construction, other ancillary sites and staging areas.
WHMIS	Workplace Hazardous Materials Information System
Workers	Nalcor employees, contractors, subcontractors and their respective employees

6.0 REFERENCE DOCUMENTS AND/OR ASSOCIATED FORMS

Nalcor Energy LCP Safety & Health Management Plan
SLI Safety Management Plan
Canadian Model

7.0 RESPONSIBILITIES

Nalcor Energy LCP Safety and Health Manager

Labour Relations and Team Effectiveness Lead

8.0 TESTING PROCESS

Drug and alcohol testing as required by this Standard will be performed by an accredited drug and alcohol testing agency who will manage the process of taking test samples, having all non-negative test result samples sent for confirmation testing at a lab certified by the Substance Abuse and Mental Health Services administration under the National Laboratory Certification Program ("Certified Lab"), have the results assessed by a Medical Review Officer ("MRO") that will report non-negative test results to the Designated Contractor Representative ("DCR"), the Designated Nalcor Representative ("DNR"), and the designated EPCM Site Access Administrator ("Administrator"). This is laid out in the attached Drug and Alcohol Testing Procedures document, Appendix "A".

For reasonable grounds or post-incident drug and alcohol testing, as per this Standard, Contractors shall utilize the Sites accredited drug and alcohol testing agency. All non-negative test samples will be sent for confirmation to a Certified Lab.

The substances that will be tested for are contained in the following five panel process:

	TARGET DRUG	SCREENING CONCENTRATION	CONFIRMATION CONCENTRATION
THC	MARIJUANA	50 ng/ml	15 ng/ml
COC	COCAINE	300 ng/ml	150 ng/ml
OPI	OPIATES	2000 ng/ml	2000 ng/ml
PCP	PHENCYCLIDINE	25 ng/ml	25 ng/ml
AMP	AMPHETAMINE	1000 ng/ml	500 ng/ml

9.0 SITE ACCESS

All persons seeking site access shall undergo drug and alcohol testing as per this standard. The pre-access test must be completed before deployment on Sites and not more than thirty (30) days prior to the deployment from the Union or Contractor to the work Sites. The pre-access test will be valid for return access to Sites for

a) A period of not more than thirty (30) days from the date the test was completed. Workers or persons will be required to provide proof of a negative pre-access test to the respective Contractor for each subsequent return to Sites, or;

b) For as long as the Worker remains in continuous employment with the same Contractor. Continuous employment means without lay-off or termination of employment.

In the case of a non-negative test result for persons seeking Site Access, Site Access will not be issued to that person in the future except in accordance with Section 10, below. The DCR or DNR must inform the person of these consequences and their options, as described below. In addition to the DCR or DNR, the persons who have applied for Site Access who have tested non-negative will be provided to the Administrator and such persons will not be granted Site Access except in accordance with Section 10, below.

10.0 WAITING PERIOD FOR SECOND SITE ACCESS TEST

Site Access will not be granted to a person who has previously tested non-negative except as follows:

a) At least thirty (30) days have elapsed since the non-negative test is confirmed as per Section 9 above, such person tests negative as per Section 9 above, such person agrees to return to work terms and conditions satisfactory to the administrator, DCR and DNR, which shall include professionally or medically

directed drug and alcohol testing; which must be reported to the Administrator and the DCR and DNR and such person is cleared as fit to work on the Site safely.

b) Such person, through or by utilization of the public health care system (contact information is described below) or other means, meets all of the following conditions:

(i) The person voluntarily meets with a substance abuse professional, who will determine whether the person requires treatment for a substance abuse problem, or such person is fit to work on Sites safely.

(ii) In the case where a substance abuse professional determines if the person is fit to work on the Sites, such substance abuse professional will provide a written report containing any restrictions, return to work conditions, and confirmation that the person is fit to work on the Sites safely to the Administrator and the DCR or the DNR. The report of the substance abuse professional must be in a form satisfactory to the Administrator, DCR and/or the DNR. Such person may be subject to a Return to Work Agreement in a form satisfactory to the Administrator, the DCR, or the DNR, which shall be based on the recommendations of the substance abuse professional in consultation with the Administrator, the DCR and/or the DNR, and which may include professionally or medically directed drug and alcohol testing.

(iii) In the case where a substance abuse professional determines the person has a substance abuse problem and requires treatment, such person shall provide to the Administrator and the DCR or DNR written confirmation from a substance abuse professional in a form satisfactory to the Administrator and the DCR or DNR when an assessment and/or treatment has been successfully completed, this report must contain any recommendations, work restrictions, and confirmation that the person is fit to work on Sites safely. Such a person who has successfully completed an assessment and/or treatment must sign a Return to Work Agreement in a form satisfactory to the Administrator and the DCR or DNR, which shall be based on the recommendations of the substance abuse professional in consultation with the Administrator, the DCR and/or the DNR, which may include professionally or medically directed drug and alcohol testing.

(iv) The person must execute a Substance Abuse Professional Release of Confidential Information, attached as Appendix "B".

(v) The person must test negative as per Section 8 above and this must be reported to the Administrator and the DCR or DNR.

10.01 Providing Substance Abuse Support Information and Accommodation

The DCR or DNR must inform a person who has tested non-negative that if the person wishes to use the option to seek help and support, the Newfoundland and Labrador public health care system provides many options for support, which are covered by Medicare, such as outpatient counselling, adult residential treatment, detoxification services, and more. The DCR or DNR must tell the person that detailed information on services can be obtained online at http://www.health.gov.nl.ca/health/commhlth_old/factlist/services_available.htm and by phoning 1-888-737-4668.

10.02 Confidentiality of Substance Abuse Professional Information

In order to preserve the confidentiality of information provided by a substance abuse professional, the Administrator, the DCR or DNR, and any person to whom disclosure is permitted under this Standard, must not disclose the information to any person other than a person who is required to know the test results to discharge an obligation under this Standard.

10.03 Testing Non-Negative More Than Once For Site Access

In the event that any person tests non-negative more than once when seeking Site Access, such person shall be prohibited from obtaining Site Access indefinitely.

11.0 REASONABLE GROUNDS TESTING

a) In any situation when a Worker at work or within two hours prior to reporting to work appears, or is reported by another Worker to appear to be unfit for work, a supervisor or manager of that Worker must investigate the situation. If they, in consultation with the next level of management, (both levels must sign off) conclude there are reasonable grounds to believe the Worker is under the influence of drugs or alcohol, or that drugs or alcohol may be a contributing factor to the Workers condition, the Worker will be requested to submit to a drug and alcohol test. Factors to consider in deciding if reasonable grounds for testing exist include, but are not limited to:

(i) The odour of alcohol and/or drugs detected on the Worker;

(ii) The observed use of a substance by the Worker;

(iii) Where the Worker's appearance, and/or performance, and/or behaviour strongly suggests that the individual is under the influence of drugs or alcohol; and

(iv) Where, after a fit for work assessment performed by a supervisor, the supervisor believes the Worker may be under the influence of drugs or alcohol.

b) A supervisor or manager of a Worker must provide the Worker with the reasons for requesting a drug and alcohol test, and those reasons must be documented. Documentation should include a reasonable grounds checklist, a copy of which is attached as Appendix "C".

c) Tests are to be conducted as soon as reasonably practicable following a reasonable grounds determination.

d) Where testing occurs more than four (4) hours from the time of the determination, the Contractor must provide to Nalcor or the designate of Nalcor, in writing, a reason for the delay.

12.0 POST-INCIDENT TESTING

a) A supervisor or manager of a Worker must request the Worker to submit to a drug and alcohol test if the supervisor or manager and the next level of management present on the Worksite, have reasonable grounds to believe that the Worker was involved in a safety related incident, a significant near miss incident, which under different circumstances could have caused serious injury or property damage or other potentially dangerous incident/activity. The supervisor should request that the worker stop all work related activities prior to testing for reasonable grounds.

b) Workers referred for drug and alcohol testing will also include those who are identified, with reasonable grounds, as having been directly involved in the chain of acts or omissions leading up to the event or incident.

c) A drug and alcohol test is automatic after a significant incident, unless there is clear evidence that the acts or omissions of Worker(s) could not have been a contributing factor (e.g. structural or mechanical failure). A significant incident would include but not be limited to the following:

(i) A fatality or serious personal injury to any person;

(ii) An environmental spill with significant implications;

(iii) Significant loss or damage to any property, equipment, or vehicles;

(iv) Significant financial loss; or

(v) A near-miss incident that had the potential for significant damage, or environmental harm.

d) In any situation, whether the incident is significant or not, reasonable grounds testing may occur, subject to 11.0.

e) Workers must not use alcohol for eight hours after the incident or until drug and alcohol testing has occurred, or the Worker is advised a test is not required.

13.0 TESTING REQUEST

The supervisor or manager must request that all workers concerned submit to drug and alcohol testing immediately in the event of reasonable grounds, or immediately following a significant accident, near miss, or other potentially dangerous incident, but if it is not practicable or reasonable to do so until a later time, collection shall not occur more than 8 hours after the incident for an alcohol test, and 32 hours after the incident for a drug test. Until the test is completed the employee shall remain in the care of his/her manager/supervisor and transferred to a medical professional during actual treatment for an incident.

14.0 FAIL TO TEST

Any Worker who fails to comply with a testing request, or delays a test pursuant to this Standard, or refuses to provide a sample for a test, will be considered to be in breach of this Standard and such Worker will be removed from the Sites, have their Site Access revoked, and shall be prohibited from obtaining Site Access indefinitely. If an attempt to tamper with a test sample is confirmed, the employer of such Worker shall remove such Worker from the Sites, shall not deploy such Worker to the Sites thereafter, and such Worker shall be prohibited from obtaining Site Access indefinitely.

15.0 POTENTIAL RETURN TO SITE AND REASONABLE GROUNDS POST-INCIDENT

Any Worker denied access to the Sites due to the results of drug and alcohol testing for reasonable grounds or post-incident may, subject to Nalcor's (EPCM) approval and the Contractor's approval, be permitted Site Access subject to the following conditions:

a) The Worker voluntarily meets with a substance abuse professional, who will make a determination whether the Worker requires treatment for a substance abuse problem or such Worker does not have a substance abuse problem. If the substance abuse professional determines that the individual does not have a substance abuse problem or is a recreational drug or alcohol user, such individual shall not be permitted site access unless Nalcor's (EPCM) determines there are exceptional circumstances that warrant considering such individual be granted site access and such individual meets the conditions set out in Section 15 (b), (c), (d), and (e) below.

b) In the case where a substance abuse professional determines the Worker is fit to work on the Sites, such substance abuse professional will provide a written report containing any restrictions, return to work conditions, and confirmation that the Worker is fit to work on the Sites safely to the Administrator and the DCR or the DNR. The report of the substance abuse professional must be in a form satisfactory to the Administrator, DCR and/or the DNR. Such Worker may be subject to a Return to Work Agreement in a form satisfactory to the Administrator and the DCR and/or the DNR, which shall be based on the recommendations of the substance abuse professional in consultation with the Administrator and the DCR and/or the DNR, and which may include professionally or medically directed drug and alcohol testing.

c) In the case where a substance abuse professional determines the Worker has a substance abuse problem and requires treatment, such Worker shall provide to the Administrator and the DCR or DNR written confirmation from a substance abuse professional in a form satisfactory to the Administrator and the DCR or DNR when an assessment and/or treatment has been successfully completed. This report must contain any recommendations, work restrictions and confirmation that the Worker is fit to work on Sites safely. Such Worker who has successfully completed an assessment and/or treatment must sign a Return to Work Agreement in a form satisfactory to the Administrator and the DCR or DNR, which shall be based on the recommendations of the substance abuse professional in consultation with the Administrator and the DCR and/or the DNR, which may include professionally or medically directed drug and alcohol testing.

d) The Worker must execute a Substance Abuse Professional Release of Confidential Information, attached as Appendix "B".

e) The worker must test negative as per Section 8 above, and this must be reported to the Administrator and the DCR or DNR.

15.01 Providing Substance Abuse Support Information and Accommodation

The DCR or DNR must inform a Worker who has tested non-negative that if the Worker wishes to use the option to seek help and support, the Newfoundland and Labrador public health care system provides many options for support, which are covered by Medicare, such as outpatient counseling, adult residential treatment, detoxification services, and more. The DCR or DNR must tell the Worker that detailed information on services can be obtained online at http://www.health.gov.nl.ca/health/commhlth_old/factlist/services_available.htm and by phoning 1-888-737-4668.

15.02 Confidentiality of Substance Abuse Professional Information

In order to preserve the confidentiality of information provided by a substance abuse professional, the Administrator, the DCR or DNR, and any Worker to whom disclosure is permitted under this standard, must not disclose the information to any Worker other than a Worker who needs to know the test results to discharge an obligation under this Standard or except as required by law.

15.03 Testing Non-Negative More Than Once

In the event that any Worker tests non-negative more than once, such Worker shall be prohibited from obtaining Site Access indefinitely.

16.0 CONSEQUENCES OF NON-COMPLIANCE WITH THIS STANDARD

Non-compliance by a Worker with this Standard will result in Site Access being temporarily revoked until the investigation of the reasons for non-compliance and the incident, including tests and results in a final determination of corrective action. Workers, who are found in non-compliance with this Standard may be removed from Sites and have their Site Access revoked by Nalcor or Nalcor's designate and may be prohibited from obtaining Site Access indefinitely. Persons who are found to be in non-compliance of this standard may be subject to discipline up to and including termination by the Contractor.

17.0 ALCOHOL AND DRUG TESTING REPORTS

The Contractors and each accredited drug and alcohol testing agency shall maintain the following:

a) A report from each accredited drug and alcohol testing agency used by the Contractor that specifies the number of drug and alcohol tests performed, the number of positive or non-negative tests by each type of test requirement, and the number of tampered specimens. Test requirement types include those for pre-access, reasonable grounds, and post-incident. This report shall be provided by the EPCM to Nalcor quarterly or more often if required by Nalcor.

b) Each Contractor shall maintain a report which identifies the total number of persons or Workers who have tested non-negative by specific trade, the number of persons or Workers tested by specific trade, but shall not provide the names of persons or Workers. A copy of this report shall be provided in hard copy and electronically by the Contractor to Nalcor quarterly or more often if required by Nalcor.

18.0 PROOF OF COMPLIANCE

Nalcor shall have the right to request proof of compliance to this Standard at any time.

19.0 SEARCH AND SEIZURE – POSSESSION OF DRUG AND ALCOHOL PARAPHERNALIA

Nalcor or its designate reserves the right to investigate, and/or require the Contractor or subcontractors to investigate, any situation when there are reasonable grounds to believe that alcohol, illicit drugs, or illicit drug paraphernalia are present on Site, in violation of this Standard or the Sites rules.

Nalcor or its designate, Contractors or subcontractors and their Workers are responsible for identifying situations where a search and seizure may be reasonable. Reasonable may be based on a combination of indicators which may include behaviour, odour, information received, or presence of paraphernalia. The supervisors will be responsible for advising their manager of the situation, who, in conjunction with onsite security, onsite Health and Safety Management (or their designates), and local police authorities, where appropriate, will make the decision as to whether or not to initiate a search.

On the Sites, Nalcor or Nalcor's designate may, for reasonable grounds, have Nalcor's supervision or the supervision of Nalcor's designate, Contractor supervisors and/or authorized search and inspection specialists, including scent-trained animals, conduct unannounced searches and inspections of Contractors, subcontractors, and/or Workers and their property. Property may include, but not limited to wallets, purses, lockers, baggage, offices, desks, tool boxes, clothing and vehicles. Where practical, such searches shall be in the presence of the affected Worker.

All Nalcor employees, contractors, sub-contractors and visitors and their property may be subject to search and seizure on arrival and departure from the Sites.

Seizure and future control of any alcohol, drugs, or drug paraphernalia will be directed by the Security personnel.

Nalcor or Nalcor's designate, along with Contractor management (if Contractor personnel involved) may determine whether law enforcement agencies will be contacted.

In the event any Nalcor employee, contractor, sub-contractor and visitor refuses to submit to a search or is believed to be in violation of this Standard as a result of a search, such Worker or person's Site Access will be temporarily revoked until an investigation of the refusal to submit to a search or violation of the Standard is completed. Workers or persons who are found in non-compliance with this Standard may be removed from Sites, have their Site Access revoked by Nalcor or its designate and may be prohibited from obtaining Site Access indefinitely. Persons found in violation of this Standard may be subject to discipline up to and including termination by the Contractor.

Approved By	Title: Project Director
Date	

20.0 ATTACHMENTS/APPENDICES

Appendix A – Drug and Alcohol Testing Procedures
Appendix B – Substance Abuse Professional Release of Confidential Information
Appendix C – Reasonable Grounds Checklist

APPENDIX "A"
Drug and Alcohol Testing Procedures

The following procedures are a general overview only. More detailed information may be obtained from the approved accredited drug and alcohol testing agency. As an alternative to the drug and alcohol testing procedure contained herein, the approved accredited drug and alcohol testing agency may utilize a point of care testing procedure commonly referred to as a quick test ("POCT"). In the case of POCT, all non-negative tests must be confirmed by a Certified Lab.

I. Alcohol testing

General

1. The donor is the person or Worker from whom a breath or saliva sample is collected.

2. The donor is directed to go to a collection site in order to give a breath or saliva sample.

3. The breath alcohol technician ("BAT") or the screening test technician ("STT") as appropriate establishes the identity of the donor. Photo identification is preferable. Positive identification by a Contractor or company representative who holds a supervisory position is acceptable.

4. The BAT or STT as appropriate explains the testing procedure to the donor.

5. The Contractor or company must securely store information about alcohol test results to ensure that disclosure to unauthorized persons does not occur.

6. Breath testing and saliva testing devices are used to conduct alcohol screening tests and must be listed on the National Highway Traffic Safety Administrations ("NHTSA") conforming products list.

Breath testing

1. The BAT and the donor complete those parts of the alcohol testing form that is to be completed before the donor provides a breath sample.

2. The BAT opens an individually wrapped or a sealed mouthpiece in the presence of the donor and attaches it to the breath testing device in the prescribed manner.

3. The BAT explains to the donor how to provide a breath sample and asks the donor to provide a breath sample.

4. The BAT reads the test result and ensures that the test result is recorded on the alcohol testing form after showing the results to the donor.

5. The BAT completes the part of the alcohol testing form that is to be completed after the donor provides a breath sample and asks the donor to do so as well.

6. If the test result shows an alcohol level that is less than 0.020 grams/210 litres of breath, the BAT informs the donor that there is no need to conduct any further testing and reports the result in a confidential manner to the DCR or DNR. While the initial communication need not be in writing, the BAT must subsequently provide a written report of the test results to the DCR or DNR.

7. If the test result shows an alcohol level that is equal to or greater than 0.020 grams/210 litres of breath, the BAT informs the donor of the need to conduct a confirmation test.

Saliva testing

1. The STT and the donor complete those parts of the alcohol testing form that are to be completed before the donor provides a sample.

2. The STT checks the expiration date of the saliva testing device shows the date to the person or Worker and uses a saliva testing device only if the expiration date has not passed.

3. The STT opens an individually wrapped or a sealed package containing the saliva testing device in the presence of the donor.

4. The STT invites the donor to insert the saliva testing device into the donor's mouth for the time it takes to secure a proper specimen. If the donor does not wish to do this, the collection site person offers to do so.

5. The STT reads the result the saliva testing device produces and records the test result on the alcohol testing form after showing the results to the donor.

6. The STT completes the part of the alcohol testing form that is to be completed after the donor provides a saliva sample and asks the donor to do so as well.

7. If the test result shows an alcohol level that is less than 0.020 grams of alcohol in 100 millilitres of saliva or an equivalent concentration in other units, the STT informs the donor that there is no need to conduct any further testing and

reports the result in a confidential manner to the DCR or DNR. While the initial communication need not be in writing, the STT must subsequently provide a written report of the test results to the DCR or DNR.

8. If the test result shows an alcohol level that is equal to or greater than 0.020 grams of alcohol in 100 millilitres of saliva or an equivalent concentration in other units, the STT informs the donor of the need to conduct a confirmation test.

Confirmation test

1. If a breath alcohol testing device was used for the screening test, an evidential breath alcohol device must be used to conduct the alcohol confirmation test. If a saliva testing device was used for the screening test, the confirmation test will use an evidential breath alcohol testing device.

2. The BAT advises the donor not to eat, drink, put anything into his or her mouth or belch before the confirmation test is complete.

3. The confirmation test must start not less than fifteen minutes after the completion of the screening test and not more than thirty minutes after the completion of the screening test.

4. The BAT and the donor complete those parts of the alcohol testing form that are to be completed before the donor provides a breath sample.

5. The BAT opens a new individually wrapped or sealed mouthpiece in the presence of the donor and inserts it into the breath testing device in the prescribed manner.

6. The BAT explains to the donor how to provide a breath sample and asks the donor to provide a breath sample.

7. The BAT reads the test result on the device and shows the donor the result displayed. If the confirmation test result is equal to or in excess of 0.040 grams per 210 litres of breath, the BAT will do an external calibration check (accuracy check) to ensure the device is in working order. The BAT ensures that the test result is recorded on the alcohol testing form. The BAT verifies the printed results with the donor.

8. The BAT completes the part of the alcohol testing form that is to be completed after the donor provides a breath sample and asks the donor to do so as well.

9. The BAT immediately reports in a confidential manner the test results to the Administrator, DCR or DNR. While the initial communication need not be in writing, the BAT must subsequently provide a written report of the test results to the Administrator, DCR or DNR.

II. Drug testing

1. The donor is the person or Worker from whom a urine specimen is collected.

2. The donor is directed to go to a collection site in order to give a urine specimen.

3. The collection site person must establish the identity of the donor. Photo identification is preferable. Positive identification by a Contractor or company representative who holds a supervisory position is acceptable.

4. The donor must remove coveralls, jacket, coat, hat or any other outer clothing and leave these garments and any briefcase or purse with the collection site person.

5. The donor must remove any items from his or her pockets and allow the collection site person to inspect them to determine that no items are present which could be used to adulterate a specimen.

6. The donor must give up possession of any item which could be used to adulterate a specimen to the collection site person until the donor has completed the testing process.

7. The collection site person may set a reasonable time limit for providing a urine specimen.

8. The collection site person selects or allows the donor to select an individually wrapped or sealed specimen container. Either the collection site person or the donor, in the presence of the other, must unwrap or break the seal of the specimen container.

9. The donor may provide his or her urine specimen in private, in most circumstances. The specimen must contain at least forty-five millilitres.

10. The collection site person notes on the chain of custody form any unusual donor behaviour.

11. The collection site person determines the volume and temperature of the urine in the specimen container.

12. The collection site person inspects the specimen and notes on the chain of custody form any unusual findings. If the temperature of the specimen is outside the acceptable range or there is evidence that the specimen has been tampered with, the donor must provide another specimen under direct observation by the collection site person or another person if the collection site person is not the same gender as the donor.

13. The collection site person splits the urine specimen into two specimen bottles. One bottle is the primary specimen and the other is the split specimen.

14. The collection site person places a tamper-evident bottle seal on each of the specimen bottles and writes the date on the tamper-evident seals.

15. The donor must initial the tamper-evident bottle seals to certify that the bottles contain the urine specimen the donor provided.

16. The donor and the collection site person complete the chain of custody form and seal the specimen bottles and the laboratory copy of the chain of custody form in a plastic bag.

17. The collection site personnel arrange to ship the two specimen bottles to the laboratory as quickly as possible.

18. The laboratory must be the holder of a certificate issued by the Substance Abuse and Mental Health Services Administration of the United States Department of Health and Human Services under the National Laboratory Certification Program.

19. The laboratory must use chain of custody procedures to maintain control and accountability of urine specimens at all times.

20. Laboratory personnel inspect each package for evidence of possible tampering and note evidence of tampering on the specimen forms.

21. Laboratory personnel conduct validity testing to determine whether certain adulterants or foreign substances were added to the urine specimen.

22. Laboratory personnel conduct an initial screening test on the primary specimen for the drugs set out in Section 8 of the Standard using established immunoassay procedures. No further testing is conducted if the initial screening test produces a negative test result.

23. Laboratory personnel conduct a confirmatory test on specimens identified as positive by the initial screening test. The confirmatory test uses gas chromatography/mass spectrometry.

24. A certifying scientist reviews the test results before certifying the results as an accurate report.

25. The laboratory reports the test results on the primary specimen to the MRO in confidence.

26. The MRO, if satisfied that there is no legitimate medical explanation for a non-negative test result, will inform the Administrator, DCR or DNR in a confidential written report that a person tested positive. Prior to making a final decision on whether a test result is non-negative, the MRO must give the person an opportunity to discuss the results. The MRO shall report to the DCR or DNR whether the test result is negative, tampered, invalid or positive, or, if positive, whether or not there is a legitimate medical explanation. The MRO shall also report to the Administrator when the test is tampered, invalid or positive.

27. A person or Worker who has received notice from the MRO that he or she has tested non-negative may ask the MRO within 72 hours of receiving notice that he or she has tested positive to direct another laboratory to test the split specimen. The person or Worker is responsible for reimbursing the Contractor or company for the cost of the second test.

28. The laboratory reports the test results on the split specimen to the MRO in confidence.

29. The MRO will declare the test results negative if the test results for the split specimen are negative and the failure to reconfirm is not due to the presence of an interfering substance or adulterant.

APPENDIX "B"
SUBSTANCE ABUSE PROFESSIONAL
RELEASE OF CONFIDENTIAL INFORMATION

I (Person or Worker), _____, give permission to _____ to contact:
_____ (Name) _____ (Substance Abuse Professional Name)

TO

Name:	Insert Name		**Name:**	Insert Name	
Organization:	Insert Name		**Organization:**	Contractor/Employer Name	
Title:	Insert Name		**Title:**	Insert Title	
Address:	Address	**Province:** NL	**Address:**	Address	**Province:** NL
City:	St. John's	**Postal Code: X#X #X#**	**City:**	City	**Postal Code: X#X #X#**
Phone:	(###) ###-####	**Fax:**(###) ###-####	**Phone:**	(###) ###-####	**Fax:**(###) ###-####

WHAT INFO

To release verbally or in writing:

☒	Assessment	☒	Participation
☒	Attendance	☒	Program Dates
☒	Relevant History	☒	Progress Summary
☒	End-Summary & Recommended Actions	☒	Reason for Referral
☐	Other:	☒	Treatment Plan

PURPOSE

The information I have consented to for purpose of disclosure shall only be used for the following reasons:

- To enable the Contractor to develop a return to work plan aimed at assisting me to obtain Site Access and completing and maintaining rehabilitation while working on the Site.
- To assist Nalcor and the Contractor to determine whether or not I should be granted Site Access or my Site Access should be revoked.

CONSENT

I understand that provision of treatment services is not dependent upon my decision to release information and that I may cancel this consent at any time. I also understand that some action may have been taken prior to cancellation.

Person or Worker

Signature:_____
Witness: _____
Date Signed: **YYYY/MMM/DD**
Permission will Expire on: YYYY/MMM/DD

CANCEL

I, _____, cancel this permission. I understand that some action may have been taken prior to this cancellation.

Signature:_____
Witness: _____
Date Signed: **YYYY/MMM/DD**

APPENDIX "C"
REASONABLE GROUNDS CHECKLIST

Worker's Name: _____

Date: _____

Workplace/Project Name: _____

ID/Brass Number: _____

Put check marks against the phrases that best describe this worker's behaviour. **Add as much information as you can** that may assist in clarifying the situation, as well as any witnesses to the behaviour you are describing.

	Date(s)	Explanation
1. General Appearance □ Sleepy □ Tremors □ Other (specify)		
2. Workplace Behaviour □ Interrupts others work □ Inflexible about procedures □ Argumentative □ Inappropriate emotional outbursts □ Physically threatening □ Alcohol or drug consumption observed		
3. Temperament at Work □ Withdrawn much more than usual □ Easily upset by everyday events □ Agitated and on edge □ Excessively worried or fearful □ Extreme variations of mood		
4. Job Performance □ Forgets instructions, abnormal □ Procedures □ Works abnormally slowly □ Erratic productivity		

	Date(s)	Explanation
□ Missed deadlines □ Signs of intoxication (smell of alcohol or drugs, slurred speech, confusion, inarticulate speech, uncoordinated) □ Poor judgment □ Fails to wear safety equipment □ Other (specify)		
5. Relationship with co-workers □ Abnormal reaction to criticism □ Imagines criticism where there is none □ Complaint received from co-worker □ Complaint from client		
6. Absenteeism □ Excessive absence □ Unlikely excuses for absence □ Excuse for absence proven false □ Absences follow a pattern □ Frequently late returning from breaks □ Excessive absence from workstation		
7. Further observations or comments:		

Names of management or supervisory personnel trained in the Comprehensive Drug and Alcohol Work Standard or contractors policy who have completed this checklist:

Do Reasonable Grounds for testing exist? ☐ Yes ☐ No If No, explain above in section #7.

Supervision:_____
___
Name (print) Signature

Do Reasonable Grounds for testing exist? ☐ Yes ☐ No If No, explain above in section #7.

Supervisor/:
Manager_____
OR Designate Name (print) Signature

Nalcor Energy – Lower Churchill Project

Coding Standard

LCP-PT-MD-0000-IM-SD-0001-01

Comments:	Total number of Pages (Including Cover):
1. All changes are indicated by horizontal line in the margin. 2. Figure 1 has been added. 3. Attachment 1 and 2 have been removed as the information is now contained within this and other standards.	11

Status/ Revision	Date	Reason For Issue	Prepared By	Functional Manager Approval	Project Manager (Marine Crossings) Approval	Project Manager (Generation + Island Link) Approval	Project Director Approval
B3	12-Mar-12	Issued for Use	N. Collins	D. Green	G. Fleming	R. Power	P. Harrington
B2	17-Nov-11	Issued For Use	N. Collins	D. Green	G. Fleming	R. Power	P. Harrington
B1	01-Apr-11	Issued for Use	K. Greene	D. Green	G. Fleming	R. Power	P. Harrington
CONFIDENTIALITY NOTE:		This document contains intellectual property of the Nalcor Energy – Lower Churchill Project and shall not be copied, used or distributed in whole or in part without the prior written consent from the Nalcor Energy – Lower Churchill Project.					

Inter-Departmental / Discipline Approval (where required)

Department	Department Manager Approval	Date
Engineering	B. Barnes	7-Mar-2012
Supply Chain	P. Hussey	7 Mar 2012
Project Controls Lead	D. Pardy	9-MAR-2012
Information Management Supervisor	V. Stanford	05-Mar-2012
Deputy PM	J. KEAN	6-MAR-2012

TABLE of CONTENTS

1.0 Purpose

This document defines the coding formats and associated component codes to be utilized on the Nalcor Energy – Lower Churchill Project. NE-LCP will provide identification of information, activities and asset elements. The intent is to provide coding direction that will facilitate consistent capture, tracking and reporting throughout the life cycle of the asset.

2.0 Scope

The coding described in this document shall apply to all coding of revision controlled documents pertaining to NE-LCP.

3.0 Definitions

Coding Format: A combination of component codes that when logically presented together provide unique identification for a piece of information, an activity or an asset element.

Component Codes: The codes utilized to construct intelligent coding formats.

Engineering/Design Document: Document (including drawings) created to capture the conception, analysis, construction/fabrication, commissioning and/or ongoing maintenance criteria required to build, operate and/or maintain a physical product or electronic system.

Supplier Document: A document created in support of the manufacture preservation, installation, commissioning, operation and ongoing maintenance of purchased equipment.

Contractor Document: Document deliverables resulting from a service related contractual relationship.

Information Set: A named collection of interrelated data grouped together due to commonalities.

Management System Document: Document created to define and/or support a function or process. (Ie. policies, strategies, standards, procedures, etc.) Document belonging to Management System.

Metadata: Electronic Properties or Attribution used to describe the particulars of a document, drawing or other data.

Originator: The person determining a specific code to be used to uniquely identify a piece of information, activity or asset element.

Originator Code: The organization creating the document to which the code applies.

Revision Controlled Document: A document subject to revision in a "controlled" fashion through a review or approval process.

Structured Data: Information that resides in fixed fields within an electronic environment. The content in the fields of databases and spreadsheets are examples of structured data.

Unstructured Data: Information that is represented as free-form text, image or graphics which can be treated as a unit. A text document or a drawing would be examples of unstructured data.

4.0 Abbreviations and Acronyms

EDMS – Electronic Document Management System
LCPDCC - Lower Churchill Project Document Control Center
NE-LCP – Nalcor Energy – Lower Churchill Project
WBS – Work Breakdown Structure

5.0 Reference Documents

LCP-PT-MD-0000-PC-LS-0001-01 – *Project Work Breakdown Structure and Code of Accounts*
LCP-PT-MD-0000-IM-PR-0008-01 – *Directions to Contractors / Suppliers for Document Requirements*

6.0 Responsibilities

NE-LCP Information Management Group: As custodians of this document, shall be responsible for coordinating the creation, implementation, maintenance and distribution of this coding standard.

Originator: As the use of this document is mandatory, originators of documents and data are responsible to comply with the coding described for the creation and ongoing maintenance of all information, activities and asset elements.

7.0 Specific Field Input Directions

It is the goal of the NE-LCP to realize efficiencies by having consistent capture, tracking and reporting of project information, activities and asset elements. Standard coding is key to achieving this goal.

All information, activities and asset elements will require project codes that will be captured on documents and/or within electronic systems used to manage the Project.

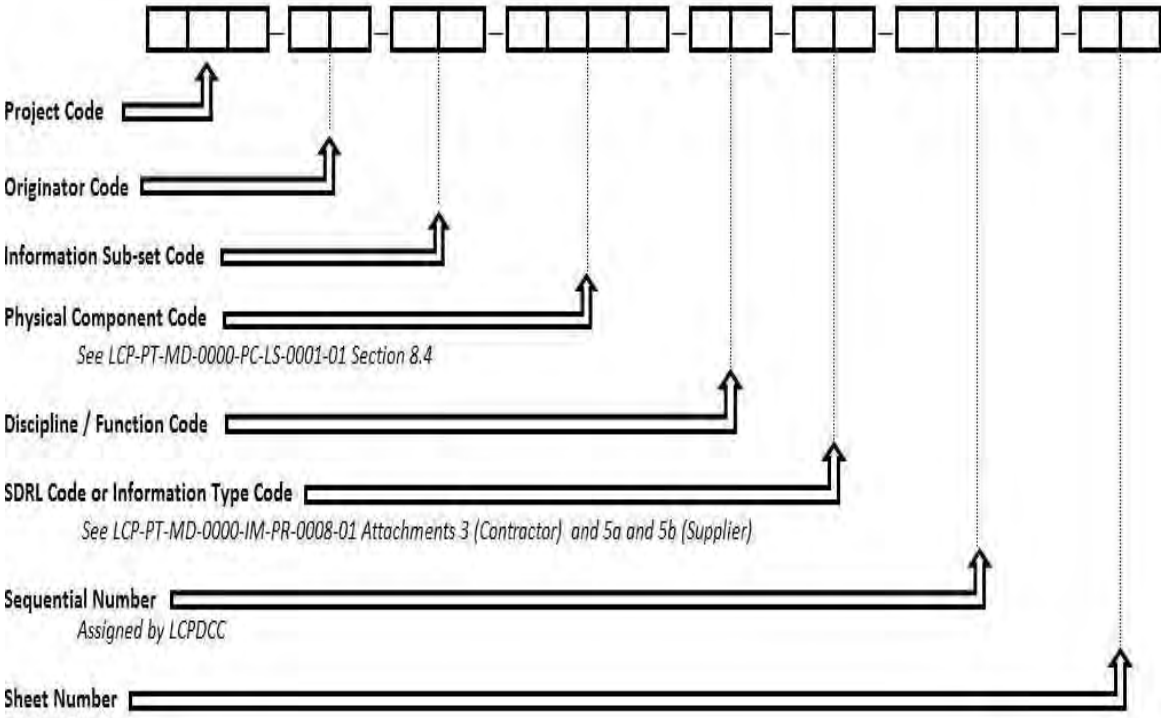
7.1 Document (Unstructured Data) Coding

Revision controlled documents are dynamic documents (including drawings) which are subject to revision control and that are required to go through a review or approval process. Revision controlled documents typically include Engineering/Design, Construction, Fabrication, Contractor and Management documentation.

The NE-LCP document number shall be applied to all LCP revision controlled documents and drawings and shall also be the reference document / drawing number when referring to other LCP revision controlled documents/drawings.

Intelligent document numbering is being implemented as shown in Figure 1.

Figure 1: Nalcor Energy – Lower Churchill Project Document Number Structure.



Document Format Sample:

Project Code:	LCP – Lower Churchill Project
Originator Code:	PT – Project Management Team
Information Sub-Set Codes:	ED – Engineering Drawing
Physical Component Codes:	1111 – Access Roads – Construction/Temporary
Discipline/Function Codes:	AR – Architectural
Information Type Code:	GA – General Arrangement
Sequence:	0001
Sheet Number:	01

Project Document Number: LCP-PT-ED-1111-AR-GA-0001-01

Note: When document numbers are being listed in a register/spreadsheet type format, dashes are to be used between each component without leaving spaces.

Component Code Descriptions:

Project Code: Three character alpha code, denoting project area to which the document pertains. (Included to provide potential for future use of this document coding structure by other areas of the parent organization and still maintain uniqueness in numbering.)

Project Code

LCP – General
GIL – Generation – Gull Island
MFA – Generation – Muskrat Falls
ILK – Island Link
MLK – Maritime Link
ETM – Export Transmission

Originator Code: Two character alpha code, denoting the specific part of the organization creating the document. It ***does not*** denote responsibility for design. Also, although inclusion of code may not provide full asset life-cycle value for identification purposes, it is included in document number to alleviate potential duplicate numbering across the project's multi-group document creation environment. Originator Codes are assigned by the NE-LCP Information Management Group upon Contract Award.

Information Sub-Set: Two character alpha code, denoting the *general* information set to which the document being created.

Information Sub-Set Codes

ED – Engineering / Design Document
MD – Management System Document
CD - Contractor Document
SD – Supplier Document

Physical Component: Four digit numeric code, denoting the structure/major work component of the asset to which the document relates, based on Work Breakdown Structure (WBS) as captured in project document LCP-PT-MD-0000-PC-LS-0001-01 - Project Work Breakdown Structure and Code of Accounts. For documents not related to a specific component (such as project management procedures) or for documents which relate to more than one component, use the code "0000".

Discipline/Function: Two character alpha code, denoting the Engineering Discipline or Project Functional group responsible for the creation of the document and to which the information contained in the document relates. See below list of accepted Discipline/functional codes.

Discipline/Function Code

AB - ABORIGINAL AFFAIRS
AD - ADMINISTRATION
AM - ASSET MANAGEMENT
AR - ARCHITECTURAL
CA - CONTRACT ADMINISTRATION
CM - COMMISSIONING
CO - COMMUNICATIONS
CS - CONSTRUCTION
CT - CERTIFICATION
CV - CIVIL (Including - Hydraulics)
DR - DRILLING
EA - ENVIRONMENTAL ASSESSMENT
EL - ELECTRICAL
EN - ENGINEERING (GENERAL)
EP - ESTIMATING & PLANNING
EV - ENVIRONMENT
FI - FINANCE AND ACCOUNTING
GT - GEOTECHNICAL

HR - HUMAN RESOURCES
HS - HEALTH, SAFETY & SECURITY
IB - INDUSTRIAL BENEFITS
IE - INVESTMENT EVALUATION
IM - INFORMATION MANAGEMENT
IN - INSPECTION
IS - INFORMATION SYSTEMS
LC - LOSS CONTROL
LE - LEGAL
LR - LABOUR RELATIONS
MA - MARKET ACCESS
ME - MECHANICAL (Including - HVAC, Piping & Hydraulics
MM - MATERIALS MANAGEMENT
MR - MARINE
MT - MAINTENANCE
OP - OPERATIONS
PC - PROJECT CONTROLS
PI - PIPING
PM - PROJECT MANAGEMENT
PO - PROCUREMENT
PP - PROPERTIES
PR - PUBLIC RELATIONS
PS - POWER SALES
PT - PROTECTION AND CONTROL
QA - QUALITY ASSURANCE
QC - QUALITY CONTROL
QM - QUALITY MANAGEMENT
RI - RISK MANAGEMENT
RT - REGULATORY
SC - SUPPLY CHAIN
SM - STAKEHOLDER MANAGEMENT
SS - SUBSEA
ST - STRUCTURAL
SU - SUB SURFACE

Information Type: Two character numeric code, denoting *specific* type of document being created.

Sequence Number: Four digit numeric code, denoting the sequence number unique to the specific prefixing document code combination. Starts at 001 each time any component of the prefix coding changes. (Assigned by Document Control - LCPDCC.)

Sheet Number: Two digit number, starting at 01. Used only for drawings. This will facilitate revision of individual documents without having to revise the associated sheets.

7.1.1 Revision Status Codes

Changes to a revision controlled document must be identified as a revision change. All documents must indicate the purpose for which it was issued, and the number of times it has been issued for that specific purpose.

Each document shall have a two character/digit alpha numeric code, comprised of the status and revision codes, applied to indicate each issue of the document.

Revision Status Code: Single character alpha code indicating the purpose for which the document was issued by the Originator. See table below for details.

Revision Status:
A - IDC - Issued for Review
B - Approved for Use / Implementation / Bid
C - Approved for Purchase /Construction / Fabrication
D - Approved for Design
L - As-built
N - Cancelled
S - Superseded
V - Void

7.2 Supplier / Contractor Coding

There are a number of contractual type documents. Documents produced as deliverables for a contract will follow the engineering/revision controlled number format.

The contract number will be cross referenced in the EDMS system in the Contract Number attribute ensuring the information is easily identified to a particular Contract or Supplier Package.

Format:

Supplier Document Coding Format Sample:

Project Code:	**MFA – Muskrat Falls**
Originator Code:	**XY – XYZ Inc.**
Information Sub-Set Code:	**SD – Supplier Document**
Physical Component:	**1550 – Buildings – Warehousing**
Discipline/Function Code:	**ST – Structural**
SDRL Code:	**B01 – General Arrangement**
Sequence:	**0001**
Sheet Number:	**01**

Project Document Number: MFA-XY-SD-1550-ST-B01-0001-01

Note: Although Contractual documents are subject to review and acceptance, the revision history for Supplier Documentation shall be maintained using an amendment process, sequential numbering per submission. A status and revision code will not be applied.

8.0 Activity Flowchart (Excel Format)

8.1. N/A

9.0 Attachments/Appendices

Code of Conduct and Business Ethics Handbook

nalcor energy

Vision

Our vision is to build a strong economic future for successive generations of Newfoundlanders and Labradorians.

Values

At Nalcor Energy, our employees share a set of values that shape how we do business every day. Our core values set common direction on how to make decisions with a sense of pride and leadership. We recognize that it is not only what we achieve, but how we achieve it that truly makes us proud of our accomplishments.

Open Communication – Fostering an environment where information moves freely in a timely manner.

Accountability – Holding ourselves responsible for our actions and performance.

Safety – Relentless commitment to protecting ourselves, our colleagues and our community.

Honest and Trust – Being sincere in everything we say and do.

Teamwork – Sharing our ideas in an open and supportive manner to achieve excellence.

Respect and Dignity – Appreciating the individuality of others by our words and actions.

Leadership – Empowering individuals to help guide and inspire others.

Table of Contents

As President and CEO of Nalcor Energy, one of my most important duties is to ensure a work environment based on trust and respect, which enables employees to work without fear of intimidation, discrimination and retaliation. Enjoying our jobs is the first step. However, all of us should also have the comfort of knowing we work in a safe, secure and ethical workplace. Only then can we all feel proud to work here, feel good about our jobs, and work productively. Every person, regardless of position, shares in the responsibility for promoting a positive work environment.

To support this type of workplace, the Board of Directors adopted the *Code of Business Conduct and Ethics* (Code) for employees of all Nalcor Energy companies to reinforce the company's commitment to professional and ethical business practices. Nalcor Energy is growing and employees are increasingly dealing with more sensitive information. This Code provides general guidance and principles for the more complex business reality. The purpose of this policy is to provide guidelines on conflict of interest and ethical business practices and conduct and to promote expected standards of conduct. It also provides general guidance on how to avoid and report potential conflicts of interest and unethical business conduct.

This code links together many existing policies and legislation like our harassment policy, conflict of interest and Occupational Health and Safety legislation. It also addresses Nalcor's safety programs like the Internal Responsibility System. The content of the Code should be familiar to you. You'll also notice, the Code is supported by our values: accountability, respect and dignity, safety, leadership, teamwork, open communications and honesty and trust.

Nalcor is committed to professional and ethical business practices. As you review the Code, if you have any questions or concerns, please take the opportunity to discuss these with your manager or feel free to contact me as well. Your cooperation is essential to ensure that we maintain a positive, productive workplace.

Regards,

Ed

Ed Martin
President and CEO

1. What the Code Means to Nalcor Employees

Our organizational goals are what define Nalcor Energy as a company dedicated to safety, the environment, business excellence, our people and our community. To ensure all Nalcor Energy companies meet our goals, we must practice the highest standards of business conduct and ethics.

This handbook should be used as a guide to practice responsible and ethical behaviour. The complete Code outlines Nalcor's commitment to professional and ethical business practices, and can be found in the policies and procedures section of the GRID. The Code defines the standards of conduct expected of our employees at all Nalcor Energy companies – including any contractors, suppliers, agents, officers or directors and anyone else who may represent the views or interests of our company.

Everyday, in everything we do, we must behave ethically, honestly and with credibility. When we apply this Code to the work we do, we become an organization that is a corporate leader not only in Newfoundland and Labrador, but around the world.

2. Purpose and Responsibilities

The Code identifies a standard for all our employees to follow when confronted with a situation that may cause us to question our ethics and principles at work. The Code defines what Nalcor considers conflicts of interest and potential conflicts of interest, as well as unethical business practices and conduct. Guidance is also provided through the Code to handle, and avoid, these situations all together.

When we follow the values and spirit of this Code, we ensure Nalcor is an organization with a reputation of integrity and sound business practices and conduct.

We all carry an individual responsibility to apply the principles of the Code to our work. The Code explains what accountabilities exist for Nalcor employees, Supervisors and Managers.

Employees

The first responsibility for Nalcor employees is to ensure we read and understand the Code. Following that, as employees, we must always conduct ourselves in a manner that reflects the principles of ethical behaviour, and avoid situations which may present a conflict of interest.

To protect the reputation of our company, employees have a responsibility to ensure everyone we work with complies with the standards and requirements of the Code. To respect our colleagues, customers, and Shareholder, we have a duty to immediately disclose any situation that may go against the principles or spirit of the Code.

Supervisors and Managers

Supervisors and Managers should always demonstrate the principles of the Code. Our Supervisors and Managers must be aware of any conduct that contradicts the Code and follow proper procedure to manage any issue. You also have a responsibility to provide guidance to employees about the Code, and address any concerns employees may raise about ethics and conduct in the workplace. Supervisors and Managers must also ensure that all Nalcor employees are provided with a copy of the Code and understand its requirements.

3. Key Principles

Four key principles guide how we should apply the Code in our day-to-day work. By understanding and following these principles, we can ensure respectable and consistent behaviour across the company.

- The commercial, reputational and other interests of Nalcor Energy must always take precedence over personal interests and those of third parties.
- We must always avoid any act or conduct – intentional or not – that may support the private interests of a third party or an individual over those of Nalcor Energy.
- Any conflict of interest – real or perceived – has the potential to impair the company's credibility, reputation and commercial interests.
- We have an obligation to perform our duties and responsibilities in a conscientious manner, and never allow our personal interests to conflict with Nalcor's.

All parties with whom we conduct business have the right to expect the highest standards of respect, professionalism and business ethics in their dealings with us.

We must demonstrate our commitment to business conduct and ethics in every interaction with our external stakeholders. Customers, suppliers, partners, competitors, shareholder representatives and regulators are among the external stakeholders with whom we regularly carry out business.

We are guided by our organizational values in the things we do and the decisions we make.

We must consider Nalcor's organizational values, standards and principles whenever we represent the company. Nalcor is committed to being an ethical and honest organization, this commitment should be considered in all Nalcor's strategies, plans and decisions.

4. Standards of Business Conduct

The Standards of Business Conduct is the corporate commitment to comply with applicable laws and established sound corporate business standards and practices. When our company fails to meet these standards, we risk damaging our reputation.

Compliance with Laws

In addition to following the Code and other corporate policy and procedures, all Nalcor Energy employees must comply with the applicable laws and regulations of the provinces and countries where we operate. Nalcor employees must never engage in, condone, or encourage any behaviour that is illegal or is not compliant with the Code. We all have an individual responsibility to understand the laws that apply to our work, recognize potential noncompliance and know when to ask for help to report on activity that is illegal or is contrary to the Code.

Safety and Health

Nalcor is committed to being a safety leader. This means ensuring we implement effective safety policies and procedures. To be a safety leader, we must also ensure organization-wide compliance with all applicable laws and standards to protect the health, safety and well being of our employees, contractors, customers and the public.

Employees must take all steps required to work safely. We all have a duty to support a working environment without injury and to foster a culture where everyone is committed to safety.

When working with each other or external parties, we must observe and actively promote Nalcor's core safety rules, which are central to our safety credo.

1. I always follow safety requirements and best practices.
2. I always take the time to complete my work safely.
3. I always take action when I see unsafe acts or conditions.

Environmental Protection

Being an environmental leader is an important goal for Nalcor Energy. Our *Environmental Policy and Guiding Principles* ensures the company sustains a diverse and healthy environment now and in the future. Nalcor's environmental principles maintain a high standard of environmental responsibility and performance. To ensure our environment is sustainable, we should all take time to understand our environmental policy and our commitment to meet and exceed environmental laws and regulations. Nalcor is working to prevent pollution and continually improve our own environmental performance. The goal of environmental protection cannot be achieved without the support and dedication of our employees and contractors.

If you observe someone endangering the environment, your legal and ethical responsibility is to report the situation to a Supervisor. When we take time to work in an environmentally-responsible manner and report environmental non-compliance, we ensure Nalcor builds its reputation as a company with sound environmental principles and actions.

5. Respecting Each Other

Each and every Nalcor employee contributes to the success of our company. We must respect one another and value each other for the different perspectives and experiences we all bring to the company. Mutual respect across divisions and lines of business will result in collaboration and new ideas to ensure Nalcor not only grows, but flourishes into the future and we achieve our vision.

Respect and Dignity

Nalcor employees deserve to work in an environment where they are treated fairly and with respect. We must all take steps to ensure we are respectful of others, supportive of the dignity and self-esteem of every person and promote an environment that is free of harassment. The importance of treating each other with respect applies to all Nalcor employees, regardless of their role or position.

Behaviours considered disrespectful and not supported by Nalcor include:

Harassment – Any behaviour directed at a person that is unwelcome and/or offensive will not be tolerated. Examples of behaviour that is considered harassment includes:

- threats
- unwelcome remarks
- derogatory comments or innuendo which may humiliate, insult or intimidate a person
- personal or sexual harassment
- abuse of authority
- any other conduct which denies a person their dignity and respect in any other way

Discrimination – We all deserve, and should expect, a workplace free of discrimination. Discrimination can be based on an individual's race, religion, religious creed, political opinion, color or ethic, national or social origin, sex, sexual orientation, marital or family status, physical or mental disability or age. The Newfoundland and Labrador Human Rights Code and the Canadian Charter of Rights and Freedoms provide basic protections against discrimination. We are all expected to apply those same standards in all our interactions as Nalcor employees.

Personal dignity and mutual respect – We are all responsible to encourage a work environment where a diversity of views, opinions and backgrounds is valued. The diversity of views and opinions of employees is a key factor in Nalcor's vitality and success. Any behaviour which denies individuals their dignity and respect is out-of-line with the Code, and the company's organizational values and principles, and will not be tolerated.

Offensive material – The posting or use of offensive, sexist, sexually explicit, racist or other discriminatory material in the work environment is never acceptable. At Nalcor, the work environment is considered the physical location where an employee performs their duties. Offensive material is prohibited on all Nalcor equipment and property, including its e-mail and intranet/internet systems and any other location that offends others.

> "The importance of treating each other with respect applies to all Nalcor employees, regardless of their role or position."

6. Protecting Our Business

Nalcor Energy's vision is to build a strong economic future for successive generations of Newfoundlanders and Labradorians. We are all responsible to contribute to the company's mandate to lead the development of the province's energy resources. To be successful, elements of Nalcor's business must be valued and protected. To protect the company and our stakeholders, we must ensure the effective management of our corporate assets, financial information and respect confidentiality and privacy requirements.

Protection of Corporate Assets

Nalcor Energy has an internal system of controls, policies and procedures designed to prevent fraud, misappropriation and other financial irregularities. To ensure the system is effective, we must all make an effort to protect Nalcor's assets against loss, damage, unauthorized use, theft and disposal. Assets may be tangible, including facilities, equipment, supplies, vehicles and property, or intangible, such as intellectual property, trade secrets and customer, business and confidential data and information.

Unless information has been produced specifically for external consumption, all Nalcor information – including records, data, project specifications and plans and processes, policies and procedures – are considered proprietary corporate information and must not be shared without proper authorization.

When circumstances arise where it is advisable or required for employees to share confidential information with external parties, we must work with management to ensure all parties must agree to, and sign, a Non-Disclosure Agreement. At any time that a contract or employment with Nalcor ends, any information or documents related to the company must also be returned.

Privacy and Confidentiality

Protecting the privacy and confidentiality of personal, business, employee, customer and contractor information is critical to maintaining Nalcor's credibility. We must all be diligent about protecting the privacy and confidentiality of our colleagues, our Shareholder, partners and customers. As a general rule, confidential information should never be released to external parties unless required by law or authorized by the affected party. To ensure we comply with privacy requirements, we should always appropriately secure any information considered confidential.

Nalcor employees who utilize the company's electronic databases or mail systems should familiarize themselves with the corporate policies and procedures regarding the storage, use and transmission of all confidential information.

Financial Information

Nalcor is dedicated to maintaining a reputation of being a financially accountable organization. All of the company's financial information, data and records are accurate, reliable, factual and complete, and are retained to meet the requirements of applicable laws and standards. Nalcor discloses its financial information in compliance with Canadian generally accepted accounting principles and all applicable laws. The company also makes full, accurate and plain disclosure in any report provided to regulatory authorities.

Security and Emergency Measures

The protection of life and property at Nalcor is committed through the development and implementation of corporate security and emergency measures, policies and processes. An example of security measures at Nalcor is the requirement for visitors to be made aware of facility safety policies and procedures.

Intellectual Property

In the performance of their duties and responsibilities, Nalcor Energy representatives may develop an innovative product that is tangible or intangible – known as intellectual property. All employees must understand that any intellectual property created while an individual is employed by, or on contract with Nalcor, belongs to the company. Because intellectual property is owned by Nalcor, the company has the rights to the intellectual property, unless otherwise authorized.

Competitors

Nalcor Energy will never support any information gathering on a competitor that is illegal or unethical. Anytime a Nalcor employee gathers information about a competitor, it must be done in a manner that is both legal and ethical. Employees should never directly or indirectly solicit proprietary or confidential information about competitors. Information that may be considered proprietary or confidential must never be solicited from any colleague who may have once worked for, or who is currently employed by, a competitor.

> Nalcor Energy will never support any information gathering on a competitor that is illegal or unethical.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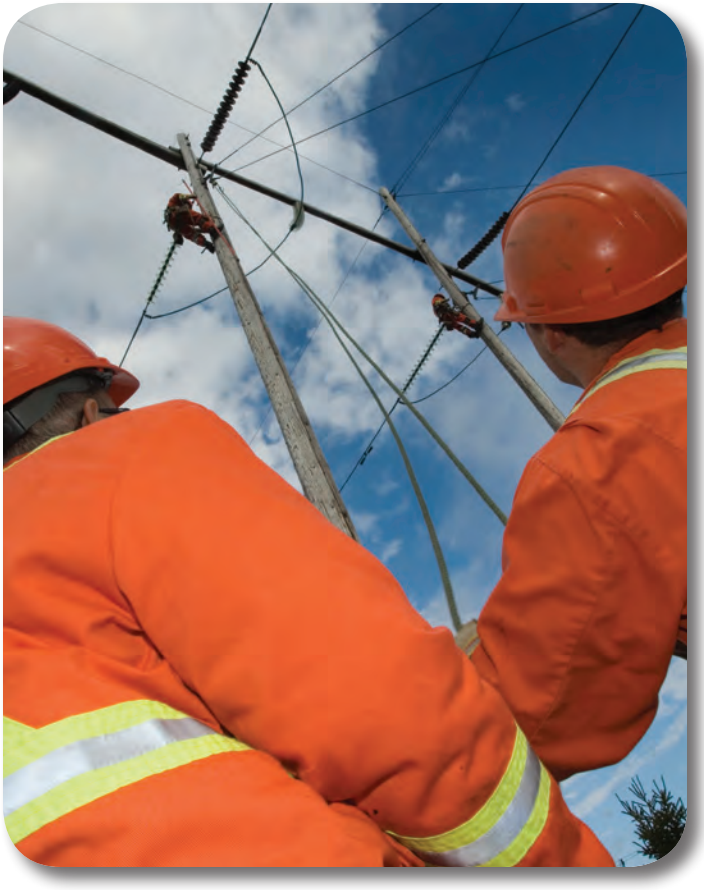

7. Conflict of Interest

At all times, employees must avoid any conflict of interest – potential or real. Agents of the Province of Newfoundland and Labrador, including Nalcor and Newfoundland and Labrador Hydro, are governed by the Conflict of Interest Act (Act). Although not all Nalcor Energy lines of business are considered Crown corporations, this Code requires that all employees comply with the spirit and intent of the Act. The Act outlines responsibilities and behaviours we should always practice to avoid any potential conflict of interest. Any employee of an outside organization or contractor working with Nalcor must also follow the spirit and intent of the Act.

We should consider the implications of an activity that adversely affects, or could affect, our performance as a Nalcor employee to be a potential conflict of interest. Employees should refrain from any activity that could offer a personal advantage because of their employment at Nalcor.

Avoiding Conflict of Interest

To avoid any potential conflict of interest, we should exercise best personal judgment at all times. If there is any question if a situation could be a conflict, it is recommended to disclose the matter to a Supervisor or Manager. Guidelines are offered in the Code to help avoid conflict of interest.

Tips to avoid conflict of interest

- Do not participate in making a decision where there may be an opportunity to improperly benefit an individual or family member – directly or indirectly.
- We are not to use our positions to influence decisions that could result in a personal benefit for ourselves or family members.
- Confidential information that is not available to the general public cannot be used for personal gain, or the benefit of family members or anyone else.
- Other than compensation provided by Nalcor, we must never accept a fee, gift or personal benefit, unless a gift is given as a matter of business custom. Cash gifts are never acceptable.
- Employees must not let offers of future employment influence their duties or decisions as a Nalcor representative.
- Insider trading is the buying and selling of securities on the basis of insider knowledge – this means knowledge that is not available to the public. Any Nalcor employee who violates provincial or Canadian insider trading laws will be subject to both legal penalties and termination of employment.
- Price-fixing, bid-rigging, kickbacks or any other similar activity related to competitions are never acceptable. Any employee who engages in these sort of activities will be subject to immediate termination and any applicable legal recourse.
- Nalcor Employees cannot personally enter a contract with an outside company or vendor, except under the following circumstances:
  - the contract existed before the individual became a Nalcor employee
  - the contract was awarded by public tender
  - the contract was made in an emergency
  - the contract is for goods and services which cannot be provided by any other vendor
  - the individual is an employee of Churchill Falls (Labrador) Corporation Limited, and the circumstances of the contract fall under the provisions of Site Administration Regulation No. 5.6

Entertainment, Gifts and Favours

When we accept any sort of invitation, gift or other benefit, we must be mindful to avoid any situation that could be perceived as a conflict of interest. Gifts may only be accepted as a gesture of appreciation, hospitality or civility and be part of routine business relationships. Gifts and benefits should never be accepted if preferential treatment could be perceived.

Business meals and entertainment are acceptable when they are consistent with accepted business practices. They should only be accepted to further normal business relations, and should never be extravagant. All business meals or entertainment, received or provided, must be approved by a Supervisor or Manager.

> “Employees are always expected to exercise good judgement in evaluating a donor’s reason or reasons for offering a gift.”

Gifts must never be accepted when the offering party is in a Request for Proposal or contractor selection process with Nalcor, or if the party has a relationship with a bid or another company making a bid.

Nominal Value

When accepting any gift, entertainment or other favour, the value of the gift must not exceed $150 CDN. If a gift is offered above this value, the gift must be disclosed to a Supervisor or Manager.

A Supervisor or Manager may approve the acceptance of any such offer when circumstances justify it as an appropriate gesture of appreciation, hospitality or civility. When receiving an offer above the acceptable nominal value, alternatives such as donating the gift to a charitable organization or sharing the benefit with the department rather than an individual should be considered.

Employee Judgement

Employees are always expected to exercise good judgement in evaluating a donor’s reason or reasons for offering a gift. Prior to accepting a gift, we should always consider the effect a gift may have on our actions and how others may perceive the gift. If there are any questions or doubts about whether a gift, entertainment or other benefit should be accepted, the gift should be politely refused.

Outside Business Interests

Any outside business interest should never interfere with our employment at Nalcor. To ensure we always influence our best judgement as Nalcor employees, employees cannot be employed by an outside business during the employee's regular working hours for Nalcor. The company's real property, intellectual property, equipment or supplies must also never be used for outside business purposes.

To avoid any perception of conflict of interest, employees cannot promote or advertise outside business interests to co-workers during work hours. Employees should not be contacted at Nalcor offices by customers or partners outside of the employee's role at Nalcor.

Outside companies in which a Nalcor employee has an interest cannot enter into a contract with Nalcor unless the following provisions are met:

a) the shareholding or interest of the employee is 10 per cent or less; or,

b) Nalcor's Chief Executive Officer (CEO) agrees the employee is not in a position to influence the awarding of the contract, and that there is no conflict with the individual's public duties; or,

c) the CEO decides the employee's shareholding or interest in the outside company will not interfere with the individual's duties and responsibilities as a Nalcor representative; or

d) the CEO is satisfied that the employee's shareholding or interest has been placed in a trust which will prevent the individual from exercising authority or control over the affairs of the outside corporation or partnership.

Disclosure

Whenever we find ourselves in a situation we reasonably believe is, or could be, a potential conflict of interest, we must disclose the nature of the conflict to our Supervisor, Manager or Vice President. After a conflict has been disclosed, we must immediately remove ourselves from the situation.

8. References Related to the Code

- The ***Code of Conduct and Business Ethics*** provides additional information on Nalcor's standards of business conduct and ethics.
- For more information on Nalcor's **Safety and Health** policies, consult the *General Policy Statement – Health and Safety* and *Safety and Health Program* documents.
- Nalcor Energy's *Environmental Policy and Guiding Principles* provides additional direction about the company's **environmental protection guidelines**.
- Additional corporate policies provide requirements and guidelines about **respect and dignity** of others at Nalcor Energy.
  - Corporate policy EMR 14 *Respectful Workplace*
  - Corporate policy COR 16 *Internet Access*
  - Corporate policy COR 17 *Electronic Mail System Usage*
- The *Dishonest or Fraudulent Activities Policy* (Corporate standard EMR-18) provides additional requirements and guidelines about the protection of Nalcor assets.
- The corporate policy *EMR 8: Conflict of Interest* provides additional requirements and guidelines on **conflicts of interest** that apply to Nalcor employees.


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LOWER CHURCHILL PROJECT

SNC·LAVALIN EPCM consultant for Nalcor

Collective Agreement Between Muskrat Falls Employers' Association Inc. and Resource Development Trades Council of Newfoundland and Labrador

Nalcor Doc. No. LCP-PT-MD-0000-LR-CT-0002-01

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B1	20-Sep-2013	Issued for Use	for David Clark	Lance Clarke

COLLECTIVE AGREEMENT

Between

Muskrat Falls Employers' Association Inc.

and

Resource Development Trades Council

of Newfoundland and Labrador

for the Construction of

The Lower Churchill Hydroelectric Generation Project

At Muskrat Falls on the Lower Churchill River

Newfoundland and Labrador

Revision 2

May 2012 – 2017

TABLE OF CONTENTS

Article 1 Purpose

1.01 The purpose of this Special Project Collective Agreement ("Agreement") is to establish certain terms and conditions of employment for workers employed by Contractors for the construction of the Lower Churchill Hydroelectric Generation Project ("Project"). The Parties jointly recognize that this is Newfoundland and Labrador's Project and is of immense importance to the Provincial Energy Plan in bringing clean, renewable energy to Atlantic Canada, under the following common vision.

"Our vision is to build a strong economic future for successive generations of Newfoundlanders and Labradorians."

1.02 The Parties agree to work collaboratively, to support positive labour relations and ensure that issues are dealt with in a timely manner. This Agreement will facilitate the Parties' relentless commitment to safety, a respectful work environment, positive labour relations and high productivity.

1.03 This Agreement will facilitate the participation of qualified Labrador Innu, residents of Newfoundland and Labrador, women and members of other disadvantaged groups.

1.04 This Agreement and its constituent Trade Appendices, Recitals, Schedules, Letters of Understanding and Memoranda of Agreement shall constitute a Collective Agreement for the purposes of a Special Project Order to be declared under Section 70 of the Labour Relations Act when executed by the Parties and shall be administered as such. The terms of this Agreement, including all Trade Appendices, Recitals, Schedules, Letters of Understanding and Memoranda of Agreement shall take precedence over any existing or future union contracts or agreements entered into by any union. In the event that a conflict exists between Article 1 to Article 38 of this Agreement and the Trade Appendices, Recitals, Schedules, Letters of Understanding and Memoranda of Agreement ("Supplementary Attachments") to this Agreement, the applicable Article in the Agreement shall prevail.

Article 2 Parties

2.01 The Parties to this Agreement shall be those listed in Articles 2.01(a), 2.01(b) and those Unions listed in Article 2.01(b) (i) to (xvii) that negotiate a Trade Appendix as per Article 2.01(2) below.

a) Muskrat Falls Employers' Association Inc.

b) Resource Development Trades Council of Newfoundland and Labrador on behalf of the following signatory departments and unions:

i) The Canadian Office of the Building and Construction Trades Department, AFL-CIO

ii) United Brotherhood of Carpenters and Joiners of America and Carpenters Local Union 579

iii) International Association of Bridge, Structural, Ornamental and Reinforcing Ironworkers and Local Union 764

iv) Labourers' International Union of North America and the Construction and General Labourers' Union, Rock and Tunnel Workers Local 1208

v) International Union of Operating Engineers and Local Union 904

vi) The International Brotherhood of Teamsters and Local Union 855

vii) Hotel Employees and Restaurant Employees International Union and Local Union 779

viii) International Association of Heat and Frost Insulators and Allied Workers, Local Union 137

ix) International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers, and Helpers and Local Union 203

x) International Union of Bricklayers and Allied Craftsworkers and Local Union 1

xi) Brotherhood of Carpenters and Joiners of America and Millwrights Local Union 1009

xii) International Union of Painters and Allied Trades and Local Union 1984

xiii) United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the U.S. and Canada, and Local Union 740

xiv) Sheet Metal Workers' International Association and Local Union 512

xv) International Brotherhood of Electrical Workers and Local Union 2330

xvi) International Brotherhood of Electrical Workers and Local Union 1620

xvii) International Union of Elevator Constructors and Local Union 125 A

c) Any Union listed in Article 2.01(b) may become a signatory to this Agreement subject to negotiating a Trade Appendix. The financial parameters of such Trade Appendix shall not be the subject of negotiations as all financial terms and conditions will be contained in the main body of the Agreement, with the exception of premiums that are Trade-specific.

Article 3 Definitions

3.01 The following definitions apply to this Agreement:

a) "Association" means the Muskrat Falls Employers' Association Inc. representing Contractors performing Special Project work at the Site.

b) "Benefits Strategy" means Lower Churchill Construction Project Benefits Strategy as established or may be amended from time to time by the Government of Newfoundland and Labrador.

c) "Commissioning" includes work required to calibrate and test equipment, processes, systems and/or facilities prior to turning a piece of equipment or a portion of the plant over to the operations team responsible for start-up and operating the plant.

d) "Contractor" or "Employer" means any Contractor engaged by the Owner or any subcontractor engaged by the Owner or the EPCM on behalf of the Owner, or any subcontractor engaged by a Contractor, to carry out Special Project work at the Site, but does not include the Owner or the Owner's agent or EPCM carrying out engineering, purchasing and construction management work.

e) "Council of Unions" means the Resource Development Trades Council of Newfoundland and Labrador comprised of trade unions as listed in Article 2 of this Agreement.

f) "EPCM" means the Owner's Engineering Procurement Construction Management Company(s) as may be designated from time to time.

g) "Labrador Resident" means a Canadian or landed immigrant who has his/her principal residence in Labrador or meets the requirement of the Elections Act, 1991, S.N.L. 1992 c. E-3.1 as amended from time to time. Factors and/or current documents to be examined when determining who is a resident may include property tax assessment, lease agreement, driver's licence, vehicle registration, income tax returns, voter's list registration or MCP number.

h) "Lower Churchill Project" or "Project" means Special Project work performed for Contractors by employees represented by the Council of Unions at the Site for the purpose of constructing hydroelectric generating installations and related facilities for the Project in the Province of Newfoundland and Labrador.

i) "Owner" means Nalcor Energy or any successor or nominee entity.

j) "Party" or "Parties" means the Party or Parties to this Agreement, namely the Association and the Council of Unions.

k) "Principal Residence" means the place where the worker maintains a self-contained domestic establishment where he/she ordinarily resides; that is, a dwelling, house or similar place of residence where a person generally eats and sleeps.

l) "Provincial Resident" means a Canadian or landed immigrant who has his/her principal residence in Newfoundland or Labrador or meets the requirement of the Elections Act, 1991, S.N.L. 1992 c. E-3.1 as amended from time to time. Factors and/or current documents to be examined when determining who is a resident may include property tax assessment, lease agreement, driver's licence, vehicle registration, income tax returns, voter's list registration or MCP number.

m) "Site" means the geographical description and/or scope of work described on Schedule "A".

n) "Special Project Work" means special project work as defined by the *Labour Relations Act* of Newfoundland and Labrador as amended from time to time.

o) "TFW" means temporary foreign workers, being workers or prospective workers who are not citizens or permanent residents of Canada.

p) "Work" means construction work as defined under the *Labour Relations Act* of Newfoundland and Labrador for the Lower Churchill Hydroelectric Generation Project carried out for contractors at the site by workers represented by the Union.

q) "Work Schedule" means the repetitive cycle of scheduled work days and of scheduled days of rest to which a worker may be assigned by the Contractor.

Article 4 Scope and Recognition

4.01 The Association hereby recognizes the Council of Unions as the sole and exclusive bargaining agent for the Union employees of the Contractors as described in the classifications set out in the Trade Appendices attached hereto as [Schedule "D"] engaged in construction work at the Site. The Council of Unions shall represent its member Unions and all employees within the scope of this Agreement in all matters relative to this Agreement.

4.02 The Council of Unions hereby recognizes the Association as the sole and exclusive bargaining agent for all Contractors engaged in the construction of the Lower Churchill Project at the Site. All Contractors engaged in construction of the Lower Churchill Project at the Site and having employees working within the scope of this Agreement shall be required, as a condition of contract award, to become members of the Association and to observe the terms and conditions of this Agreement.

4.03 This Agreement is limited to the Site, designated offsite quarries and transport of these aggregate and till materials between designated quarries and the Site. Commitments under this Agreement do not in any way create bargaining rights or obligations for Contractor employees not on the Site, nor shall such commitments be the basis of support for creation of rights or obligations off the Site.

4.04 This Agreement does not apply to:

a) Construction Trades Supervisors above the rank of General Foreperson, those employees excluded under the *Labour Relations Act* of Newfoundland and Labrador, office staff employed in a confidential capacity relating to labour relations, engineering, technical and drafting personnel, lab technicians, and quality control and visual inspectors excepting those normally employed by the Quality Control Council of Canada as is set out in the appendices attached hereto of the International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers, and Helpers and Local Union 203 and the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the U.S. and Canada Local Union 740.

b) This Agreement does not apply to any scope of work which falls under a different special project order issued pursuant to Section 70 of the *Labour Relations Act* as referenced in Schedule “A.2”.

4.05 It is understood and agreed by the Parties hereto that no bargaining relationship is created or will be created at any time during the term of this Agreement or any extension of the term of this Agreement between the Owner. or the Owner's Engineering Procurement Construction Management ("EPCM"), or their subsidiaries and affiliates and their successors (unless such subsidiaries, affiliates or successors of the EPCM directly hire members of the Council of Unions to work on the Site in which case this Agreement shall apply) and a local union, the Council of Unions, or any affiliate of the Council of Unions, by voluntary recognition or by action of law pursuant to the *Labour Relations Act* of the Province of Newfoundland and Labrador or by any other means. Accordingly this Agreement does not apply to the Owner or EPCM, their subsidiaries, affiliates and their successors or to the employees of any of the aforementioned. .Accordingly, an arbitrator shall have no authority or jurisdiction to make any order or award any remedy against the Owner or the EPCM, their successors, affiliate and their successors or to any employees of the aforementioned, save and except where those employees have been hired directly by the EPCM as is provided for above.

4.06 The Association shall designate, in writing, one or more Site representatives with full authority to administer the terms of this Agreement. The Council of Unions agrees to recognize said representatives and their authority to carry out those duties. There shall be at least one Association Site Representative as an ex-officio member of all joint committees. Should the Association change any of its designated Site representatives, it shall inform the Council of Unions of such change in writing.

4.07 The Council of Unions shall designate one or more Site representatives, in writing, with full authority to administer the terms of this Agreement. The Association agrees to recognize said representatives and their authority to carry out their duties. There shall be at least one Council of Unions Site Representative as an ex officio member of all joint committees. Should the Council of Unions change any of its designated Site representatives, it shall inform the Association of such change in writing. The Council of Unions shall be provided an appropriate office at the Site to be shared by the Council of Unions’ Site Representative(s).

4.08 The Association, the Contractor(s), the Council of Unions, the Union(s) and employee(s) shall not seek to agree, or agree on any matter, within the scope of this Agreement or as to the interpretation of this Agreement or application of this Agreement except as provided in this Article. Only the Association and the Council of Unions may, by written agreement signed by the duly authorized representative of each Party, amend the terms of this Agreement or enter into any agreement as to the interpretation or application of this Agreement. This Article does not extend to the exercise of practical labour relations between the Contractor(s) and the Council of Unions on a day-to-day basis provided that the exercise of practical labour relations does not contravene this Article or Agreement.

4.09 The Unions who are members of the Council of Unions jointly and severally agree with the Association and with each other to maintain the Council of Unions and they hereby delegate to the Council of Unions their rights as bargaining agents for all members of their respective Unions who come within the scope of this Agreement, and they agree during the term thereof, not to seek to bargain individually with the Association or any Contractor and to be governed exclusively by the terms of this Agreement and by all lawful settlements of disputes, grievances and differences made pursuant to the terms of this Agreement.

4.10 The Parties agree that the Innu Liaison position is not a representative of the Union, Contractors, or Association and is not included in the bargaining unit.

Article 5 Management Rights

5.01 The Contractors retain full and exclusive authority for the management of their business and to exercise such rights, subject to the provisions of this Agreement. In addition to the rights of the Contractors set forth in this Agreement, the Contractors shall retain all rights of management.

5.02 Without restricting the generality of the foregoing, it is agreed that it is the exclusive function of the Contractors:

a) to determine qualifications, skills, abilities and competency of employees;

b) to determine workforce requirements, including the required number of employees;

c) to hire, transfer, select, assign work, monitor and manage productivity, promote, demote, lay off, discipline and discharge employees for just cause and to increase or decrease the workforce from time to time;

d) to determine job content, materials to be used, design of products, facilities and equipment required, to prescribe tools, methods of performing work and the location of equipment, the location work is to occur and the scheduling of work; and

e) to establish, implement, monitor and enforce policies, procedures, rules, regulations and standards to be observed by employees, and non-compliance

may involve discipline, including dismissal, which discipline or dismissal is subject to the grievance and arbitration process under this Agreement.

5.03 This Article is subject to the grievance and arbitration process as per Article 15.01 of this Agreement.

Article 6 Union Security

6.01 The Contractor shall not discriminate against any employee by reason of membership in a Union;

a) Every worker who is a member or becomes a member of a Union shall maintain his/her membership in a Union as a condition of employment;

b) Every new worker, including, but not limited to, Labrador Innu, residents of Labrador, residents of the Province and TFWs, shall be given the option to make application to become a member in a Union; however, they are required to pay union dues and assessments as a condition of employment;

c) The deductions for union dues, field dues, initiation fees, permit fees and/or all other assessments shall be authorized by any worker covered by this Agreement. Any worker who refuses or neglects to sign the appropriate forms or who revokes the authorization or who resigns membership in the Union will be deemed to have forfeited his/her right for employment on the Project and will be deemed to have voluntarily resigned; and

d) A person shall be deemed to be in good standing with the Union for the purposes of compliance with Article 6.01(c) above if he/she has paid the one time permit fee. The person shall authorize deduction of union dues and assessments notwithstanding the fact that that person has not joined the Union.

6.02 The Contractor agrees to deduct monthly union dues from all employees covered by this Agreement as a condition of employment. Union dues as defined herein shall include field dues or permit fees if applicable. When remitting union dues, the Contractor shall provide the names, SIN and classification of the employees from whose pay such deductions have been made.

6.03 The Contractor further agrees to deduct from all employees such union dues, assessments and/or all initiation fees as evidenced by a signed authorization from employees and to forward such monies to the appropriate Unions as provided for in Article 6.04.

6.04 The Contractor shall deduct, as notified by the Union, such union dues or back dues from the employee's first paycheque of each month and/or if applicable, from the employee's final paycheque upon termination and forward such monies on or before the fifteenth (15th) day of the following month to the appropriate Union.

6.05 Initiation fees or permit fees will be deducted from an employee's pay in equal amounts over a period of three (3) pay periods, or such longer time as directed by the Union. Initiation fees, union dues, assessments, permit fees and other fees or costs related to the Union must be reasonable and will be no more than the average charged by other affiliated unions in other areas of Canada.

6.06 Qualified Newfoundlanders and Labradorians or other qualified persons have the option to make application for membership to the appropriate Union that such person has the necessary qualifications to join. Access to Union membership for such non-union members will be enabled through the ongoing and expeditious review of membership, which shall occur at least monthly.

6.07 International representatives, Union managers or agents, designated in writing by the Council of Unions, may have access to Site, subject to Site policies, procedures, standards or regulations applicable to the Site. Prior arrangements for access to Site will be made with the Council of Unions Site Representative through the Association Site Representative, and in no case shall such visit interfere with the progress of work. The Association shall be given reasonable notice of a Site visit.

Article 7 Hiring Provisions

7.01 The Parties agree that creating a sustainable and flexible workforce will benefit the Council of Unions and ensure there is a significant workforce in Newfoundland and Labrador with the ability to obtain workers from Atlantic Canada and other parts of Canada to support Project construction

7.02 The Parties agree to ensure compliance with the Gender Equity and Diversity obligations regarding hiring of females and persons from underrepresented groups as specified by the Benefits Strategy or any employment equity plan that may be applicable to the hiring of qualified Labrador Innu, to be hired or referred in the following order of priority:

i) Qualified Labrador Innu;

ii) Qualified residents of Labrador; and

iii) Qualified residents of Newfoundland.

7.03 In order to meet the obligations applicable to the hiring and retention of qualified Labrador Innu and obligations contained within the Benefits Strategy, the Parties agree that all Project partners, including the Association, its Contractor members, the Council of Unions and its Union members will work proactively and progressively to advance the participation and integration in the areas of employment, training and apprenticeship for all employees/groups under Article 7.02 above.

7.04 After employment priority is given with the obligations contained in Articles 7.02 and 7.03, the Parties are committed to work cooperatively to identify, recruit, refer and hire workers in the following order of priority:

a) Qualified Canadian workers who are members of affiliated Unions;

b) Qualified Canadian workers;

c) Qualified legal residents of the United States of America, who are members of Unions affiliated with the Council of Unions and who are authorized to enter and work in Canada; and

d) Other qualified non-Canadian workers who are authorized to enter and work in Canada.

7.05 The Parties agree that should Temporary Foreign Workers be required for employment on the Project, the following will apply:

a) Temporary Foreign Workers employed by Contractor(s) on Site shall be permitted mobility from one Contractor on Site to another Contractor on Site should another Contractor on Site require the services of such Temporary Foreign Worker, provided there are no qualified Newfoundland and Labradorian workers or qualified Canadian workers available at the time of hire or transfer.

b) Temporary Foreign Workers, if required, will be initially accessed from affiliate American unions, and if such unions cannot supply Temporary Foreign Workers in a reasonable timeframe, such Temporary Foreign Workers may then be accessed from other sources.

c) Temporary Foreign Workers will be subject to the same financial package and other terms and conditions of this Agreement as Newfoundland and Labrador workers, with the exception of, if necessary, adjustment to the financial allocation of benefits, provided there is no change to the gross hourly package. Such adjustments shall be agreed upon with the applicable Local Union, and such Local Union will not unreasonably withhold their consent.

7.06 The Council of Unions and member Unions will fully cooperate in the Temporary Foreign Worker application process, including the execution of any documents that are reasonably necessary to support an application for utilization of Temporary Foreign Workers to Human Resources and Skills Development Canada or any other regulatory agency. All costs associated with Temporary Foreign Worker applications will be paid by the Association and/or Contractor(s).

7.07 The Parties agree to adhere to the following hiring procedure:

a) Each Contractor may name hire or select all forepersons and general forepersons from the Union's out-of-work list;

b) All workers name hired, selected or referred shall be from the appropriate Union's out-of-work list; for those Innu referenced in Article 7.02 there is no requirement for them to be on the out-of-work list;

c) The first worker shall be appointed by the Union who may be appointed as the Shop Steward, with the next five (5) workers being name hired or selected by the Contractor from the Union's out-of-work list and the next five (5) workers being referred by the Union;

d) All remaining hires shall be dispatched on a fifty/fifty (50/50) basis with the Contractor selecting the first worker and the Union referring the next and so on thereafter. The Shop Steward(s) will be appointed from the Union's referrals;

e) i) All hiring will be done through the Union office, and no one will be employed unless they are in possession of a referral slip from the Union office, which must be presented and approved by a Council of Unions Site Representative and/or Shop Steward prior to commencing work unless provided otherwise in this Agreement.

ii) In the event that a prospective worker is given a dispatch slip and has completed the reasonable requirements for hire, they shall report to work as soon as practicable. In the event the Contractor is not ready to engage the prospective worker within fourteen (14) days of the dispatch, the worker may return the dispatch slip and become available to other Contractors.

7.08 a) The Parties agree that highly qualified supervision is fundamental to the success of the Project, therefore the following will apply:

i) Foreperson and general foreperson will be selected or name hired after having received pre-employment multi-faceted training, including but not limited to safety, cultural sensitivity, respectful workplace, labour relations dispute resolution pursuant to the Agreement and productivity;

ii) Foreperson and general foreperson may also be selected or name hired from a group that have not received training described in Article 7.08 a) i) in which case such foreperson or general foreperson shall receive the training set out in paragraph 7.08 a) i) above within a reasonable period of time after being hired;

iii) The Contractor may promote a journeyperson to the position of foreperson or general foreperson. Within a reasonable time after the appointment, such foreperson or general foreperson shall receive the training set out in Article 7.08 a) i) above;

iv) The designation and determination of the number of forepersons and general forepersons is the responsibility of the Contractor. The average ratio of workers to forepersons shall be 10:1 and the average ratio of forepersons and working forepersons to general forepersons shall be 3:1 (with the general forepersons having an average of one (1) working foreperson per general foreperson). The foreperson may be a working foreperson and use the tools of the trade as determined by the Contractor provided the ratio of working forepersons to workers on a crew does not exceed three (3) workers to one working foreperson unless the Trade Appendices provides a higher ratio; and

v) The selection of forepersons and general forepersons must be in alignment with the Benefits Strategy and Gender Equity and Diversity

objectives established in consultation with the Province and Article 7.02 a).

b) The Parties agree that it is fundamental to the success of the Project to have highly qualified trained employees, and accordingly agree to the following:

i) Workers will be selected or name hired by the Contractor and/or referred by the Union from a group of workers that have received pre-employment multifaceted orientation and training, including Site and collective agreement orientation, safety, environment, cultural and gender sensitivity, respectful workplace and productivity, as is set out above in 7.08 a), so that such employees have the skills and tools to succeed; and

ii) In the event that no qualified workers described in 7.08 b) i) are available, workers may be selected or name hired from a group that have not received the pre-employment orientation and training. In which case, such workers shall receive the orientation and training prior to commencing work on the Site.

c) The Parties will collaborate to identify and access available funding for the purposes of developing and delivering pre-employment training as contemplated by 7.08 a) i) and 7.08 b) i). In the event that funding is not available to cover the full cost, any financial shortfall will be the responsibility of the Association and/or Contractor. The Council of Unions members may contribute resources to assist in these important training initiatives and will be reimbursed on a cost basis.

7.09 If the Union is unable to supply the workers required within seventy-two (72) hours or such other time as may be initially agreed by the Association and the Council of Unions, from the date requested, exclusive of Saturdays, Sundays and holidays, the Contractor may hire from other sources. Each worker hired from other sources will be governed by the terms and conditions of this Agreement and shall be represented by the Union and pay initiation fees, dues and other assessments upon and after hiring as per Article 6.

7.10 The Council of Unions recognizes the Contractor's right to evaluate all persons to determine their level of competency, qualifications and physical and medical fitness to perform the required work.

7.11 Once employed on the Site, an employee, subject to Contractor’s approval, shall be permitted mobility from contract job to another contract job within the Site as long as they continue on the payroll of the same Contractor without interruption of earnings at or about the time of change

7.12 Once an employee working on the Site resigns his/her employment with a Contractor, such employee will not be permitted to work on the Site for sixty (60) days from the date such employee ceased to be employed, unless the sixty (60) days is waived by the Association in consultation with the Council of Unions.

7.13 In the event that an employee is terminated or suspended for cause, such employee will not be name hired, selected or referred to the Site, except by agreement of the Parties or in the event the termination is set aside and a lesser penalty is imposed or the

suspension has been served. After any suspension imposed or upheld is served, such employee may be name hired, selected or referred to the Site.

Article 8 Access & Deliveries to Site

8.01 Except as otherwise provided herein, vehicles transporting or delivering persons, equipment, materials, modules, goods and supplies to and from the Site, which are not operated by members of the Council of Unions, shall be permitted to make one drop or pick up on the Site.

Any module, or materials transported to the Site requiring specialized delivery equipment (i.e Mammoet heavy hauler) may be delivered from its point of disembarkation to its point of installation by personnel who are not members of the Council of Unions.

Batch plants, rock crushers and quarry operations on Site or at Designated Quarries shall be covered by the terms of this Agreement. If concrete is required prior to this, deliveries will be made to the points of installation by personnel who may not be members of the Council of Unions. If the capacity of the batch plant(s) operation on Site cannot supply the required concrete in a timely fashion, or in the case of breakdown of the plant(s), or other circumstances outside the control of the Contractor, concrete deliveries may be made to points of installation on an as needed basis only, by personnel who may not be members of the Council of Unions.

All truck transportation of aggregate, till, materials and spoil, for the Site or between the Site and Designated Quarries is under the terms of the Agreement.

8.02 There shall be a fuel depot established on Site as soon as is practicable. Once the fuel depot is established, fueling will be done from a fuel truck operated under the terms of this Agreement. However, during the early works and prior to the installation of a fuel depot, transporting of fuel and fuelling of vehicles and equipment on Site may be done by employees of a fuel supplier, but such employees shall become members of the Council of Unions and receive the wages and terms of employment in this Agreement.

8.03 In order to maintain the validity of a factory warranty, and where it is not practicable to have bargaining unit employees perform the work on any equipment on Site, then the work may be performed by qualified person(s) who are not members of the Council of Unions including vendor representatives where a second or more worker(s) is required they shall be from the bargaining unit.

8.04 Repair work on any equipment on Site where bargaining unit employees do not have the skill, expertise or equipment to perform such work efficiently, the Contractor, in consultation with the Union, may have the repair work performed by persons who are not members of the Council of Unions, with the assistance of the bargaining unit members, if required.

Article 9 Security and Site Regulations

9.01 Subject to the provisions of this Agreement, the Association and Contractor(s) may initiate appropriate measures including the establishment of rules, policies, procedures, standards and regulations to safeguard the Site or a portion of the Site or the area of the Site controlled by the Contractor(s), and to govern the behaviour and conduct of all persons therein.

9.02 The Council of Unions hereby agrees that their members employed on the Project shall observe security procedures, rules, standards and regulations instituted including, but not limited to, identification of personal identity, the recording of the time of any persons entering or leaving the Site, and the search of any vehicles, packages and/or personal baggage, including lunch boxes, entering or leaving the Site.

9.03 This Article is subject to the grievance and arbitration process as per Article 15.01 of this Agreement.

Article 10 Health and Safety

10.01 The Parties acknowledge that health and safety is a shared responsibility for every person participating in the Lower Churchill Project. Both Parties acknowledge that a safety first culture and a healthy work environment will be the foundation of a successful Lower Churchill Project.

10.02 All work shall be performed and equipment operated in accordance with the *Occupational Health and Safety Act* and in compliance with Site regulations, rules, policies, standards or procedures. The Parties recognize that it is the responsibility of everyone to cooperate in the reduction of risk and exposure with the objective of eliminating accidents, health and safety hazards and advocating observance of all safety rules, standards, procedures, regulations and policies.

10.03 Both the Association and the Council of Unions recognize the mutual value of improving, by all proper and reasonable means, the health and safety of the employees and will co-operate to promote health and safety.

10.04 The Contractor(s) agrees to provide to each employee, upon commencement of his/her employment, the following specific articles for use by the employee during the course of his/her employment at the Site:

a) one (1) safety hat colour coded for identification together with a winter liner;

b) one (1) pair of non-prescription safety glasses;

c) one (1) safety vest;

d) appropriate work gloves;

e) rain gear (jacket and pants) and protective clothing (including rubber boots) when the nature of the job requires such clothing; and

f) such equipment shall be of reasonable quality, fit and size for the worker.

10.05 Where the Contractor determines that the nature of the work or working conditions so require, employees shall be supplied, at the Contractor's expense, all necessary safety equipment and/or devices to enable the employee to safely perform his/her duties.

10.06 All such equipment or articles provided under Article 10.04 and 10.05 hereof shall remain the property of the Contractor. It shall be the responsibility of the employee to care for the articles and equipment provided. Should the articles or equipment be rendered unsafe for use due to normal wear and tear during employment, the Contractor shall replace the articles by exchange upon return by the employee. The employee shall be responsible to return such equipment or articles in good working order (subject to reasonable wear and tear) at the end of an employee's employment. Failure to return equipment or articles shall result in the cost thereof being charged to the employee, which the Contractor may deduct from the employee's wages.

10.07 All personal protective equipment as is described in this Article, whether employee or Contractor supplied, shall be Canadian Standards Association approved.

10.08 The Employee shall be responsible to provide his/her prescription eyeglasses and personal safety footwear required for normal working conditions. If the employee requires prescription lenses and does not possess approved prescription safety lenses, he/she shall be entitled to receive reimbursement for the personal provision of safety prescription lenses, up to a maximum cost of two hundred and fifty dollars ($250.00) (subject to verification of receipt to the worker) for the life of the Agreement.

10.09 A Joint Health and Safety Committee shall be established at the Site in accordance with the *Occupational Health and Safety Act* and its Regulations. The frequency of meetings will be determined by the Committee itself, but no fewer than the number required by the *Occupational Health and Safety Act*. All employees on Committee shall receive, without loss of earnings, all training necessary to carry out their duties.

10.10 Medical aid shall be provided at no cost to employees for occupational injuries and diseases in accordance with the *Workplace Health, Safety and Compensation Act* of the Province of Newfoundland and Labrador.

Article 11 Human Rights

11.01 The Parties agree to comply with the Newfoundland and Labrador *Human Rights Act*.

11.02 The Parties agree that there will be no contravention of this Agreement by a Contractor, Association or Union as a result of the Contractor complying with all obligations that benefit the Labrador Innu in this Agreement including but not limited to hiring priority, retention priority, cultural leave benefit or any other benefits or provisions.

Article 12 Diversity and Gender Equity on the Project

12.01 The Association, its Contractor members, the Council of Unions and its Union members will promote and support Gender Equity Programs and Diversity Programs established in accordance with the Benefits Strategy and programs established in order to support the training, hiring and retention of Labrador Innu. The Parties to this Agreement recognize and support the principles of diversity and employment and gender equity in the workplace and will work cooperatively to create a respectful and inclusive work culture.

12.02 The Association, its Contractor members, the Council of Unions and its Union members will support the Lower Churchill Project Gender Equity and Diversity Program and the participation goals for women and underrepresented groups established in consultation with the Province.

Article 13 Strikes, Lockouts and Slowdowns

13.01 The Association, its Contractors, the Council of Unions and its Union members agree that maintaining positive work environment based on trust, respect and accountability is essential to Project success and there should be no strikes, lockouts, or slowdowns, and accordingly, the Parties agree to the following:

a) During the life of this Agreement there shall be no lockout by the Association or Contractors and there shall be no strike on the part of the Council of Unions, the Unions or any employee employed at the Lower Churchill Project. Strikes and lockouts shall have that meaning defined in the Newfoundland and Labrador *Labour Relations Act.*

b) No Union or worker shall refuse to handle or install any material, equipment or components or to honour hot cargo edicts or otherwise during the life of this Agreement.

c) After the Association and/or Contractor has completed an investigation, consulted with the Council of Unions as to the outcome of the investigation and determines that employee(s) have instigated a violation of Article 13.01 a) or 13.01 b), or employee(s) have taken a leadership role in causing a violation of Article 13.01 a) or 13.01 b) to continue, such employee(s) shall be terminated and shall not be referred by the Council of Unions or any of its Union members to the Site. Should such termination be grieved and subsequently arbitrated, the Parties agree that should an arbitrator determine that a violation of Article 13.01 a) or 13.01 b) has occurred and that the grievor was an instigator or had a leadership role in causing the violation of Article 13.01 a) or 13.01 b), the arbitrator shall have no jurisdiction to substitute a lesser penalty.

d) After the Association and/or Contractor has completed an investigation, consulted with the Council of Unions as to the outcome of the investigation and determines that employee(s) have violated Article 13.01 a) or 13.01 b), such employee(s) may be terminated and, if terminated, shall not be referred by the

Council of Unions or its members to the Site without the consent of the Association or for a period of 180 calendar days. Should such termination be grieved and subsequently arbitrated, the Parties agree that should an arbitrator determine that a violation of Article 13.01 a) or 13.01 b) has occurred, the arbitrator shall only have jurisdiction to substitute a lesser penalty if there are exceptional mitigating circumstances. In the event that an employee commits a second violation of Article 13.01 a) or 13.01 b), such employee shall be terminated and shall not be referred to by the Council of Unions or its members to the Site. Should such termination be grieved and subsequently arbitrated, the Parties agree that should an arbitrator determine that a violation of Article 13.01 a) or 13.01 b) has occurred, the arbitrator shall have no jurisdiction to substitute a lesser penalty.

13.02 Nothing herein shall be interpreted or construed to permit or restrict access to the grievance and arbitration provisions or to limit the remedies available to the Association and/or Contractor or Council of Unions in the event of a violation of Article 13.01 a) or 13.01 b).

Article 14 Labour Relations Management Program and Dispute Resolution that Distinguishes Project

14.01 The Association, its Contractors, the Council of Unions and its Union members agree to the following:

a) Provide strong leadership in both the Association and Council of Unions in dealing with all workplace issues and disputes;

b) Commit to dealing with work related issues or disputes on the Site in a timely and collaborative manner with minimal impact to the working environment;

c) Administer the grievance and arbitration process in a way that adheres to the above principles and ensures such grievances and arbitrations are dealt with in a timely and collaborative manner with minimal impact; and

d) Achieve consistency across the Site to the standards and obligations found within the Collective Agreement.

14.02 Both the Association and Council of Unions agree to form a Liaison Committee to work collectively to achieve the following:

a) Promote and maintain a safety first and healthy work environment;

b) Adhere to Article 14.01 above;

c) Promote and maintain open and respectful communication in regard to all matters pertaining to the Project or the Agreement;

d) Maximize productivity to ensure completion on, or ahead of schedule;

e) Foster and maintain proactive and positive labour relations;

f) Speedy resolution of disputes or issues arising under the Agreement; and

g) Address matters of mutual interest pertaining to the Project and/or this Agreement.

14.03 The Liaison Committee shall maintain a maximum of seven (7) and a minimum of five (5) representatives of the Association and a maximum of seven (7) and a minimum of five (5) representatives of the Council of Unions. At any meeting of the Liaison Committee, each of the Association and the Council of Unions shall be entitled to cumulative representation equal to the number of representatives present from the other Party. Each Party shall notify the other in writing of its designated representatives on the Liaison Committee

14.04 A meeting of the full Liaison Committee shall occur once every three (3) months, or more often if necessary, on written request of a Party.

14.05 The Liaison Committee will create a subcommittee for more frequent meetings. The Council of Unions and Association will appoint representatives to be members of the subcommittee. A meeting of the subcommittee of the Liaison Committee shall occur monthly, or more often if necessary, on written consent of the Parties.

Article 15 Grievance and Arbitration

15.01 A dispute arising out of the interpretation, application or alleged violation of this Agreement, including a dispute as to whether a matter is arbitrable, but excluding disputes under Article 17 (Pre-Job Conference) or Article 18 (Work Team Composition), which shall not be subject to the herein grievance procedure, shall be adjudicated in accordance with the following procedures:

a) An employee assisted by his/her Shop Steward, if he/she so desires, and the employee's immediate non-bargaining unit supervisor shall meet to discuss and, if possible, resolve such matter. Such resolution shall not contravene the terms and conditions of the Collective Agreement; it is solely for the purpose of resolving the matter and shall not be considered precedential or binding in any other grievance dispute.

b) STEP 1: If the matter discussed in a) above cannot be settled by the Steward and the non-bargaining unit supervisor then the grievance shall be reduced to writing within five (5) days after the circumstances giving rise to the grievance. The supervisor shall render his/her decision, in writing, within five (5) days of his/her receiving the written grievance. The written grievance shall state the alleged violation, the date of the violation, the facts describing the alleged violation, the location of the violation, the person or entity committing the violation, the Article or Articles of the Agreement alleged to have been violated and the remedy sought.

c) STEP 2: Should the written decision rendered in Step 1 be unsatisfactory to the employee or should no decision be rendered, the employee, assisted by the Council of Unions Site Representative, shall submit the written grievance within a further two (2) days to the Association and the Contractor's Designated Representative on the Project.

The Association representative, the Council of Unions representative, the Contractor's representative and the employee, assisted by the Steward, shall meet within five (5) days to discuss the matter. Prior to the second step meeting, the Association and Council of Unions commit to engage in a joint fact finding exercise with a view of developing a common understanding of the facts surrounding the dispute to better position the Parties to resolve such dispute. The Contractor shall render a decision in writing within one (1) day of the second step meeting. If such a meeting is not held, the matter shall be referred to Step 3.

d) STEP 3: Should the decision rendered at Step 2 be unsatisfactory, within two (2) days of the decision, the Contractor, the Association representative and the Council of Unions representative shall meet to discuss the matter. If no resolution can be achieved within two (2) days of such a meeting, either the Council of Unions or the Association may, within five (5) days of the meeting, refer the matter to arbitration in accordance with the procedure contained herein. If such meeting is not held, the matter may be referred by either the Council of Unions or the Association to the next step -- arbitration.

15.02 No employee shall be disciplined or discharged except for just cause. Any dispute arising out of the discipline or discharge of an employee shall commence at Step 3 and may be referred to arbitration in the same manner as an employee’s grievance.

15.03 The Association or Council of Unions may file a grievance, in writing, with the other Party within five (5) days after the circumstances giving rise to the grievance have occurred or originated or within five (5) days of the Association or Council of Unions becoming aware of such circumstances. If such grievances are not resolved within two (2) days, the grievance may be treated as a grievance commencing at Step 3 and may be referred to arbitration in the same manner as an employee's grievance.

15.04 The appointment of an arbitrator will be made within four (4) days of a referral to arbitration under Step 3. The arbitrator shall be selected in rotation from a list of five (5) arbitrators acceptable to the Parties, which list is attached hereto as Schedule “D” and forms part of this Agreement. The list shall be reviewed and may be updated by the Parties once every year during the term of this Agreement. Should the arbitrator, who is next in rotation, be unable to act within the time requirements set out in this Article, he/she shall be passed over to the next person on the list.

15.05 The arbitrator shall, within thirty (30) days of his/her appointment, convene an arbitration hearing to hear the relevant evidence. The decision of the arbitrator shall be final and binding on the Parties.

15.06 The arbitrator shall not have any power to alter, change, add to or detract from the Agreement or to substitute any new provision for any existing provision nor to give any decision inconsistent with the terms and provisions of this Agreement. An arbitrator shall

not dismiss any grievance on a technicality or error on the grievance form provided the grieving party has provided the particulars set out in Article 15.01 b).

15.07 In the interest of providing speedy resolution to grievances, arbitration hearings shall be conducted by video and/or telephone conference call unless mutually agreed otherwise, with the Association representative and the Council of Unions representative or their designated respective legal counsel(s) acting as presenters. All rulings will be given by the arbitrator within fifteen (15) days.

15.08 The time limits specified in this procedure are mandatory. Failure of a Party to file a grievance within the time limited or failure of the grieving Party to advance a grievance to the next step in the time limited shall mean the matter is not grievable and shall constitute abandonment.

15.09 The Parties may, by mutual consent and in writing, extend the time limits of this grievance and arbitration procedure, which consent shall not be unreasonably withheld. In order to take into account applicable work schedules, reference to a number of “days” within this Article 15 shall be construed as working days.

15.10 The Contractor/Association, whichever is the case, and the Council of Unions involved in an arbitration shall pay the fees and expenses of the arbitrator in accordance with the following:

a) In the event the arbitrator makes a determination that there is a losing Party(s) the arbitrator may order the losing Party(s) to pay the arbitrator’s fees and expenses.

b) In the event the arbitrator makes no order as to the payment of fees and expenses, each of the Party(s) shall pay an equal share of the fees and expenses of the arbitrator.

Article 16 Shop Stewards

16.01 Stewards shall be appointed by the Union Business Manager or his/her representative. Skill, ability and competency as well as Gender Equity and Diversity shall be considerations in the appointment of Stewards. When a scheduled second and/or third shift occurs, Stewards for such shift(s) may be appointed at the discretion of the Business Manager. Such appointments shall be confirmed in writing to the Contractor and the Association. Stewards assigned to represent a particular shift will not retain their status if that shift is cancelled; however, where workers are transferred to another shift the former Steward shall be one of the transferred provided that the Steward has the skill, ability and competency to perform the required work.

16.02 This Article 16 does not affect a Contractor’s right to determine where and when employees work or on what shifts they work on; however, the Steward shall be assigned to shifts in consultation with the Union Business Manager to assure the most appropriate coverage for the worksite.

16.03 Stewards shall not be discriminated against in the performance of union duties. The Steward will notify and obtain permission from his/her immediate supervisor before leaving his/her work location to deal with any matter relating to this Agreement, which permission will not be unreasonably denied.

16.04 There shall be no non-working Stewards. Subject to Article 16.03 above, Stewards will be granted sufficient time to conduct their legitimate union duties during working hours.

16.05 Stewards shall be the last employee laid off where the Steward has the skill, ability and competency to perform the required work.

16.06 Where overtime is worked by a crew, the Steward shall be one of the overtime crew or a replacement shall be designated by the Union Business Manager or Steward in the event he/she does not possess the necessary skill, ability and competency to perform the required work.

Article 17 Pre-Job Conference

17.01 a) The Parties agree in principle that obtaining high standards of labour productivity will be a key factor for Project success. Accordingly, given the importance of the Project to the people of Newfoundland and Labrador, the Association, its Contractor members, the Council of Unions and its Union members should each take affirmative steps to ensure productivity opportunities are maximized by all stakeholders including the Owner, Contractors, the Association, the Council of Unions and its Union members.

b) Each Union maintains claims to jurisdiction pursuant to the Plan for the Settlement of Jurisdictional Disputes in the Construction Industry (commonly called the "Green Book" and referred to hereinafter as the "Plan"). In order to provide for orderly and mutual understanding between the Council of Unions, the Association and Contractors, the Council of Unions shall provide an electronic copy of the Plan and an electronic copy, where available, of the following:

i) Agreements of Record including (Attested Agreements which have priority over Non-Attested Agreements);

ii) All Decisions of Record;

iii) Prevailing practices in Newfoundland and Labrador that have been documented; and

iv) Trade practices in the industry that have been documented.

17.02 The Association and/or the Contractor shall give notice to the Council of Unions of all contracts awarded which come within the scope of this Agreement. Wherever possible, a mark-up conference will be conducted prior to the commencement of work.

17.03 In order to minimize and resolve initial work assignments or initial assignments to assist in determining the composition of Work Teams a mark-up will be held. The mark-up will be in accordance with the following timetable:

a) **Day 1** – The Association or the Contractor will give written notice of a mark-up meeting and issue initial assignments to the Council of Unions and all Unions. A copy of drawings and specifications will be placed in the Council of Unions' St. John's office.

b) **Day 4** – The Association and/or the applicable Contractor will convene a mark-up meeting to outline the scope of work and record claims of Unions on initial assignments. All claims for work shall be finalized at the mark-up meeting or by prior written notice from the Union.

c) **Day 6** – The Association and/or the applicable Contractor will distribute a record of all claims made at the mark-up meeting.

d) **Day 8** – Last day of claiming or defending Unions to file evidence in support of their claim or assignment wherever possible Parties should endeavour to provide any and all copies of the evidence on which they seek to rely.

e) **Day 11** – The Association or Contractor will notify all Unions of final assignment(s).

f) **Day 13** – Last day for claiming Union to request jurisdictional umpire, failure to do so leading to the relinquishment of the right to call for an umpire for the assignment(s) made on Day 11.

g) **Day 17** – Last day for the jurisdictional umpire to hold a hearing.

h) **Day 20** – Last day for the jurisdictional umpire to render a decision.

The foregoing timetable may be revised by mutual written consent from the RDTC and the Association, the umpire may, with the consent of the Parties, vary the process following his appointment to facilitate the prompt processing and adjudication of claims.

17.04 Days are calendar days excluding Saturdays, Sundays and recognized holidays as listed in Article 23. Each day shall end at 5:00 p.m. local (location of the mark-up meeting) time.

17.05 Having regard for special requirements for construction of a project of this type, together with safety, efficiency, maintaining maximum levels of labour productivity, cost, continuity and good management, the Parties have agreed to an intended assignment plan by a jurisdictional umpire they have selected. The Association and the Council of Unions will retain the services of a jurisdictional umpire. The umpire shall be selected in rotation from a list of five (5) umpires acceptable to the Parties, which list is attached hereto as Schedule C1 and forms part of this Agreement. The list shall be reviewed and may be updated by the Parties once every year during the term of this Agreement. Should the umpire who is next on rotation be unable to act within the time requirements set out in this Article, or for reasons of conflict of interest, he/she shall be passed over to the next person on the list.

17.06 The procedural rules of the jurisdictional umpire, jurisdiction and operational restrictions shall be as set forth in the Plan except as modified by this Agreement.

17.07 a) The existence of a Work Team or the choice to assign any of the marked up work to a Work Team is not subject to review by an umpire on the following conditions:

i) upon completion of the mark-up process after the initial assignment where there are no claims; or

ii) in the event of a challenge as to a work assignment in the final mark up after the umpire process and other appeal processes contained herein have been exhausted.

b) Unions or Contractors may make claims and request jurisdictional review of the initial assignment of work to a specific Union.

c) Unions or Contractors may make claims and request jurisdictional review to ensure work assignments in the mark-up are followed.

17.08 The Parties shall take affirmative steps to ensure productivity opportunities are maximized. An umpire, in resolving a disputed work assignment in a mark-up or a dispute as to whether a mark-up is being followed, shall consider the following factors:

a) Agreements of Record and Decisions of Record established by or reported by the Impartial Jurisdictional Dispute Board, established international trade practices, prevailing practices as defined, together with a reasonable acceptance of considerations for efficiency and capacity to furnish construction services to the public at reasonable costs.

17.09 If the Association and/or the Contractor and the Unions involved cannot agree to accept the jurisdictional umpire's decision, any one of them can refer the dispute to the Canadian Plan. The criteria for considering any appeal shall be as per Article 17.01 b) and 17.08 herein.

17.10 The jurisdictional umpire cannot award costs or damages.

17.11 The Contractor/Association, whichever is the case, and the Unions involved in a dispute shall pay a share of the fees and expenses of the jurisdictional umpire in accordance with the following:

a) The umpire shall determine the losing Party in each case;

b) If the Contractor or Association's final assignment is changed by the umpire, the Contractor or Association (whichever Party made the assignment) AND the originally assigned Union are the losing Parties and they shall equally share the umpire's fees and expenses;

c) If the Contractor or Association's final assignment is not changed by the umpire, the claiming Union shall pay the umpire's fees and expense; and

d) In the event that the disputing Unions agree on how to perform the work but the Contractor disagrees and the umpire upholds the Union's position then the Contractor is deemed to be the loser and shall pay the umpire's full fees and expenses.

17.12 All jurisdictional disputes shall be resolved without the occurrence of any strike, work stoppage or slow down and the Contractor's final assignment shall be respected. The work will continue unless otherwise directed by the jurisdictional umpire under the intended assignment plan and that intended assignment shall continue in force and effect unless varied by the decision of a Canadian Plan Arbitrator.

17.13 Given the remoteness of the Site, all mark-up meetings and jurisdictional umpire hearings will take place in St. John's via video conference and/or telephone conference call unless otherwise agreed.

17.14 This procedure is available to and binding upon all Unions, the Council of Unions, the Contractor(s) and the Association. The Association will ensure that its Contractor(s) shall comply with the provisions of this Article, the procedures herein, and promptly implement decisions that are made. Such Contractor(s) shall abide by the outcomes of the process. The Council of Unions will ensure that the Union(s) shall comply with the provisions of this Article and the procedures therein. Such Union(s) shall abide by the outcomes of the process.

17.15 The local Union Business Manager or his/her delegate, the Union International Representative, the affected Contractor and Association, to ensure the efficiency and success of the implementation and/or operation of this Article, Schedule B and the Plan, shall participate in the markup process, umpire's process and arbitration processes.

17.16 The Parties agree to develop a training and education process for Council of Unions members and Association members to ensure this Article, Schedule B and the Plan are administered so as to maximize the benefit to all Parties and minimize disputes.

Article 18 Productivity Enhancement Through the Utilization of Work Teams

18.01 Where a Work Team is to be utilized by the Association and/or Contractor, the following procedures shall be employed:

a) The full process of the mark-up as is set out in this Agreement shall be applied. This process shall establish the Unions involved in that Work Team;

b) The Association and/or the Contractor shall notify the Council of Unions and the affected Unions designated by the mark-up process of the establishment of a Work Team as well as the composition of such team;

c) The composition of the Work Team shall be based on the overall percentage each Union has relative to the overall work to be performed by that Work Team as determined by the Association and/or Contractor; and

d) If, during the execution of the work, the nature of the work changes which impacts the composition of the team, a panel shall be requested to review the numbers and change them to comply with the percentages deemed appropriate.

18.02 This panel shall consist of three persons who shall serve for the duration of the Project. In the event that any one of the panellists can no longer serve for whatever cause, the Parties agree to forthwith replace their nominee or to agree to the independent third party (ITP). If the Parties cannot agree to an ITP, they shall apply to the Minister of Labour, Government of Newfoundland and Labrador, for the appointment of the ITP. The panel shall consist of three persons:

a) One appointed by the Association;

b) One appointed by the Council of Unions by its Executive; and

c) An ITP who is neither a lawyer nor an arbitrator under this Agreement and is familiar with jurisdiction.

18.03 This panel may investigate the initial or subsequent composition of the Work Team, when and if requested by one of the Parties.

18.04 Decisions of the panel, by agreement of the Parties, shall be final, binding and not subject to appeal, judicial review or any other form of judicial intervention.

18.05 Decisions of the panel shall be made on an expedited basis:

a) Any dispute as to the initial composition of a Work Team as established under Article 18.01 will be referred in writing to the panel within seven (7) days of the Contractor advising the Union in writing of the initial composition of the Work Team. The referral must itemize the issues in dispute, including the number of members a Union is claiming should be on the Work Team or any other issues as to the composition of the Work Team in dispute;

b) All referrals to the panel will be heard within seven (7) days of such written referral. Notice of the referral shall be provided to all affected Parties by the referring Party. Each Party shall have the right to present evidence and make representations to the panel, which presentation of evidence and/or making of representation shall be limited to two (2) hours unless such period is extended by a majority of the panel. The panel will render its decision within forty-eight (48) hours of the completion of the hearing. All decisions must be by a majority of the panel;

c) From time to time, as work advances, the composition of a Work Team may be revisited and adjusted as appropriate by the panel upon request of the Contractor or any Union providing workers to the Work Team. In no event shall a Work Team be revisited within ninety (90) days after the panel has rendered a decision

as to the composition of a specific Work Team except in the event there has been a material change in circumstances; and

d) There will be no claims permitted for lost wages, other benefits or premiums as a result of an adjustment to the Work Team, and Work Teams will continue to work cooperatively, without disruption, while any claim to adjust a Work Team is being adjudicated.

18.06 The following shall apply to each Work Team:

a) Each Union shall provide members to work on the Work Team on a pro-rated basis as per the distribution determined by the Contractor or in accordance with this Article.

b) The Union that provides the greatest number of employees to the Work Team shall provide the first requested foreman/general foreman subject to availability. If more foremen are requested, such foremen shall be provided on a pro-rated basis if practical.

c) Unions dispatching members to a Work Team shall advise members they will be working on a Work Team.

A willingness to work on a flexible basis if the needs of the work so dictate is the essential element of a Work Team. It is understood that while on a Work Team an employee may be required to work in and outside of his/her trade or craft.

Article 19 Regular Work Schedule, Extended Work Schedule, and Overtime Provisions to Address Unique Project Needs

19.01 The Association, its Contractor members, the Council of Unions and its Union members agree to the following guiding principles to be taken into account for the creation of hours of Work Schedules and overtime provisions contained herein:

a) The nature of the work;

b) Cultural issues;

c) Seasonality of work;

d) Weather conditions such as wind, rain, snow and cold;

e) The remoteness of the work area;

f) The need to be flexible to meet project needs; and

g) These provisions are not intended to reduce or replace overtime provisions to which Employees would otherwise be entitled.

19.02 The Association, its Contractor members, the Council of Unions and its Union members recognize that developing Regular Work Schedules will be important to Project success and accordingly agree to the following guiding principles and application of this Article:

a) Take into account geographical source of workforce; and

b) Structure Work Schedules to attract and retain a highly skilled and productive workforce.

Regular Work Schedule/Overtime Premiums

19.03 The following Article is intended to identify regular hours of work, Work Schedules and overtime hours. In order that there shall be consistency on the Site, the following hours of work and scheduling shall apply:

a) The regular work week shall consist of forty (40) hours of work divided into five (5) consecutive eight (8) hour work days from Monday to Friday, or four (4) consecutive ten (10) hour work days from Monday to Thursday. The start time for the day shift for a regular work day will be between 5:00 a.m. and 9:00 a.m.

b) Overtime premiums shall be paid as follows for the work week consisting of five (5) consecutive eight (8) hour work days:

i) All hours worked in excess of eight (8) hours per day at double the straight time rate of pay; and
ii) All hours worked on the Saturday, Sunday, scheduled days of rest and Recognized Holidays at double the straight time rate of pay.
iii) All hours worked after a Regular Work Schedule or an Extended Work Schedule have been completed and prior to the commencement of an employee's next Regular Work Schedule or Extended Work Schedule, shall be paid double the straight time rate of pay.

c) Overtime premiums shall be paid as follows for the work week consisting of four (4) consecutive ten (10) hour work days:

i) All hours worked in excess of ten (10) hours per day at double the straight time rate of pay;
ii) For all hours worked up to ten (10) hours on every Friday of any Work Schedule of ten (10) consecutive days or more, at one and one-half (1 ½) the straight time rate of pay;
iii) All hours worked on Saturday and Sunday of any schedule, or on the Friday of any schedule not requiring work on ten (10) or more consecutive days, at double the straight time rate of pay; and
iv) All hours worked after a Regular Work Schedule or Extended Work Schedule have been completed and prior to the commencement of an Employee's next Regular Work Schedule or Extended Work Schedule, shall be paid at double the straight time rate of pay.

Extended Work Schedules

19.04 The Parties understand and agree that the remote nature of the Project and the climatic conditions pose exceptional challenges in the successful completion of the work. To this end the Contractors, through the Association, may make use of Extended Work Schedules which are set out below. Such Work Schedules shall consist of scheduled days of work followed by scheduled days of rest. All hours worked on a scheduled day of rest shall be paid at double time the straight time rate of pay.

Extended Work Schedules

21 days on and 7 days of rest x 10 hours/day;

10 days on and 4 days of rest x 10 hours/day;

14 days on and 7 days of rest x 10 hours/day;

14 days on and 14 days of rest x 10 hours/day;

20 days on and 8 days of rest x 10 hours/day;

20 days on and 10 days of rest x 10 hours/day;

28 days on and 14 days of rest x 10 hours/day

Other Designated Shifts

6 days on and 1 day of rest x 10 hours/day

7 days on and 7 days of rest x 10 hours/day;

7 days on and 7 days of rest x 12 hours/day.

1. These Extended Work Schedules allow for an any-day start. Examples of hours paid and hours worked for each Extended Work Schedule are contained in Schedule [E].

2. Additional Extended Work Schedules may be implemented by the Association after meaningful consultation with the Council of Unions.

3. The Work Schedules and related terms for Site Service Worker shall be contained in the trade appendices for those Employees

General

19.05 An Employee who is transferred to a different Work Schedule must be provided with a minimum of two (2) scheduled work days' notice. If an Employee requests a transfer and it is approved, overtime rates will not apply for days worked that that Employee would have been entitled to under his/her previous Work Schedule. If the transfer is not as a result of an Employee request, overtime provisions will apply for days worked on the scheduled days of rest that the Employee would have been entitled to under his/her Work Schedule.

19.06 There shall be no pyramiding of overtime and/or premiums nor shall such overtime and/or premiums be in addition to, but not limited to Reporting Time under Article 21,

Call Out under Article 22 or pay for working a Recognized Holiday under Article 23 or height pay.

19.07 Unpaid lunch breaks will normally be at mid-shift (usually between 1100 and 1300) but may be staggered to coincide with start time and shall be one half (1/2) hour. An Employee who is required by the Contractor to work through the two (2) hour period shall be paid at the applicable overtime rate for one half (1/2) hour and shall, as soon as practicable thereafter, be given sufficient time, for which he/she will be paid to consume his/her meal.

19.08 One paid rest break of ten (10) minutes will be allowed during each half shift in an eight (8) hour shift. One paid rest break of fifteen (15) minutes will be allowed during each half of a ten (10) hour or greater shift. The scheduling of such rest breaks shall be at the time set by the Contractor per Employee but shall normally be midway through each half shift unless there are unusual or overriding circumstances requiring change of breaks.

19.09 The Parties are committed to delivering value for paid time accordingly:

a) Unless some other reporting location is designated by the Contractor, Employees shall be in attendance at their work location and prepared to commence work at the scheduled starting time for their respective shifts. Employees shall only be paid when they start work at their designated work location, not the point where they enter the Site. The worker will be at the designated brass point (card swipe), at the quit time. Employees, where appropriate, shall have reasonable time for clean-up and to store their tools before leaving their work location at the end of the shift.

b) Employees shall be diligent in respecting start and shift completion times.

19.10 a) When an Employee is required to work in excess of ten (10) hours and less than twelve (12) hours he/she shall be provided a twenty-five ($25.00) dollar meal allowance in lieu of a meal. He/she shall also be paid an additional twenty (20) minutes at double the straight time rate of pay in lieu of a meal time break. Employees affected by this Article, who are residents in the Camp, shall also receive a Camp supplied hot meal at the Accommodations Complex.

b) When an Employee is required to work in excess of twelve (12) hours, he/she shall be provided a hot meal, where feasible, at the end of the ten (10) hour shift and after each four (4) hours thereafter. The Employee shall be allowed twenty (20) minutes at double the straight time rate of pay to consume his/her meal. A ten (10) minute rest break shall be provided every two (2) hours.

19.11 When a general foreperson or foreperson is required to extend his//her shift (early start and/or late quit) for the purposes of organizing work or dealing with turnover issues to the oncoming shift up to a maximum of one (1) hour, Article 19.10 will not apply unless his crew also receives the meal and that foreperson (general foreperson) is required to supervise that crew. The general foreperson and/or foreperson shall be compensated at the overtime rate of pay for the time worked.

19.12 The hours of work and overtime provisions for Employees represented by the Hotel Employees and Restaurant Employees International Union and Local Union 779 and the International Brotherhood of Teamsters and Local 855 are set out in the Trade Appendices for each of those trades. The hours of work for the Employees they represent shall be governed by those Trade Appendices, save and except where those Trade Appendices direct that the provisions of Article 19 apply.

19.13 The nature of the work on the Project shall, from time to time, require the interruption of work, which shall result in temporary layoff of Employees for short periods of time. For those work interruptions not exceeding thirty (30) days, the Contractor shall advise the affected Union(s) of its recall needs and those Union(s) shall issue a referral slip in the same order as the initial hire of those temporarily laid off.

19.14 Work on the Site may be reduced during periods like Christmas/New Year's; however, certain Employees may be scheduled to work. Advance notice will be provided to all Employees regarding the observance dates, once available.

19.15 Nothing in this Agreement shall be construed as guaranteeing hours of work per day, per week, the days of work in any week or the days of work in any Work Schedule.

Article 20 Shifts

20.01 The scheduling of the number of days of work in a week, the number of shifts in a day and the number of hours in a shift shall be at the sole discretion of the Contractor.

20.02 The start time for the day shift for a regular work day shall be between 5:00 a.m. and 9:00 a.m.

20.03 For workers assigned to snow removal, site services, transportation, road maintenance or similar work there may be times when, due to climatic conditions or abnormal circumstances, workers are required to commence their shift prior to 5:00 a.m. and the shift will not commence prior to 3:00 a.m. For all other workers the start time, subject to climatic conditions or abnormal circumstances, will not vary on a daily basis, but may be adjusted to deal with job conditions.

20.04 The nature of the work on this Project may require, from time to time, the delay of the commencement of a shift due to climatic conditions or abnormal circumstances.

20.05 The second shift may commence at any time between the hours of 4:00 p.m. and 9:00 p.m. and nothing herein shall restrict the Contractor from implementing a third shift if business or other requirements necessitate. These shifts are to be classified as Shift Schedule(s) rather than as overtime and shall be scheduled for the duration of at least one (1) Work Schedule unless valid business reasons dictate otherwise.

20.06 A shift premium of three dollars ($3.00) per hour shall be paid for all hours worked on other than the day shift, whether or not the time worked is overtime or straight time. There shall be no pyramiding.

20.07 No worker shall work more than one (1) straight time shift in each consecutive twenty-four (24) hour period. A worker shall receive the overtime rate for each hour worked beyond the straight time shift until a break of eight (8) consecutive hours occurs.

20.08 An employee whose shift is changed (moved from one shift to another shift) shall receive twenty-four (24) hours' notice of the shift change. No employee shall suffer loss of regular earnings due to his/her shift change.

If a worker requests a transfer and it is approved, then overtime rates will not apply for days worked on the scheduled days of rest that the worker would have been entitled to under his/her previous Work Schedule unless any of the days worked in the new Work Schedule are deemed to be premium days, in which case the applicable premium rate will apply.

Article 21 Reporting Time

21.01 If the employee reports to work as requested at the regular starting time and is not put to work, the so affected employee shall be entitled to be paid to the employee's mid-shift at the applicable rate.

21.02 If the employee reports to work as requested at the regular starting time and is put to work, the so affected employee shall be paid all hours worked at the applicable rate of pay and in no case less than to mid shift at the applicable rate.

21.03 If the employee is given two (2) hours' notice not to report for work, he/she shall not receive any reporting time.

21.04 If the employee reports to work as requested at the regular starting time and is requested to stand by, either at the workplace or another area designated by the Contractor, the so affected employee shall be paid for all hours he/she works and stands by at the request of the Contractor at the applicable rate of pay and in no case less than to mid shift at the applicable rate.

21.05 In order to qualify for reporting time, the employee must remain on the job until otherwise directed by the Contractor.

21.06 When the conditions set forth in this Article occur on other than day shift, the shift premium as set out in Article 20 shall be paid.

21.07 A worker who is resident in Camp shall not be eligible for payment of reporting time if notice of "no work available" is posted on the Camp kitchen bulletin board at the pre-shift meal at least two (2) hours prior to regular shift start. Non-camp residents shall not be eligible for payment of reporting time if they have been provided at least two (2) hours' notice by their employer that there is no work available; such notice can be by telephone, telephone call-in system, public radio or personal notice.

Article 22 Call Out

22.01 Employees who have completed their day's scheduled hours of work and have left the work site or have returned to the Camp and are called out and return to work, such employee shall receive no less than four (4) hours' pay at the overtime rate. Workers who work in excess of four (4) hours shall be paid for the actual hours worked at the appropriate overtime rate until the commencement of their regularly scheduled shift.

22.02 When the conditions set forth in this Article occur on other than day shift, the shift premium as set out in Article 23 shall be paid.

Article 23 Vacation and Recognized Holidays

23.01 Vacation pay and recognized holiday pay shall be paid as part of an employee's regular paycheque in accordance with the Trade Appendices, attached as Schedule "D".

23.02 The following recognized holidays will be observed:

a) New Year's Day

b) Family Day

c) St. Patrick's Day

d) Good Friday

e) Victoria Day

f) Canada Day

g) Civic Holiday

h) Labour Day

i) Thanksgiving Day

j) Remembrance Day

k) Christmas Day

l) Boxing Day

23.03 All work performed on a recognized holiday shall be paid at the rate of double the regular rate.

23.04 The date of observation of recognized holidays shall be as gazetted by the Provincial Government or as mutually agreed between the Association and the Council of Unions.

23.05 An employee who is entitled to take vacation shall notify his/her Contractor in writing and such request shall not be unreasonably denied. The date of same shall be mutually agreed between the employee and the Contractor before the vacation is taken. No more

than twenty-five (25) per cent of the members of a crew may be on vacation at a given time.

Article 24 Camp Accommodations

24.01 An Accommodations Complex shall be provided, maintained and operated in full compliance with all applicable laws and regulations. During the early work phase of the Project, a temporary Accommodations Complex may be provided to accommodate workers until the Accommodations Complex becomes available.

24.02 The Owner or his/her designee shall have the sole right to manage the Accommodations Complex, including the assignment of accommodations. Such accommodations shall be suitable, properly maintained and operated.

24.03 An Accommodations Complex Committee composed of an equal number of representatives from the Association and Council of Unions shall be established for the purposes of providing input as to the development, implementation and administration of accommodation rules.

24.04 Workers living in the Accommodations Complex who do not report for work on a regular work day due to causes other than legitimate illness and/or legitimate absences when they are physically able to do so, may be charged the full room and board rate for each regular day not worked.

24.05 Workers failing to make use of Accommodations Complex on a repeated basis may be charged at the full room and board rate for each day not used and may forfeit their right to accommodations.

24.06 Accommodations Complex residents will be provided with sufficient and suitable food appropriate for the required breaks specified under this Agreement.

Article 25 Travel and Board

25.01 For the purpose of this Article, the definition of “permanent residence” for a resident of Newfoundland and Labrador shall be the same as the definition of Provincial Residence in this Agreement and for those outside of Newfoundland and Labrador, as follows:

> “An Employee’s permanent residence is the place where he/she maintains a self-contained domestic establishment where he/she ordinarily resides such as a dwelling, house or similar place of residence where a person generally eats and sleeps. Factors and/or current documents to be examined when determining who is a resident may include property tax assessment, lease agreement, driver’s licence, vehicle registration, income tax returns, voter’s list registration or proof of provincial health care coverage.”

25.02 Free Zone: There shall be a Free Zone of thirty-five (35) road kilometres from a designated pick up location in Happy Valley-Goose Bay, to the city or town boundary of the employee's permanent residence. Employees living within the Free Zone shall travel to and from the designated pick up location at their own expense. The Association will establish a daily commuting busing system from designated pick up areas within the Free Zone, which designated pick up areas will include a location in Sheshatshiu, North West River and Happy Valley-Goose Bay. Given the limited parking available at the Site, employees whose permanent residence is in the Free Zone and Travel Zone shall be required to utilize the commuting service, at no cost, to travel to and from the designated pick up areas to a designated location at or near the Site.

25.03 Travel Zone: Employees traveling to work who predominantly reside a distance greater than thirty-five (35) kilometers but less than one hundred (100) kilometers from the designated pick up location at Happy Valley-Goose Bay, to the city or town boundary of the community of the employee's permanent residence shall be paid travel allowance set out in Article 25.06 per road kilometer one way between the above noted points.

25.04 Employees travelling to work who permanently reside at a distance of one hundred (100) kilometers or greater, from the designated pick up location at Happy Valley-Goose Bay, to the city or town boundary of the community of the employee's permanent residence shall, to the extent of the capacity of the Accommodations Complex and other accommodations available to the Contractor, be provided with accommodations at no cost to the employee.

25.05 When an employee is entitled to accommodations pursuant to this Article and accommodation or space is not available, such employee shall be provided a board allowance in accordance with Article 25.07.

If accommodation space becomes available, such employee must commence residing at the accommodations within seven (7) days of being so notified. The employee shall cease being paid the board allowance once they commence residing at the accommodations or upon the expiration of seven (7) days of being notified, whichever is first.

25.06 The travel allowance in accordance with Article 25.03 shall be as follows:

a) $0.72 per road kilometer effective May 1, 2012;
b) $0.74 per road kilometre effective May 1, 2013;
c) $0.76 per road kilometer effective May 1, 2014;
d) $0.78 per road kilometer effective May 1, 2015;
e) $0.80 per road kilometer effective May 1, 2016;
f) $0.82 per road kilometer effective May 1, 2017.

25.07 The board allowance in accordance with Article 25.05 shall be as follows:

a) $100.00 per day effective May 1, 2012;
b) $104.00 per day effective May 1, 2013;
c) $108.00 per day effective May 1, 2014;
d) $112.00 per day effective May 1, 2015;
e) $116.00 per day effective May 1, 2016;
f) $120.00 per day effective May 1, 2017.

25.08 Zone 1 through 5:

An employee, whose permanent residence is located in Zones 1 through 5 as set out below shall be provided a Travel Allowance for Work Schedules of ten (10) consecutive days or more, provided the employee travels by road from the Site or Accommodation Complex to the employee's permanent residence during a Work Schedule turnaround and upon providing proof of travel expense in a form satisfactory to the Contractor. The Travel Allowance shall be payable as follows:

a) Zone 1 (100 – 200 km) - $90 (round trip);
b) Zone 2 (201 – 300 km) - $120 (round trip);
c) Zone 3 (301 – 400 km) - $150 (round trip);
d) Zone 4 (401 – 500 km) - $220 (round trip);
e) Zone 5 (501 – 700+ km) - $260 (round trip).

25.09 Employees on a Work Schedule of ten (10) or more consecutive days, whose permanent residence is located outside of Labrador or in an area of Labrador only accessible by air, will be provided by the Contractor, during each Work Schedule turnaround, the following:

a) For permanent Newfoundland residents, air transportation to and from St. John's, Deer Lake, Gander or such other designated hubs in Newfoundland to Happy Valley-Goose Bay;

b) For permanent Labrador residents, air transportation to and from designated hubs in Labrador to Happy Valley-Goose Bay; and

c) For permanent residents outside Newfoundland and Labrador, air transportation to and from designated hubs in other parts of Canada to Happy Valley-Goose Bay.

In the event that an overnight stay is required while in transit to the Site because of a disruption in air travel, the Contractor shall provide a Temporary Accommodation Allowance of one hundred and twenty dollars ($120.00) for each day the employee is delayed provided such employees permanent residence is one hundred (100) kilometers or more from the departing hub and the employee provides proof of a hotel expenditure in a form satisfactory to the Contractor.

In the event an overnight stay is required because an employee is unable to leave Happy Valley-Goose Bay on the employee's turnaround because of a disruption in air travel, such employee may remain in the Accommodations Complex at no cost until air transportation from Happy Valley-Goose Bay is available.

The Association and/or Contractor shall provide ground transportation to and from the Site to the Happy Valley-Goose Bay airport.

Employees shall not be paid travel time.

Employees whose permanent residence is 100 kilometers or more from the designated airhead shall receive a payment equal to the travel zone payment set out in Article 25.08.

25.10 When an employee is laid off, the Contractor shall provide return air travel or a Travel Allowance consistent with Articles 25.08 and 25.09. Employees who quit or have their employment terminated for cause prior to the completion of the employee's Work Schedule may not be entitled to return air travel or Travel Allowance consistent with Articles 25.08 and 25.09.

25.11 For the purposes of this Article, all distances will be determined by a website used for measuring distances, which website will be agreed to by the Association and Council of Unions. A worker may appeal to construction management to have his/her travel distance reassessed.

Article 26 Wages and Benefits

26.01 All workers covered by this Agreement shall be paid in accordance with the classification in the applicable Trade Appendices attached as Schedule "D".

26.02 Payday shall be Thursday and the method of payment shall be by electronic deposit. A weekly Statement of Earnings and Deductions shall be issued to each worker on Thursday.

26.03 The Contractor shall remit contributions in an amount and manner as required by the applicable Trade Appendix. The remittance of these funds shall in no way require the Contractor to become or remain a member of any trustees' group or association as a condition for making these contributions

26.04 Changes to benefit contributions may be made at the request of a Union in writing, subject to the gross hourly package remaining unchanged. Such request to change benefit contributions may be made annually between April 1 and April 30 and shall be implemented no later than June 1.

26.05 The work week for payday purposes shall end on Saturday at midnight. Workers shall be paid on Thursday of the following week

26.06 The payment of wages shall be accompanied by a statement showing:

a) Wage rate;

b) Number of hours paid at the straight time rate of pay;

c) Number of hours paid at the overtime rate of pay;

d) Amount of premium and allowances;

e) Vacation pay;

f) Holiday pay;

g) The amount and purpose of each deduction;

h) Name of the Contractor issuing the payment;

i) The worker's name and payroll number;

j) The pay period;

k) Gross and net earnings; and

l) Pension contributions.

Article 27 Lower Churchill Project Premium

27.01 In recognition of the uniqueness of the Lower Churchill Project, its importance to the Province of Newfoundland and Labrador and the duration of the Project, workers shall receive a Lower Churchill Project Premium payment of three dollars and fifty cents ($3.50) per hour for all hours earned. Contractors shall pay the premium weekly. The premium is not part of the wage package and does not attract vacation pay and recognized holiday pay.

27.02 Upon layoff, workers shall receive the Lower Churchill Project Premium in their final pay.

Article 28 Resource Development Trades Council Industry Fund

28.01 The Contractor shall remit to the Council of Unions the sum of thirty cents ($0.30) per person per hour earned for all hours earned by all members of the bargaining unit covered by this Agreement, which amount shall be in addition to the gross hourly package set out in each Trade Appendix.

Article 29 Canadian Building Trades Fund

29.01 The Contractors shall remit to the Canadian Building Trades Fund five cents ($0.05) per person per hour earned for all hours earned by all members of the bargaining unit covered by this Agreement, which amount shall be in addition to the gross hourly package set out in each Trade Appendix.

Article 30 Termination of Employment

30.01 When an employee has been terminated or laid off while away from the Site, any personal belongings shall be shipped to his/her last known address, at the Employer's expense, unless previous arrangements have been made.

30.02 Contractors shall provide four (4) hours' notice or pay in lieu of notice to employees who are laid off. These four (4) hours are to be used for the purposes of picking up and returning the Contractor(s) tools, checking out of accommodations or in preparing his/her own tools for the next job.

30.03 Layoffs shall occur in reverse order of hiring priority described in Article 7. For greater clarity, the last worker laid off shall be Newfoundland and Labrador residents and layoffs shall be in compliance with the Benefits Strategy and hiring priority for qualified Labrador Innu, subject to the retained employees having the competence and qualifications necessary to complete the remaining work.

30.04 Workers who are laid off and for whom transportation is not available shall be entitled to receive accommodations until such transportation is made available by the Contractor.

30.05 In the event of a reduction of the workforce anyone promoted from journeyperson may be demoted to journeyperson. Anyone name hired as a foreman or general foreman shall be laid off as a foreman or general foreman.

Article 31 Tools

31.01 Workers are to supply appropriate tools in accordance with the schedules listed in the Trade Appendices attached to and made part of this Agreement.

The tools are subject to verification by the Contractor upon employment. If the Contractor deems other tools are necessary, they shall be supplied by the Contractor.

31.02 The worker's personal tools shall be in good condition when he/she is hired on the job and they shall be maintained and kept in good condition.

31.03 The Contractors will provide the appropriate lock-fast facilities for storage of personal tools.

31.04 Workers will be held responsible for tools, special and/or protective clothing and safety apparatus supplied to them by the Contractor. If the worker fails to return the supplied items in good condition to the Contractor, with the exception of fair wear and tear, at the time of termination or on request prior to the worker's termination, the replacement cost shall be deducted from any monies due to the worker.

Workers will not, however, be held responsible for loss or damage to Contractor supplied tools, clothing or equipment as a result of fire, theft due to break-in or forcible entry of Contractor arranged lock-fast facilities, provided the loss or damage is immediately reported by the worker, in writing, to the Contractor.

31.05 The Contractor shall replace a worker's personal tools when:

a) The tools are destroyed by fire, lost through theft by forced entry of a designated storage place on the Contractor's premises and provided that the loss or damage is immediately reported by the worker, in writing, to the Contractor; and

b) In the course of the worker's work assignment, the tools are damaged beyond repair, provided the worker satisfies his/her Contractor the damage was not intentional or caused by the worker's failure to exercise due care and attention.

31.06 Contractors will not be held responsible for personal tools which have not been identified on the worker's tool list by an authorized representative of the Contractor. The worker shall provide an inventory list and the Contractor shall conduct an inventory check prior to commencement of work.

31.07 A worker's tools which have to be replaced or sent off the job site for repair will be replaced and returned as soon as possible.

Article 32 Welding Testing

32.01 When welders are hired on the Project, the Contractor hiring the welder shall compensate the Union supplying the welder, five hundred and fifty dollars ($550.00) for each welding ticket the welder is required to have to perform the work. The welder shall be reimbursed four (4) hours pay for each ticket to compensate for time involved in completing each test. In the event a Union member is laid off and rehired by the Contractor or another Contractor working on Site, the Contractor or the other Contractor shall not be required to pay the five hundred and fifty dollars ($550.00) for each ticket and the welder shall not be reimbursed pay if the same welding tickets are required. The Contractor is responsible for the cost of Canadian Welding Bureau re-certifications if the certification expires more than one (1) year after the welder commences to work on Site. These re-certifications shall be without loss of pay to a maximum of one (1) regularly scheduled work day at straight time.

Article 33 Lunch Room and Sanitary Facilities

33.01 The Contractor shall provide and maintain clean, heated, sanitary facilities which shall include modern flush toilets, urinals and wash basins. Where this is not practicable, chemical toilets and pump tank facilities will be provided.

33.02 Fresh, safe drinking water and sanitary cups shall be provided to the workers.

33.03 The Contractor shall provide lunch rooms and determine their location subject to restrictions of the work area in which the employees may take their breaks and meals.

33.04 When lunch rooms are used, they shall be kept heated and clean, with adequate size and seating capacity to accommodate the number of people using the facility. General lunch rooms shall be provided with reasonable amenities, such as kettles and microwaves.

33.05 There shall be suitable heated warm-up shacks for drying clothes.

Article 34 Apprenticeship and Training

34.01 The Association, the Contractors, the Council of Unions and the Unions agree, in alignment with the Benefits Strategy and obligations to the Labrador Innu, to create training, development and apprenticeship opportunities.

34.02 The Association, the Contractors, the Council of Unions and the Unions agree to the utilization of apprentices as follows:

a) Not less than one (1) apprentice for every three (3) journeypersons; and

b) Not more than two (2) apprentices for each journeyperson.

34.03 Gender Equity and Diversity shall be a consideration when hiring or referring Apprentices to the Project as part of the Parties' cooperative effort to achieve and sustain participation rates for women and underrepresented groups established in consultation with the Province.

34.04 The employment of apprentices (within regulatory requirements and limitations) will be promoted throughout the duration of the Project and will provide for a spectrum of apprentices from the first year through the fourth year as appropriate to their respective trade(s). The Parties will facilitate this through the effective utilization of the hiring provisions contained in Article 7 of this Agreement.

Article 35 Leave of Absence

35.01 Workers shall be granted three (3) regularly scheduled work days leave with pay (the worker's regular rate times the number of hours the worker is scheduled to work on those days plus any applicable premium) commencing on the day after the date of death of the spouse or common law spouse, child (step child), parent (step parent), legal guardian, brother, sister, parent-in-law, grandparent, grandchild, daughter-in-law, son-in-law, sister-in-law, brother-in-law or other relative or dependant living in the same principal residence.

35.02 Bereavement leave shall not be granted for time that would not normally have been worked and under no circumstances shall pay be granted for unscheduled overtime missed as a result of a worker's absence.

35.03 Workers shall be entitled to pregnancy, maternity, parental and adoption leave in accordance with the provisions of the Newfoundland and Labrador *Labour Standards Act* in effect as of the date of this Agreement.

35.04 Workers summoned to attend upon a court of inquiry or any other judicial proceeding as a juror or prospective juror in accordance with the Newfoundland and Labrador Jury Act, 1991 shall be paid the same as they would if they had been scheduled to work.

35.05 The Contractor may grant a leave of absence without pay to any employee for personal or cultural reasons. Requests for such leave shall be made in writing at least one week in advance; such leave shall not be arbitrarily denied.

Article 36 Commissioning

36.01 Commissioning activities are important to the success of the Project. During the Commissioning process, the Owner, EPCM or Commissioning Contractor may utilize Union members, Owner employees or vendor representatives or Commissioning Contractor employees who are not members of the bargaining unit. Notwithstanding any other Article in this Agreement, Union employees required for Commissioning may be selected by the Owner, EPCM or the Commissioning Contractor from the Council of Unions' bargaining unit or out-of-work list and may be required to work in multi-disciplined Crews. Commissioning work executed by Union members shall fall within the scope of this Agreement. Commissioning work executed by Owner employees, vendor employees or representatives or EPCM employees or Commissioning Contractor employees who are not members of the bargaining unit shall fall outside the scope of this Agreement.

Article 37 Saving

37.01 Should any provision of this Agreement be found by a court of competent jurisdiction to be in conflict with any law or regulation of Canada or Newfoundland and Labrador, such provision shall be superseded by such law or regulation. Notwithstanding such invalidation, the remaining provisions shall remain in full force and effect.

37.02 Unless prohibited from doing so by such law or regulation or court ruling, the Parties shall commence negotiations within fourteen (14) days to provide a valid replacement of such provision.

37.03 In the event that negotiations do not result in agreement on a legal replacement for such provision within fourteen (14) days of commencement of negotiations or such longer period as may be mutually agreed, the matter shall be resolved in accordance with the arbitration process in this Agreement.

Article 38 Duration

38.01 This Agreement shall be for a term commencing on the later of:

a) Date of its signing; or

b) Date the Lieutenant Governor-in-Council issued a Special Project Order respecting the Project and continuing for the duration of the work at the Site, including mobilization and demobilization by the Contractors except as provided herein.

38.02 Without restricting the generality of the aforegoing, this Agreement ceases to apply when Mechanical Completion of the work is attained and is handed over to the Owner or its designate.

38.03 Mechanical Completion occurs when construction is physically complete (manufactured, fabricated, installed and connected), safe (related systems necessary for protection of personnel and property are in place), clean (flushed, clean and dry), tight (bolt tensioned, hydro tested and reinstated), inspected, tested and documented.

38.04 Notwithstanding Article 38.02, a unit(s), system(s) or area(s) may be deemed ready for acceptance by the Owner or its designate upon near completion. Upon acceptance, prior to Mechanical Completion by the Owner or its designate, this Agreement ceases to apply to that work.

38.05 Should the Owner or its designate require assistance from the Contractor in modifying, altering or fixing up any system or facility described above the work shall be performed by members of the Council of Unions.

Signed at St. John's, Newfoundland and Labrador this 14th day of March, 2013.

RESOURCE DEVELOPMENT TRADES COUNCIL OF NEWFOUNDLAND AND LABRADOR

(digital copy of signed agreement)

(digital copy of signed agreement)

(digital copy of signed agreement)

MUSKRAT FALLS EMPLOYERS' ASSOCIATION INC.

(digital copy of signed agreement)

(digital copy of signed agreement)

FORMALLY SIGNED AT ST. JOHN'S, NEWFOUNDLAND AND LABRADOR THIS 14th DAY OF MARCH, 2013 BY THE INDIVIDUAL MEMBERS OF THE RESOURCE DEVELOPMENT TRADES COUNCIL OF NEWFOUNDLAND AND LABRADOR

(digital copy of signed agreement)
Hotel Employees and Restaurant Employees International Union and Local 779

(digital copy of signed agreement)
International Association of Bridge, Structural, Ornamental and Reinforcing Ironworkers and Local Union 764

(digital copy of signed agreement)
International Brotherhood of Electrical Workers and Local Union 1620

(digital copy of signed agreement)
Labourers' International Union of North America and the Construction and General Labourers' Union, Rock and Tunnel Workers Local 1208

(digital copy of signed agreement)
International Union of Operating Engineers and Local Union 904

(digital copy of signed agreement)
The International Brotherhood of Teamsters and Local Union 855

(digital copy of signed agreement)
International Union of Bricklayers and Allied Craftsworkers and Local Union 1

(digital copy of signed agreement)
International Brotherhood of Boilermakers Iron Ship Builders Blacksmiths, Forgers and Helpers, Local 203

(digital copy of signed agreement)
International Brotherhood of Electrical Workers and Local Union 2330

(digital copy of signed agreement)
United Brotherhood of Carpenters and Joiners of America and Millwrights Local Union 1009

(digital copy of signed agreement)

United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the U.S. and Canada, and Local Union 740

(digital copy of signed agreement)

United Brotherhood of Carpenters and Joiners of America and Carpenters Local Union 579

(digital copy of signed agreement)

International Union of Painters and Allied Trades and Local Union 1984

(digital copy of signed agreement)

International Association of Heat and Frost Insulators and Allied Workers, Local Union 137

(digital copy of signed agreement)

Sheet Metal Workers' International Association and Local Union 512

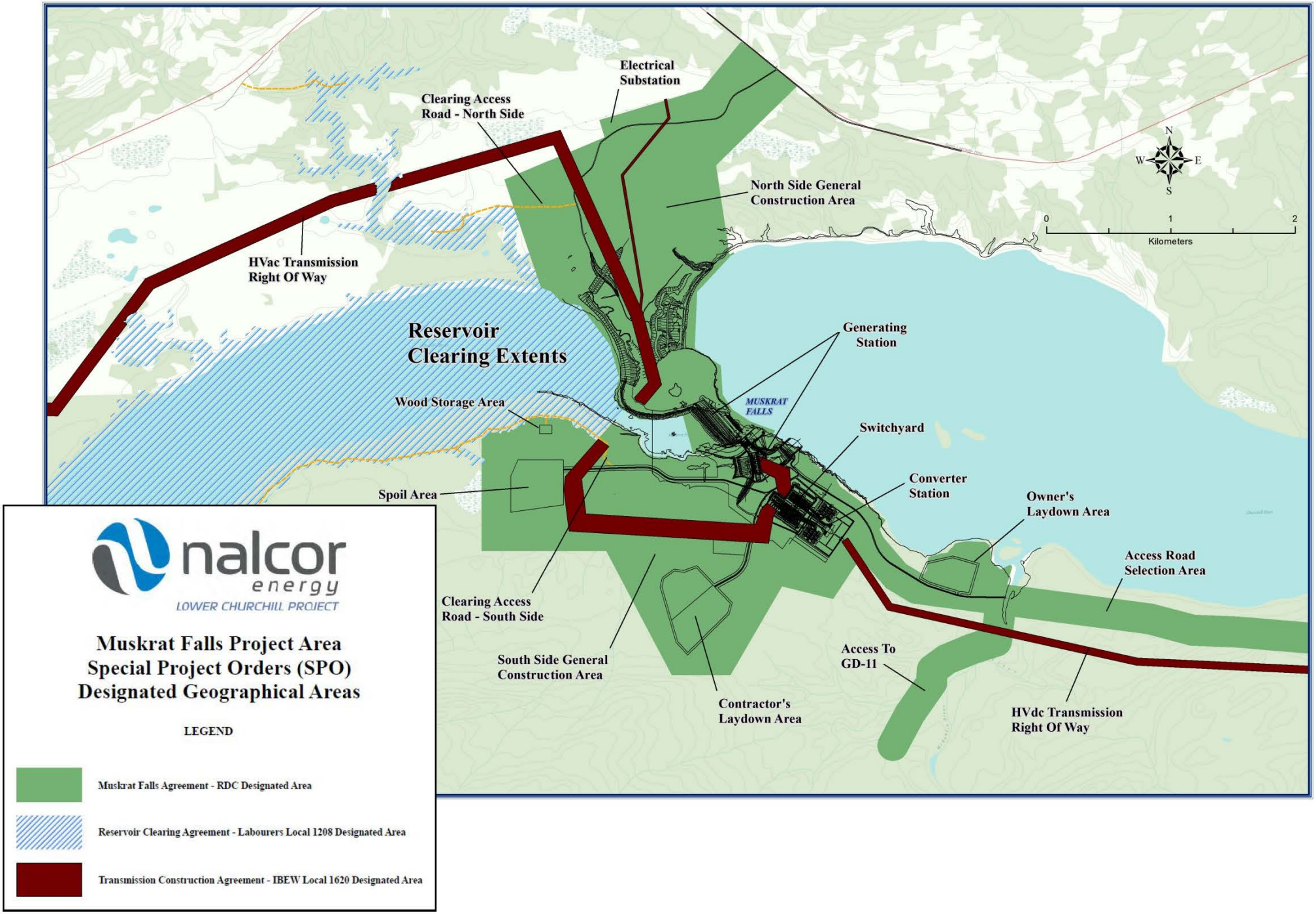
(digital copy of signed agreement)

International Union of Elevator Constructors and Local Union 125 A

SCHEDULE “A.1”

GEOGRAPHICAL AREA MAPS

Close up of the North Side and South Side General Construction Area

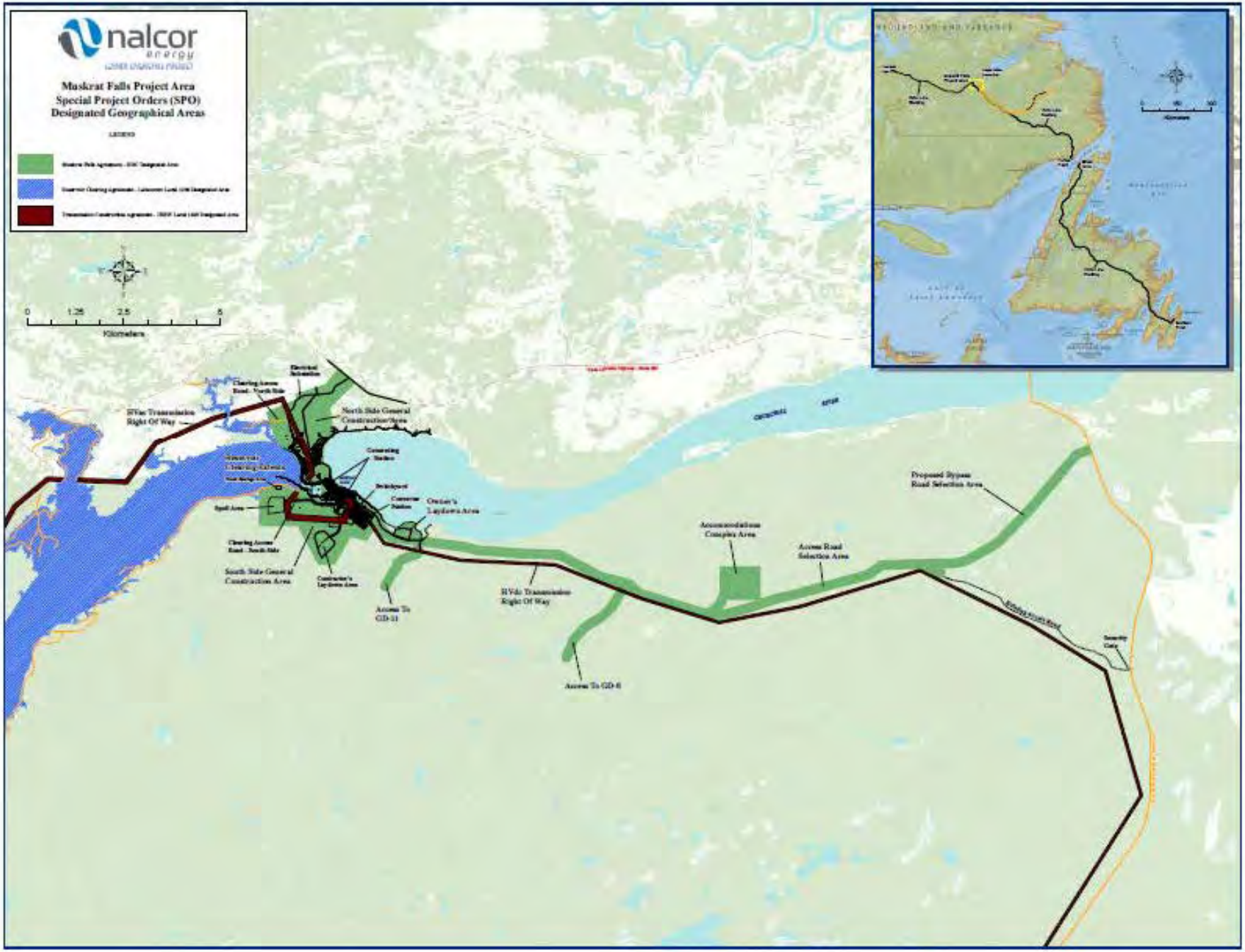


nalcor energy
LOWER CHURCHILL PROJECT

Muskrat Falls Project Area
Special Project Orders (SPO)
Designated Geographical Areas

LEGEND

- Muskrat Falls Agreement - RDC Designated Area
- Reservoir Clearing Agreement - Labourers Local 1208 Designated Area
- Transmission Construction Agreement - IBEW Local 1620 Designated Area


nalcor energy
Muskrat Falls Project Area
Special Project Orders (SPO)
Designated Geographical Areas
0 1.25 2.5 5
Kilometers
Proposed Bypass Road Selection Area
Accommodations Complex Area
Access Road Selection Area
Owner's Laydown Area
North Side General Construction Area
South Side General Construction Area
Access To GD-11
Access To GD-8
Churchill River

SCHEDULE “A.2”

SCOPE OF WORK

Schedule “A.2”

SCOPE OF WORK

Scope of construction work that will be included will be as follows:

Designated quarries as per the Letter of Understanding, transportation of aggregate and till to the Site from the designated quarries, the construction of the Dams / Spillways, construction of the Powerhouse, construction of the Switch Yard at Muskrat Falls to the Anchor Bolts, the construction of foundation and envelope of the converter station building (structural steel, exterior cladding and roofing) at Muskrat Falls, bulk excavation of the Site for the Dam and Powerhouse, and construction and operation of the Accommodations Complex.

This scope of construction work does not include construction activities performed under another Special Project Order issued pursuant to Section 70 of the *Labour Relations Act* (as per Article 4.04(b)).

SCHEDULE “B”

JURISDICTIONAL UMPIRE – TERMS OF REFERENCE

Schedule "B"

JURISDICTIONAL UMPIRE – TERMS OF REFERENCE

SECTION I: DEFINITIONS

In this Agreement:

"Agreements between Unions" There are three types of Agreements – Agreements of Record, Attested Agreements and Non Attested Agreements. These Agreements are not binding on other crafts not signatory to the Agreements and, insofar as the Impartial Jurisdictional Disputes Board is concerned, they do not affect the claims or rights of work jurisdiction of Unions not parties to the Agreement.

"Agreements of Record" are those Agreements between Building Trades Unions which have been recorded with the Impartial Jurisdictional Disputes Board and are binding on the signatory Unions. These are the only Agreements contained in the "Green Book".

"Attested Agreements" are those Agreements signed by the General Presidents of two International Unions and attested to by the Impartial Jurisdictional Disputes Board. These Agreements have the same status as an Agreement of Record.

"Decision of Umpire" means the decision of work assignment made by the umpire.

"Decisions of Record" are those which appear in the publication commonly referred to as the "Green Book" published and approved by the Building and Construction Trades Department, AFL-CIO, (current issue), and are international or national in scope. They are applicable to all trades even though a dispute which resulted in a Decision of Record may originally have involved only two trades. They are not to be confused with job decisions rendered by the Impartial Jurisdictional Disputes Board which apply only to the job decisions. However, the Impartial Jurisdictional Disputes Board is required to give due consideration to Decisions of Record in arriving at job decisions. Decisions of Record in the "Green Book" do not appear in chronological order and are always referred to by dates.

"Impartial Jurisdictional Disputes Board" means the Impartial Jurisdictional Disputes Board in Washington, D.C., the International Appeal board, the International Plan for the Settlement of Jurisdictional Disputes in the Construction Industry (approved June, 1984, as amended December 2008), or its successor.

"Intended Work Assignment" means the initial step wherein the Contractor declares his intention to assign certain work to a certain trade(s).

"Jurisdictional Dispute" means dispute between Unions and/or Unions and a Contractor over the assignment of work, or a difference between two or more Unions as to which trade or which workmen will do certain work which must be grounded and be founded upon the scope or claimed jurisdiction as set forth in the International Constitution applicable to the Claimant(s).

"Non Attested Agreements" are those which have not been filed with the Impartial Jurisdictional Disputes Board, nor attested by the Chairman of the Impartial Jurisdictional Disputes Board.

"Participating Contractor" means a Contractor working under the terms and conditions of this Agreement.

"Participating Unions" means a Union which is a member of the Council of Unions.

"Prevailing Practice" is the practice of that craft which submits valid evidence indicating that its members have performed more of the work in the area where the dispute exists than have members of other crafts. The area, for the purpose of determining the Prevailing Practice, shall be defined ordinarily to mean the geographical jurisdiction of the Province of Newfoundland and Labrador.

"Specific Work Assignment" means the assignment of work as determined by the umpire. The "intended work assignment" shall be considered the specific assignment where the assignment remains unchallenged before the umpire.

"Umpire" means the Jurisdictional Umpire appointed pursuant to Article 17:00 of this Agreement.

SECTION II PROCEDURES TO BE USED BY THE UMPIRE

1. Agreements of Record and Decisions of Record established by or recorded by the Impartial Jurisdictional Disputes Board, prevailing practice as defined, established international trade practice, together with a reasonable acceptance of considerations for efficiency and capacity to furnish construction services to the public at reasonable cost, shall be accepted by the umpire as factors in assigning work (see Article 2.2(b) of the Procedural Rules of the Canadian Plan).

2. Decisions on Assignment of work (Reference Article 17.00) – When the umpire has received a claim of work assignment from the Council of Unions or for a request for a decision from the Association or Contractor, he/she shall proceed to make a decision as outlined below:

i) Any request for a decision shall contain the following information:

Name and address of the Contractor.

Disputing trades.

The assignment of work made by the Contractor.

A full and detailed description of the disputed work.

When the request is made by the Union, it shall also state the basis of its claim for the work.

ii) All requests for services of an umpire shall be made to the RDTC Office at 78 Brookfield Road, St. John's, NL.

iii) The Council of Unions shall file a copy of each request for a decision with the Association, the affected Contractor(s), the umpire and all of the Local Union(s) involved in the dispute.

iv) When notice of a request for a decision has been sent to a Union or Contractor directly affected, the Union or Contractor shall be allowed twenty-four (24) hours (except as provided below) in which to state its position to the umpire. The Union shall be notified of this period at the same time it is sent notice of the request for a decision.

v) Where a request for a decision has been filed with the umpire by the Council of Unions, the Association or Contractor shall be requested to furnish a full description of the disputed work.

vi) Where two Unions have established procedures for the adjustment of jurisdictional disputes without resorting to the procedures set out herein, they shall be allowed a reasonable length of time as determined by the umpire in which to effect a settlement which settlement much be approved by the Contractor. If the Unions are unable to reach agreement, they shall jointly render a statement of facts of the dispute to the umpire for a decision.

vii) When the umpire has decided to process a dispute in accordance with the provisions of Article 17, the Union and Contractor(s) involved and the Association shall be notified and allowed five (5) working days from receipt of the notice in which to submit evidence. The Unions shall be notified by registered mail, courier, or facsimile of this period in each case processed.

The notice must also include a clear definition of the dispute on which evidence is to be secured, and the locality from which evidence will be received which shall be the same for both trades and shall be the Province of Newfoundland and Labrador. The umpire will consider only evidence which identifies projects within the Province of Newfoundland and Labrador and the Contractor on the project. It is desirable wherever possible for the evidence to show the year the work was performed and the amount of work involved.

viii) If the umpire finds that the dispute is not covered by an appropriate or applicable Decision or Agreement of Record, he/she shall render a decision in which he/she shall consider the established and prevailing practices, in the Province of Newfoundland and Labrador specific to major projects, in the Province of Newfoundland and Labrador in other sections of the construction industry, Canada and the United States, in accordance with Section II 1) herein, and the decision shall be effective for the duration of the Project.

ix) The Council of Unions and the Association shall ensure that their members promptly comply with each decision of the umpire.

x) If, during the course of consideration of a dispute, the umpire should decide that there is a substantial and material question of fact which cannot be resolved on the basis of the available evidence, the umpire shall temporarily suspend the deliberation and make the investigation as he/she deems necessary to avail himself/herself of all facts and evidence bearing on the dispute.

xi) If, during the course of consideration of a dispute, any Party to the dispute or the umpire should decide that there is a substantial and material question of technological change attendant to a dispute which cannot be resolved on the

basis of available evidence, the umpire shall temporarily suspend the deliberations and make any investigation as he/she deems necessary to avail himself/herself of all facts and evidence bearing on the dispute and shall in any event make a decision prior to the scheduled commencement of work.

xii) In addition to all other requirements in these Rules and Regulations with respect to the form of a decision rendered by the umpire, it is also required that any decision shall include a brief statement of the description of the work in dispute and the conclusions of the umpire with respect to the principal material issues which are involved in the dispute. The umpire's written decision shall be as brief and concise as possible.

xiii) In keeping with the expressed intent of the Parties to address jurisdictional matters in a timely, efficient and cost effective manner, the hearing may be conducted by electronic audio/visual means.

xiv) Each Party to the jurisdictional dispute shall pay its own expenses in accordance with Article 17.11. The fees and expenses for the umpire shall be paid by the losing Party.

xv) Unless and until it is re-assigned by the umpire, work shall be performed in accordance with the Contractor's final mark up and the Contractor shall have no liability in respect of work subsequently re-assigned.

xvi) Once a decision is rendered by an umpire as to a work assignment in a mark-up, such work assignment shall not be the subject of review by an umpire for the same work assignment under a different mark up and contractors will be required to assign the work in future mark ups as per the decision of the umpire for the duration of the Project, provided that the work or the method of performing the work is the same or substantially the same as the work that was awarded by the umpire or contained in the different mark-up.

SECTION III IMPLEMENTATION OF DECISIONS

Decisions as to jurisdiction claims and decisions determining whether or not the decisions have been violated as rendered by the umpire shall be binding, final and conclusive on all of the Parties agreeing to the operation of this Jurisdiction Dispute Resolution Plan, except as otherwise provided in Section III.

To further implement the decision of the umpire, any Party, may, at any time, file a complaint in writing with the umpire alleging a violation of a decision previously made. The umpire shall thereupon set a hearing to be held within three (3) days of receipt of the complaint with respect to the alleged violation and shall notify, by registered mail or facsimile, all interested Parties of the time and place thereof. The umpire shall conduct a hearing at the time and place specified in this notice. All Parties shall be given an opportunity to testify and present documentary evidence relating to the said matter of the hearing within forty-eight (48) hours after the conclusion thereof. The umpire shall render a written decision in the matter and shall state whether or not there has been a violation of his/her prior decision. Copies of the decision shall be mailed by registered mail or facsimile to all parties thereto. Should the umpire determine that

there has been a violation of his/her decision, he/she shall order immediate compliance by the offending Party or Parties.

The umpire shall take the following action to enforce compliance with his/her decision including a directive to make a specific assignment of work.

a) He/she shall levy a fine of $250.00 per day for each violation against the offender, i.e. Contractor and/or Union, represented by the Parties hereto. The fine shall be paid to the Council of Unions and submitted to the affected Union or Unions consistent with the decision of the umpire. Should a member of either Party to this Agreement fail to pay the amount levied within fifteen (15) days, he/she shall be deprived of all benefits of the umpire until the time as the matter is adjusted to the satisfaction of the umpire.

b) He/she shall file an application in any court of competent jurisdiction to have his/her decision confirmed and for entry of a judgment in conformity therewith.

c) He/she shall take any further or additional action he/she deems necessary to secure compliance with his/her decision.

d) The umpire shall determine the losing Party in each case. If the Contractor or Association's final assignment is changed by the umpire, the Contractor or Association (whichever Party made the assignment) and the assigned trade are the losing Parties, and they shall equally share the umpire's fees and expenses. If the Contractor or Association's final assignment is not changed by the umpire, the claiming trades shall pay the umpire's fees and expenses.

SECTION IV RECOURSE

Any Party or person bound by a decision of the umpire may apply for a Jurisdictional award to the Canadian Plan, or its successor, created by the Building and Construction Trades Department, AFL-CIO, and the person or Party shall be bound by all of the Procedural Rules and Regulations of the said Canadian Plan, or its successor, except as amended by this Agreement, so far as may be applicable, and shall be bound by any Decision of the said Canadian Plan, or its successor (including any decision of the International Appeal Board provided herein) as if the decision were a decision of the umpire referred to in Section II.

SCHEDULE “C”

LIST OF ARBITRATORS

Schedule “C”

LIST OF ARBITRATORS

1. Robert Andrews
2. Morgan Cooper
3. John Clarke
4. David Alcock
5. James Oakley
6. John Roil
7. Wayne Thistle
8. Norman Whalen

SCHEDULE “D”

TRADE APPENDICES

Schedule "D"

TRADE APPENDICES

Gross Hourly Package – the Gross Hourly Package as of May 1, 2012 is equal to the Gross Hourly Rate specified under the Construction Labour Relations Association ("CLRA") Collective Agreements for the RDTC signatory members to the Project Agreement. In addition to the Gross Hourly Package, the following amounts are paid:

a. Resource Development Trades Council Industry Fund - $0.30 per hour paid on hours earned as per Article 28
b. Canadian Building Trades Fund - $0.05 per hour paid on hours earned as per Article 29

Gross Hourly Package Increases – provided above the May 1, 2012 CLRA rates are as follows:

a. May 1, 2013 - $2.00
b. May 1, 2014 - $2.50
c. May 1, 2015 - $2.00
d. May 1, 2016 - $2.50
e. May 1, 2017 - $2.00

HOTEL EMPLOYEES AND RESTAURANT EMPLOYEES INTERNATIONAL AND HOTEL AND RESTAURANT WORKERS, LOCAL UNION 779

1.0 APPLICATION

Security

Group 1 Crew Chief (General Foreperson)

Group 2 Assistant Crew Chief (Foreperson)

Group 3 Security Officer, Communications, Dispatch

Catering – Kitchen / Dormitories & Janitorial

Group 1- Chef

Group 2- 1st Cook

Group 3- Meat Cutter, Baker and Non-Working Foreperson

Group 4- 2nd Cook, Service Attendant, Inventory Attendant

Group 5- 3rd Cook, Baker's Helper, and Working Foreperson

Group 6- Salad/Sandwich Person and Commissary

Group 7- Pot/Dishwasher, Waiter/Waitress, Front Line Attendant, General Help, Camp Attendant/Housekeeping and Janitor

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be 13% percent of gross wages including overtime for all employees.

3.0 HEALTH & WELFARE, PENSION, INDUSTRY AND TRAINING FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage and Benefits Schedule for each hour earned. Payments shall be made no later than the 15th of the month following the month in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payments shall be made as follows:

(a) Health and Welfare, and Registered Retirement Savings Plan

Address: Benefit Plan Administrators
7001 Mumford Road
Tower 1, Suite 216
Halifax, NS B3L 4N9

Cheques for each are payable to: Benefit Plan Administrators

(b) Building Fund

Address: Hotel & Restaurant Workers, Local 779
15-A Bay Bulls Road
P. O. Box 6142
St. John's, NL A1C 5X8

Cheques for each are payable to: Hotel & Restaurant Workers Local 799 Building Fund

(c) Industry (RDTC) Fund

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque payable to: Resource Development Trades Council Industry Fund

(d) Canadian Building Trades Fund

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Canadian Building Trades Fund

3.04 Union Dues

Union Dues are per Article 6 shall be forwarded to:

Address: Hotel & Restaurant Workers, Local 779
15-A Bay Bulls Road
P. O. Box 6142
St. John's, NL A1C 5X8

4.0 UNIFORMS

4.01 Security – Section 1: Security personnel shall be provided with:

(a) Summer clothing to consist of safety footwear, two pants, three shirts, two jackets and rain gear.

(b) Winter clothing to consist of safety footwear, two pants, three shirts, leather gloves, one parka.

Uniforms shall have badges and decals clearly identifying security personnel. Alterations shall be the responsibility of the Employer.

4.02 Catering: All catering staff shall be supplied with:

(a) Three uniforms per employee (Kitchen, Whites) and (Camp Attendants, Blues) and safety footwear. Alterations shall be the responsibility of the Employer.

5.0 BULLETIN BOARDS

5.01 The Union shall use the Bulletin Board for notices of importance concerning Union business and the Company agrees that they shall use the Bulletin Board for any business concerning Union matters\, such as layoffs, hiring and recall.

6.0 SPLIT SHIFTS

6.01 Employees working a split shift shall be paid an additional two dollars and fifty cents ($2.50) per hour for all hours worked.

6.02 Employees required to work in excess of twelve (12) hours from commencement of their shift shall be paid overtime for all hours worked in excess of twelve(12).

6.03 There shall be one (1) split only in a split shift.

6.04 The split shift premium is not to be included in the base hourly rate when computing overtime.

7.0 SECURITY SPECIAL CONDITIONS

7.01 Notwithstanding Article 19 (Regular Work Schedule, Extended Work Schedule, and Overtime Provisions to Address Unique Project Needs) in the Agreement, the Crew Chief Security, Assistant Crew Chief Security, and Security workers may work a schedule of seven (7) consecutive twelve (12) hour shifts and seven (7) consecutive days off. The employee, when working this schedule, shall be paid one hundred and thirteen (113) hours at his/her straight time hourly rate of pay for such eighty-four (84) hours worked. Employees shall be paid sixteen point one four (16.14) hours for each regularly scheduled 12 hour shift worked on the 7 days on / 7 day offs Work Schedule. In the event that the employee does not work a regularly scheduled 12 hour shift on this work schedule, the amount paid to such employee shall be reduced sixteen point one four (16.14) hours for each day not worked on the Work Schedule. When working this schedule, the employee shall be paid the first fifty six and one-half (56.5) hours in the week worked (provided such employee worked each of the scheduled work days), and the other fifty six and one-half (56.5) hours in his/her week off (provided such employee worked each of the scheduled work days).

7.02 Notwithstanding Article 19 (Regular Work Schedule, Extended Work Schedule, and Overtime Provisions to Address Unique Project Needs) in the Agreement, the Crew Chief Security, Assistant Crew Chief Security, and Security workers may work a schedule of fourteen (14) consecutive twelve (12) hour shifts and fourteen (14) consecutive days off. The employee, when working this schedule, shall be paid two hundred and twenty six (226) hours at his/her straight time hourly rate of pay for such one hundred and sixty eight (168) hours worked. Employees shall be paid sixteen point one four (16.14) hours for each regularly scheduled 12 hour shift worked on the 14 days on / 14 days off Work Schedule. In the event that the employee does not work a

regularly scheduled 12 hour shift on this work schedule, the amount paid to such employee shall be reduced sixteen point one four (16.14) hours for each day not worked on the Work Schedule. When working this schedule, each of the two weeks such employee works (provided such employee worked each of the scheduled work days), the employee shall be paid fifty-six and one-half (56.5) hours, and fifty-six and one-half (56.5) hours each of the weeks in his/her two weeks off (provided such employee worked each of the scheduled work days).

8.0 CASUAL WORKERS

8.01 Casual workers may be procured by the employer and shall be hired to replace full time workers who are on vacation, have approved leave of absence, off due to illness, or replacements for no-shows. Casual workers shall be referred by the Union after being notified by the Contractor of the identity of the casual workers the employer wishes to hire.

8.02 Casual workers shall be advised that no assurance is given or assumed that they shall be promoted by the Contractor to a full time position.

8.03 Casual workers shall pay three percent (3%) working dues only.

9.0 ASSISTANT CREW CHIEFS

9.01 Assistant Crew Chiefs shall be Working Forepersons when supervising a crew of four (4) employees or less, whether or not there is a Crew Chief. Once a crew exceeds four (4) employees, the Assistant Crew Chief shall be Non-Working.

10.0 LOWER CHURCHILL PROJECT PREMIUM ALLOCATION

10.01 The Lower Churchill Project Premium paid pursuant to Article 27 of the Agreement shall be allocated as follows:

(a) Two dollars and fifty cents ($2.50) for each hour earned to be paid into the Employees' Registered Retirement Savings Plan to the Benefit Plan Administrator in accordance with 3.03(a) monthly.

(b) One dollar ($1.00) for each hour earned to be paid weekly.

Hotel Employees and Restaurant Employees International
And Hotel and Restaurant Workers, Local Union 779
Schedule "A"
Effective May 1, 2012

Group	Classification	Hourly Rate	Vacation Pay (8%)	Holiday Pay (5%)	Health & Welfare	RRSP	Building Fund	**Total Gross Hourly Package**
	Security							
Group 1	Crew Chief	$ 32.97	$ 2.64	$ 1.65	$ 3.00	$ 7.50	$ 2.64	**$ 50.40**
Group 2	Assistant Crew Chief	$ 31.43	$ 2.51	$ 1.57	$ 3.00	$ 7.50	$ 2.64	**$ 48.66**
Group 3	Security Officer, Communications Dispatch	$ 29.94	$ 2.40	$ 1.50	$ 3.00	$ 7.50	$ 2.64	**$ 46.98**
	Catering / Kitchen							
Group 1	Chef	$ 33.91	$ 2.71	$ 1.70	$ 3.00	$ 7.50	$ 2.64	**$ 51.46**
Group 2	First Cook	$ 30.93	$ 2.47	$ 1.55	$ 3.00	$ 7.50	$ 2.64	**$ 48.10**
Group 3	Baker, Meat Cutter, Non-Working Foreperson	$ 29.94	$ 2.40	$ 1.50	$ 3.00	$ 7.50	$ 2.64	**$ 46.98**
Group 4	2nd Cook, Inventory Attendant, Service Attendant	$ 28.92	$ 2.31	$ 1.45	$ 3.00	$ 7.50	$ 2.64	**$ 45.82**
Group 5	3rd Cook, Baker's Helper, Working Foreperson	$ 28.44	$ 2.28	$ 1.42	$ 3.00	$ 7.50	$ 2.64	**$ 45.28**
Group 6	Salad / Sandwich Person, Commissary	$ 27.93	$ 2.23	$ 1.40	$ 3.00	$ 7.50	$ 2.64	**$ 44.71**
Group 7	Pot/Dishwasher, Waiter/Waitress, Front Line Attendant, General Help	$ 26.92	$ 2.15	$ 1.35	$ 3.00	$ 7.50	$ 2.64	**$ 43.56**
	Catering / Dormitories							
Group 3	Non-Working Foreperson	$ 29.94	$ 2.40	$ 1.50	$ 3.00	$ 7.50	$ 2.64	**$ 46.98**
Group 5	Working Foreperson	$ 28.44	$ 2.28	$ 1.42	$ 3.00	$ 7.50	$ 2.64	**$ 45.28**
Group 7	Camp Attendant / Housekeeping	$ 26.92	$ 2.15	$ 1.35	$ 3.00	$ 7.50	$ 2.64	**$ 43.56**
	Janitorial							
Group 7	** Janitor	$ 26.92	$ 2.15	$ 1.35	$ 3.00	$ 7.50	$ 2.64	**$ 43.56**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27 of the Agreement and Article 10 of this Trade Appendix

Hotel Employees and Restaurant Employees International
And Hotel and Restaurant Workers, Local Union 779
Schedule "A"
Effective May 1, 2013

Group	Classification	Hourly Rate	Vacation Pay (8%)	Holiday Pay (5%)	Health & Welfare	RRSP	Building Fund	Total Gross Hourly Package
	Security							
Group 1	Crew Chief	$ 34.74	$ 2.78	$ 1.74	$ 3.00	$ 7.50	$ 2.64	$ 52.40
Group 2	Assistant Crew Chief	$ 33.20	$ 2.66	$ 1.66	$ 3.00	$ 7.50	$ 2.64	$ 50.66
Group 3	Security Officer, Communications Dispatch	$ 31.71	$ 2.54	$ 1.59	$ 3.00	$ 7.50	$ 2.64	$ 48.98
	Catering / Kitchen							
Group 1	Chef	$ 35.68	$ 2.85	$ 1.78	$ 3.00	$ 7.50	$ 2.64	$ 53.46
Group 2	First Cook	$ 32.70	$ 2.62	$ 1.64	$ 3.00	$ 7.50	$ 2.64	$ 50.10
Group 3	Baker, Meat Cutter, Non-Working Foreperson	$ 31.71	$ 2.54	$ 1.59	$ 3.00	$ 7.50	$ 2.64	$ 48.98
Group 4	2nd Cook, Inventory Attendant, Service Attendant, Front Desk Attendant	$ 30.69	$ 2.46	$ 1.53	$ 3.00	$ 7.50	$ 2.64	$ 47.82
Group 5	3rd Cook, Baker's Helper, Bartender, Working Foreperson	$ 30.21	$ 2.42	$ 1.51	$ 3.00	$ 7.50	$ 2.64	$ 47.28
Group 6	Salad / Sandwich Person, Commissary	$ 29.70	$ 2.38	$ 1.49	$ 3.00	$ 7.50	$ 2.64	$ 46.71
Group 7	* General Help	$ 28.69	$ 2.30	$ 1.43	$ 3.00	$ 7.50	$ 2.64	$ 45.56
	Catering / Dormitories							
Group 3	Non-Working Foreperson	$ 31.71	$ 2.54	$ 1.59	$ 3.00	$ 7.50	$ 2.64	$ 48.98
Group 5	Working Foreperson	$ 30.21	$ 2.42	$ 1.51	$ 3.00	$ 7.50	$ 2.64	$ 47.28
Group 7	Camp Attendant / Housekeeping	$ 28.69	$ 2.30	$ 1.43	$ 3.00	$ 7.50	$ 2.64	$ 45.56
	Janitorial							
Group 7	** Janitor	$ 28.69	$ 2.30	$ 1.43	$ 3.00	$ 7.50	$ 2.64	$ 45.56

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27 of the Agreement and Article 10 of this Trade Appendix

Hotel Employees and Restaurant Employees International
And Hotel and Restaurant Workers, Local Union 779
Schedule "A"
Effective May 1, 2014

Group	Classification	Hourly Rate	Vacation Pay (8%)	Holiday Pay (5%)	Health & Welfare	RRSP	Building Fund	Total Gross Hourly Package
	Security							
Group 1	Crew Chief	$ 36.96	$ 2.96	$ 1.85	$ 3.00	$ 7.50	$ 2.64	$ 54.90
Group 2	Assistant Crew Chief	$ 35.42	$ 2.83	$ 1.77	$ 3.00	$ 7.50	$ 2.64	$ 53.16
Group 3	Security Officer, Communications Dispatch	$ 33.93	$ 2.71	$ 1.70	$ 3.00	$ 7.50	$ 2.64	$ 51.48
	Catering / Kitchen							
Group 1	Chef	$ 37.90	$ 3.03	$ 1.89	$ 3.00	$ 7.50	$ 2.64	$ 55.96
Group 2	First Cook	$ 34.92	$ 2.79	$ 1.75	$ 3.00	$ 7.50	$ 2.64	$ 52.60
Group 3	Baker, Meat Cutter, Non-Working Foreperson	$ 33.93	$ 2.71	$ 1.70	$ 3.00	$ 7.50	$ 2.64	$ 51.48
Group 4	2nd Cook, Inventory Attendant, Service Attendant, Front Desk Attendant	$ 32.91	$ 2.63	$ 1.65	$ 3.00	$ 7.50	$ 2.64	$ 50.32
Group 5	3rd Cook, Baker's Helper, Bartender, Working Foreperson	$ 32.43	$ 2.59	$ 1.62	$ 3.00	$ 7.50	$ 2.64	$ 49.78
Group 6	Salad / Sandwich Person, Commissary	$ 31.92	$ 2.55	$ 1.60	$ 3.00	$ 7.50	$ 2.64	$ 49.21
Group 7	* General Help	$ 30.91	$ 2.47	$ 1.55	$ 3.00	$ 7.50	$ 2.64	$ 48.06
	Catering / Dormitories							
Group 3	Non-Working Foreperson	$ 33.93	$ 2.71	$ 1.70	$ 3.00	$ 7.50	$ 2.64	$ 51.48
Group 5	Working Foreperson	$ 32.43	$ 2.59	$ 1.62	$ 3.00	$ 7.50	$ 2.64	$ 49.78
Group 7	Camp Attendant / Housekeeping	$ 30.91	$ 2.47	$ 1.55	$ 3.00	$ 7.50	$ 2.64	$ 48.06
	Janitorial							
Group 7	** Janitor	$ 30.91	$ 2.47	$ 1.55	$ 3.00	$ 7.50	$ 2.64	$ 48.06

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27 of the Agreement and Article 10 of this Trade Appendix

Hotel Employees and Restaurant Employees International
And Hotel and Restaurant Workers, Local Union 779
Schedule "A"
Effective May 1, 2015

Group	Classification	Hourly Rate	Vacation Pay (8%)	Holiday Pay (5%)	Health & Welfare	RRSP	Building Fund	Total Gross Hourly Package
	Security							
Group 1	Crew Chief	$ 38.73	$ 3.10	$ 1.94	$ 3.00	$ 7.50	$ 2.64	$ 56.90
Group 2	Assistant Crew Chief	$ 37.19	$ 2.97	$ 1.86	$ 3.00	$ 7.50	$ 2.64	$ 55.16
Group 3	Security Officer, Communications Dispatch	$ 35.70	$ 2.86	$ 1.78	$ 3.00	$ 7.50	$ 2.64	$ 53.48
	Catering / Kitchen							
Group 1	Chef	$ 39.67	$ 3.17	$ 1.98	$ 3.00	$ 7.50	$ 2.64	$ 57.96
Group 2	First Cook	$ 36.69	$ 2.93	$ 1.83	$ 3.00	$ 7.50	$ 2.64	$ 54.60
Group 3	Baker, Meat Cutter, Non-Working Foreperson	$ 35.70	$ 2.86	$ 1.78	$ 3.00	$ 7.50	$ 2.64	$ 53.48
Group 4	2nd Cook, Inventory Attendant, Service Attendant, Front Desk Attendant	$ 34.68	$ 2.77	$ 1.73	$ 3.00	$ 7.50	$ 2.64	$ 52.32
Group 5	3rd Cook, Baker's Helper, Bartender, Working Foreperson	$ 34.20	$ 2.74	$ 1.71	$ 3.00	$ 7.50	$ 2.64	$ 51.78
Group 6	Salad / Sandwich Person, Commissary	$ 33.69	$ 2.69	$ 1.68	$ 3.00	$ 7.50	$ 2.64	$ 51.21
Group 7	* General Help	$ 32.68	$ 2.61	$ 1.63	$ 3.00	$ 7.50	$ 2.64	$ 50.06
	Catering / Dormitories							
Group 3	Non-Working Foreperson	$ 35.70	$ 2.86	$ 1.78	$ 3.00	$ 7.50	$ 2.64	$ 53.48
Group 5	Working Foreperson	$ 34.20	$ 2.74	$ 1.71	$ 3.00	$ 7.50	$ 2.64	$ 51.78
Group 7	Camp Attendant / Housekeeping	$ 32.68	$ 2.61	$ 1.63	$ 3.00	$ 7.50	$ 2.64	$ 50.06
	Janitorial							
Group 7	** Janitor	$ 32.68	$ 2.61	$ 1.63	$ 3.00	$ 7.50	$ 2.64	$ 50.06

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27 of the Agreement and Article 10 of this Trade Appendix

Hotel Employees and Restaurant Employees International
And Hotel and Restaurant Workers, Local Union 779
Schedule "A"
Effective May 1, 2016

Group	Classification	Hourly Rate	Vacation Pay (8%)	Holiday Pay (5%)	Health & Welfare	RRSP	Building Fund	Total Gross Hourly Package
	Security							
Group 1	Crew Chief	$ 40.94	$ 3.28	$ 2.05	$ 3.00	$ 7.50	$ 2.64	$ 59.40
Group 2	Assistant Crew Chief	$ 39.40	$ 3.15	$ 1.97	$ 3.00	$ 7.50	$ 2.64	$ 57.66
Group 3	Security Officer, Communications Dispatch	$ 37.91	$ 3.03	$ 1.90	$ 3.00	$ 7.50	$ 2.64	$ 55.98
	Catering / Kitchen							
Group 1	Chef	$ 41.88	$ 3.35	$ 2.09	$ 3.00	$ 7.50	$ 2.64	$ 60.46
Group 2	First Cook	$ 38.90	$ 3.11	$ 1.94	$ 3.00	$ 7.50	$ 2.64	$ 57.10
Group 3	Baker, Meat Cutter, Non-Working Foreperson	$ 37.91	$ 3.03	$ 1.90	$ 3.00	$ 7.50	$ 2.64	$ 55.98
Group 4	2nd Cook, Inventory Attendant, Service Attendant, Front Desk Attendant	$ 36.89	$ 2.95	$ 1.84	$ 3.00	$ 7.50	$ 2.64	$ 54.82
Group 5	3rd Cook, Baker's Helper, Bartender, Working Foreperson	$ 36.41	$ 2.91	$ 1.82	$ 3.00	$ 7.50	$ 2.64	$ 54.28
Group 6	Salad / Sandwich Person, Commissary	$ 35.90	$ 2.87	$ 1.79	$ 3.00	$ 7.50	$ 2.64	$ 53.71
Group 7	* General Help	$ 34.89	$ 2.79	$ 1.74	$ 3.00	$ 7.50	$ 2.64	$ 52.56
	Catering / Dormitories							
Group 3	Non-Working Foreperson	$ 37.91	$ 3.03	$ 1.90	$ 3.00	$ 7.50	$ 2.64	$ 55.98
Group 5	Working Foreperson	$ 36.41	$ 2.91	$ 1.82	$ 3.00	$ 7.50	$ 2.64	$ 54.28
Group 7	Camp Attendant / Housekeeping	$ 34.89	$ 2.79	$ 1.74	$ 3.00	$ 7.50	$ 2.64	$ 52.56
	Janitorial							
Group 7	** Janitor	$ 34.89	$ 2.79	$ 1.74	$ 3.00	$ 7.50	$ 2.64	$ 52.56

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27 of the Agreement and Article 10 of this Trade Appendix

Hotel Employees and Restaurant Employees International
And Hotel and Restaurant Workers, Local Union 779
Schedule "A"
Effective May 1, 2017

Group	Classification	Hourly Rate	Vacation Pay (8%)	Holiday Pay (5%)	Health & Welfare	RRSP	Building Fund	Total Gross Hourly Package
	Security							
Group 1	Crew Chief	$ 42.71	$ 3.42	$ 2.14	$ 3.00	$ 7.50	$ 2.64	$ 61.40
Group 2	Assistant Crew Chief	$ 41.17	$ 3.29	$ 2.06	$ 3.00	$ 7.50	$ 2.64	$ 59.66
Group 3	Security Officer, Communications Dispatch	$ 39.68	$ 3.17	$ 1.98	$ 3.00	$ 7.50	$ 2.64	$ 57.98
	Catering / Kitchen							
Group 1	Chef	$ 43.65	$ 3.49	$ 2.18	$ 3.00	$ 7.50	$ 2.64	$ 62.46
Group 2	First Cook	$ 40.67	$ 3.25	$ 2.03	$ 3.00	$ 7.50	$ 2.64	$ 59.10
Group 3	Baker, Meat Cutter, Non-Working Foreperson	$ 39.68	$ 3.17	$ 1.98	$ 3.00	$ 7.50	$ 2.64	$ 57.98
Group 4	2nd Cook, Inventory Attendant, Service Attendant, Front Desk Attendant	$ 38.66	$ 3.09	$ 1.93	$ 3.00	$ 7.50	$ 2.64	$ 56.82
Group 5	3rd Cook, Baker's Helper, Bartender, Working Foreperson	$ 38.18	$ 3.05	$ 1.91	$ 3.00	$ 7.50	$ 2.64	$ 56.28
Group 6	Salad / Sandwich Person, Commissary	$ 37.67	$ 3.01	$ 1.88	$ 3.00	$ 7.50	$ 2.64	$ 55.71
Group 7	* General Help	$ 36.66	$ 2.93	$ 1.83	$ 3.00	$ 7.50	$ 2.64	$ 54.56
	Catering / Dormitories							
Group 3	Non-Working Foreperson	$ 39.68	$ 3.17	$ 1.98	$ 3.00	$ 7.50	$ 2.64	$ 57.98
Group 5	Working Foreperson	$ 38.18	$ 3.05	$ 1.91	$ 3.00	$ 7.50	$ 2.64	$ 56.28
Group 7	Camp Attendant / Housekeeping	$ 36.66	$ 2.93	$ 1.83	$ 3.00	$ 7.50	$ 2.64	$ 54.56
	Janitorial							
Group 7	** Janitor	$ 36.66	$ 2.93	$ 1.83	$ 3.00	$ 7.50	$ 2.64	$ 54.56

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27 of the Agreement and Article 10 of this Trade Appendix

INTERNATIONAL ASSOCIATION OF BRIDGE, STRUCTURAL ORNAMENTAL AND REINFORCING IRONWORKERS AND LOCAL UNION 764

1.0 APPLICATION

1.01 This Trade Appendix shall apply to the following:

Structural:

Welders
Apprentices
Journeyperson
Riggers
Connectors
Working foreperson
Non-working foreperson
Non-working general foreperson
Pre-heat / Post-heat

Rodman:

Welders
Apprentices
Riggers
Journeyperson
Working foreperson
Non-working foreperson
Non-working general foreperson
Post-tensioning

1.02 When two (2) or more workers are employed, one (1) shall be selected by the Contractor to act as a Working foreperson and receive the wages as set forth in the Appendix.

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be thirteen and one half (13.5%) percent of gross wages including over-time for all employees.

3.0 BENEFITS FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the month following the month in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payments shall be made as follows:

(a) Health and Welfare Fund

Address: Manion Wilkins and Associates
222 Rowntree Dairy Road, 3rd Floor
Woodbridge, ON L4L 9T2

Cheques payable to: Trustees of Ironworkers Local Union 764 B.T.

(b) Pension Fund

Address: Manion Wilkins and Associates
222 Rowntree Dairy Road, 3rd Floor
Woodbridge, ON L4L 9T2

Cheques payable to: Trustees of Ironworkers Local Union 764 B.T.

(c) EAP

Address: Manion Wilkins and Associates
222 Rowntree Dairy Road, 3rd Floor
Woodbridge, ON L4L 9T2

Cheques payable to: Trustees of Ironworkers Local Union 764 B.T.

(d) Trade Promotion Fund

Address: Business Manager, F.S.T.
Ironworkers Local Union 764
38 Sagona Avenue
Donavan's Industrial Park
Mount Pearl, NL A1N 4R3

Cheques payable to: Trustees of Ironworkers Local Union 764

(e) Trade Improvement Fund

Address: Business Manager, F.S.T.
Ironworkers Local Union 764
38 Sagona Avenue
Donavan's Industrial Park
Mount Pearl, NL A1N 4R3

Cheques payable to: Trustees of Ironworkers Local Union 764

(f) Welding Testing Fund

Address: Business Manager, F.S.T.
Ironworkers Local Union 764
38 Sagona Avenue
Donavan's Industrial Park
Mount Pearl, NL A1N 4R3

Cheques payable to: Trustees of Ironworkers Local Union 764

(g) Industry Fund (RDTC)

Address: Resource Development Trades Council of
Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheques payable to: Resource Development Trades Council Industry Fund

(h) Apprentice Training

Address: Business Manager, F.S.T.
Ironworkers Local Union 764
38 Sagona Avenue
Donavan's Industrial Park
Mount Pearl, NL A1N 4R3

Cheques payable to: Trustees of Ironworkers Local Union 764

(i) Impact

Address: Business Manager, F.S.T.
Ironworkers Local Union 764
38 Sagona Avenue
Donavan's Industrial Park
Mount Pearl, NL A1N 4R3

Cheques payable to: Trustees of Ironworkers Local Union 764

(j) Canadian Building Trades Fund

Address: Resource Development Trades Council of
Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheques Payable to: Canadian Building Trades Fund

4.0 UNION DUES AND FIELD DUES

4.01 Union Dues as per Article 6 shall be forwarded to:

Address: Business Manager, F.S.T.
Ironworkers Local Union 764
38 Sagona Avenue
Donavan's Industrial Park
Mount Pearl, NL A1N 4R3

5.0 APPRENTICES

5.01 Where Apprentices are employed, the Contractor shall pay wages in accordance with this Agreement, and will not be compelled, under any circumstances, to pay the Journeyperson rate of pay. However, the Union recognizes the fact that the Contractor may, after consultation with the Union, increase the rate of pay for Apprentices that have demonstrated the ability to perform work at the next Apprenticeship level. When the Apprentice has completed his four thousand (4,000) hour program, he shall appear before the examining board of the Local Union and be required to pass a test before receiving his/her Journeyperson Ironworkers card.

6.0 TOOLS

6.01 Employees shall furnish, for their own use, standard hand tools to enable them to effectively perform their work.

7.0 HEALTH AND SAFETY

7.01 Every employee shall, as a condition of employment, own and wear suitable protective footwear and other personal equipment required in the normal course of his duties. On abnormally dirty or corrosive work, suitable coveralls, rubber gloves and rubber boots shall be provided when necessary; (not to include normal re-bar work), but including post tensioning and pre-stressing work.

7.02 Safety Harness and Double Lanyard with shock absorbers shall be signed for by employee and if not returned, then the employee shall pay the cost for the same.

7.03 On multi-storied erection projects, and on floors where employees are required to work, not more than two (2) floors or a distance of thirty (30) feet shall remain uncovered without suitable planking, decking or netting that is properly secured. The perimeter of the working floors shall have protection consisting of wire rope.

7.04 *Stiffening and Supporting Working Load Points*: Where iron is landed on the floor or any point of a structure under construction all connections shall be fully fitted and tightened and substantial supports provided to safely sustain such added weight.

7.05 *Riding The Load Fall*: No employee shall be permitted to ride the load. Riding the load fall shall not be allowed except for emergency reasons as determined by the foreperson and not more than two (2) employees any one time.

7.06 *Slings*: Steel cable will be used instead of chains or hemp slings. Slings using a ferruled eye instead of an open sliced eye shall have a Flemish splice in the eye with the ferrule. All slings shall be inspected weekly and slings with wires broken or cut off shall be destroyed by cutting in two (2) pieces. When floats or suspended scaffolds are used by workers using torches or welding equipment, fibre rope shall not be used to suspend such floats. Wire rope with a minimum 3/8" diameter shall be used.

7.07 *Protection of Signal Devices*: Proper practical safe housing, casing or tube shall be provided for any and every means, method, appliance or equipment to transmit or give

signals, directing work or operation or any and various devices in connection with work being done by employees.

7.08 *Overhead Crane Protection*: No employee shall be permitted to work on cranes rails unless safety provisions are taken regarding hot rails or crane operation while work is being performed.

7.09 *Operational Equipment*: To properly secure any or all operational controls two (2) key type locking devices shall be used. Such keys shall be divided between operating management and the foreperson supervising the crew.

7.10 *Blind Lifts*: When the vision of employee is impaired during the course of erection or hoisting of materials, and an adequate audio signal device is not available, and extra employee shall be employed to act as a signalperson.

8.0 IRONWORKERS REQUIRED ON CRANES

8.01 On all mobile or power operated rigs of any description utilized for heavy steel erection in the construction of a building, no less than four (4) employees and a foreperson shall be employed (this article is not applicable to boom trucks).

9.0 HEIGHT PAY

9.01 The premium above the regular hourly rate shall be paid to workers required to work at heights under such conditions: temporary staging, scaffolding, tower like structures or structures with a direct drop of forty (40) feet or more shall receive one dollar ($1.00).

International Association of Bridge, Structural, Ornamental and Reinforcing Ironworkers and Local Union 764

Schedule "A"

Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay (10%)	Holiday Pay (3.5%)	Health & Welfare Benefit	Pension Plan	EAP	Trade Promotion Fund	Trade Improve Fund	Welding Testing Fund	Apprentice Training Fund	Impact Fund	**Gross Hourly Package**
Structural												
General Foreman	$ 38.93	3.89	1.36	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 53.01**
+20% over JM Rate												
Foreman	$ 37.31	3.73	1.30	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 51.17**
+15% over JM Rate												
Connectors	$ 33.35	3.34	1.16	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 46.68**
Journeyman	$ 32.44	3.24	1.14	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 45.65**
Apprentices												
1st 1000 hours - 70% of JM	$ 22.71	2.27	0.80	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 34.61**
2nd 1000 hours - 80% of JM	$ 25.95	2.60	0.91	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 38.29**
3rd 1000 hours - 90% of JM	$ 29.20	2.92	1.02	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 41.97**
4th 1000 hours - 95% of JM	$ 30.82	3.08	1.08	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 43.81**
Rodman (Rebar)												
General Foreman	$ 37.55	3.76	1.31	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 51.45**
+20% over JM Rate												
Foreman	$ 35.98	3.60	1.26	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 49.67**
+15% over JM Rate												
Journeyman	$ 31.29	3.13	1.10	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 44.35**
Apprentices												
1st 1000 hours - 70% of JM	$ 21.90	2.19	0.77	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 33.69**
2nd 1000 hours = 80% of JM	$ 25.03	2.50	0.88	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 37.24**
3rd 1000 hours = 90% of JM	$ 28.16	2.82	0.99	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 40.80**
4th 1000 hours - 95% of JM	$ 29.73	2.97	1.04	1.81	5.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 42.57**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

International Association of Bridge, Structural, Ornamental and Reinforcing Ironworkers and Local Union 764

Schedule "A"

Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay (10%)	Holiday Pay (3.5%)	Health & Welfare Benefit	Pension Plan	EAP	Trade Promotion Fund	Trade Improve Fund	Welding Testing Fund	Apprentice Training Fund	Impact Fund	**Gross Hourly Package**
Structural												
General Foreman	$ 39.98	4.00	1.40	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 55.21**
+20% over JM Rate												
Foreman	$ 38.32	3.83	1.34	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 53.32**
+15% over JM Rate												
Connectors	$ 34.23	3.42	1.19	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 48.67**
Journeyman	$ 33.32	3.33	1.17	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 47.65**
Apprentices												
1st 1000 hours - 70% of JM	$ 23.32	2.33	0.82	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 36.30**
2nd 1000 hours - 80% of JM	$ 26.66	2.67	0.93	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 40.09**
3rd 1000 hours - 90% of JM	$ 29.99	3.00	1.05	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 43.87**
4th 1000 hours - 95% of JM	$ 31.65	3.17	1.11	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 45.76**
Rodman (Rebar)												
General Foreman	$ 38.60	3.86	1.35	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 53.64**
+20% over JM Rate												
Foreman	$ 37.00	3.70	1.30	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 51.83**
+15% over JM Rate												
Journeyman	$ 32.17	3.22	1.13	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 46.35**
Apprentices												
1st 1000 hours - 70% of JM	$ 22.52	2.25	0.79	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 35.39**
2nd 1000 hours = 80% of JM	$ 25.74	2.57	0.90	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 39.04**
3rd 1000 hours = 90% of JM	$ 28.95	2.90	1.01	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 42.69**
4th 1000 hours - 95% of JM	$ 30.56	3.06	1.07	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 44.52**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

International Association of Bridge, Structural, Ornamental and Reinforcing Ironworkers and Local Union 764

Schedule "A"

Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay (10%)	Holiday Pay (3.5%)	Health & Welfare Benefit	Pension Plan	EAP	Trade Promotion Fund	Trade Improve Fund	Welding Testing Fund	Apprentice Training Fund	Impact Fund	**Gross Hourly Package**
Structural												
General Foreman	$ 42.62	4.26	1.49	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 58.20**
+20% over JM Rate												
Foreman	$ 40.85	4.08	1.42	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 56.18**
+15% over JM Rate												
Connectors	$ 36.43	3.64	1.27	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 51.17**
Journeyman	$ 35.52	3.55	1.24	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 50.14**
Apprentices												
1st 1000 hours - 70% of JM	$ 24.86	2.49	0.88	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 38.06**
2nd 1000 hours - 80% of JM	$ 28.42	2.84	0.99	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 42.08**
3rd 1000 hours - 90% of JM	$ 31.97	3.20	1.12	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 46.12**
4th 1000 hours - 95% of JM	$ 33.74	3.37	1.18	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 48.12**
Rodman (Rebar)												
General Foreman	$ 41.24	4.12	1.44	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 56.63**
+20% over JM Rate												
Foreman	$ 39.53	3.95	1.38	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 54.69**
+15% over JM Rate												
Journeyman	$ 34.37	3.44	1.20	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 48.84**
Apprentices												
1st 1000 hours - 70% of JM	$ 24.06	2.41	0.84	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 37.14**
2nd 1000 hours = 80% of JM	$ 27.50	2.75	0.96	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 41.04**
3rd 1000 hours = 90% of JM	$ 30.93	3.09	1.08	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 44.93**
4th 1000 hours - 95% of JM	$ 32.65	3.27	1.14	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 46.89**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

International Association of Bridge, Structural, Ornamental and Reinforcing Ironworkers and Local Union 764

Schedule "A"

Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay (10%)	Holiday Pay (3.5%)	Health & Welfare Benefit	Pension Plan	EAP	Trade Promotion Fund	Trade Improve Fund	Welding Testing Fund	Apprentice Training Fund	Impact Fund	**Gross Hourly Package**
Structural												
General Foreman	$ 44.74	4.47	1.57	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 60.61**
+20% over JM Rate												
Foreman	$ 42.87	4.28	1.50	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 58.48**
+15% over JM Rate												
Connectors	$ 38.19	3.82	1.33	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 53.17**
Journeyman	$ 37.28	3.73	1.30	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 52.14**
Apprentices												
1st 1000 hours - 70% of JM	$ 26.10	2.61	0.92	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 39.46**
2nd 1000 hours - 80% of JM	$ 29.82	2.98	1.04	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 43.67**
3rd 1000 hours - 90% of JM	$ 33.55	3.36	1.17	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 47.91**
4th 1000 hours - 95% of JM	$ 35.42	3.54	1.24	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 50.03**
Rodman (Rebar)												
General Foreman	$ 43.36	4.34	1.52	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 59.05**
+20% over JM Rate												
Foreman	$ 41.55	4.16	1.45	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 56.99**
+15% over JM Rate												
Journeyman	$ 36.13	3.61	1.26	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 50.83**
Apprentices												
1st 1000 hours - 70% of JM	$ 25.29	2.53	0.89	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 38.54**
2nd 1000 hours = 80% of JM	$ 28.90	2.89	1.01	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 42.63**
3rd 1000 hours = 90% of JM	$ 32.52	3.25	1.14	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 46.74**
4th 1000 hours - 95% of JM	$ 34.32	3.43	1.20	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 48.78**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

International Association of Bridge, Structural, Ornamental and Reinforcing Ironworkers and Local Union 764

Schedule "A"

Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay (10%)	Holiday Pay (3.5%)	Health & Welfare Benefit	Pension Plan	EAP	Trade Promotion Fund	Trade Improve Fund	Welding Testing Fund	Apprentice Training Fund	Impact Fund	**Gross Hourly Package**
Structural												
General Foreman	$ 47.38	4.74	1.66	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 63.61**
+20% over JM Rate												
Foreman	$ 45.40	4.54	1.58	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 61.35**
+15% over JM Rate												
Connectors	$ 40.39	4.04	1.41	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 55.67**
Journeyman	$ 39.48	3.95	1.38	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 54.64**
Apprentices												
1st 1000 hours - 70% of JM	$ 27.64	2.76	0.97	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 41.20**
2nd 1000 hours - 80% of JM	$ 31.58	3.16	1.11	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 45.68**
3rd 1000 hours - 90% of JM	$ 35.53	3.55	1.24	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 50.15**
4th 1000 hours - 95% of JM	$ 37.51	3.75	1.31	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 52.40**
Rodman (Rebar)												
General Foreman	$ 46.00	4.60	1.61	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 62.04**
+20% over JM Rate												
Foreman	$ 44.08	4.41	1.54	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 59.86**
+15% over JM Rate												
Journeyman	$ 38.33	3.83	1.34	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 53.33**
Apprentices												
1st 1000 hours - 70% of JM	$ 26.83	2.68	0.94	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 40.28**
2nd 1000 hours = 80% of JM	$ 30.66	3.07	1.07	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 44.63**
3rd 1000 hours = 90% of JM	$ 34.50	3.45	1.21	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 48.99**
4th 1000 hours - 95% of JM	$ 36.41	3.64	1.27	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 51.15**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly), as per Article 27

International Association of Bridge, Structural, Ornamental and Reinforcing Ironworkers and Local Union 764

Schedule "A"

Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay (10%)	Holiday Pay (3.5%)	Health & Welfare Benefit	Pension Plan	EAP	Trade Promotion Fund	Trade Improve Fund	Welding Testing Fund	Apprentice Training Fund	Impact Fund	**Gross Hourly Package**
Structural												
General Foreman	$ 49.49	4.95	1.73	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 66.00**
+20% over JM Rate												
Foreman	$ 47.43	4.74	1.66	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 63.66**
+15% over JM Rate												
Connectors	$ 42.15	4.22	1.47	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 57.67**
Journeyman	$ 41.24	4.12	1.44	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 56.63**
Apprentices												
1st 1000 hours - 70% of JM	$ 28.87	2.89	1.02	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 42.61**
2nd 1000 hours - 80% of JM	$ 32.99	3.30	1.15	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 47.27**
3rd 1000 hours - 90% of JM	$ 37.12	3.71	1.30	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 51.96**
4th 1000 hours - 95% of JM	$ 39.18	3.92	1.37	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 54.30**
Rodman (Rebar)												
General Foreman	$ 48.11	4.81	1.68	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 64.43**
+20% over JM Rate												
Foreman	$ 46.10	4.61	1.61	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 62.15**
+15% over JM Rate												
Journeyman	$ 40.09	4.01	1.40	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 55.33**
Apprentices												
1st 1000 hours - 70% of JM	$ 28.06	2.81	0.98	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 41.68**
2nd 1000 hours = 80% of JM	$ 32.07	3.21	1.12	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 46.23**
3rd 1000 hours = 90% of JM	$ 36.08	3.61	1.26	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 50.78**
4th 1000 hours - 95% of JM	$ 38.09	3.81	1.33	1.81	6.00	0.03	1.00	0.30	0.30	0.12	0.27	**$ 53.06**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS AND LOCAL UNION 1620

1.0 APPLICATION

1.01 This Trade Appendix shall apply to the following:

General Foreperson
Foreperson
Lead Lineperson
Journey (Lineperson and/or Cable Splicer)
Apprentices
Utility Worker

1.02 A lead lineperson is a journeyperson having charge of not more than four (4) other tradespersons, whether journeypersons, ground persons, or apprentices, or not more than twelve (12) utility workers. Only lead linepersons, journeypersons and / or apprentice linepersons shall be allowed to frame poles on the ground.

A Foreperson shall be appointed when supervising more than four (4) other tradespersons whether journeypersons, ground persons, or apprentices, or more than twelve (12) utility workers. A Foreperson shall not work with the tools of the trade when he/she supervises more than six (6) employees.

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be thirteen (13%) percent of gross wages including over-time for all employees, paid to the Union Office on the 15th of the following month, along with a list of names and amounts for each employee to the Union Office address below.

Address: IBEW Local 1620
67 LeMarchant Road
St. John's, NL A1C 2G9

Cheque payable to: Vacation Pay Trust Fund

3.0 BENEFIT FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage and Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the month following the month in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payments shall be made to the following addresses:

(a) Health and Welfare Fund

Address: Benefit Plan Administrators
7001 Mumford Road, Suite 216
Halifax, NS B3L 4N9

Cheque payable to: IBEW Local 1620 Health and Welfare Benefit Trust

(b) Pension Fund

Address: Benefit Plan Administrators
7001 Mumford Road, Suite 216
Halifax, NS B3L 4N9

Cheque payable to: IBEW Local 1620 Pension Trust Fund

(c) Training and Scholarship Fund

Address: Benefit Plan Administrators
7001 Mumford Road, Suite 216
Halifax, NS B3L 4N9

Cheque payable to: IBEW Local 1620 Training and Scholarship Fund

(d) Industry Fund (RDTC)

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque payable to: Resource Development Trades Council Industry Fund

(e) Canadian Building Trades Fund

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Canadian Building Trades Fund

4.0 UNION DUES

4.01 Union Dues as per Article 6 shall be forwarded to the following address:

Address: IBEW Local 1620
67 LeMarchant Road
St. John's, NL A1C 2G9

5.0 APPRENTICES

5.01 Except in the interest of safety, as stated below, the ratio of apprentices on hot line crews will be one (1) on every three (3) person truck and two (2) per truck on large crews subject to clearance from Newfoundland Light & Power Company Limited and Newfoundland & Labrador Hydro.

5.02 In the interest of safety, and in accordance with the Operating Lineperson's Program of Training, no first year apprentices will work on a hot line crew, no second year apprentices will work with a hot line crew working above 300 volts. Third and fourth year apprentices will work on live lines under the supervision of a qualified journeyperson.

5.03 The Contractor agrees to cooperate to the fullest extent with any government instituted Apprenticeship Training Plan including the granting of time off for yearly in school training where requested by the employee or the Department of Human Resources, Labour and Employment.

5.04 The Contractor further agrees to endeavour to do all in their power to see that apprentices are given the necessary work experience as outlined in the Operating Lineperson's Course.

5.05 Apprentices who have attained a certificate in the linesperson's pre-employment course will be credited with six (6) months towards their apprenticeship (first year) and shall be paid first year rate for the remaining six (6) months.

6.0 TOOLS

6.01 Employees will supply one each of the following tools:

Belt & Pole Strap
Hooks, Pads and Straps
10" Crescent Wrench
12" Crescent Wrench
Set Ratchet and Sockets (½" Drive)
Ball Peen Hammer (2 lbs.)
9" Klien Pliers
Hand Line (other to be supplied by the Contractor)
Straight End Screwdriver (14")
Skinning Knife
3' Wooden Rule (all others to be supplied by the Contractor)
Non-Metallic Tape Measure (all others to be supplied by the Contractor)
Line Level
Spud Wrench (15/16")

International Brotherhood of Electrical Workers
and Local Union 1620
Schedule "A"
Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training and Scholarship	**Gross Hourly Package**
		10%	3%				
General Foreperson	$ 34.18	3.42	1.03	1.00	4.55	0.25	**$ 44.43**
+3.20 over JM rate							
Foreperson	$ 32.18	3.22	0.97	1.00	4.55	0.25	**$ 42.17**
+1.20 over JM rate							
Lead Lineperson	$ 31.66	3.17	0.95	1.00	4.55	0.25	**$ 41.58**
+.68 over JM rate							
Utility Worker	$ 24.83	2.49	0.74	1.00	4.55	0.25	**$ 33.86**
Mechanic	$ 28.19	2.82	0.85	1.00	4.55	0.25	**$ 37.66**
Operator + Driller/Blaster	$ 27.52	2.76	0.83	1.00	4.55	0.25	**$ 36.91**
Full-time Storekeeper	$ 26.78	2.68	0.80	1.00	4.55	0.25	**$ 36.06**
Instrument Person	$ 25.42	2.55	0.76	1.00	4.55	0.25	**$ 34.53**
Journey (Lineperson and/or Cable Splicer)	$ 30.98	3.10	0.92	1.00	4.55	0.25	**$ 40.80**
Apprentices							
1st year - 55% of JM	$ 17.04	1.70	0.51	1.00	4.55	0.25	**$ 25.05**
2nd year - 65% of JM	$ 20.14	2.01	0.60	1.00	4.55	0.25	**$ 28.55**
3rd year - 70% of JM	$ 21.69	2.17	0.65	1.00	4.55	0.25	**$ 30.31**
4th year - 80% of JM	$ 24.79	2.48	0.74	1.00	4.55	0.25	**$ 33.81**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Electrical Workers
and Local Union 1620
Schedule "A"
Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training and Scholarship	**Gross Hourly Package**
		10%	3%				
General Foreperson	$ 35.95	3.60	1.08	1.00	4.55	0.25	**$ 46.43**
+3.20 over JM rate							
Foreperson	$ 33.95	3.40	1.02	1.00	4.55	0.25	**$ 44.17**
+1.20 over JM rate							
Lead Lineperson	$ 33.43	3.34	1.01	1.00	4.55	0.25	**$ 43.58**
+.68 over JM rate							
Utility Worker	$ 26.60	2.66	0.80	1.00	4.55	0.25	**$ 35.86**
Mechanic	$ 29.96	3.00	0.90	1.00	4.55	0.25	**$ 39.66**
Operator + Driller/Blaster	$ 29.29	2.93	0.88	1.00	4.55	0.25	**$ 38.90**
Full-time Storekeeper	$ 28.55	2.86	0.86	1.00	4.55	0.25	**$ 38.07**
Instrument Person	$ 27.19	2.72	0.82	1.00	4.55	0.25	**$ 36.53**
Journey (Lineperson and/or Cable Splicer)	$ 32.75	3.28	0.98	1.00	4.55	0.25	**$ 42.81**
Apprentices							
1st year - 55% of JM	$ 18.01	1.80	0.54	1.00	4.55	0.25	**$ 26.15**
2nd year - 65% of JM	$ 21.29	2.13	0.64	1.00	4.55	0.25	**$ 29.86**
3rd year - 70% of JM	$ 22.93	2.29	0.69	1.00	4.55	0.25	**$ 31.71**
4th year - 80% of JM	$ 26.20	2.62	0.79	1.00	4.55	0.25	**$ 35.41**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Electrical Workers
and Local Union 1620
Schedule "A"
Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training and Scholarship	**Gross Hourly Package**
		10%	3%				
General Foreperson	$ 38.16	3.82	1.14	1.00	4.55	0.25	**$ 48.92**
+3.20 over JM rate							
Foreperson	$ 36.16	3.62	1.08	1.00	4.55	0.25	**$ 46.66**
+1.20 over JM rate							
Lead Lineperson	$ 35.64	3.56	1.07	1.00	4.55	0.25	**$ 46.07**
+.68 over JM rate							
Utility Worker	$ 28.81	2.89	0.86	1.00	4.55	0.25	**$ 38.36**
Mechanic	$ 32.17	3.22	0.97	1.00	4.55	0.25	**$ 42.16**
Operator + Driller/Blaster	$ 31.50	3.15	0.95	1.00	4.55	0.25	**$ 41.40**
Full-time Storekeeper	$ 30.76	3.08	0.92	1.00	4.55	0.25	**$ 40.56**
Instrument Person	$ 29.40	2.94	0.88	1.00	4.55	0.25	**$ 39.02**
Journey (Lineperson and/or Cable Splicer)	$ 34.96	3.50	1.04	1.00	4.55	0.25	**$ 45.30**
Apprentices							
1st year - 55% of JM	$ 19.23	1.92	0.58	1.00	4.55	0.25	**$ 27.53**
2nd year - 65% of JM	$ 22.72	2.27	0.68	1.00	4.55	0.25	**$ 31.47**
3rd year - 70% of JM	$ 24.47	2.45	0.73	1.00	4.55	0.25	**$ 33.45**
4th year - 80% of JM	$ 27.97	2.80	0.84	1.00	4.55	0.25	**$ 37.41**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Electrical Workers
and Local Union 1620
Schedule "A"
Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training and Scholarship	**Gross Hourly Package**
		10%	3%				
General Foreperson	$ 39.93	4.00	1.20	1.00	4.55	0.25	**$ 50.93**
+3.20 over JM rate							
Foreperson	$ 37.93	3.79	1.14	1.00	4.55	0.25	**$ 48.66**
+1.20 over JM rate							
Lead Lineperson	$ 37.41	3.74	1.13	1.00	4.55	0.25	**$ 48.08**
+.68 over JM rate							
Utility Worker	$ 30.58	3.06	0.92	1.00	4.55	0.25	**$ 40.36**
Mechanic	$ 33.94	3.40	1.02	1.00	4.55	0.25	**$ 44.16**
Operator + Driller/Blaster	$ 33.27	3.33	1.00	1.00	4.55	0.25	**$ 43.40**
Full-time Storekeeper	$ 32.53	3.26	0.98	1.00	4.55	0.25	**$ 42.57**
Instrument Person	$ 31.17	3.12	0.94	1.00	4.55	0.25	**$ 41.03**
Journey (Lineperson and/or Cable Splicer)	$ 36.73	3.67	1.10	1.00	4.55	0.25	**$ 47.30**
Apprentices							
1st year - 55% of JM	$ 20.20	2.02	0.61	1.00	4.55	0.25	**$ 28.63**
2nd year - 65% of JM	$ 23.87	2.39	0.72	1.00	4.55	0.25	**$ 32.78**
3rd year - 70% of JM	$ 25.71	2.57	0.77	1.00	4.55	0.25	**$ 34.85**
4th year - 80% of JM	$ 29.39	2.94	0.88	1.00	4.55	0.25	**$ 39.01**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Electrical Workers
and Local Union 1620
Schedule "A"
Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training and Scholarship	**Gross Hourly Package**
		10%	3%				
General Foreperson	$ 42.14	4.22	1.26	1.00	4.55	0.25	**$ 53.42**
+3.20 over JM rate							
Foreperson	$ 40.14	4.01	1.20	1.00	4.55	0.25	**$ 51.15**
+1.20 over JM rate							
Lead Lineperson	$ 39.62	3.96	1.19	1.00	4.55	0.25	**$ 50.57**
+.68 over JM rate							
Utility Worker	$ 32.79	3.28	0.98	1.00	4.55	0.25	**$ 42.85**
Mechanic	$ 36.15	3.62	1.08	1.00	4.55	0.25	**$ 46.65**
Operator + Driller/Blaster	$ 35.48	3.55	1.06	1.00	4.55	0.25	**$ 45.89**
Full-time Storekeeper	$ 34.74	3.48	1.04	1.00	4.55	0.25	**$ 45.06**
Instrument Person	$ 33.38	3.34	1.00	1.00	4.55	0.25	**$ 43.52**
Journey (Lineperson and/or Cable Splicer)	$ 38.94	3.89	1.16	1.00	4.55	0.25	**$ 49.79**
Apprentices							
1st year - 55% of JM	$ 21.42	2.14	0.64	1.00	4.55	0.25	**$ 30.00**
2nd year - 65% of JM	$ 25.31	2.53	0.76	1.00	4.55	0.25	**$ 34.40**
3rd year - 70% of JM	$ 27.26	2.73	0.82	1.00	4.55	0.25	**$ 36.61**
4th year - 80% of JM	$ 31.16	3.12	0.93	1.00	4.55	0.25	**$ 41.01**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Electrical Workers
and Local Union 1620
Schedule "A"
Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training and Scholarship	**Gross Hourly Package**
		10%	3%				
General Foreperson	$ 43.91	4.40	1.32	1.00	4.55	0.25	**$ 55.43**
+3.20 over JM rate							
Foreperson	$ 41.91	4.19	1.26	1.00	4.55	0.25	**$ 53.16**
+1.20 over JM rate							
Lead Lineperson	$ 41.39	4.14	1.25	1.00	4.55	0.25	**$ 52.58**
+.68 over JM rate							
Utility Worker	$ 34.56	3.46	1.04	1.00	4.55	0.25	**$ 44.86**
Mechanic	$ 37.92	3.80	1.14	1.00	4.55	0.25	**$ 48.66**
Operator + Driller/Blaster	$ 37.25	3.73	1.12	1.00	4.55	0.25	**$ 47.90**
Full-time Storekeeper	$ 36.51	3.66	1.10	1.00	4.55	0.25	**$ 47.07**
Instrument Person	$ 35.15	3.52	1.05	1.00	4.55	0.25	**$ 45.52**
Journey (Lineperson and/or Cable Splicer)	$ 40.71	4.07	1.22	1.00	4.55	0.25	**$ 51.80**
Apprentices							
1st year - 55% of JM	$ 22.39	2.24	0.67	1.00	4.55	0.25	**$ 31.10**
2nd year - 65% of JM	$ 26.46	2.65	0.79	1.00	4.55	0.25	**$ 35.70**
3rd year - 70% of JM	$ 28.50	2.85	0.86	1.00	4.55	0.25	**$ 38.01**
4th year - 80% of JM	$ 32.57	3.26	0.98	1.00	4.55	0.25	**$ 42.61**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

LABOURERS' INTERNATIONAL UNION OF NORTH AMERICA AND THE CONSTRUCTION AND GENERAL LABOURERS' UNION, ROCK AND TUNNEL WORKERS AND LOCAL UNION 1208

1.0 CLASSIFICATION

Class 1:	General Labourer
	Tamper Compactor
	Store & Tool Crib Attendant
	Grouter
	Rodman on Survey
	Chalker
	Pumpman
	Spotter
	Power Saw Operator
	Brush Cutter
	Powderman Helper
	Heaters & Fuel Attendant
	Electric / Air Chipping Tool
	Sandblasting, Masonry & Concrete
	Pickup & Service Vehicle
	Grinder Operator
Class 2:	Signal & Flagman
	Trades Helper
Class 3:	Motorized Buggie
	Checker
	Mortar Mixer
	Compressor Operator
	Mason Tender
Class 4:	Time Keeper / Office Clerk
Class 5:	Vibrator Operator
	Jack Hammer Driller
	Breaker
Class 6:	Wagon & Air Track Drill Operator
	Drill Doctor
Class 7:	Pipelayer
Class 8:	Diamond & Rotary Drill
	Hoist Operator
	Air Tugger
	Powderman
Class 9:	Cement Patcher & Rubber
Class 10:	Cement Finisher
	Roofer
Class 11:	Geomatic Technician (Surveyor)

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be (13%) percent of gross wages including overtime for all employees.

3.0 BENEFIT FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage and Benefits Schedule for each hour earned. Payments shall be made no later than the 15th of the month following the month in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payments shall be made as follows:

(a) Health & Welfare Fund

Address: Benefit Plan Administrators
7001 Mumford Road
Tower 1, Suite 216
Halifax, NS B3L 4N9

Cheque payable to: Labourers Health & Welfare Trust

(b) Pension Fund

Address: Labourers Pension Fund of Central & Eastern Canada
PO Box 40, Station Q
Toronto, ON M4T 2L7

Cheque payable to: Labourers Pension Fund of Central and Eastern Canada

(c) Market Recovery

Address: LIUNA, Local 1208
Market Recovery Fund
PO Box 1872
St. John's, NL A1C 5R4

Cheque payable to: LIUNA, Local 1208

(d) Building Fund

Address: LIUNA, Local 1208
Building Fund
PO Box 1872
St. John's, NL A1C 5R4

Cheque payable to: LIUNA, Local 1208

(e) Industry / Training Fund

Address: Benefit Plan Administrators

7001 Mumford Road
Tower 1, Suite 216
Halifax, NS B3L 4N9

Cheque payable to: Labourers Local 1208 Training Fund

(f) Industry (RDTC) Fund

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque payable to: Resource Development Trades Council Industry Fund

(g) Canadian Building Trades Fund

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Canadian Building Trades Fund

3.04 Union Dues

Union Dues are per Article 6 shall be forwarded to:

Address: Labourers, Local 1208
456 Water Street
PO Box 1872
St. John's, NL A1C 5R4

3.05 Height Pay

The following premiums above the regular hourly rate shall be paid to Employees required under such conditions as:

A free fall height of 40 – 100 feet	$1.00 per hour
A free fall height of over 100 feet	$1.50 per hour

4.0 FOREPERSON

4.01 An employee appointed as a Foreperson shall receive $1.75/hour over his/her classification. An employee appointed as a General Foreperson shall receive $2.50/hour over his/her classification.

Labourers' International Union Of North America and the
Construction and General Labourers' Union, Rock and Tunnel Workers Local 1208
Schedule "A"
Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Fund	Building Fund	Market Recovery	Industry / Training	**Gross Hourly Package**
		10%	3%						
Class 1	$ 28.21	2.82	0.85	2.39	5.25	0.30	1.00	1.00	**$ 41.82**
Class 2	$ 28.25	2.83	0.85	2.39	5.25	0.30	1.00	1.00	**$ 41.87**
Class 3	$ 28.31	2.83	0.85	2.39	5.25	0.30	1.00	1.00	**$ 41.93**
Class 4	$ 28.36	2.84	0.85	2.39	5.25	0.30	1.00	1.00	**$ 41.99**
Class 5	$ 28.41	2.84	0.85	2.39	5.25	0.30	1.00	1.00	**$ 42.04**
Class 6	$ 28.46	2.85	0.85	2.39	5.25	0.30	1.00	1.00	**$ 42.10**
Class 7	$ 28.64	2.86	0.86	2.39	5.25	0.30	1.00	1.00	**$ 42.30**
Class 8	$ 28.71	2.87	0.86	2.39	5.25	0.30	1.00	1.00	**$ 42.38**
Class 9	$ 29.16	2.92	0.87	2.39	5.25	0.30	1.00	1.00	**$ 42.89**
Class 10	$ 29.26	2.93	0.88	2.39	5.25	0.30	1.00	1.00	**$ 43.01**
Class 11	$ 34.26	3.43	1.03	2.39	5.25	0.30	1.00	1.00	**$ 48.66**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

Labourers' International Union Of North America and the
Construction and General Labourers' Union, Rock and Tunnel Workers Local 1208
Schedule "A"
Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Fund	Building Fund	Market Recovery	Industry / Training	**Gross Hourly Package**
		10%	3%						
Class 1	$ 29.98	3.00	0.90	2.39	5.25	0.30	1.00	1.00	**$ 43.82**
Class 2	$ 30.02	3.00	0.90	2.39	5.25	0.30	1.00	1.00	**$ 43.86**
Class 3	$ 30.08	3.01	0.90	2.39	5.25	0.30	1.00	1.00	**$ 43.93**
Class 4	$ 30.13	3.01	0.90	2.39	5.25	0.30	1.00	1.00	**$ 43.98**
Class 5	$ 30.18	3.02	0.91	2.39	5.25	0.30	1.00	1.00	**$ 44.05**
Class 6	$ 30.23	3.02	0.91	2.39	5.25	0.30	1.00	1.00	**$ 44.10**
Class 7	$ 30.41	3.04	0.91	2.39	5.25	0.30	1.00	1.00	**$ 44.30**
Class 8	$ 30.48	3.05	0.91	2.39	5.25	0.30	1.00	1.00	**$ 44.38**
Class 9	$ 30.93	3.09	0.93	2.39	5.25	0.30	1.00	1.00	**$ 44.89**
Class 10	$ 31.03	3.10	0.93	2.39	5.25	0.30	1.00	1.00	**$ 45.00**
Class 11	$ 36.03	3.60	1.08	2.39	5.25	0.30	1.00	1.00	**$ 50.65**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

Labourers' International Union Of North America and the
Construction and General Labourers' Union, Rock and Tunnel Workers Local 1208
Schedule "A"
Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Fund	Building Fund	Market Recovery	Industry / Training	**Gross Hourly Package**
		10%	3%						
Class 1	$ 32.19	3.22	0.97	2.39	5.25	0.30	1.00	1.00	**$ 46.32**
Class 2	$ 32.23	3.22	0.97	2.39	5.25	0.30	1.00	1.00	**$ 46.36**
Class 3	$ 32.29	3.23	0.97	2.39	5.25	0.30	1.00	1.00	**$ 46.43**
Class 4	$ 32.34	3.23	0.97	2.39	5.25	0.30	1.00	1.00	**$ 46.48**
Class 5	$ 32.39	3.24	0.97	2.39	5.25	0.30	1.00	1.00	**$ 46.54**
Class 6	$ 32.44	3.24	0.97	2.39	5.25	0.30	1.00	1.00	**$ 46.59**
Class 7	$ 32.62	3.26	0.98	2.39	5.25	0.30	1.00	1.00	**$ 46.80**
Class 8	$ 32.69	3.27	0.98	2.39	5.25	0.30	1.00	1.00	**$ 46.88**
Class 9	$ 33.14	3.31	0.99	2.39	5.25	0.30	1.00	1.00	**$ 47.38**
Class 10	$ 33.24	3.32	1.00	2.39	5.25	0.30	1.00	1.00	**$ 47.50**
Class 11	$ 38.24	3.82	1.15	2.39	5.25	0.30	1.00	1.00	**$ 53.15**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

Labourers' International Union Of North America and the
Construction and General Labourers' Union, Rock and Tunnel Workers Local 1208
Schedule "A"
Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Fund	Building Fund	Market Recovery	Industry / Training	**Gross Hourly Package**
		10%	3%						
Class 1	$ 33.96	3.40	1.02	2.39	5.25	0.30	1.00	1.00	**$ 48.32**
Class 2	$ 34.00	3.40	1.02	2.39	5.25	0.30	1.00	1.00	**$ 48.36**
Class 3	$ 34.06	3.41	1.02	2.39	5.25	0.30	1.00	1.00	**$ 48.43**
Class 4	$ 34.11	3.41	1.02	2.39	5.25	0.30	1.00	1.00	**$ 48.48**
Class 5	$ 34.16	3.42	1.02	2.39	5.25	0.30	1.00	1.00	**$ 48.54**
Class 6	$ 34.21	3.42	1.03	2.39	5.25	0.30	1.00	1.00	**$ 48.60**
Class 7	$ 34.39	3.44	1.03	2.39	5.25	0.30	1.00	1.00	**$ 48.80**
Class 8	$ 34.46	3.45	1.03	2.39	5.25	0.30	1.00	1.00	**$ 48.88**
Class 9	$ 34.91	3.49	1.05	2.39	5.25	0.30	1.00	1.00	**$ 49.39**
Class 10	$ 35.01	3.50	1.05	2.39	5.25	0.30	1.00	1.00	**$ 49.50**
Class 11	$ 40.01	4.00	1.20	2.39	5.25	0.30	1.00	1.00	**$ 55.15**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

Labourers' International Union Of North America and the
Construction and General Labourers' Union, Rock and Tunnel Workers Local 1208
Schedule "A"
Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Fund	Building Fund	Market Recovery	Industry / Training	**Gross Hourly Package**
		10%	3%						
Class 1	$ 36.17	3.62	1.09	2.39	5.25	0.30	1.00	1.00	**$ 50.82**
Class 2	$ 36.21	3.62	1.09	2.39	5.25	0.30	1.00	1.00	**$ 50.86**
Class 3	$ 36.27	3.63	1.09	2.39	5.25	0.30	1.00	1.00	**$ 50.93**
Class 4	$ 36.32	3.63	1.09	2.39	5.25	0.30	1.00	1.00	**$ 50.98**
Class 5	$ 36.37	3.64	1.09	2.39	5.25	0.30	1.00	1.00	**$ 51.04**
Class 6	$ 36.42	3.64	1.09	2.39	5.25	0.30	1.00	1.00	**$ 51.09**
Class 7	$ 36.60	3.66	1.10	2.39	5.25	0.30	1.00	1.00	**$ 51.30**
Class 8	$ 36.67	3.67	1.10	2.39	5.25	0.30	1.00	1.00	**$ 51.38**
Class 9	$ 37.12	3.71	1.11	2.39	5.25	0.30	1.00	1.00	**$ 51.88**
Class 10	$ 37.22	3.72	1.12	2.39	5.25	0.30	1.00	1.00	**$ 52.00**
Class 11	$ 42.22	4.22	1.27	2.39	5.25	0.30	1.00	1.00	**$ 57.65**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

Labourers' International Union Of North America and the
Construction and General Labourers' Union, Rock and Tunnel Workers Local 1208
Schedule "A"
Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Fund	Building Fund	Market Recovery	Industry / Training	**Gross Hourly Package**
		10%	3%						
Class 1	$ 37.94	3.79	1.14	2.39	5.25	0.30	1.00	1.00	**$ 52.81**
Class 2	$ 37.98	3.80	1.14	2.39	5.25	0.30	1.00	1.00	**$ 52.86**
Class 3	$ 38.04	3.80	1.14	2.39	5.25	0.30	1.00	1.00	**$ 52.92**
Class 4	$ 38.09	3.81	1.14	2.39	5.25	0.30	1.00	1.00	**$ 52.98**
Class 5	$ 38.14	3.81	1.14	2.39	5.25	0.30	1.00	1.00	**$ 53.03**
Class 6	$ 38.19	3.82	1.15	2.39	5.25	0.30	1.00	1.00	**$ 53.10**
Class 7	$ 38.37	3.84	1.15	2.39	5.25	0.30	1.00	1.00	**$ 53.30**
Class 8	$ 38.44	3.84	1.15	2.39	5.25	0.30	1.00	1.00	**$ 53.37**
Class 9	$ 38.89	3.89	1.17	2.39	5.25	0.30	1.00	1.00	**$ 53.89**
Class 10	$ 38.99	3.90	1.17	2.39	5.25	0.30	1.00	1.00	**$ 54.00**
Class 11	$ 43.99	4.40	1.32	2.39	5.25	0.30	1.00	1.00	**$ 59.65**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

INTERNATIONAL UNION OF OPERATING ENGINEERS
AND LOCAL UNION 904

1.0 APPLICATION

1.01 This Trade Appendix shall apply to the following:

Operator Group 1:

Engineers operating: mobile or crawler cranes, clams, draglines, skyhorse and ringer type cranes with a manufacturer's rating of 50 tons capacity and over. Also, tower crane operators, certified divers, heavy duty Mechanics and Welders.

Operator Group 2:

Engineers operating: skyway, climbing, hammerhead and kangaroo type cranes, boat operators with ticket, 1st. class stationary engineers, backhoes, excavators, shovels, gradalls, graders, bulldozers, front end loaders, boom trucks, mobile truck cranes including gallion and austin-western type, and all rough terrain type hydraulic cranes, overhead cranes, pile drivers, caisson boring machines, drill rigs, pittman type cranes of 12 tons capacity and over, hydrovac operator, vacuum truck operator.

Operator Group 3:

Engineers operating: asphalt roller, skid steer (bobcat), dredges-suction and dipper, gantry cranes, creter cranes, side booms, power hoist, mine hoist, chimney hoist, tower type man and materials hoists, 2nd. class stationary engineers, telehandler (zoom boom), forklifts, off highway truck, fifth wheel truck, truck over 10 tons and operators of batching and crushing plants.

Operator Group 4:

Operators of: bullmoose, pittman type cranes of less than 12 tons capacity, air tuggers, air compressor feeding low pressure into air locks, tractors, scrapers, emcos, overhead and industrial tractors with attachments, trenching machine, mucking machines, mobile pumpcretes, side loaders, end booms, mobile pressure grease units, elevators, dinky locomotive type engines, boat operators without tickets and 3rd. class stationary engineers, mechanic's helper, serviceman, concrete pump operator, block accerate mixer.

Operator Group 5:

Operators of 6" discharge pumps and over, wellpoint systems and all other types of dewatering systems, concrete mixers of one cubic yard and over, portable air compressor over 150 C.F.M., "A" Frames, post hole augers, gas, diesel or steam driven generators over 50 H.P. (portable), and 4th. class stationary engineers. Operators of: rollers on grade work, driver mounted compaction units, concrete conveyors, and concrete pumps. Firemen and attendants for forced air, gas or oil burning temporary heating units of 500,000 BTU or over per hour; or five or more heating units of the same job site, signalman, pumps under 6" discharge where 3 or more pumps are employed on the same job site, driver mounted power sweeper, truck crane oiler drivers, oilers, bus driver.

Clerical Group 1:

Office Assistant. Receptionist, Typist, Clerk I
(All office equipment other than computers)

Clerical Group 2:

Clerk II, Administrative Assistant, Document Control
(Includes computers)

Clerical Group 3:

Payroll Clerk, Senior Clerk, Senior Administrative Assistant

1.02 Foreperson

There shall be the following classes of Foreperson:

Working Foreperson (as per Article 7.08(a)(iv))
Non-working Foreperson
General Foreperson

1.03 Foreperson

Working / Non-Working Foreperson – Working and Non-Working Foreperson shall receive a premium of fifteen (15%) percent over the hourly rate of the highest Operating Engineer classification under their supervision.

General Foreperson – The General Foreperson shall receive a premium of twenty (20%) percent over the hourly rate of the highest operating engineer classification under his/her supervision.

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be thirteen (13%) percent of gross wages including over-time for all employees.

3.0 BENEFIT FUNDS

3.01 Each Contractor shall contribute the amounts stated in the attached Wage and Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the month following the month in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees and Social Insurance Numbers (SIN) in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payments shall be made as follows:

(a) Health and Welfare Plan

Each payment shall be made by a cheque made payable to:

Address: O.E. Local 904 Trust
PO Box 96
St. John's, NL A1C 5H5

(b) Pension Plan

Each payment shall be made by a cheque made payable to:

Address: O.E. Local 904 Trust
PO Box 96
St. John's, NL A1C 5H5

(c) Training & Promotional Fund

Each payment shall be made by a cheque made payable to:

Address: Operating Engineers Training & Promotional Fund
62 Commonwealth Avenue
Mount Pearl, NL A1N 1W8

(d) Membership Benefit Fund

Each payment shall be made by a cheque made payable to:

Address Operating Engineers Membership Benefit Fund
62 Commonwealth Avenue
Mount Pearl, NL A1N 1W8

(e) Charity Fund

Each payment shall be made by cheque made payable to:

Address: Operating Engineers Charity Fund
62 Commonwealth Avenue
Mount Pearl, NL A1N 1W8

(f) Industry Fund (RDTC)

Each payment shall be made by cheque made payable to:

Address: Resource Development Trades Council Industry Fund
78 Brookfield Road
St. John's, NL A1E 3T9

(g) Canadian Building Trades Fund

Each payment shall be made by cheque made payable to:

Address: Canadian Building Trades Fund
c/o Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

4.0 UNION DUES

4.01 Union Dues shall be deducted at the following rate:

(a) Working dues – 3.5% of the employee's gross income
(b) Monthy dues - $22.00 per month (identifying both deductions separately on report)

4.02 Union Dues as per Article 6 shall be forwarded to:

Address: Operating Engineers Local 904
62 Commonwealth Avenue
Mount Pearl, NL A1N 1W8

5.0 APPRENTICES

5.01 The Contractor, the Council of Unions and the Unions agree, to Project conditions and law, to maximize placement and utilization of apprentices as follows:

a) Not less than one (1) apprentice for every three (3) journey persons; and
b) Not more than two (2) apprentices for each journey person

5.02 Apprenticeship Rates and Other Conditions

The following scheme of remuneration shall apply for all apprentices:

1st	1000 hrs. --- 60% of Group 2 Rate
2nd	1000 hrs. --- 65% of Group 2 Rate
3rd	1000 hrs. --- 70% of Group 2 Rate
4th	1000 hrs. --- 75% of Group 2 Rate
5th	1000 hrs. --- 80% of Group 2 Rate
6th	1000 hrs. --- 90% of Group 2 Rate

5.03 A period shall be defined as six (6) months or one thousand (1000) working hours, whichever is greater.

5.04 Where an Apprentice is not available then an Oiler or Oiler Driver shall be utilized.

5.05 Utilization of Apprentices / Manning of Cranes

(a) The following formula will be used for the purpose of manning certain equipment set out in the classifications. It is further agreed that this formula shall only apply to employers covered by this Agreement.

The following shall be manned by one (1) operator and one (1) apprentice, oiler and oiler driver;

(i) All conventional truck mounted or crawler cranes with a manufacturer's rating of 25 tons capacity and over.

(ii) All truck mounted hydraulic and rough terrain type cranes with a manufacturer's rating of 100 tons capacity and over.

(iii) All clams and draglines with a capacity over 1 ¾ cubic yards (excavators and shovels are excluded from Article 5.05(a)(iii) herein for the Lower Churchill Muskrat Falls Project Agreement only).

(b) The following shall require one apprentice, oiler or oiler driver, for each two (2) pieces of equipment.

(i) Climbing, tower, traveler, hammerhead, skyway, Kodiak and kangaroo type cranes.

(c) The following shall require one apprentice, oiler and oiler driver, for each four (4) pieces of equipment;

(i) All truck mounted hydraulic and rough terrain type cranes with a manufacturer's rating between thirty (30) and one hundred (100) tons capacity.

(ii) Shovels, clams and draglines with a manufacturer's capacity of 1 ¾ cubic yards and under.

It is recognized that the moving (driving) and oiling of any equipment coming within the jurisdiction of the Operating Engineers, is work of the Operating Engineers. No operator shall be required to move a machine using the assistance of another trade on the machine.

6.0 SPECIAL CONDITIONS

6.01 Overtime Operations

If an Operator is regularly assigned to a machine from Monday through Friday in a given week and productive Work is required after the normal hours of work or on the Saturday, Sunday or holiday of that week, such Operator will be assigned to such particular machine for such Saturday, Sunday or holiday work.

6.02 Owner Operated Equipment

Owner Operated equipment performing work on the project shall be subject to the terms and conditions of the Agreement. Each Contractor shall advise the Council when Owner Operated Equipment is being contracted.

6.03 Heavy Lifting

Four ($4.00) dollars per hour worked premium will be paid to operators of cranes from 225-300 tons. An additional thirty ($0.30) cents per hour worked will be paid to the operator for every 50 tons thereafter (i.e. 450 ton crane + $4.90 premium).

6.04 Boom Premium

A boom premium of one dollar and fifty cents ($1.50) per hour worked shall be paid to crane operators operating cranes with a boom of 140-200 ft.

A boom premium of two dollars ($2.00) per hour worked shall be paid to crane operators operating cranes with a boom in excess of 200 ft.

Cranes that carry jibs that are stowed, stored and not in use, would not apply to a premium, until such lengths are equipped and in use.

A telescopic hydraulic crane equipped with 140 – 200 ft. main boom, the premium shall apply regardless of the boom length in use. It may be main boom or a combination of main boom and jib that the total length applies.

A telescopic hydraulic crane equipment with more than 200 ft. main boom, the premium shall apply regardless of the boom length in use.

6.05 Equipment Assembly

It is agreed that the assembling and dismantling of the Contractor's construction equipment described in the Classification or falling within the jurisdiction of the Operating Engineers, will be performed by members of the Operating Engineer's Union.

7.0 HEALTH AND SAFETY

7.01 The Contractor will provide, without cost, safety hats, rain coats, rubber boots, welding helmets, safety goggles, work gloves, coveralls, and safety equipment for high voltage work for the use of employees. The employee will sign for such equipment supplied by the Contractor and authorize deductions of the cost from his/her wages if he/she does not return such equipment in good condition, subject to reasonable wear and tear when they are returned. Employees who fail to observe and practice the established safety and working rules of the Contractor shall be subject to disciplinary action.

8.0 OWNER / OPERATORS – MANNED RENTED EQUIPMENT

8.01 Owner operated and manned rented equipment shall in no way be used to circumvent the intentions and provisions of this Agreement. Where an “Owner/Operator” performs

work for which they have been engaged, they shall thereafter become an employee and be entitled to all of the provisions of this Agreement.

8.02 The Contractor agrees that they will not, under any circumstances, engage an Owner/Operator to perform work for them unless, and until, the Owner/Operator, prior to the commencement of such work obtains from the Union, a clearance or permit to perform such work.

9.0 EPCM

9.01 The document control persons employed by the Owner's EPCM Agent working in non-confidential positions shall be included in the bargaining unit and paid the appropriate Clerical Group Rate. All other clerical staff in confidential positions shall remain outside of the bargaining unit and shall not perform bargaining unit work.

10.0 TOOL LIST

10.01
1) ¼ Drive set standard and metric including ratchet and extensions
2) 3/8 Drive set up to 7/8 socket standard and metric including ratchet and extensions
3) Combination wrench set from ¼ to 1 ¼ and 5mm to 30mm
4) ½ Drive socket set from 3/8 to 1 ¼ shallow and deep including ratchet and extensions
5) ½ Drive metric socket set from 10mm to 30mm
6) Punch and chisel set
7) Various pliers, side cutters, water pump pliers, vise grip, wire crimpers, long nose pliers
8) Pry bar set
9) Various ball peen hammers
10) Volt meter, test light
11) Crow feet socket set from 3/8 to 15/16
12) 3/8 drive air ratchet, ½ drive air impact
13) Complete set of screwdrivers
14) Allan wrenches metric and standard
15) Torques bit socket set and screwdrivers
16) Line wrenches from 3/8 to ¾ inclusive
17) ½ Drive impact sockets 3/8 to 1 ¼
18) ½ Drive impact swivel socket set ½ to 15/16

10.02 Tool Premium of one dollar and fifty cents ($1.50) per hour worked.

International Union of Operating Engineers and
Local Union 904
Schedule "A"
Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training Promotion	Member Benefits	Charity Fund	**Gross Hourly Package**
		9%	4%						
Operating Engineers									
Group 1	$ 32.30	2.91	1.29	2.15	5.70	0.90	0.25	0.20	**$ 45.70**
Group 2	$ 31.30	2.82	1.25	2.15	5.70	0.90	0.25	0.20	**$ 44.57**
Group 3	$ 30.90	2.78	1.24	2.15	5.70	0.90	0.25	0.20	**$ 44.12**
Group 4	$ 29.91	2.69	1.20	2.15	5.70	0.90	0.25	0.20	**$ 43.00**
Group 5	$ 29.17	2.62	1.17	2.15	5.70	0.90	0.25	0.20	**$ 42.16**
Group 6	Working / Non-Working Foreperson will receive 15% over the highest classification under their supervision.								
Group 7	General Foreperson will receive 20% over the highest classification under their supervision.								
Apprentices									
1st Period	$ 18.78	1.69	0.75	2.15	5.70	0.90	0.25	0.20	**$ 30.42**
60% of Group 2									
2nd Period	$ 20.35	1.83	0.81	2.15	5.70	0.90	0.25	0.20	**$ 32.19**
65% Group 2									
3rd Period	$ 21.91	1.97	0.88	2.15	5.70	0.90	0.25	0.20	**$ 33.96**
70% of Group 2									
4th Period	$ 23.48	2.11	0.94	2.15	5.70	0.90	0.25	0.20	**$ 35.73**
75% of Group 2									
5th Period	$ 25.04	2.25	1.00	2.15	5.70	0.90	0.25	0.20	**$ 37.49**
80% of Group 2									
6th Period	$ 28.17	2.54	1.13	2.15	5.70	0.90	0.25	0.20	**$ 41.04**
90% of Group 2									
Clerical									
Group 1	$ 23.95	2.16	0.96	2.15	5.70	0.90	0.25	0.20	**$ 36.27**
Group 2	$ 26.17	2.36	1.05	2.15	5.70	0.90	0.25	0.20	**$ 38.78**
Group 3	$ 27.51	2.48	1.11	2.15	5.70	0.90	0.25	0.20	**$ 40.30**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly,)as per Article 27

International Union of Operating Engineers and
Local Union 904
Schedule "A"
Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training Promotion	Member Benefits	Charity Fund	**Gross Hourly Package**
		9%	4%						
Operating Engineers									
Group 1	$ 33.80	3.04	1.36	2.15	6.00	0.90	0.25	0.20	**$ 47.70**
Group 2	$ 32.80	2.95	1.32	2.15	6.00	0.90	0.25	0.20	**$ 46.57**
Group 3	$ 32.40	2.92	1.30	2.15	6.00	0.90	0.25	0.20	**$ 46.12**
Group 4	$ 31.41	2.83	1.26	2.15	6.00	0.90	0.25	0.20	**$ 45.00**
Group 5	$ 30.67	2.76	1.23	2.15	6.00	0.90	0.25	0.20	**$ 44.16**
Group 6	Working / Non-Working Foreperson will receive 15% over the highest classification under their supervision								
Group 7	General Foreperson will receive 20% over the highest classification under their supervision.								
Apprentices									
1st Period	$ 19.68	1.77	0.79	2.15	6.00	0.90	0.25	0.20	**$ 31.74**
60% of Group 2									
2nd Period	$ 21.32	1.92	0.85	2.15	6.00	0.90	0.25	0.20	**$ 33.59**
65% Group 2									
3rd Period	$ 22.96	2.07	0.92	2.15	6.00	0.90	0.25	0.20	**$ 35.45**
70% of Group 2									
4th Period	$ 24.60	2.21	0.98	2.15	6.00	0.90	0.25	0.20	**$ 37.29**
75% of Group 2									
5th Period	$ 26.24	2.36	1.05	2.15	6.00	0.90	0.25	0.20	**$ 39.15**
80% of Group 2									
6th Period	$ 29.52	2.66	1.19	2.15	6.00	0.90	0.25	0.20	**$ 42.87**
90% of Group 2									
Clerical									
Group 1	$ 25.45	2.29	1.02	2.15	6.00	0.90	0.25	0.20	**$ 38.26**
Group 2	$ 27.67	2.49	1.11	2.15	6.00	0.90	0.25	0.20	**$ 40.77**
Group 3	$ 29.01	2.61	1.17	2.15	6.00	0.90	0.25	0.20	**$ 42.29**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

International Union of Operating Engineers and
Local Union 904
Schedule "A"
Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training Promotion	Member Benefits	Charity Fund	**Gross Hourly Package**
		9%	4%						
Operating Engineers									
Group 1	$ 36.01	3.24	1.44	2.15	6.00	0.90	0.25	0.20	**$ 50.19**
Group 2	$ 35.01	3.15	1.40	2.15	6.00	0.90	0.25	0.20	**$ 49.06**
Group 3	$ 34.61	3.11	1.38	2.15	6.00	0.90	0.25	0.20	**$ 48.60**
Group 4	$ 33.62	3.03	1.34	2.15	6.00	0.90	0.25	0.20	**$ 47.49**
Group 5	$ 32.88	2.95	1.32	2.15	6.00	0.90	0.25	0.20	**$ 46.65**
Group 6	Working / Non-Working Foreperson will receive 15% over the highest classification under their supervision								
Group 7	General Foreperson will receive 20% over the highest classification under their supervision.								
Apprentices									
1st Period	$ 21.01	1.89	0.84	2.15	6.00	0.90	0.25	0.20	**$ 33.24**
60% of Group 2									
2nd Period	$ 22.76	2.05	0.91	2.15	6.00	0.90	0.25	0.20	**$ 35.22**
65% Group 2									
3rd Period	$ 24.51	2.21	0.99	2.15	6.00	0.90	0.25	0.20	**$ 37.21**
70% of Group 2									
4th Period	$ 26.26	2.36	1.06	2.15	6.00	0.90	0.25	0.20	**$ 39.18**
75% of Group 2									
5th Period	$ 28.01	2.52	1.12	2.15	6.00	0.90	0.25	0.20	**$ 41.15**
80% of Group 2									
6th Period	$ 31.51	2.84	1.27	2.15	6.00	0.90	0.25	0.20	**$ 45.12**
90% of Group 2									
Clerical									
Group 1	$ 27.66	2.49	1.10	2.15	6.00	0.90	0.25	0.20	**$ 40.75**
Group 2	$ 29.88	2.69	1.19	2.15	6.00	0.90	0.25	0.20	**$ 43.26**
Group 3	$ 31.22	2.81	1.25	2.15	6.00	0.90	0.25	0.20	**$ 44.78**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

International Union of Operating Engineers and
Local Union 904
Schedule "A"
Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training Promotion	Member Benefits	Charity Fund	**Gross Hourly Package**
		9%	4%						
Operating Engineers									
Group 1	$ 37.78	3.40	1.51	2.15	6.00	0.90	0.25	0.20	**$ 52.19**
Group 2	$ 36.78	3.31	1.47	2.15	6.00	0.90	0.25	0.20	**$ 51.06**
Group 3	$ 36.38	3.27	1.46	2.15	6.00	0.90	0.25	0.20	**$ 50.61**
Group 4	$ 35.39	3.19	1.42	2.15	6.00	0.90	0.25	0.20	**$ 49.50**
Group 5	$ 34.65	3.11	1.39	2.15	6.00	0.90	0.25	0.20	**$ 48.65**
Group 6	Working / Non-Working Foreperson will receive 15% over the highest classification under their supervision.								
Group 7	General Foreperson will receive 20% over the highest classification under their supervision.								
Apprentices									
1st Period	$ 22.07	1.99	0.88	2.15	6.00	0.90	0.25	0.20	**$ 34.44**
60% of Group 2									
2nd Period	$ 23.91	2.15	0.95	2.15	6.00	0.90	0.25	0.20	**$ 36.51**
65% Group 2									
3rd Period	$ 25.75	2.32	1.03	2.15	6.00	0.90	0.25	0.20	**$ 38.60**
70% of Group 2									
4th Period	$ 27.59	2.48	1.11	2.15	6.00	0.90	0.25	0.20	**$ 40.68**
75% of Group 2									
5th Period	$ 29.42	2.65	1.17	2.15	6.00	0.90	0.25	0.20	**$ 42.74**
80% of Group 2									
6th Period	$ 33.10	2.98	1.33	2.15	6.00	0.90	0.25	0.20	**$ 46.91**
90% of Group 2									
Clerical									
Group 1	$ 29.43	2.65	1.17	2.15	6.00	0.90	0.25	0.20	**$ 42.75**
Group 2	$ 31.65	2.85	1.26	2.15	6.00	0.90	0.25	0.20	**$ 45.26**
Group 3	$ 32.99	2.97	1.32	2.15	6.00	0.90	0.25	0.20	**$ 46.78**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

International Union of Operating Engineers and
Local Union 904
Schedule "A"
Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training Promotion	Member Benefits	Charity Fund	**Gross Hourly Package**
		9%	4%						
Operating Engineers									
Group 1	$ 39.99	3.60	1.59	2.15	6.00	0.90	0.25	0.20	**$ 54.68**
Group 2	$ 38.99	3.51	1.55	2.15	6.00	0.90	0.25	0.20	**$ 53.55**
Group 3	$ 38.59	3.47	1.54	2.15	6.00	0.90	0.25	0.20	**$ 53.10**
Group 4	$ 37.60	3.38	1.50	2.15	6.00	0.90	0.25	0.20	**$ 51.98**
Group 5	$ 36.86	3.31	1.48	2.15	6.00	0.90	0.25	0.20	**$ 51.15**
Group 6	Working / Non-Working Foreperson will receive 15% over the highest classification under their supervision.								
Group 7	General Foreperson will receive 20% over the highest classification under their supervision.								
Apprentices									
1st Period	$ 23.39	2.11	0.93	2.15	6.00	0.90	0.25	0.20	**$ 35.93**
60% of Group 2									
2nd Period	$ 25.34	2.28	1.01	2.15	6.00	0.90	0.25	0.20	**$ 38.13**
65% Group 2									
3rd Period	$ 27.29	2.46	1.10	2.15	6.00	0.90	0.25	0.20	**$ 40.35**
70% of Group 2									
4th Period	$ 29.24	2.63	1.17	2.15	6.00	0.90	0.25	0.20	**$ 42.54**
75% of Group 2									
5th Period	$ 31.19	2.81	1.24	2.15	6.00	0.90	0.25	0.20	**$ 44.74**
80% of Group 2									
6th Period	$ 35.09	3.16	1.41	2.15	6.00	0.90	0.25	0.20	**$ 49.16**
90% of Group 2									
Clerical									
Group 1	$ 31.64	2.85	1.26	2.15	6.00	0.90	0.25	0.20	**$ 45.25**
Group 2	$ 33.86	3.05	1.35	2.15	6.00	0.90	0.25	0.20	**$ 47.76**
Group 3	$ 35.20	3.17	1.41	2.15	6.00	0.90	0.25	0.20	**$ 49.28**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

International Union of Operating Engineers and
Local Union 904
Schedule "A"
Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training Promotion	Member Benefits	Charity Fund	**Gross Hourly Package**
		9%	4%						
Operating Engineers									
Group 1	$ 41.76	3.76	1.67	2.15	6.00	0.90	0.25	0.20	**$ 56.69**
Group 2	$ 40.76	3.67	1.63	2.15	6.00	0.90	0.25	0.20	**$ 55.56**
Group 3	$ 40.36	3.63	1.61	2.15	6.00	0.90	0.25	0.20	**$ 55.10**
Group 4	$ 39.37	3.54	1.57	2.15	6.00	0.90	0.25	0.20	**$ 53.98**
Group 5	$ 38.63	3.47	1.55	2.15	6.00	0.90	0.25	0.20	**$ 53.15**
Group 6	Working / Non-Working Foreperson will receive 15% over the highest classification under their supervision.								
Group 7	General Foreperson will receive 20% over the highest classification under their supervision.								
Apprentices									
1st Period	$ 24.46	2.20	0.97	2.15	6.00	0.90	0.25	0.20	**$ 37.13**
60% of Group 2									
2nd Period	$ 26.49	2.38	1.05	2.15	6.00	0.90	0.25	0.20	**$ 39.42**
65% Group 2									
3rd Period	$ 28.53	2.57	1.15	2.15	6.00	0.90	0.25	0.20	**$ 41.75**
70% of Group 2									
4th Period	$ 30.57	2.75	1.23	2.15	6.00	0.90	0.25	0.20	**$ 44.05**
75% of Group 2									
5th Period	$ 32.61	2.93	1.30	2.15	6.00	0.90	0.25	0.20	**$ 46.34**
80% of Group 2									
6th Period	$ 36.68	3.30	1.47	2.15	6.00	0.90	0.25	0.20	**$ 50.95**
90% of Group 2									
Clerical									
Group 1	$ 33.41	3.01	1.33	2.15	6.00	0.90	0.25	0.20	**$ 47.25**
Group 2	$ 35.63	3.21	1.42	2.15	6.00	0.90	0.25	0.20	**$ 49.76**
Group 3	$ 36.97	3.33	1.48	2.15	6.00	0.90	0.25	0.20	**$ 51.28**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly), as per Article 27

THE INTERNATIONAL BROTHERHOOD OF TEAMSTERS
AND LOCAL UNION 855

1.0 APPLICATION

1.01 This Trade Appendix shall apply to the following classifications:

GROUP 1 Heavy Truck

Lowbed trucks, picker/boom truck (over 12 ton), bed tandem, concrete transit mix driver, magnum driver, fuel truck (over 2000 gallons), flat deck, articulate dumps, side dumps, dynamite truck, cat truck, rock truck, semi-trailer, pipe and pole trailer, light duty and heavy duty mechanics, forklifts and crane mobiles (used in warehouse area) and belly dump, semi-dump and fifth wheel.

GROUP 2 Dual Axle / Tandum Axle

Tree farmer, hovercraft, picker/boom truck (under 12 ton), dump truck, fuel truck (under 2000 gallons), garbage truck, lugger truck, rolloff truck, compactor truck, vacuum truck, bus, water truck, manhaul, crewcab, propane truck, and dump trucks.

GROUP 3 Single Axle

Bombardier, nodwell driver, track truck, farm type tractor, preheat truck, pick-up or car (except when used by supervisory personnel, office staff, and field engineering crews) pilot car, fuel truck helper, fuel pump attendants and small boat operators.

GROUP 4 Warehouse personnel

GROUP 5 Primary Care Paramedic

GROUP 6 Registered Nurse and Fire Prevention Officer

GROUP 7 Owner/Operators

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be thirteen percent (13%) of gross wages including overtime for all employees.

3.0 FOREPERSONS

3.01 Working Foreperson: When the Contractor works the first eight (8) workers on any one shift, one of these workers shall be appointed a Working Foreperson.

Where the Contractor works the second eight (8) workers on any one shift, one of these workers shall be appointed a Working Foreperson.

The Working Foreperson shall receive a premium of one dollar and fifty cents ($1.50) per hour over the hourly rate of the highest classification under his/her supervision.

3.02 Non-Working Foreperson: Where the Contractor works more than sixteen (16) workers on any one shift, one of these workers shall be appointed a Non-working Foreperson.

The Non-working Foreperson shall receive a premium of one dollar and fifty cents ($1.50) per hour over the hourly rate of the highest classification under his/her supervision.

3.03 Foreperson: Where three (3) or more pieces of equipment are worked on any one shift, all equipment shall be under the supervision of a Foreperson. At the Contractor's discretion, he/she may be a driver.

3.04 General Foreperson: Shall receive a premium of two dollars ($2.00) per hour over the hourly rate of the highest classification under his/her supervision.

4.0 BENEFIT FUNDS

4.01 The Contractor shall remit the amounts in the attached Wage and Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the month following in which the hours were earned.

4.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

4.03 Payments shall be made as follows:

(a) Health and Welfare Fund

Address: Global Benefits
88 St. Regis Cres S
Toronto, ON M3J 1Y8

Cheque payable to: Teamsters Local 855 Health and Welfare Trust Fund

(b) Pension Fund

Address: Industrial Alliance
238 Brownlow Avenue, Suite 320
Dartmouth, NS B3B 1Y2

Cheque payable to: Industrial Alliance/Teamsters Local 855 Pension Plan

(c) Teamsters Building Fund

Address: Teamsters Union Local 855
PO Box 1472, Stn. C
St. John's, NL A1C 5N8

Cheque payable to: Teamsters Local 855 Teamsters Building Fund

(d) Advancement Fund

Address: Teamsters Union Local 855
PO Box 1472, Stn. C
St. John's, NL A1C 5N8

Cheque payable to: Teamsters Local 855 Advancement Fund

(e) Industry Fund (RDTC)

Address: Resource Development Trades Council of
Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Resource Development Trades Council Industry Fund

(f) Canadian Building Trades Fund

Address: Resource Development Trades Council of
Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Canadian Building Trades Fund

5.0 UNION DUES

5.01 Union dues shall be forwarded and payable to:

Address: Teamsters Local 855
PO Box 1472, Stn. C
St. John's, NL A1C 5N8

6.0 TOOLS

6.01 Mechanics shall provide and maintain hand tools necessary to the job.

7.0 OWNER/OPERATORS (GROUP 7)

7.01 The following provisions make up the way in which a Contractor or Sub-Contractor working under the Project Agreement fulfills its requirements for Dump Trucks.

1. Contractors or Sub-Contractors may provide their own trucks and the Union shall dispatch qualified Drivers who will be paid in accordance with the terms of the Collective Agreement.
2. Contractors or Sub-Contractors working under the Project Agreement may request Dump “Trucks from Contractors who are signatory to the Teamsters CLRA Agreements and payment shall be paid the appropriate Group 7 Dump Truck hourly rate as per Schedule A or as adjusted from time to time as per Schedule B paragraph 2.

3. Contractors or Sub-Contractors working under the Project Agreement may hire Owner/Operators directly as per Schedule B.

8.0 WAREHOUSE APPRENTICESHIP RATES

8.01 The Teamsters will establish apprenticeship rates which shall be as follows:

(a) 70% of the Warehouse Person's current hourly rate for hours worked from 0 – 1,000;

(b) 80% of the Warehouse Person's current hourly rate for hours worked from 1,001 – 2,000;

(c) 90% of the Warehouse Person's current hourly rate for hours worked from 2,001 – 3,000; and

(d) 100% of the Warehouse Person's current hourly rate for hours worked in excess of 3,000 hours;

PRIMARY CARE PARAMEDICS, REGISTERED NURSES AND FIRE PREVENTION OFFICERS SUPPLEMENT TO TEAMSTERS TRADE APPENDIX

1.0 APPLICATION

1.01 This supplement shall apply to the following:

Primary Care Paramedic
Registered Nurse
Fire Prevention Officer (if fulltime person is required)

1.02 Fire Prevention Officer(s) will be hired if a Contractor determines a fulltime Fire Prevention Officer is required.

2.0 BENEFITS

2.01 All employees under this Supplement will participate in the Union's benefit package which includes Group Insurance and Pension.

3.0 PRIMARY CARE PARAMEDICS AND REGISTERED NURSES SPECIAL CONDITIONS

3.01 Notwithstanding Article 19 (Regular Work Schedule, Extended Work Schedule, and Overtime Provisions to Address Unique Project Needs) in the Agreement, the Primary Care Paramedics and Registered Nurses may work a schedule of seven (7) consecutive twelve (12) hour shifts and seven (7) consecutive days off. The employee, when working this schedule, shall be paid one hundred and thirteen (113) hours at his/her straight time rate of pay for such eighty-four (84) hours worked. Employees shall be paid sixteen point one four (16.14) hours for each regularly scheduled 12 hour shift worked on the 7 days on / 7 days off Work Schedule. In the event that the employee does not work a regularly scheduled 12 hour shift on this Work Schedule, the amount paid to such employee shall be reduced sixteen point one four (16.14) hours for each day not worked on the Work Schedule. When working this schedule, the employee shall be paid the first fifty six and one-half (56.5) hours in the week worked (provided such employee worked each of the scheduled work days), and the other fifty six and one-half (56.5) hours in his/her week off (provided such employee worked each of the scheduled work days).

3.02 Notwithstanding Article 19 (Regular Work Schedule, Extended Work Schedule, and Overtime Provisions to Address Unique Project Needs) in the Agreement, the Primary Care Paramedics and Registered Nurses may work a schedule of fourteen (14) consecutive twelve (12) hour shifts and fourteen (14) consecutive days off. The employee, when working this schedule, shall be paid two hundred and twenty six (226) hours at his/her straight time hourly rate of pay for such one hundred and sixty eight (168) hours worked. Employees shall be paid sixteen point one four (16.14) hours for each regularly scheduled 12 hour shift worked on the 14 days on / 14 days off Work Schedule. In the event that the employee does not work a regularly scheduled 12 hour shift on this Work Schedule, the amount paid to such employee shall be reduced sixteen point one four (16.14) hours for each day not worked on the Work Schedule. When

working this schedule, each of the two weeks such employee works (provided such employee worked each of the scheduled work days), the employee shall be paid fifty-six and one-half (56.5) hours, and fifty-six and one-half (56.5) hours each of the weeks in his/her two weeks off (provided such employee worked each of the scheduled work days).

The International Brotherhood of Teamsters and Local Union 855
Schedule "A"
Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Teamsters Building Fund	Advancement Fund	**Gross Hourly Package**
		9%	4%					
Group 1 (Heavy Trucks)	$ 33.20	2.99	1.33	1.70	2.00	0.25	0.50	**$ 41.97**
Group 2 (Dual Axle/Tandem Axle)	$ 32.99	2.97	1.32	1.70	2.00	0.25	0.50	**$ 41.73**
Group 3 (Single Axle)	$ 32.78	2.95	1.31	1.70	2.00	0.25	0.50	**$ 41.49**
Group 4 (Warehouse)	$ 33.20	2.99	1.33	1.70	2.00	0.25	0.50	**$ 41.97**
Warehouse Apprentice 1 - 70%	$ 23.24	2.09	0.93	1.70	2.00	0.25	0.50	**$ 30.71**
Warehouse Apprentice 2 - 80%	$ 26.56	2.39	1.06	1.70	2.00	0.25	0.50	**$ 34.46**
Warehouse Apprentice 3 - 90%	$ 29.88	2.69	1.20	1.70	2.00	0.25	0.50	**$ 38.22**
Group 5 (Primary Care Paramedics)	$ 38.61	3.47	1.54	1.70	2.00	0.25	0.50	**$ 48.07**
Group 6 (Registered Nurse & Fire Prevention Officers)	$ 44.32	3.99	1.77	1.70	2.00	0.25	0.50	**$ 54.53**

Group 7 (Dump Trucks)	Basic Hourly Rate	Total (incl HST)	Adv. Fund	Building Fund	Gross Hourly Pkg
Tandem Axle	$ 91.75	103.68	0.50	0.25	104.43
Tandem Tandem Axle	$ 103.75	117.24	0.50	0.25	117.99

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

The International Brotherhood of Teamsters and
Local Union 855
Schedule "A"
Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Teamsters Building Fund	Advancement Fund	**Gross Hourly Package**
		9%	4%					
Group 1 (Heavy Trucks)	$ 34.48	3.11	1.38	1.75	2.50	0.25	0.50	**$ 43.97**
Group 2 (Dual Axle/Tandem Axle)	$ 34.27	3.08	1.38	1.75	2.50	0.25	0.50	**$ 43.73**
Group 3 (Single Axle)	$ 34.06	3.07	1.36	1.75	2.50	0.25	0.50	**$ 43.49**
Group 4 (Warehouse)	$ 34.48	3.10	1.38	1.75	2.50	0.25	0.50	**$ 43.96**
Warehouse Apprentice 1 - 70%	$ 24.14	2.17	0.97	1.75	2.50	0.25	0.50	**$ 32.28**
Warehouse Apprentice 2 - 80%	$ 27.58	2.48	1.10	1.75	2.50	0.25	0.50	**$ 36.16**
Warehouse Apprentice 3 - 90%	$ 31.03	2.79	1.24	1.75	2.50	0.25	0.50	**$ 40.06**
Group 5 (Primary Care Paramedics)	$ 39.89	3.59	1.60	1.75	2.50	0.25	0.50	**$ 50.08**
Group 6 (Registered Nurse & Fire Prevention Officers)	$ 45.60	4.10	1.82	1.75	2.50	0.25	0.50	**$ 56.52**

Group 7 (Dump Trucks)	Basic Hourly Rate	Total (incl HST)	Adv. Fund	Building Fund	Gross Hourly Pkg
Tandem Axle	$ 91.75	103.68	0.50	0.25	104.43
Tandem Tandem Axle	$ 103.75	117.24	0.50	0.25	117.99

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

The International Brotherhood of Teamsters and Local Union 855
Schedule "A"
Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Teamsters Building Fund	Advancement Fund	**Gross Hourly Package**
		9%	4%					
Group 1 (Heavy Trucks)	$ 36.69	3.30	1.47	1.75	2.50	0.25	0.50	**$ 46.46**
Group 2 (Dual Axle/Tandem Axle)	$ 36.48	3.28	1.46	1.75	2.50	0.25	0.50	**$ 46.22**
Group 3 (Single Axle)	$ 36.27	3.26	1.45	1.75	2.50	0.25	0.50	**$ 45.98**
Group 4 (Warehouse)	$ 36.69	3.30	1.47	1.75	2.50	0.25	0.50	**$ 46.46**
Warehouse Apprentice 1 - 70%	$ 25.68	2.31	1.03	1.75	2.50	0.25	0.50	**$ 34.02**
Warehouse Apprentice 2 - 80%	$ 29.35	2.64	1.17	1.75	2.50	0.25	0.50	**$ 38.16**
Warehouse Apprentice 3 - 90%	$ 33.02	2.97	1.32	1.75	2.50	0.25	0.50	**$ 42.31**
Group 5 (Primary Care Paramedics)	$ 42.10	3.79	1.68	1.75	2.50	0.25	0.50	**$ 52.57**
Group 6 (Registered Nurse & Fire Prevention Officers)	$ 47.81	4.30	1.91	1.75	2.50	0.25	0.50	**$ 59.02**

Group 7 (Dump Trucks)	Basic Hourly Rate	Total (incl HST)	Adv. Fund	Building Fund	Gross Hourly Pkg
Tandem Axle	$ 91.75	103.68	0.50	0.25	104.43
Tandem Tandem Axle	$ 103.75	117.24	0.50	0.25	117.99

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

The International Brotherhood of Teamsters and Local Union 855
Schedule "A"
Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Teamsters Building Fund	Advancement Fund	**Gross Hourly Package**
		9%	4%					
Group 1 (Heavy Trucks)	$ 38.46	3.46	1.54	1.75	2.50	0.25	0.50	**$ 48.46**
Group 2 (Dual Axle/Tandem Axle)	$ 38.25	3.44	1.53	1.75	2.50	0.25	0.50	**$ 48.22**
Group 3 (Single Axle)	$ 38.04	3.42	1.52	1.75	2.50	0.25	0.50	**$ 47.98**
Group 4 (Warehouse)	$ 38.46	3.46	1.54	1.75	2.50	0.25	0.50	**$ 48.46**
Warehouse Apprentice 1 - 70%	$ 26.92	2.42	1.08	1.75	2.50	0.25	0.50	**$ 35.42**
Warehouse Apprentice 2 - 80%	$ 30.77	2.77	1.23	1.75	2.50	0.25	0.50	**$ 39.77**
Warehouse Apprentice 3 - 90%	$ 34.61	3.12	1.38	1.75	2.50	0.25	0.50	**$ 44.11**
Group 5 (Primary Care Paramedics)	$ 43.87	3.95	1.75	1.75	2.50	0.25	0.50	**$ 54.57**
Group 6 (Registered Nurse & Fire Prevention Officers)	$ 49.58	4.46	1.98	1.75	2.50	0.25	0.50	**$ 61.02**

Group 7 (Dump Trucks)	Basic Hourly Rate	Total (incl HST)	Adv. Fund	Building Fund	Gross Hourly Pkg
Tandem Axle	$ 91.75	103.68	0.50	0.25	104.43
Tandem Tandem Axle	$ 103.75	117.24	0.50	0.25	117.99

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

The International Brotherhood of Teamsters and Local Union 855
Schedule "A"
Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Teamsters Building Fund	Advancement Fund	**Gross Hourly Package**
		9%	4%					
Group 1 (Heavy Trucks)	$ 40.67	3.66	1.63	1.75	2.50	0.25	0.50	**$ 50.96**
Group 2 (Dual Axle/Tandem Axle)	$ 40.46	3.64	1.62	1.75	2.50	0.25	0.50	**$ 50.72**
Group 3 (Single Axle)	$ 40.25	3.62	1.61	1.75	2.50	0.25	0.50	**$ 50.48**
Group 4 (Warehouse)	$ 40.67	3.66	1.63	1.75	2.50	0.25	0.50	**$ 50.96**
Warehouse Apprentice 1 - 70%	$ 28.47	2.56	1.14	1.75	2.50	0.25	0.50	**$ 37.17**
Warehouse Apprentice 2 - 80%	$ 32.54	2.93	1.30	1.75	2.50	0.25	0.50	**$ 41.77**
Warehouse Apprentice 3 - 90%	$ 36.60	3.29	1.46	1.75	2.50	0.25	0.50	**$ 46.35**
Group 5 (Primary Care Paramedics)	$ 46.08	4.15	1.84	1.75	2.50	0.25	0.50	**$ 57.07**
Group 6 (Registered Nurse & Fire Prevention Officers)	$ 51.79	4.66	2.07	1.75	2.50	0.25	0.50	**$ 63.52**

Group 7 (Dump Trucks)	Basic Hourly Rate	Total (incl HST)	Adv. Fund	Building Fund	Gross Hourly Pkg
Tandem Axle	$ 91.75	103.68	0.50	0.25	104.43
Tandem Tandem Axle	$ 103.75	117.24	0.50	0.25	117.99

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

The International Brotherhood of Teamsters and Local Union 855
Schedule "A"
Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Teamsters Building Fund	Advancement Fund	**Gross Hourly Package**
		9%	4%					
Group 1 (Heavy Trucks)	$ 42.44	3.82	1.70	1.75	2.50	0.25	0.50	**$ 52.96**
Group 2 (Dual Axle/Tandem Axle)	$ 42.23	3.80	1.69	1.75	2.50	0.25	0.50	**$ 52.72**
Group 3 (Single Axle)	$ 42.02	3.78	1.68	1.75	2.50	0.25	0.50	**$ 52.48**
Group 4 (Warehouse)	$ 42.44	3.82	1.70	1.75	2.50	0.25	0.50	**$ 52.96**
Warehouse Apprentice 1 - 70%	$ 29.71	2.67	1.19	1.75	2.50	0.25	0.50	**$ 38.57**
Warehouse Apprentice 2 - 80%	$ 33.95	3.06	1.36	1.75	2.50	0.25	0.50	**$ 43.37**
Warehouse Apprentice 3 - 90%	$ 38.20	3.44	1.53	1.75	2.50	0.25	0.50	**$ 48.17**
Group 5 (Primary Care Paramedics)	$ 47.85	4.31	1.91	1.75	2.50	0.25	0.50	**$ 59.07**
Group 6 (Registered Nurse & Fire Prevention Officers)	$ 53.56	4.82	2.14	1.75	2.50	0.25	0.50	**$ 65.52**

Group 7 (Dump Trucks)	Basic Hourly Rate	Total (incl HST)	Adv. Fund	Building Fund	Gross Hourly Pkg
Tandem Axle	$ 91.75	103.68	0.50	0.25	104.43
Tandem Tandem Axle	$ 103.75	117.24	0.50	0.25	117.99

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly) as per Article 27

Schedule "B" – Owner / Operator
Terms and Conditions of Retention

1. The purpose of this Schedule is to set out the terms and conditions for Contractor(s) to retain Owner/Operator trucks ("Equipment") to work on the Project. If there is a conflict between the terms and conditions contained in Articles 1 to 38 of the Agreement and the terms and conditions of this Schedule, the terms and conditions in this Schedule shall prevail.

2. The total compensation and benefits, paid to Owner/Operators for Equipment shall be, as of the date of ratification, as per Schedule A Group 7 attached hereto, (the "Owner/Operator Compensation"). The Owner/Operator Compensation shall be determined prior to the commencement of work by Owner/Operators and may be changed at any time during the term of this Agreement, after consultation with the Union, and subject to the prior written approval of the Association. Owner/Operators shall not be entitled to any financial compensation and benefits as contained within the Agreement, except as provided for in this Schedule "B".

3. Owner/Operator, for the purposes of the Agreement, shall mean any person who owns, leases or rents and operates equipment who has been retained by a Contractor to work on the Project. Person, for the purposes of this Schedule, shall include any individual, firm, business, partnership or corporate entity that owns, leases or rents the Equipment that has been retained by the Contractor, which individual, firm, business, partnership or corporate entity is controlled by the person who operates the Equipment.

4. Notwithstanding Article 7.07 of this Agreement or any other provision of the Agreement, the retention of Owner/Operators shall be done at the sole discretion of each Contractor. In exercising its discretion, each Contractor must be in compliance where required with the Benefits Strategy and where required shall give preference in hiring to qualified Innu Owner/Operators.

5. Notwithstanding Article 30 of the Agreement or any other Article, a Contractor may discontinue the services of an Owner/Operator at any time.

6. All Owner/Operators will be represented by the Union as per Article 6. Prior to commencing work the Contractor shall provide the name, address and social insurance number of the Owner/Operator to the Union.

7. Articles 7, 10, 19 - 27, 30 - 32, and 34 - 38 of the Agreement shall not apply to Owner/Operators.

8. All work shall be performed and equipment operated in accordance with the *Occupational Health and Safety Act*.

9. The hours of operation of Equipment for Owner/Operators shall be determined by the Contractor and subject to the approval of the Association.

10. The Contractor shall save the Association and Union harmless from any and all causes of action, claims or demands of any nature or kind, including but not limited to expenses, costs, legal fees and disbursements, that may be made against the Union and/or Association for amounts due and owing by the Contractor to the Owner/Operator.

11. The Contractor may, subject to the prior written approval of the Association, develop policies, procedures, rules, regulations, working conditions, terms or standards in relation to the Equipment and the Owner/Operator's work on the Project (collectively referred to as the "Owner/Operator Regulations") which may be amended from time to time, subject to the prior written approval of the Association. The Owner/Operator Regulations shall include but are not limited to the following:

    a) Owner/Operators shall comply with all site standards, rules, regulations, policies and procedures as developed and amended by the Association from time to time.

    b) Contractor(s) may provide fuel to Owner/Operators, which fuel and delivery costs may be deducted from the Owner/Operator Compensation.

    c) The Contractor(s) shall have the right to require an inspection(s) of Equipment before Equipment comes onto a Project work site and/or an Owner/Operator commences work or at any time during the Project. Any Equipment not in good working condition will not be permitted on a work site and/or will not be permitted to commence work or continue to work. All Equipment must be equipped with back up alarms, flashing lights or any other equipment or device required by Occupational Health & Safety legislation or other applicable provincial legislation, the Contractor and/or Association.

    d) Owner/Operators shall maintain, with each piece of Equipment, a fire extinguisher, first aid kit or any other safety devices required by Occupational Health & Safety legislation or other applicable provincial legislation, the Contractor and/or Association.

    e) Owner/Operators can request the Contractor to do normal routine maintenance from any maintenance facility on the Project, (eg. belts, hoses, tires). Subject to available facilities and resources on the Project, the Contractor may provide these services to Owner/Operators. The labour and all other costs or expense associated with all repairs and/or maintenance will be charged to each Owner/Operator and deducted from the Owner/Operator Compensation. Owner/Operators are responsible for all repair and maintenance costs.

    f) Owner/Operators will be required to obtain a medical assessment as determined by the Association from time to time, prior to commencing work on the Project and shall be required to comply with all Project safety standards, policies, procedures, rules and regulations as determined by the Association. The Contractor shall pay the reasonable costs of the medical assessment.

    g) Owner/Operators will be required to participate in Project orientation developed for Owner/Operators, prior to commencing work on the Project.

    h) Contractor(s) shall not be responsible to compensate Owner/Operators for any costs, expenses, charges, damages or lost compensation or benefits of any nature or kind as a result of downtime to Equipment caused by required maintenance or repairs or waiting for maintenance or repairs or any other reason.

    i) Contractor(s) have the right to select or determine the nature, type, size or any other specifications of Equipment before the Owner/Operators commences work.

j) Owner/Operators must provide to the Contractor and/or the Association, upon request, proof of Equipment registration, proof of registration and good standing with Workplace, Health, Safety & Compensation Commission, proof of Equipment insurance, proof of liability insurance in an amount to be determined by the Contractor and subject to the approval of the Association, and inspection certificates when requested.

INTERNATIONAL UNION OF BRICKLAYERS AND ALLIED CRAFTWORKERS AND LOCAL UNION 1

1.0 APPLICATION

1.01 This Trade Appendix shall apply to the following:

Group 1: Bricklayer
Precast Welder and Erector
Cement Finisher
Plasterer
Tile and Terrazzo Mechanic
Epoxy Applicator
Fireproofer

Group 2: Tile Helper
Masonry Helper

Group 3: Caulker, Pointer, Cleaner
Brickpaver
Masonry Water Proofer

Apprentice
Foreperson & General Foreperson

1.02 The Foreperson shall receive fifteen (15%) percent over the Journeyperson rate. A General Foreperson shall receive twenty (20%) percent over the Journeyperson rate.

Mixer/Helper and Forklift/Helpers shall receive one dollar ($1.00) per hour over the Masonry Helper rate when the fifth Helper is hired (per job).

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be ten percent (10%) percent of gross wages including over-time for all employees.

3.0 BENEFIT FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage and Benefit Schedule for each hours earned. Payments shall be made no later than the 15th of the month following the month in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payments shall be made as follows:

(a) Health and Welfare Fund

Address: Atlantic Provinces Health and Welfare Trust Fund
1216 Sand Cove Road, Unit 32
Saint John, NB E2M 5V8

Cheque payable to: Atlantic Provinces Health and Welfare Trust Fund

(b) Pension Fund

Address: I.U. of B.A.C. Pension Fund
1216 Sand Cove Road, Unit 32
Saint John, NB E2M 5V8

Cheque payable to: I.U. of B.A.C. Pension Fund

(c) BAC Industry Fund

Address: I.U. of B.A.C. Organizing Fund
631 CBS Highway
Conception Bay South NL A1A 7L4

Cheque payable to: I.U. of B.A.C. Organizing Fund

(d) Training Fund

Address: I.U. of B.A.C. Training Fund
631 CBS Highway
Conception Bay South NL A1A 7L4

Cheque payable to: Training Fund

(e) Industry Fund (RDTC)

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Resource Development Trades Council Industry Fund

(f) Canadian Building Trades Fund

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Canadian Building Trades Fund NL

4.0 UNION DUES

4.01 Subject to Article 6 of the Agreement, each Contractor shall deduct from the employee's wages the appropriate monthly dues, percentage and initiation fee as per the Union referral slip each month. International Union Dues shall also be deducted as per the Union referral slip.

4.02 These dues shall be forwarded to:

Address: B.A.C. Local 1
631 CBS Hwy
Conception Bay South NL A1A 7L4

4.03 Payment of dues shall be made not later than fifteen (15) days after the end of the calendar month for which the dues were collected.

5.0 REFRACTORY:

5.01 Workers engaged on firebrick refractory work, furnace repair, acid tile, epoxy coating or similar work shall work in accordance with the four Province Agreements covering same.

6.0 APPRENTICES

6.01 Apprentices shall become indentured as soon as possible under the provisions of the Apprenticeship Act of the Province. The document of Indenture shall not conflict in any way with the provisions of this agreement.

6.02 The probationary period for apprenticeship shall not exceed four (4) months from the time the apprenticeship period started.

6.03 The Apprenticeship Standards for the trade of Bricklayers and Masonry, approved April 28, 1954, shall continue to remain in force and effect except where any provision of such Standards may conflict with any provision of this agreement.

6.04 Apprentices shall be given one-year credit for pre-job training at BAC Masonry College or any Provincial Vocational.

6.05 An apprentice shall not replace the mason's helper.

Apprentices shall receive the following percentage of a Journeyperson's rate:

First six months in the trade 56%
Second six months in the trade 62%
Third six months in the trade 68%
Fourth six months in the trade 74%
Fifth six months in the trade 80%
Sixth six months in the trade 85%
Seventh six months in the trade 90%
Eight six months in the trade 95%
Full Journeyman's rate thereafter.

The third six months and thereafter shall be the percentages for the three year apprenticeship of a Cement Mason.

7.0 HEIGHT PAY

7.01 The premium above the regular hourly rate shall be paid to employees required to work at heights under such conditions; temporary staging, scaffolding, tower like structures or structures with a direct drop of (50) feet or more shall receive one dollar ($1.00).

8.0 TOOLS

8.01 Cement Finishers shall provide and maintain the following tools:

One 6' tape	Hand floats-one wood, one metal
One 11" trowel	One hammer
One 14" trowel	One spirit level
One pointing trowel	One brush – excluding wash brushes
One side edger	

All tools to be in serviceable condition

8.02 Bricklayers shall provide and maintain the following tools:

1 Brick Trowel	3 Jointers—1/2", 5/8", ¾"
1 Brick Hammer	1 10' Space rule
1 Pointing Trowel	2 Slicks—¼" and ½"
1 Brick Set	1 4'-0" Level

International Union of Bricklayers and Allied Craftworkers
And Local Union 1
Schedule "A"
Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	BAC Industry Fund	Training Fund	**Gross Hourly Package**
		8%	2%					
General Foreperson	$ 39.41	3.15	0.79	1.90	5.00	1.00	0.50	**$ 51.75**
+20% over JP rate								
Foreperson	$ 37.77	3.02	0.76	1.90	5.00	1.00	0.50	**$ 49.95**
+15% over JP rate								
Bricklayers								
Group 1	$ 32.84	2.62	0.66	1.90	5.00	1.00	0.50	**$ 44.52**
Group 2	$ 29.43	2.35	0.59	1.90	5.00	1.00	0.50	**$ 40.77**
Group 3	$ 31.20	2.49	0.62	1.90	5.00	1.00	0.50	**$ 42.71**
Bricklayers Apprentices								
1st 6 months - 56% of JP rate	$ 18.39	1.47	0.37	1.90	5.00	1.00	0.50	**$ 28.63**
2nd 6 months - 62% of JP rate	$ 20.36	1.63	0.41	1.90	5.00	1.00	0.50	**$ 30.80**
3rd 6 months - 68% of JP rate	$ 22.33	1.79	0.45	1.90	5.00	1.00	0.50	**$ 32.97**
4th 6 months - 74% of JP rate	$ 24.30	1.94	0.49	1.90	5.00	1.00	0.50	**$ 35.13**
5th 6 months - 80% of JP rate	$ 26.27	2.10	0.53	1.90	5.00	1.00	0.50	**$ 37.30**
6th 6 months - 85% of JP rate	$ 27.91	2.23	0.56	1.90	5.00	1.00	0.50	**$ 39.10**
7th 6 months - 90% of JP rate	$ 29.56	2.36	0.59	1.90	5.00	1.00	0.50	**$ 40.91**
8th 6 months - 95% of JP rate	$ 31.20	2.50	0.62	1.90	5.00	1.00	0.50	**$ 42.72**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Bricklayers and Allied Craftworkers
And Local Union 1
Schedule "A"
Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	BAC Industry Fund	Training Fund	**Gross Hourly Package**
		8%	2%					
General Foreperson	$ 41.59	3.33	0.83	1.90	5.00	1.00	0.50	**$ 54.15**
+20% over JP rate								
Foreperson	$ 39.86	3.19	0.80	1.90	5.00	1.00	0.50	**$ 52.25**
+15% over JP rate								
Bricklayers								
Group 1	$ 34.66	2.77	0.69	1.90	5.00	1.00	0.50	**$ 46.52**
Group 2	$ 31.25	2.50	0.63	1.90	5.00	1.00	0.50	**$ 42.78**
Group 3	$ 33.02	2.64	0.66	1.90	5.00	1.00	0.50	**$ 44.72**
Bricklayers Apprentices								
1st 6 months - 56% of JP rate	$ 19.41	1.55	0.39	1.90	5.00	1.00	0.50	**$ 29.75**
2nd 6 months - 62% of JP rate	$ 21.49	1.72	0.43	1.90	5.00	1.00	0.50	**$ 32.04**
3rd 6 months - 68% of JP rate	$ 23.57	1.89	0.47	1.90	5.00	1.00	0.50	**$ 34.33**
4th 6 months - 74% of JP rate	$ 25.65	2.05	0.51	1.90	5.00	1.00	0.50	**$ 36.61**
5th 6 months - 80% of JP rate	$ 27.73	2.22	0.55	1.90	5.00	1.00	0.50	**$ 38.90**
6th 6 months - 85% of JP rate	$ 29.46	2.36	0.59	1.90	5.00	1.00	0.50	**$ 40.81**
7th 6 months - 90% of JP rate	$ 31.19	2.50	0.62	1.90	5.00	1.00	0.50	**$ 42.71**
8th 6 months - 95% of JP rate	$ 32.93	2.63	0.66	1.90	5.00	1.00	0.50	**$ 44.62**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Bricklayers and Allied Craftworkers
And Local Union 1
Schedule "A"
Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	BAC Industry Fund	Training Fund	**Gross Hourly Package**
		8%	2%					
General Foreperson	$ 44.32	3.55	0.89	1.90	5.00	1.00	0.50	**$ 57.16**
+20% over JP rate								
Foreperson	$ 42.47	3.40	0.85	1.90	5.00	1.00	0.50	**$ 55.12**
+15% over JP rate								
Bricklayers								
Group 1	$ 36.93	2.95	0.74	1.90	5.00	1.00	0.50	**$ 49.02**
Group 2	$ 33.52	2.68	0.67	1.90	5.00	1.00	0.50	**$ 45.27**
Group 3	$ 35.29	2.82	0.70	1.90	5.00	1.00	0.50	**$ 47.21**
Bricklayers Apprentices								
1st 6 months - 56% of JP rate	$ 20.68	1.65	0.41	1.90	5.00	1.00	0.50	**$ 31.14**
2nd 6 months - 62% of JP rate	$ 22.90	1.83	0.46	1.90	5.00	1.00	0.50	**$ 33.59**
3rd 6 months - 68% of JP rate	$ 25.11	2.01	0.50	1.90	5.00	1.00	0.50	**$ 36.02**
4th 6 months - 74% of JP rate	$ 27.33	2.19	0.55	1.90	5.00	1.00	0.50	**$ 38.47**
5th 6 months - 80% of JP rate	$ 29.54	2.36	0.59	1.90	5.00	1.00	0.50	**$ 40.89**
6th 6 months - 85% of JP rate	$ 31.39	2.51	0.63	1.90	5.00	1.00	0.50	**$ 42.93**
7th 6 months - 90% of JP rate	$ 33.24	2.66	0.66	1.90	5.00	1.00	0.50	**$ 44.96**
8th 6 months - 95% of JP rate	$ 35.08	2.81	0.70	1.90	5.00	1.00	0.50	**$ 46.99**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Bricklayers and Allied Craftworkers
And Local Union 1
Schedule "A"
Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	BAC Industry Fund	Training Fund	**Gross Hourly Package**
		8%	2%					
General Foreperson	$ 46.50	3.72	0.93	1.90	5.00	1.00	0.50	**$ 59.55**
+20% over JP rate								
Foreperson	$ 44.56	3.56	0.89	1.90	5.00	1.00	0.50	**$ 57.41**
+15% over JP rate								
Bricklayers								
Group 1	$ 38.75	3.10	0.78	1.90	5.00	1.00	0.50	**$ 51.03**
Group 2	$ 35.34	2.83	0.71	1.90	5.00	1.00	0.50	**$ 47.28**
Group 3	$ 37.11	2.96	0.74	1.90	5.00	1.00	0.50	**$ 49.21**
Bricklayers Apprentices								
1st 6 months - 56% of JP rate	$ 21.70	1.74	0.43	1.90	5.00	1.00	0.50	**$ 32.27**
2nd 6 months - 62% of JP rate	$ 24.03	1.92	0.48	1.90	5.00	1.00	0.50	**$ 34.83**
3rd 6 months - 68% of JP rate	$ 26.35	2.11	0.53	1.90	5.00	1.00	0.50	**$ 37.39**
4th 6 months - 74% of JP rate	$ 28.68	2.29	0.57	1.90	5.00	1.00	0.50	**$ 39.94**
5th 6 months - 80% of JP rate	$ 31.00	2.48	0.62	1.90	5.00	1.00	0.50	**$ 42.50**
6th 6 months - 85% of JP rate	$ 32.94	2.64	0.66	1.90	5.00	1.00	0.50	**$ 44.64**
7th 6 months - 90% of JP rate	$ 34.88	2.79	0.70	1.90	5.00	1.00	0.50	**$ 46.77**
8th 6 months - 95% of JP rate	$ 36.81	2.94	0.74	1.90	5.00	1.00	0.50	**$ 48.89**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Bricklayers and Allied Craftworkers
And Local Union 1
Schedule "A"
Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	BAC Industry Fund	Training Fund	**Gross Hourly Package**
		8%	2%					
General Foreperson	$ 49.22	3.94	0.98	1.90	5.00	1.00	0.50	**$ 62.54**
+20% over JP rate								
Foreperson	$ 47.17	3.77	0.94	1.90	5.00	1.00	0.50	**$ 60.28**
+15% over JP rate								
Bricklayers								
Group 1	$ 41.02	3.28	0.82	1.90	5.00	1.00	0.50	**$ 53.52**
Group 2	$ 37.61	3.01	0.75	1.90	5.00	1.00	0.50	**$ 49.77**
Group 3	$ 39.38	3.15	0.78	1.90	5.00	1.00	0.50	**$ 51.71**
Bricklayers Apprentices								
1st 6 months - 56% of JP rate	$ 22.97	1.84	0.46	1.90	5.00	1.00	0.50	**$ 33.67**
2nd 6 months - 62% of JP rate	$ 25.43	2.03	0.51	1.90	5.00	1.00	0.50	**$ 36.37**
3rd 6 months - 68% of JP rate	$ 27.89	2.23	0.56	1.90	5.00	1.00	0.50	**$ 39.08**
4th 6 months - 74% of JP rate	$ 30.35	2.43	0.61	1.90	5.00	1.00	0.50	**$ 41.79**
5th 6 months - 80% of JP rate	$ 32.82	2.63	0.66	1.90	5.00	1.00	0.50	**$ 44.51**
6th 6 months - 85% of JP rate	$ 34.87	2.79	0.70	1.90	5.00	1.00	0.50	**$ 46.76**
7th 6 months - 90% of JP rate	$ 36.92	2.95	0.74	1.90	5.00	1.00	0.50	**$ 49.01**
8th 6 months - 95% of JP rate	$ 38.97	3.12	0.78	1.90	5.00	1.00	0.50	**$ 51.27**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Bricklayers and Allied Craftworkers
And Local Union 1
Schedule "A"
Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	BAC Industry Fund	Training Fund	**Gross Hourly Package**
		8%	2%					
General Foreperson	$ 51.41	4.11	1.03	1.90	5.00	1.00	0.50	**$ 64.95**
+20% over JP rate								
Foreperson	$ 49.27	3.94	0.99	1.90	5.00	1.00	0.50	**$ 62.60**
+15% over JP rate								
Bricklayers								
Group 1	$ 42.84	3.42	0.86	1.90	5.00	1.00	0.50	**$ 55.52**
Group 2	$ 39.43	3.15	0.79	1.90	5.00	1.00	0.50	**$ 51.77**
Group 3	$ 41.20	3.29	0.82	1.90	5.00	1.00	0.50	**$ 53.71**
Bricklayers Apprentices								
1st 6 months - 56% of JP rate	$ 23.99	1.92	0.48	1.90	5.00	1.00	0.50	**$ 34.79**
2nd 6 months - 62% of JP rate	$ 26.56	2.12	0.53	1.90	5.00	1.00	0.50	**$ 37.61**
3rd 6 months - 68% of JP rate	$ 29.13	2.33	0.58	1.90	5.00	1.00	0.50	**$ 40.44**
4th 6 months - 74% of JP rate	$ 31.70	2.54	0.63	1.90	5.00	1.00	0.50	**$ 43.27**
5th 6 months - 80% of JP rate	$ 34.27	2.74	0.69	1.90	5.00	1.00	0.50	**$ 46.10**
6th 6 months - 85% of JP rate	$ 36.41	2.91	0.73	1.90	5.00	1.00	0.50	**$ 48.45**
7th 6 months - 90% of JP rate	$ 38.56	3.08	0.77	1.90	5.00	1.00	0.50	**$ 50.81**
8th 6 months - 95% of JP rate	$ 40.70	3.26	0.81	1.90	5.00	1.00	0.50	**$ 53.17**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

**INTERNATIONAL BROTHERHOOD OF BOILERMAKERS,
IRON SHIP BUILDERS, BLACKSMITHS, FORGERS,
AND HELPERS AND LOCAL UNION 203**

1.0 APPLICATION

1.01 This Trade Appendix shall apply to the following:

General Foreperson
Foreperson
Assistant Foreperson (Working)
Journeyperson
Apprentice
Helper

1.02 On crews of six (6) members or less (including the Foreperson) the Foreperson shall be allowed to work with the tools. The Union recognizes that there may be situations where a General Foreperson, Foreperson or Assistant Foreperson is required to work with the tools to provide instructions on work procedures or where safety is a compelling factor.

1.03 The use of General Forepersons will be determined by management.

1.04 The Assistant Foreperson (working) shall receive a premium of one dollar and seventy cents ($1.70) per hour above the Journeyperson rate.

1.05 The Non-Working Foreperson shall receive a premium of three dollars and five cents ($3.05) per hour above the Journeyperson rate.

1.06 The General Foreperson shall receive a premium of four dollars and fifteen cents ($4.15) per hour above the Journeyperson rate.

1.07 The Helper shall receive seventy-five percent (75%) the Journeyperson rate.

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be twelve (12%) percent of gross wages including over-time for all employees.

3.0 BENEFIT FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage and Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the month following in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payments shall be made as follows:

(a) Health and Welfare Fund

Address: J.J. McAteer & Associates Inc.

45 McIntosh Drive
Markham, ON L3R 8C7

Cheque payable to: Boilermakers National Benefit Fund's (Canada)

(b) Pension Fund

Address: J.J. McAteer & Associates Inc.
45 McIntosh Drive
Markham, ON L3R 8C7

Cheque payable to: Boilermakers National Benefit Fund's (Canada)

(c) Provincial Education and Training Fund

Address: Boilermakers Local 203
PO Box 250
Holyrood, NL A0A 2R0

Cheque payable to: Boilermakers Local Lodge 203

(d) Building Fund

Address: Boilermakers Local 203
PO Box 250
Holyrood, NL A0A 2R0

Cheque payable to: Boilermakers Local Lodge 203

(e) National Training Fund

Address: J.J. McAteer & Associates Inc.
45 McIntosh Drive
Markham, ON L3R 8C7

Cheque payable to: Boilermakers National Benefit Fund's (Canada)

(f) Apprenticeship Fund

Address: Boilermakers Local 203
PO Box 250
Holyrood, NL A0A 2R0

Cheque payable to: Boilermakers Local Lodge 203

(g) Audiometric Testing Fund

Address: J.J. McAteer & Associates Inc.
45 McIntosh Drive
Markham, ON L3R 8C7

Cheque payable to: Boilermakers National Benefit Fund's (Canada)

(h) Benevolent Fund

Address: Boilermakers Local 203
PO Box 250
Holyrood, NL A0A 2R0

Cheque payable to: Boilermakers Local Lodge 203

(i) Industry Fund (RDTC)

Address: Resource Development Trades Council of
Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque payable to: Resource Development Trades Council Industry Fund

(j) Canadian Building Trades Fund

Address: Resource Development Trades Council of
Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Canadian Building Trades Fund

4.0 UNION DUES

4.01 Union Dues as per Article 6 shall be forwarded to:

Address: Boilermakers Local 203
PO Box 250
Holyrood, NL A0A 2R0

5.0 APPRENTICES

5.01 All Apprentices shall be employed in accordance with the provisions of the *Apprenticeship Act*. Apprentices shall be given the support of the Journeyperson working on the job on which the Apprentices are employed, and the supervision of the Foreperson and, under the guidance of the Journeyperson, they may perform rigging, fitting, welding, layout work or any other part of the trade of a Journeyperson Boilermaker.

5.02 Apprentices shall receive the following percentage of a Boilermaker Journeyperson's rate:

First Year	60%
Second Year	75%
Third Year	90%

6.0 HEALTH AND SAFETY

6.01 The Contractor shall supply at no cost to the employee when required by the work he/she is to perform: safety hats, new sweat bands, new liners, appropriate welding gloves, welding helmets, welding and burning goggles, appropriate welding leathers (i.e. Jackets, capes and/or sleeves), non-prescription safety glasses and leather faced gloves (unless special processes dictate otherwise).

International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers, and Helpers and Local Union 203
Schedule "A"
Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Provincial Education and Training Fund	Building Fund	National Training	Apprentice ship Fund	Admin Fund	Audio-metric Testing	Bene-volent Fund	**Gross Hourly Package**
		8%	4%										
General Foreman	$ 34.98	2.80	1.40	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 51.66**
+4.15 over JM													
Foreman	$ 33.88	2.71	1.36	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 50.43**
+3.05 over JM													
Assistant Foreman	$ 32.53	2.60	1.30	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 48.91**
+1.70 over JM													
Journeyman	$ 30.83	2.47	1.23	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 47.01**
Helper - 75% of JM	$ 23.12	1.85	0.92	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 38.37**
Apprentices													
3rd Year - 90% of JM	$ 27.75	2.22	1.11	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 43.56**
2nd Year - 75% of JM	$ 23.12	1.85	0.92	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 38.37**
1st Year - 60% of JM	$ 18.50	1.48	0.74	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 33.20**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trad+B21es Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers, and Helpers and Local Union 203

Schedule "A"

Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Provincial Education and Training Fund	Building Fund	National Training	Apprentice ship Fund	Admin Fund	Audio-metric Testing	Bene-volent Fund	**Gross Hourly Package**
		8%	4%										
General Foreman	$ 36.77	2.94	1.47	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 53.66**
+4.15 over JM													
Foreman	$ 35.67	2.85	1.43	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 52.43**
+3.05 over JM													
Assistant Foreman	$ 34.32	2.75	1.37	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 50.92**
+1.70 over JM													
Journeyman	$ 32.62	2.61	1.30	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 49.01**
Helper - 75% of JM	$ 24.47	1.96	0.98	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 39.89**
Apprentices													
3rd Year - 90% of JM	$ 29.36	2.35	1.17	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 45.36**
2nd Year - 75% of JM	$ 24.47	1.96	0.98	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 39.89**
1st Year - 60% of JM	$ 19.57	1.57	0.78	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 34.40**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trad+B21es Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers, and Helpers and Local Union 203

Schedule "A"

Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Provincial Education and Training Fund	Building Fund	National Training	Apprentice ship Fund	Admin Fund	Audio-metric Testing	Bene-volent Fund	**Gross Hourly Package**
		8%	4%										
General Foreman	$ 39.00	3.12	1.56	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 56.16**
+4.15 over JM													
Foreman	$ 37.90	3.03	1.52	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 54.93**
+3.05 over JM													
Assistant Foreman	$ 36.55	2.92	1.46	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 53.41**
+1.70 over JM													
Journeyman	$ 34.85	2.79	1.39	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 51.51**
Helper - 75% of JM	$ 26.14	2.09	1.05	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 41.76**
Apprentices													
3rd Year - 90% of JM	$ 31.37	2.51	1.25	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 47.61**
2nd Year - 75% of JM	$ 26.14	2.09	1.05	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 41.76**
1st Year - 60% of JM	$ 20.91	1.67	0.84	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 35.90**

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3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers, and Helpers and Local Union 203
Schedule "A"
Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Provincial Education and Training Fund	Building Fund	National Training	Apprentice ship Fund	Admin Fund	Audio-metric Testing	Bene-volent Fund	**Gross Hourly Package**
		8%	4%										
General Foreman	$ 40.79	3.26	1.63	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 58.16**
+4.15 over JM													
Foreman	$ 39.69	3.18	1.59	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 56.94**
+3.05 over JM													
Assistant Foreman	$ 38.34	3.07	1.53	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 55.42**
+1.70 over JM													
Journeyman	$ 36.64	2.93	1.47	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 53.52**
Helper - 75% of JM	$ 27.48	2.20	1.10	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 43.26**
Apprentices													
3rd Year - 90% of JM	$ 32.98	2.64	1.32	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 49.42**
2nd Year - 75% of JM	$ 27.48	2.20	1.10	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 43.26**
1st Year - 60% of JM	$ 21.98	1.76	0.88	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 37.10**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trad+B21es Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers, and Helpers and Local Union 203
Schedule "A"
Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Provincial Education and Training Fund	Building Fund	National Training	Apprentice ship Fund	Admin Fund	Audio-metric Testing	Bene-volent Fund	**Gross Hourly Package**
		8%	4%										
General Foreman	$ 43.02	3.44	1.72	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 60.66**
+4.15 over JM													
Foreman	$ 41.92	3.35	1.68	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 59.43**
+3.05 over JM													
Assistant Foreman	$ 40.57	3.25	1.62	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 57.92**
+1.70 over JM													
Journeyman	$ 38.87	3.11	1.55	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 56.01**
Helper - 75% of JM	$ 29.15	2.33	1.17	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 45.13**
Apprentices													
3rd Year - 90% of JM	$ 34.98	2.80	1.40	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 51.66**
2nd Year - 75% of JM	$ 29.15	2.33	1.17	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 45.13**
1st Year - 60% of JM	$ 23.32	1.87	0.93	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 38.60**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trad+B21es Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers, and Helpers and Local Union 203

Schedule "A"

Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Provincial Education and Training Fund	Building Fund	National Training	Apprentice ship Fund	Admin Fund	Audio-metric Testing	Bene-volent Fund	**Gross Hourly Package**
		8%	4%										
General Foreman	$ 44.81	3.58	1.79	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 62.66**
+4.15 over JM													
Foreman	$ 43.71	3.50	1.75	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 61.44**
+3.05 over JM													
Assistant Foreman	$ 42.36	3.39	1.69	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 59.92**
+1.70 over JM													
Journeyman	$ 40.66	3.25	1.63	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 58.02**
Helper - 75% of JM	$ 30.50	2.44	1.22	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 46.64**
Apprentices													
3rd Year - 90% of JM	$ 36.59	2.93	1.46	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 53.46**
2nd Year - 75% of JM	$ 30.50	2.44	1.22	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 46.64**
1st Year - 60% of JM	$ 24.40	1.95	0.98	2.25	7.50	0.33	1.30	0.18	0.22	0.55	0.03	0.12	**$ 39.81**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trad+B21es Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS AND LOCAL UNION 2330

1.0 TRADE CLASSIFICATIONS

1.01 This trade appendix shall apply to the following trade classifications:

Apprentice
Journeyperson (including Instrument Technicians)
Electrician Welder and Welder
Working Foreperson
Non-Working Foreperson
General Foreperson

1.02 On any job where there are less than four (4) workers and the job warrants, one (1) Journeyperson shall be appointed Working Foreperson.

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 The Contractor shall pay each employee 10% of earnings based on gross pay as vacation pay and 3% of earnings based on gross pay as recognized holiday pay.

3.0 BENEFIT FUNDS

3.01 Each Contractor shall contribute the amounts stated in the attached Wage and Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the month following the month in which the hours were earned. Income Tax to be deducted weekly as part of gross earnings.

3.02 Vacation Pay and Holiday Pay shall be deducted weekly and shall be paid to the union office once a month to the following address:

Address: IBEW Local 2330
1082 Thorburn Road
Portugal Cove
St. Phillip's, NL A1M 1V8

Cheque Payable to: IBEW 2330 Vacation and Holiday Pay Fund

3.03 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.04 Payments shall be made as follows:

(a) Health and Welfare Fund

Address: Benefit Plan Administrators
7001 Mumford Road
Suite 216, Tower 1
Halifax, NS B3L 4N9

Cheque payable to: IBEW 2330 Health and Welfare Fund

(b) Pension Fund

Address: Benefit Plan Administrators
7001 Mumford Road
Suite 216, Tower 1
Halifax, NS B3L 4N9

Cheque payable to: IBEW 2330 Pension Benefit Fund

(c) Trade Improvement Fund

Address: IBEW Local 2330
1082 Thorburn Road
Portugal Cove
St. Phillip's, NL A1M 1V8

Cheque Payable to: IBEW 2330 Trade Improvement Fund

(d) Membership Development Fund

Address: IBEW Local 2330
1082 Thorburn Road
Portugal Cove
St. Phillip's, NL A1M 1V8

Cheque Payable to: IBEW 2330 Membership Development Fund

(e) Industry Fund (RDTC)

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Resource Development Trades Council Industry Fund

(f) Canadian Building Trades Fund

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Canadian Building Trades Fund

4.0 UNION DUES

4.01 Each Contractor shall deduct from the employee's wages the appropriate monthly dues, percentage and initiation fee as stipulated under Article 6 of the Agreement.

4.02 These dues will be forwarded to:

Address: IBEW Local 2330
1082 Thorburn Road
Portugal Cove
St. Phillip's, NL A1M 1V8

4.03 Payment of dues shall be made not later than fifteen (15) days after the end of the calendar month for which the dues were collected.

5.0 GENERAL

5.01 Only employees who have been instructed in the proper use of explosive actuated tools will be permitted to use them, and no employee shall be discriminated against for refusing to use such tools.

5.02 First and second year apprentices shall not be permitted to use explosive actuated tools.

5.03 There shall be two (2) journeypersons assigned to work on energized circuits of 220 volts or over, when circuits cannot be de-energized or where there is no obvious danger.

6.0 APPRENTICES

6.01 The employment of apprentices shall be in accordance with the Apprenticeship Act and Regulations and Amendments thereto. The Contractor shall maintain where practical, an equal number of each class of apprentices in his/her employ. Hiring of new apprentices shall be done (Subject to Article 7 and 34) in accordance with maintaining the equal number of each class of apprentice where practical.

6.02 If a Contractor lays off a third or fourth year apprentice, he shall not be replaced by a second or third year apprentice while there are third or fourth year apprentices unemployed in the immediate area.

6.03 First, second and third year apprentices shall work under the direct supervision of a journeyperson, fourth year apprentice shall not supervise any other apprentice.

6.04 An apprentice shall not be used as a storeroom man, warehouseman or Truckdriver for a continuous period of more than two (2) months.

6.05 Apprentice Rates of Pay:

The rates for apprentice will be as follows:

First year	55% of journeyperson's Hourly Rate
Second year	65% of journeyperson's Hourly Rate
Third year	70% of journeyperson's Hourly Rate
Fourth year	80% of journeyperson's Hourly Rate

A fourth year apprentice must write his/her journeyperson examination within twelve (12) months of obtaining his/her fourth year status, provided he/she has the required hours.

If the apprentice does not write the examination, then his/her rate of pay will be 75% of the journeyperson's rate.

7.0 RATES OF PAY

7.01 Working Foreperson's rate shall be five (5%) percent above a Journeyperson's hourly rate.

7.02 Non-working Foreman's rate of pay shall be ten (10%) percent above a journeyperson's hourly rate of pay.

7.03 The General Foreman's rate of pay shall be fifteen (15%) percent above a journeyperson's hourly rate of pay.

7.04 Apprentice Electricians/Electricians performing welding shall receive five (5%) percent above the journeyperson's hourly rate of pay.

8.0 HEIGHT PAY

8.01 Employees required to work on smoke stacks, structural steel, towers, from a bosun's chair or bucket, staging, or other areas which are fifteen (15) to thirty (30) meters shall receive an additional ten (10%) percent of his/hers straight basic hourly rate while on such work. If over thirty (30) meters, the pay will be one and one half times (1 ½) the straight basic hourly rate while on such work.

8.02 The height shall be measured from the employees standing or sitting surface position while working to the first permanent floor, planked in floor, formed in surface or metal deck or to the ground, whichever is higher. Height pay shall be paid in no less than one (1) hour increments.

9.0 TOOLS

9.01 Journeypersons shall be required to have:

1	8" Linesman Pliers	1	Channellocks
1	Side Cutting Pliers	1	Needle Nose Pliers
1	Tool Box	1	Metal Rule, 3 meter minimum
1	Knife	1	Philips Head Screwdrivers #6, 8 and 10
1	Robertson Head Screwdrivers #6, 8 and 10	1	Set Allen Key Wrenches up to ½"
1	Straight Head Screwdrivers	1	Meter, A/C, Amps/Volts/Ohms
1	Hacksaw Frame	1	Ball Peen Hammer
1	Flashlight	1	Set Socket Head or Nut Drivers
1	Box End Wrenches or Adjustable Wrench		

9.02 Apprentices shall supply themselves with the following basic tools for each year and be in possession of a complete list of tools upon becoming a journeyperson:

FIRST YEAR – BASIC TOOLS

1	8" Pliers	1	Channellocks
1	Knife	1	Tool Box
3	Robertson Head Screwdrivers #6, 8 and 10	1	Tape, 10' minimum
3	Straight Head Screwdrivers		

SECOND YEAR – ADDITIONAL TOOLS

1	Hacksaw Frame	1	Ball Peen Hammer
1	Locksaw		

THIRD YEAR – ADDITIONAL TOOLS

1	Side Cutting Pliers	1	Needle Nose Pliers
3	Phillips Head Screwdrivers #6, 8 and 10	1	Box End or Adjustable Wrench

FOURTH YEAR – ADDITIONAL TOOLS

1	Set Socket or Nut Drivers

9.03 The Contractor shall furnish all other necessary tools or equipment. Employees will be held responsible for the tools issued to theme provided the Contractor furnishes the necessary lockers, gang boxes or other safe places for storage.

International Brotherhood of Electrical Workers
and Local Union 2330
Schedule "A"
Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Trade Improvement Fund	Member Develop Fund	**Gross Hourly Package**
		10%	3%					
General Foreperson	$ 38.66	3.87	1.16	2.00	5.95	0.14	0.40	**$ 52.18**
+15% over JP Rates								
Non-Working Foreperson	$ 36.98	3.70	1.11	2.00	5.95	0.14	0.40	**$ 50.28**
+10% over JP Rates								
Working Foreperson	$ 35.30	3.53	1.06	2.00	5.95	0.14	0.40	**$ 48.38**
+5% over JP Rates								
Apprentice/Journeyman Electrician Welder/Welder	$ 35.30	3.53	1.06	2.00	5.95	0.14	0.40	**$ 48.38**
+5% over JP Rates								
Journeyperson	$ 33.62	3.36	1.01	2.00	5.95	0.14	0.40	**$ 46.48**
Apprentices								
1st year - 55% of JP Rate	$ 18.49	1.85	0.55	2.00	5.95	0.14	0.40	**$ 29.38**
2nd year - 65% of JP Rate	$ 21.85	2.19	0.66	2.00	5.95	0.14	0.40	**$ 33.19**
3rd year - 70% of JP Rate	$ 23.53	2.35	0.71	2.00	5.95	0.14	0.40	**$ 35.08**
4th year - 80% of JP Rate	$ 26.90	2.69	0.81	2.00	5.95	0.14	0.40	**$ 38.89**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Electrical Workers
and Local Union 2330
Schedule "A"
Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Trade Improvement Fund	Member Develop Fund	**Gross Hourly Package**
		10%	3%					
General Foreperson	$ 40.70	4.07	1.22	2.00	5.95	0.14	0.40	**$ 54.48**
+15% over JP Rates								
Non-Working Foreperson	$ 38.93	3.89	1.17	2.00	5.95	0.14	0.40	**$ 52.48**
+10% over JP Rates								
Working Foreperson	$ 37.16	3.72	1.11	2.00	5.95	0.14	0.40	**$ 50.48**
+5% over JP Rates								
Apprentice/Journeyman Electrician Welder/Welder	$ 37.16	3.72	1.11	2.00	5.95	0.14	0.40	**$ 50.48**
+5% over JP Rates								
Journeyperson	$ 35.39	3.53	1.06	2.00	5.95	0.14	0.40	**$ 48.47**
Apprentices								
1st year - 55% of JP Rate	$ 19.46	1.95	0.58	2.00	5.95	0.14	0.40	**$ 30.48**
2nd year - 65% of JP Rate	$ 23.00	2.30	0.69	2.00	5.95	0.14	0.40	**$ 34.48**
3rd year - 70% of JP Rate	$ 24.77	2.48	0.74	2.00	5.95	0.14	0.40	**$ 36.48**
4th year - 80% of JP Rate	$ 28.31	2.83	0.85	2.00	5.95	0.14	0.40	**$ 40.48**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Electrical Workers
and Local Union 2330
Schedule "A"
Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Trade Improvement Fund	Member Develop Fund	**Gross Hourly Package**
		10%	3%					
General Foreperson	$ 43.24	4.32	1.30	2.00	5.95	0.14	0.40	**$ 57.35**
+15% over JP Rates								
Non-Working Foreperson	$ 41.36	4.14	1.24	2.00	5.95	0.14	0.40	**$ 55.23**
+10% over JP Rates								
Working Foreperson	$ 39.48	3.95	1.18	2.00	5.95	0.14	0.40	**$ 53.10**
+5% over JP Rates								
Apprentice/Journeyman Electrician Welder/Welder	$ 39.48	3.95	1.18	2.00	5.95	0.14	0.40	**$ 53.10**
+5% over JP Rates								
Journeyperson	$ 37.60	3.76	1.13	2.00	5.95	0.14	0.40	**$ 50.98**
Apprentices								
1st year - 55% of JP Rate	$ 20.68	2.07	0.62	2.00	5.95	0.14	0.40	**$ 31.86**
2nd year - 65% of JP Rate	$ 24.44	2.44	0.73	2.00	5.95	0.14	0.40	**$ 36.10**
3rd year - 70% of JP Rate	$ 26.32	2.63	0.79	2.00	5.95	0.14	0.40	**$ 38.23**
4th year - 80% of JP Rate	$ 30.08	3.01	0.90	2.00	5.95	0.14	0.40	**$ 42.48**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Electrical Workers
and Local Union 2330
Schedule "A"
Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Trade Improvement Fund	Member Develop Fund	**Gross Hourly Package**
		10%	3%					
General Foreperson	$ 45.28	4.53	1.36	2.00	5.95	0.14	0.40	**$ 59.66**
+15% over JP Rates								
Non-Working Foreperson	$ 43.31	4.33	1.30	2.00	5.95	0.14	0.40	**$ 57.43**
+10% over JP Rates								
Working Foreperson	$ 41.34	4.13	1.24	2.00	5.95	0.14	0.40	**$ 55.20**
+5% over JP Rates								
Apprentice/Journeyman Electrician Welder/Welder	$ 41.34	4.13	1.24	2.00	5.95	0.14	0.40	**$ 55.20**
+5% over JP Rates								
Journeyperson	$ 39.37	3.93	1.18	2.00	5.95	0.14	0.40	**$ 52.97**
Apprentices								
1st year - 55% of JP Rate	$ 21.65	2.17	0.65	2.00	5.95	0.14	0.40	**$ 32.96**
2nd year - 65% of JP Rate	$ 25.59	2.56	0.77	2.00	5.95	0.14	0.40	**$ 37.41**
3rd year - 70% of JP Rate	$ 27.56	2.76	0.83	2.00	5.95	0.14	0.40	**$ 39.64**
4th year - 80% of JP Rate	$ 31.50	3.15	0.95	2.00	5.95	0.14	0.40	**$ 44.09**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Electrical Workers
and Local Union 2330
Schedule "A"
Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Trade Improvement Fund	Member Develop Fund	**Gross Hourly Package**
		10%	3%					
General Foreperson	$ 47.82	4.78	1.43	2.00	5.95	0.14	0.40	**$ 62.52**
+15% over JP Rates								
Non-Working Foreperson	$ 45.74	4.57	1.37	2.00	5.95	0.14	0.40	**$ 60.17**
+10% over JP Rates								
Working Foreperson	$ 43.66	4.37	1.31	2.00	5.95	0.14	0.40	**$ 57.83**
+5% over JP Rates								
Apprentice/Journeyman Electrician Welder/Welder	$ 43.66	4.37	1.31	2.00	5.95	0.14	0.40	**$ 57.83**
+5% over JP Rates								
Journeyperson	$ 41.58	4.15	1.25	2.00	5.95	0.14	0.40	**$ 55.47**
Apprentices								
1st year - 55% of JP Rate	$ 22.87	2.29	0.69	2.00	5.95	0.14	0.40	**$ 34.34**
2nd year - 65% of JP Rate	$ 27.03	2.70	0.81	2.00	5.95	0.14	0.40	**$ 39.03**
3rd year - 70% of JP Rate	$ 29.11	2.91	0.87	2.00	5.95	0.14	0.40	**$ 41.38**
4th year - 80% of JP Rate	$ 33.26	3.33	1.00	2.00	5.95	0.14	0.40	**$ 46.08**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Brotherhood of Electrical Workers
and Local Union 2330
Schedule "A"
Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Trade Improvement Fund	Member Develop Fund	**Gross Hourly Package**
		10%	3%					
General Foreperson	$ 49.85	4.99	1.50	2.00	5.95	0.14	0.40	**$ 64.83**
+15% over JP Rates								
Non-Working Foreperson	$ 47.69	4.77	1.43	2.00	5.95	0.14	0.40	**$ 62.38**
+10% over JP Rates								
Working Foreperson	$ 45.52	4.55	1.37	2.00	5.95	0.14	0.40	**$ 59.93**
+5% over JP Rates								
Apprentice/Journeyman Electrician Welder/Welder	$ 45.52	4.55	1.37	2.00	5.95	0.14	0.40	**$ 59.93**
+5% over JP Rates								
Journeyperson	$ 43.35	4.33	1.30	2.00	5.95	0.14	0.40	**$ 57.47**
Apprentices								
1st year - 55% of JP Rate	$ 23.84	2.38	0.72	2.00	5.95	0.14	0.40	**$ 35.43**
2nd year - 65% of JP Rate	$ 28.18	2.82	0.85	2.00	5.95	0.14	0.40	**$ 40.34**
3rd year - 70% of JP Rate	$ 30.35	3.04	0.91	2.00	5.95	0.14	0.40	**$ 42.79**
4th year - 80% of JP Rate	$ 34.68	3.47	1.04	2.00	5.95	0.14	0.40	**$ 47.68**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

UNITED BROTHERHOOD OF CARPENTERS AND JOINERS OF AMERICA AND MILLWRIGHTS, LOCAL UNION 1009

1.0 APPLICATION

1.01 This Trade Appendix shall apply to the following:

Millwright General Foreperson
Millwright Non-Working Foreperson
Millwright Working Foreperson
Millwright Journeyperson
Millwright Welder
Millwright Apprentice
Machinist

The ratios of Forepersons shall be:

1 – 7 Employees	1 Working Foreperson
8 – 15 Employees	1 Non-Working Foreperson
16 – 20 Employees	1 General Foreperson 1 Non-Working Forepersons
21 – 25 Employees	1 General Foreperson 2 Non-Working Forepersons
26 – 35 Employees	1 General Foreperson 4 Non-Working Forepersons
36 – 47 Employees	2 General Forepersons 5 Non-Working Forepersons
Each additional eight (8) Employees	One (1) Non-Working Foreperson
Each additional thirty (30) Employees	One (1) General Foreperson

The Rate of Pay for Forepersons and General Forepersons shall be:

Working Foreperson	10% above Journeyperson base rate of pay
Non-Working Foreperson	15% above Journeyperson base rate of pay
General Foreperson	20% above Journeyperson base rate of pay

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be thirteen (13%) percent of gross wages including over-time for all employees.

3.0 BENEFIT FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage and Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the month following the month in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of

each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 A member who is currently in receipt of a Millwright 1009 Union pension may request in writing to have the pension amount applied to their basic hourly wage. Such request to change benefit contributions may be made annually between April 1 and April 30 and shall be implemented no later than June 1. This amount will not result in an increase in vacation and holiday pay.

3.04 Payments shall be made as follows:

(a) Health and Welfare Fund

Address: ACRC Joint Contributions Fund
c/o Belmont Financial Services
3 Ralston Avenue, Burnside Industrial Park
Dartmouth, NS B3B 1H5

Cheque payable to: ACRC Health & Wellness Trust

(b) Pension Fund

Address: ACRC Joint Contributions Fund
c/o Belmont Financial Services
3 Ralston Avenue, Burnside Industrial Park
Dartmouth, NS B3B 1H5

Cheque payable to: ACRC Health & Wellness Trust

(c) Building and Training Fund

Address: Millwright Local 1009
Box 3040
Paradise NL A1L 3W2

Cheque payable to: Millwright Local 1009

(d) Organizing Fund

Address: Atlantic Canada Regional Council
1000 Sackville Drive
Lower Sackville NS A1L 3W2

Cheque payable to: Atlantic Canada Regional Council

(e) Stabilization Fund

Address: Millwright Local 1009
Box 3040
Paradise, NL A1L 3W2

Cheque payable to: Millwright Local 1009

(f) Industry Fund (RDTC)

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's NL A1E 3T9

Cheque payable to: Resource Development Trades Council Industry Fund

(g) Canadian Building Trades Fund

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Canadian Building Trades Fund

4.0 UNION DUES

4.01 Union dues as per Article 6 shall be forwarded to:

Address: Atlantic Canada Regional Council
1000 Sackville Drive
Lower Sackville NS, A1L 3W2

Cheque payable to: Atlantic Canada Regional Council

The Union Dues and Organizing amounts shall be submitted on one cheque.

4.02 The employer shall deduct each month from the wages of each employee within the Union Jurisdiction 3.5% of basic hourly rate

5.0 APPRENTICES

5.01 Apprentice pay rate:

1st year	0 – 1,000 hours – 60% of journeyperson rate of pay 1,001 – 2,000 hours – 65% of journeyperson rate of pay
2nd year	2,001 – 3,000 hours - 70% of journeyperson rate of pay 3,001 – 4,000 hours – 75% of journeyperson rate of pay
3rd year	4,001 – 5,000 hours - 80% of journeyperson rate of pay 5,001 – 6,000 hours – 85% of journeyperson rate of pay
4th year	6,001 – 7,000 hours – 90% of journeyperson rate of pay 7,001 – 8,000 hours – 95% of journeyperson rate of pay

5.02 Apprentices will receive an increase of 5% of Journeyperson's rate for each 6 months worked or 1000 hours worked, whichever is greater. The required Block Training will have to be completed prior to advancing to the next year Apprentice pay rate.

6.0 TOOLS

6.01 Every employee must have and maintain a proper kit of tools and it shall be the responsibility of the Contractor in conjunction with the Shop Steward to check the employee's tools to be sure he/she has and maintains the required tools. This shall be a condition of employment.

6.02 Upon commencement of employment, an employee must present to the Contractor a list and value of personal tools of his/her kit.

6.03 Apprentices shall not be required to supply precision tools, such as a micrometer or precision levels, but must be expected to have some of the tools of the trade as befits their experience.

7.0 HEALTH AND SAFETY

7.01 The Contractor shall supply approved safety helmets and such other safety equipment as the employee is not required to provide, and when necessary, shall supply rain suits and rubber boots at no charge to the employee. Tools, safety equipment and other attire furnished by the Contractor shall be at the responsibility of the employee subject to normal wear and tear and shall be returned on the termination of employment or as the Contractor may require.

8.0 WELDERS

8.01 Millwright welders shall receive $0.80/hr in addition to the basic hourly rate for welding, burning or grinding on stainless steel, chrome-moly, galvanized or other alloy materials.

United Brotherhood of Carpenters and Joiners of America and Millwrights
Local Union 1009
Schedule "A"
Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay 10%	Holiday Pay 3%	Health & Welfare Benefit	Pension Plan 18% of Total Pay	Building & Training Fund	Org Fund	Stabilization Fund	**Gross Hourly Package**
	Total Pay								
General Foreman	$ 38.78	3.88	1.16	1.78	7.89	0.40	0.30	0.50	**$ 54.69**
Working Foreman	$ 35.55	3.56	1.07	1.78	7.23	0.40	0.30	0.50	**$ 50.39**
Non-working Foreman	$ 37.17	3.72	1.12	1.78	7.56	0.40	0.30	0.50	**$ 52.55**
Journeyman Millwright - Welder, Machinist	$ 32.32	3.23	0.97	1.78	6.57	0.40	0.30	0.50	**$ 46.07**
Apprentice 1									
0-1000 hrs - 60% of JP	$ 19.39	1.94	0.58	1.78	3.94	0.40	0.30	0.50	**$ 28.83**
1000-2000 hrs - 65% of JP	$ 21.01	2.10	0.63	1.78	4.27	0.40	0.30	0.50	**$ 30.99**
Apprentice 2									
2001-3000 hrs - 70% of JP	$ 22.62	2.26	0.68	1.78	4.60	0.40	0.30	0.50	**$ 33.14**
3001-4000 hrs - 75% of JP	$ 24.24	2.42	0.73	1.78	4.93	0.40	0.30	0.50	**$ 35.30**
Apprentice 3									
4001-5000 hrs - 80% of JP	$ 25.86	2.59	0.78	1.78	5.26	0.40	0.30	0.50	**$ 37.47**
5001-6000 hrs - 85% of JP	$ 27.47	2.75	0.82	1.78	5.59	0.40	0.30	0.50	**$ 39.61**
Apprentice 4									
6001-7000hrs - 90% of JP	$ 29.09	2.91	0.87	1.78	5.92	0.40	0.30	0.50	**$ 41.77**
7001-8000 hrs - 95% of JP	$ 30.70	3.07	0.92	1.78	6.24	0.40	0.30	0.50	**$ 43.91**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Brotherhood of Carpenters and Joiners of America and Millwrights
Local Union 1009
Schedule "A"
Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay 10%	Holiday Pay 3%	Health & Welfare Benefit	Pension Plan 18% of Total Pay	Building & Training Fund	Org Fund	Stabilization Fund	**Gross Hourly Package**
	Total Pay								
General Foreman	$ 40.62	4.06	1.22	1.78	8.26	0.40	0.30	0.50	**$ 57.14**
Working Foreman	$ 37.24	3.72	1.12	1.78	7.57	0.40	0.30	0.50	**$ 52.63**
Non-working Foreman	$ 38.93	3.90	1.17	1.78	7.92	0.40	0.30	0.50	**$ 54.90**
Journeyman Millwright - Welder, Machinist	$ 33.85	3.38	1.02	1.78	6.89	0.40	0.30	0.50	**$ 48.12**
Apprentice 1									
0-1000 hrs - 60% of JP	$ 20.31	2.03	0.61	1.78	4.13	0.40	0.30	0.50	**$ 30.06**
1000-2000 hrs - 65% of JP	$ 22.00	2.20	0.66	1.78	4.47	0.40	0.30	0.50	**$ 32.31**
Apprentice 2									
2001-3000 hrs - 70% of JP	$ 23.70	2.37	0.71	1.78	4.82	0.40	0.30	0.50	**$ 34.58**
3001-4000 hrs - 75% of JP	$ 25.39	2.54	0.76	1.78	5.16	0.40	0.30	0.50	**$ 36.83**
Apprentice 3									
4001-5000 hrs - 80% of JP	$ 27.08	2.71	0.81	1.78	5.51	0.40	0.30	0.50	**$ 39.09**
5001-6000 hrs - 85% of JP	$ 28.77	2.88	0.86	1.78	5.85	0.40	0.30	0.50	**$ 41.34**
Apprentice 4									
6001-7000hrs - 90% of JP	$ 30.47	3.05	0.91	1.78	6.20	0.40	0.30	0.50	**$ 43.61**
7001-8000 hrs - 95% of JP	$ 32.16	3.22	0.96	1.78	6.54	0.40	0.30	0.50	**$ 45.86**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Brotherhood of Carpenters and Joiners of America and Millwrights
Local Union 1009
Schedule "A"
Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay 10%	Holiday Pay 3%	Health & Welfare Benefit	Pension Plan 18% of Total Pay	Building & Training Fund	Org Fund	Stabilization Fund	**Gross Hourly Package**
	Total Pay								
General Foreman	$ 42.91	4.29	1.29	1.78	8.73	0.40	0.30	0.50	**$ 60.20**
Working Foreman	$ 39.34	3.93	1.18	1.78	8.00	0.40	0.30	0.50	**$ 55.43**
Non-working Foreman	$ 41.12	4.12	1.24	1.78	8.37	0.40	0.30	0.50	**$ 57.83**
Journeyman Millwright - Welder, Machinist	$ 35.76	3.57	1.07	1.78	7.27	0.40	0.30	0.50	**$ 50.65**
Apprentice 1									
0-1000 hrs - 60% of JP	$ 21.46	2.15	0.64	1.78	4.37	0.40	0.30	0.50	**$ 31.60**
1000-2000 hrs - 65% of JP	$ 23.24	2.32	0.70	1.78	4.73	0.40	0.30	0.50	**$ 33.97**
Apprentice 2									
2001-3000 hrs - 70% of JP	$ 25.03	2.50	0.75	1.78	5.09	0.40	0.30	0.50	**$ 36.35**
3001-4000 hrs - 75% of JP	$ 26.82	2.68	0.80	1.78	5.45	0.40	0.30	0.50	**$ 38.73**
Apprentice 3									
4001-5000 hrs - 80% of JP	$ 28.61	2.86	0.86	1.78	5.82	0.40	0.30	0.50	**$ 41.13**
5001-6000 hrs - 85% of JP	$ 30.40	3.04	0.91	1.78	6.18	0.40	0.30	0.50	**$ 43.51**
Apprentice 4									
6001-7000hrs - 90% of JP	$ 32.18	3.22	0.97	1.78	6.55	0.40	0.30	0.50	**$ 45.90**
7001-8000 hrs - 95% of JP	$ 33.97	3.40	1.02	1.78	6.91	0.40	0.30	0.50	**$ 48.28**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Brotherhood of Carpenters and Joiners of America and Millwrights
Local Union 1009
Schedule "A"
Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay 10%	Holiday Pay 3%	Health & Welfare Benefit	Pension Plan 18% of Total Pay	Building & Training Fund	Org Fund	Stabilization Fund	**Gross Hourly Package**
	Total Pay								
General Foreman	$ 44.75	4.47	1.34	1.78	9.10	0.40	0.30	0.50	**$ 62.64**
Working Foreman	$ 41.02	4.10	1.23	1.78	8.34	0.40	0.30	0.50	**$ 57.67**
Non-working Foreman	$ 42.88	4.29	1.29	1.78	8.72	0.40	0.30	0.50	**$ 60.17**
Journeyman Millwright - Welder, Machinist	$ 37.29	3.72	1.12	1.78	7.58	0.40	0.30	0.50	**$ 52.69**
Apprentice 1									
0-1000 hrs - 60% of JP	$ 22.37	2.24	0.67	1.78	4.55	0.40	0.30	0.50	**$ 32.81**
1000-2000 hrs - 65% of JP	$ 24.24	2.42	0.73	1.78	4.93	0.40	0.30	0.50	**$ 35.30**
Apprentice 2									
2001-3000 hrs - 70% of JP	$ 26.10	2.61	0.78	1.78	5.31	0.40	0.30	0.50	**$ 37.78**
3001-4000 hrs - 75% of JP	$ 27.97	2.80	0.84	1.78	5.69	0.40	0.30	0.50	**$ 40.28**
Apprentice 3									
4001-5000 hrs - 80% of JP	$ 29.83	2.98	0.89	1.78	6.07	0.40	0.30	0.50	**$ 42.75**
5001-6000 hrs - 85% of JP	$ 31.70	3.17	0.95	1.78	6.45	0.40	0.30	0.50	**$ 45.25**
Apprentice 4									
6001-7000hrs - 90% of JP	$ 33.56	3.36	1.01	1.78	6.83	0.40	0.30	0.50	**$ 47.74**
7001-8000 hrs - 95% of JP	$ 35.43	3.54	1.06	1.78	7.21	0.40	0.30	0.50	**$ 50.22**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Brotherhood of Carpenters and Joiners of America and Millwrights
Local Union 1009
Schedule "A"
Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay 10%	Holiday Pay 3%	Health & Welfare Benefit	Pension Plan 18% of Total Pay	Building & Training Fund	Org Fund	Stabilization Fund	**Gross Hourly Package**
	Total Pay								
General Foreman	$ 47.04	4.70	1.41	1.78	9.57	0.40	0.30	0.50	**$ 65.70**
Working Foreman	$ 43.12	4.31	1.29	1.78	8.77	0.40	0.30	0.50	**$ 60.47**
Non-working Foreman	$ 45.08	4.51	1.36	1.78	9.17	0.40	0.30	0.50	**$ 63.10**
Journeyman Millwright - Welder, Machinist	$ 39.20	3.92	1.18	1.78	7.97	0.40	0.30	0.50	**$ 55.25**
Apprentice 1									
0-1000 hrs - 60% of JP	$ 23.52	2.35	0.71	1.78	4.78	0.40	0.30	0.50	**$ 34.34**
1000-2000 hrs - 65% of JP	$ 25.48	2.55	0.76	1.78	5.18	0.40	0.30	0.50	**$ 36.95**
Apprentice 2									
2001-3000 hrs - 70% of JP	$ 27.44	2.74	0.82	1.78	5.58	0.40	0.30	0.50	**$ 39.56**
3001-4000 hrs - 75% of JP	$ 29.40	2.94	0.88	1.78	5.98	0.40	0.30	0.50	**$ 42.18**
Apprentice 3									
4001-5000 hrs - 80% of JP	$ 31.36	3.14	0.94	1.78	6.38	0.40	0.30	0.50	**$ 44.80**
5001-6000 hrs - 85% of JP	$ 33.32	3.33	1.00	1.78	6.78	0.40	0.30	0.50	**$ 47.41**
Apprentice 4									
6001-7000hrs - 90% of JP	$ 35.28	3.53	1.06	1.78	7.18	0.40	0.30	0.50	**$ 50.03**
7001-8000 hrs - 95% of JP	$ 37.24	3.72	1.12	1.78	7.57	0.40	0.30	0.50	**$ 52.63**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Brotherhood of Carpenters and Joiners of America and Millwrights
Local Union 1009
Schedule "A"
Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay 10%	Holiday Pay 3%	Health & Welfare Benefit	Pension Plan 18% of Total Pay	Building & Training Fund	Org Fund	Stabilization Fund	**Gross Hourly Package**
	Total Pay								
General Foreman	$ 48.88	4.89	1.47	1.78	9.94	0.40	0.30	0.50	**$ 68.16**
Working Foreman	$ 44.80	4.48	1.34	1.78	9.11	0.40	0.30	0.50	**$ 62.72**
Non-working Foreman	$ 46.84	4.69	1.41	1.78	9.53	0.40	0.30	0.50	**$ 65.45**
Journeyman Millwright - Welder, Machinist	$ 40.73	4.07	1.22	1.78	8.28	0.40	0.30	0.50	**$ 57.28**
Apprentice 1									
0-1000 hrs - 60% of JP	$ 24.44	2.44	0.73	1.78	4.97	0.40	0.30	0.50	**$ 35.56**
1000-2000 hrs - 65% of JP	$ 26.47	2.65	0.79	1.78	5.38	0.40	0.30	0.50	**$ 38.27**
Apprentice 2									
2001-3000 hrs - 70% of JP	$ 28.51	2.85	0.86	1.78	5.80	0.40	0.30	0.50	**$ 41.00**
3001-4000 hrs - 75% of JP	$ 30.55	3.06	0.92	1.78	6.22	0.40	0.30	0.50	**$ 43.73**
Apprentice 3									
4001-5000 hrs - 80% of JP	$ 32.58	3.26	0.98	1.78	6.63	0.40	0.30	0.50	**$ 46.43**
5001-6000 hrs - 85% of JP	$ 34.62	3.46	1.04	1.78	7.04	0.40	0.30	0.50	**$ 49.14**
Apprentice 4									
6001-7000hrs - 90% of JP	$ 36.66	3.67	1.10	1.78	7.46	0.40	0.30	0.50	**$ 51.87**
7001-8000 hrs - 95% of JP	$ 38.69	3.87	1.16	1.78	7.87	0.40	0.30	0.50	**$ 54.57**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

UNITED ASSOCIATION OF JOURNEYMEN AND APPRENTICES OF THE PLUMBING AND PIPEFITTING INDUSTRY OF THE U.S. AND CANADA, AND LOCAL UNION 740

1.0 APPLICATION

1.01 This Trade Appendix shall apply to all aspects of the Plumbing and Pipefitting industry:

Apprentice
Journeyperson
Welding Inspectors
Foreperson
General Foreperson

1.02 The Rate of Pay for Forepersons and General Forepersons shall be as follows:

Foreperson	115% of the applicable Journeyperson's rate
General Foreperson	120% of the applicable Journeyperson's rate

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be ten (10%) percent of gross wages including over-time for all employees.

3.0 BENEFIT FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage and Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the month following the month in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payments shall be made as follows:

(a) Pension, Health and Welfare, and Building, Training and Resource Fund

Address: Newfoundland Plumbers & Pipefitters
PO Box 156
Mount Pearl, NL A1N 2C2

Cheque payable to: Newfoundland Plumbers & Pipefitters Trust Fund

(b) Industry Fund (RDTC)

Address: Resource Development Trades Council of
Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1C 5J2

Cheque payable to: Resource Development Trades Council Industry Fund

(c) Canadian Building Trades Fund

Address: Resource Development Trades Council of
Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1C 5J2

Cheque payable to: Canadian Building Trades Fund

4.0 UNION DUES

4.01 Union Dues as per Article 6 shall be forwarded to:

Address: Newfoundland Plumbers & Pipefitters
PO Box 156
Mount Pearl, NL A1N 2C2

5.0 APPRENTICES

5.01 All apprentices shall work under the direct supervision of a working Journeyperson Plumber or Fitter at all times.

5.02 The Apprentice Wage Rate shall be as follows:

(a) Second year – 65% of Journeyperson's rate
(b) Third year – 75% of Journeyperson's rate
(c) Fourth year – 85% of Journeyperson's rate

5.03 In the event a Contractor intends to utilize two (2) Apprentices to one (1) Journeyperson as per Article 34 of the Agreement, such Contractor must have consultation with the Union prior to implementing this ratio.

6.0 HEIGHT PAY

6.01 The following premiums above the regular hourly rate shall be paid to employees required to work at heights under such conditions as Temporary Staging, Scaffolding, Tower Like Structures or Structures with a direct drop of 40ft. or more:

40 to 64 feet	50 cents per hour
65 to 89 feet	60 cents per hour
90 to 124 feet	70 cents per hour
125 feet and up	Time and one half the hourly rate

7.0 WELDING TESTS

7.01 All welders to be engaged in work under this Trade Appendix shall be tested at the UA Local 740 Training Center prior to commencement of employment. By mutual agreement, exceptions will be made for workers referred to Site whose principal residence is outside of Newfoundland.

7.02 No welder shall be dispatched unless he/she has current tickets to perform work required.

8.0 SPECIAL CONDITIONS

8.01 Tools shall be supplied by the Contractor. When piping tool cribs or piping stock rooms are required on piping projects covered under the terms of this Agreement, they must be manned by all United Association Local 740 members. The employer agrees to give every consideration to older or handicapped employees to fill positions in such piping tool cribs or piping stock rooms.

8.02 All journeymen fitters, welders, and apprentices working on stainless steel, chrome-moly, galvanized or other alloy piping which are being burnt or ground and all heliarc and argon welding on heavy wall piping 120 schedule and up shall receive $0.80 cents above the applicable rate of pay.

8.03 Where an employee is required to perform his duties in an abnormally dirty area, he/she shall be provided with coveralls and respirators (at the employees request) while performing his/her duties.

8.04 All tacking and welding on piping shall be done by a qualified welder only. Welding mitts and goggles shall be supplied to the welder also to the fitter while he/she is fitting for the welder. Welding jackets shall be provided to the welders as a tool crib item.

8.05 Where an employee is required to perform his/her duties in an area heated in excess of 100 degrees F, he/she shall receive $1.00 per hour above the normal rate of pay.

8.06 The Contractor shall name hire from any source all Welding Inspectors and they shall be paid the Foreman's rate of pay. It shall be the responsibility of the Contractor to identify qualifications for all Welding Inspectors and to ensure they meet this criteria prior to employment. It is acknowledged that the Contractor may also employ Welding Engineers or Quality Assurance who shall inspect in accordance with all applicable Industry Codes and Specifications and shall not be subject to this Agreement.

United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the U.S. and Canada, and Local Union 740

Schedule "A"

Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation + Holiday Pay 10%	Health & Welfare Benefit	Pension Plan	Building, Training & Resource Fund	**Gross Hourly Package**
Journeyperson	$ 34.41	3.44	2.25	6.00	2.08	**$ 48.18**
Foreperson	$ 39.57	3.96	2.25	6.00	2.08	**$ 53.86**
+15% over JP rates						
General Foreperson	$ 41.29	4.13	2.25	6.00	2.08	**$ 55.75**
+20% over JP rates						
Apprentices						
2nd Year - 65% of JP	$ 22.37	2.24	2.25	6.00	2.08	**$ 34.94**
3rd Year - 75% of JP	$ 25.81	2.58	2.25	6.00	2.08	**$ 38.72**
4th Year - 85% of JP	$ 29.25	2.93	2.25	6.00	2.08	**$ 42.51**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the U.S. and Canada, and Local Union 740

Schedule "A"

Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation + Holiday Pay 10%	Health & Welfare Benefit	Pension Plan	Building, Training & Resource Fund	**Gross Hourly Package**
Journeyperson	$ 35.55	3.55	2.50	6.00	2.58	**$ 50.18**
Foreperson	$ 40.88	4.09	2.50	6.00	2.58	**$ 56.05**
+15% over JP rates						
General Foreperson	$ 42.66	4.27	2.50	6.00	2.58	**$ 58.01**
+20% over JP rates						
Apprentices						
2nd Year - 65% of JP	$ 23.11	2.31	2.50	6.00	2.58	**$ 36.50**
3rd Year - 75% of JP	$ 26.66	2.67	2.50	6.00	2.58	**$ 40.41**
4th Year - 85% of JP	$ 30.22	3.02	2.50	6.00	2.58	**$ 44.32**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the U.S. and Canada, and Local Union 740

Schedule "A"

Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation + Holiday Pay 10%	Health & Welfare Benefit	Pension Plan	Building, Training & Resource Fund	**Gross Hourly Package**
Journeyperson	$ 37.82	3.78	2.50	6.00	2.58	**$ 52.68**
Foreperson	$ 43.49	4.35	2.50	6.00	2.58	**$ 58.92**
+15% over JP rates						
General Foreperson	$ 45.38	4.54	2.50	6.00	2.58	**$ 61.00**
+20% over JP rates						
Apprentices						
2nd Year - 65% of JP	$ 24.58	2.46	2.50	6.00	2.58	**$ 38.12**
3rd Year - 75% of JP	$ 28.37	2.84	2.50	6.00	2.58	**$ 42.29**
4th Year - 85% of JP	$ 32.15	3.22	2.50	6.00	2.58	**$ 46.45**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the U.S. and Canada, and Local Union 740

Schedule "A"

Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation + Holiday Pay 10%	Health & Welfare Benefit	Pension Plan	Building, Training & Resource Fund	**Gross Hourly Package**
Journeyperson	$ 39.64	3.96	2.50	6.00	2.58	**$ 54.68**
Foreperson	$ 45.59	4.56	2.50	6.00	2.58	**$ 61.23**
+15% over JP rates						
General Foreperson	$ 47.57	4.76	2.50	6.00	2.58	**$ 63.41**
+20% over JP rates						
Apprentices						
2nd Year - 65% of JP	$ 25.77	2.58	2.50	6.00	2.58	**$ 39.43**
3rd Year - 75% of JP	$ 29.73	2.97	2.50	6.00	2.58	**$ 43.78**
4th Year - 85% of JP	$ 33.69	3.37	2.50	6.00	2.58	**$ 48.14**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the U.S. and Canada, and Local Union 740

Schedule "A"

Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation + Holiday Pay 10%	Health & Welfare Benefit	Pension Plan	Building, Training & Resource Fund	**Gross Hourly Package**
Journeyperson	$ 41.91	4.19	2.50	6.00	2.58	**$ 57.18**
Foreperson	$ 48.20	4.82	2.50	6.00	2.58	**$ 64.10**
+15% over JP rates						
General Foreperson	$ 50.29	5.03	2.50	6.00	2.58	**$ 66.40**
+20% over JP rates						
Apprentices						
2nd Year - 65% of JP	$ 27.24	2.72	2.50	6.00	2.58	**$ 41.04**
3rd Year - 75% of JP	$ 31.43	3.14	2.50	6.00	2.58	**$ 45.65**
4th Year - 85% of JP	$ 35.62	3.56	2.50	6.00	2.58	**$ 50.26**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the U.S. and Canada, and Local Union 740

Schedule "A"

Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation + Holiday Pay 10%	Health & Welfare Benefit	Pension Plan	Building, Training & Resource Fund	**Gross Hourly Package**
Journeyperson	$ 43.73	4.37	2.50	6.00	2.58	**$ 59.18**
Foreperson	$ 50.29	5.03	2.50	6.00	2.58	**$ 66.40**
+15% over JP rates						
General Foreperson	$ 52.48	5.25	2.50	6.00	2.58	**$ 68.81**
+20% over JP rates						
Apprentices						
2nd Year - 65% of JP	$ 28.42	2.84	2.50	6.00	2.58	**$ 42.34**
3rd Year - 75% of JP	$ 32.80	3.28	2.50	6.00	2.58	**$ 47.16**
4th Year - 85% of JP	$ 37.17	3.72	2.50	6.00	2.58	**$ 51.97**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

UNITED BROTHERHOOD OF CARPENTERS AND JOINERS OF AMERICA, LOCAL UNION 579

1.0 APPLICATION

1.01 This Trade Appendix shall apply to the following:

Carpenter General Foreperson
Carpenter Non-Working Foreperson
Carpenter Working Foreperson
Carpenter Journeyperson
Carpenter Welder
Scaffolder

1.02 The ratio of Forepersons shall be:

1 – 8 Workers	1 Working Foreperson
9 – 16 Workers	1 Non-working Foreperson
17 – 24 Workers	2 Non-working Forepersons and 1 Working Foreperson
25 and over Workers	1 General Foreperson and 2 Non-working Forepersons

The Rate of Pay for Forepersons and General Forepersons shall be:

Working Foreperson	10% above the Journeyperson rate
Non-Working Foreperson	15% above the Journeyperson rate
General Foreperson	20% above the Journeyperson rate

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be thirteen (13%) percent of gross wages including overtime for all employees.

3.0 BENEFIT FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage and Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the month following in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payments shall be made as follows:

(a) Health and Welfare Fund, Pension Fund

Address: Belmont Health and Welfare
700-33 Alderney Dr.
Dartmouth NS B2Y 2N4

Cheque payable to: ACRC Benefit and Welfare Fund

(b) Union Dues and Organizing Fund

Address: Atlantic Canada Regional Council
1000 Sackville Drive
Lower Sackville NS B4E 0C2

Cheque payable to: Atlantic Canada Regional Council

(c) Stabilization Fund, Building & Training Fund

Address: UBC Local 579
Box 3040
Paradise NL A1L 3W2

Cheque payable to: UBC Local 579

(d) Industry Fund (RDTC)

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's NL A1E 3T9

Cheque Payable to: Resource Development Trades Council Industry Fund

(e) Canadian Building Trades Fund

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's NL A1E 3T9

Cheque Payable to: Canadian Building Trades Fund

4.0 APPRENTICES

4.01 Rates for apprentices shall be as herein contained.

Period	# of Hours Complete	Courses Complete	Rate of Journeypersons Pay
Carpenter Helper	0	0	60%
First	1000	18	65%
Second	2200	19 – 20	70%
Third	4200	21 – 22	80%

Fourth	6200	23 – 24	90%
Journeyperson	7200	All	100%

4.02 The United Brotherhood of Carpenters and Joiners of America, Local 579 will be recognized as the sole employer of all union Carpenter Apprentices in the Province of Newfoundland and Labrador for the purpose of apprenticeship training. Further, the Brotherhood of Carpenters and Joiners of America, Local 579 will be given full authority to remove any carpenter apprentice for failure to fulfill his or her apprenticeship contract obligations. Further, each apprentice will be able to return to his/her job after the proper in school training, if the job is continuing.

4.03 Each candidate fort apprenticeship must have successfully completed a high school program or equivalent and in addition may be required to have completed certain academic subjects as specified in particular plans of training. Mature students, at the discretion of the Provincial Director of Institutional and Industrial Education, may be registered. A Mature student is defined as one who has reached the age of 19 and who can demonstrate the ability and the interest to complete the requirements for certification.

4.04 The direct entry apprentice's (with no work or school experience) starting rate will be 60% of the Journeyperson's rate. When they attain the maximum hours and successfully complete the maximum courses for that period they will receive the next wage scale increase. When the apprentice finishes one period of training and schooling, they will not get an increase in pay regardless of how many hours they have accumulated until they present a validated Log Book and have returned to school again.

4.05 The term of apprenticeship for Carpenters shall be 7200 hours actually occupied in the trade, and successful completion of all courses.

4.06 The Contractor will endeavour to hire certified Carpenters.

5.0 TOOLS

5.01 Employees will supply the following tools:

Carpenters Apron
Measuring Tape
Plumb Bob with line
Sliding Square
Combination Square
Pencils
Hammer
Level
Screw Driver Set
Framing Square
Wood Chisels
Stair Buttons/Square Gauges
Block Plane
Chalk Box with line
Claw Bar

6.0 UNION DUES

6.01 Union dues as per Article 6 of the Agreement shall be included in the same cheque as the Organizing Fund cheque as per Article 3.03(b).

6.02 The Contractor shall deduct each month from the wages of each employee within the Union Jurisdiction four (4%) percent of gross earnings, excluding room and board, vacation pay and travel expenses. These deductions shall be made on a weekly basis.

7.0 HEIGHT PAY

7.01 Employees working on a swing stage, scaffold, ladder, bosun chair or temporary working platform (excluding platforms that are in good condition, solidly constructed, rigidly fixed to the structure by mechanical means and equipped with wire mesh fencing to prevent falling) shall receive a premium over his/her regular rate as follows:

Forty (40) feet and over	$1.75/hour

Heights shall be determined on the basis of vertical free fall to the base of the structure.

8.0 HEALTH AND SAFETY

8.01 On all heavy industrial jobs, the Contractor shall supply weather appropriate coveralls that are necessary for the employee, who shall return them on completion of the job.

8.02 The following safety apparel will be made available in the manner indicated, as required by work being done on sites:

(a) Hard Hat
(b) Safety Glasses – non-prescriptive
(c) Safety Vests
(d) Goggles, face shield
(e) Safety ear protection
(f) Gloves
(g) Dust Masks

Employees will be issued this equipment. Should any of the provided safety items be made unserviceable through normal wear and tear during the employees continued employment with the Contractor, a new item will be given to the employee upon his/her presenting the unserviceable item to his/her supervisor.

United Brotherhood of Carpenters and Joiners of America
and Carpenters Local Union 579
Schedule "A"
Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Building & Training Fund	Org Fund	Rate Stab Fund	**Gross Hourly Package**
		10%	3%						
General Foreperson	$ 36.24	3.62	1.09	1.78	5.75	0.38	0.30	0.50	**$ 49.66**
Non-Working Foreperson	$ 34.73	3.47	1.04	1.78	5.75	0.38	0.30	0.50	**$ 47.95**
Working Foreperson	$ 33.22	3.32	1.00	1.78	5.75	0.38	0.30	0.50	**$ 46.25**
Journeyperson Carpenter Welder Scaffolder	$ 30.20	3.02	0.91	1.78	5.75	0.38	0.30	0.50	**$ 42.84**
Carpenter Trade Helper	$ 18.12	1.81	0.54	1.78	5.75	0.38	0.30	0.50	**$ 29.18**
Apprentice 1	$ 19.63	1.96	0.58	1.78	5.75	0.38	0.30	0.50	**$ 30.88**
Apprentice 2	$ 21.14	2.11	0.64	1.78	5.75	0.38	0.30	0.50	**$ 32.60**
Apprentice 3	$ 24.16	2.42	0.73	1.78	5.75	0.38	0.30	0.50	**$ 36.02**
Apprentice 4	$ 27.18	2.71	0.82	1.78	5.75	0.38	0.30	0.50	**$ 39.42**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Brotherhood of Carpenters and Joiners of America
and Carpenters Local Union 579
Schedule "A"
Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Building & Training Fund	Org Fund	Rate Stab Fund	**Gross Hourly Package**
		10%	3%						
General Foreman	$ 38.08	3.81	1.14	1.80	6.00	0.38	0.30	0.50	**$ 52.01**
Non-Working Foreman	$ 36.49	3.65	1.09	1.80	6.00	0.38	0.30	0.50	**$ 50.21**
Working Foreman	$ 34.91	3.49	1.05	1.80	6.00	0.38	0.30	0.50	**$ 48.43**
Journeyman Carpenter Welder Scaffolder	$ 31.73	3.18	0.95	1.80	6.00	0.38	0.30	0.50	**$ 44.84**
Carpenter Trade Helper	$ 19.04	1.90	0.57	1.80	6.00	0.38	0.30	0.50	**$ 30.49**
Apprentice 1	$ 20.63	2.06	0.62	1.80	6.00	0.38	0.30	0.50	**$ 32.29**
Apprentice 2	$ 22.21	2.22	0.67	1.80	6.00	0.38	0.30	0.50	**$ 34.08**
Apprentice 3	$ 25.39	2.54	0.76	1.80	6.00	0.38	0.30	0.50	**$ 37.67**
Apprentice 4	$ 28.56	2.86	0.86	1.80	6.00	0.38	0.30	0.50	**$ 41.26**

*employer's contributions for Health & Welfare and Pension shall be on all hours earned

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Brotherhood of Carpenters and Joiners of America
and Carpenters Local Union 579
Schedule "A"
Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Building & Training Fund	Org Fund	Rate Stab Fund	**Gross Hourly Package**
		10%	3%						
General Foreman	$ 40.74	4.07	1.22	1.80	6.00	0.38	0.30	0.50	**$ 55.01**
Non-Working Foreman	$ 39.04	3.90	1.17	1.80	6.00	0.38	0.30	0.50	**$ 53.09**
Working Foreman	$ 37.34	3.73	1.12	1.80	6.00	0.38	0.30	0.50	**$ 51.17**
Journeyman Carpenter Welder Scaffolder	$ 33.95	3.39	1.02	1.80	6.00	0.38	0.30	0.50	**$ 47.34**
Carpenter Trade Helper	$ 20.37	2.04	0.61	1.80	6.00	0.38	0.30	0.50	**$ 32.00**
Apprentice 1	$ 22.07	2.21	0.66	1.80	6.00	0.38	0.30	0.50	**$ 33.92**
Apprentice 2	$ 23.76	2.38	0.71	1.80	6.00	0.38	0.30	0.50	**$ 35.83**
Apprentice 3	$ 27.16	2.72	0.81	1.80	6.00	0.38	0.30	0.50	**$ 39.67**
Apprentice 4	$ 30.55	3.06	0.92	1.80	6.00	0.38	0.30	0.50	**$ 43.51**

*employer's contributions for Health & Welfare and Pension shall be on all hours earned

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Brotherhood of Carpenters and Joiners of America
and Carpenters Local Union 579
Schedule "A"
Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Building & Training Fund	Org Fund	Rate Stab Fund	**Gross Hourly Package**
		10%	3%						
General Foreman	$ 42.86	4.29	1.29	1.80	6.00	0.38	0.30	0.50	**$ 57.42**
Non-Working Foreman	$ 41.07	4.11	1.23	1.80	6.00	0.38	0.30	0.50	**$ 55.39**
Working Foreman	$ 39.29	3.93	1.18	1.80	6.00	0.38	0.30	0.50	**$ 53.38**
Journeyman Carpenter Welder Scaffolder	$ 35.72	3.57	1.07	1.80	6.00	0.38	0.30	0.50	**$ 49.34**
Carpenter Trade Helper	$ 21.43	2.14	0.64	1.80	6.00	0.38	0.30	0.50	**$ 33.19**
Apprentice 1	$ 23.22	2.32	0.70	1.80	6.00	0.38	0.30	0.50	**$ 35.22**
Apprentice 2	$ 25.00	2.50	0.75	1.80	6.00	0.38	0.30	0.50	**$ 37.23**
Apprentice 3	$ 28.57	2.86	0.86	1.80	6.00	0.38	0.30	0.50	**$ 41.27**
Apprentice 4	$ 32.14	3.21	0.96	1.80	6.00	0.38	0.30	0.50	**$ 45.29**

*employer's contributions for Health & Welfare and Pension shall be on all hours earned

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Brotherhood of Carpenters and Joiners of America
and Carpenters Local Union 579
Schedule "A"
Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Building & Training Fund	Org Fund	Rate Stab Fund	**Gross Hourly Package**
		10%	3%						
General Foreman	$ 45.51	4.55	1.37	1.80	6.00	0.38	0.30	0.50	**$ 60.41**
Non-Working Foreman	$ 43.62	4.36	1.31	1.80	6.00	0.38	0.30	0.50	**$ 58.27**
Working Foreman	$ 41.72	4.17	1.25	1.80	6.00	0.38	0.30	0.50	**$ 56.12**
Journeyman Carpenter Welder Scaffolder	$ 37.93	3.79	1.14	1.80	6.00	0.38	0.30	0.50	**$ 51.84**
Carpenter Trade Helper	$ 22.76	2.28	0.68	1.80	6.00	0.38	0.30	0.50	**$ 34.70**
Apprentice 1	$ 24.65	2.47	0.74	1.80	6.00	0.38	0.30	0.50	**$ 36.84**
Apprentice 2	$ 26.55	2.66	0.80	1.80	6.00	0.38	0.30	0.50	**$ 38.99**
Apprentice 3	$ 30.34	3.03	0.91	1.80	6.00	0.38	0.30	0.50	**$ 43.26**
Apprentice 4	$ 34.14	3.41	1.02	1.80	6.00	0.38	0.30	0.50	**$ 47.55**

*employer's contributions for Health & Welfare and Pension shall be on all hours earned

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

United Brotherhood of Carpenters and Joiners of America
and Carpenters Local Union 579
Schedule "A"
Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Building & Training Fund	Org Fund	Rate Stab Fund	**Gross Hourly Package**
		10%	3%						
General Foreman	$ 47.64	4.76	1.43	1.80	6.00	0.38	0.30	0.50	**$ 62.81**
Non-Working Foreman	$ 45.65	4.57	1.37	1.80	6.00	0.38	0.30	0.50	**$ 60.57**
Working Foreman	$ 43.67	4.37	1.31	1.80	6.00	0.38	0.30	0.50	**$ 58.33**
Journeyman Carpenter Welder Scaffolder	$ 39.70	3.97	1.19	1.80	6.00	0.38	0.30	0.50	**$ 53.84**
Carpenter Trade Helper	$ 23.82	2.38	0.71	1.80	6.00	0.38	0.30	0.50	**$ 35.89**
Apprentice 1	$ 25.80	2.58	0.77	1.80	6.00	0.38	0.30	0.50	**$ 38.13**
Apprentice 2	$ 27.79	2.78	0.83	1.80	6.00	0.38	0.30	0.50	**$ 40.38**
Apprentice 3	$ 31.76	3.18	0.95	1.80	6.00	0.38	0.30	0.50	**$ 44.87**
Apprentice 4	$ 35.73	3.57	1.07	1.80	6.00	0.38	0.30	0.50	**$ 49.35**

*employer's contributions for Health & Welfare and Pension shall be on all hours earned

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28

2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29

3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

INTERNATIONAL UNION OF PAINTERS AND ALLIED TRADES AND LOCAL UNION 1984

1.0 APPLICATION

1.01 This Trade Appendix shall apply to the following:

Apprentice
Painter
Glazier
Drywall Taper
Spray Painter
High Pressure Washer over 10,000 psi
Abrasive Blaster
Vinyl Hanger
Fireproofer
Working Foreperson
Non-working Foreperson
General Foreperson

1.02 The Working Forepersons ratio shall be one (1) Working Foreperson for two (2) to ten (10) Journeypersons.

1.03 The Rate of Pay for Working Foreperson, Non-Working Foreperson and General Forepersons shall be as follows:

(a)	Working Foreperson (Chargehand)	$1.50 above the applicable Journeyperson's rate including all premiums
(b)	Non-Working Foreperson	$2.00 above the applicable Journeyperson's rate including all premiums
(c)	General Foreperson	$2.50 above the applicable Journeyperson's rate including all premiums

1.04 Group 2 shall receive three dollars ($3.00) per hour above the Group 1 rate. Pay shall be for a minimum of one-half shift and if work goes into the second half of the shift, the employees shall be paid for the regular day.

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be thirteen (13%) percent of gross wages including overtime for all employees.

3.0 BENEFIT FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage and Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the following month in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payments shall be made as follows:

(a) Health and Welfare Fund

Address: IUPAT - DC 39 Fund
95 Simmonds Drive
Dartmouth, NS B3B 1N7

Cheque payable to: IUPAT - District Council 39 Fund

(b) Pension Fund

Address: IUPAT - DC 39 Fund
95 Simmonds Drive
Dartmouth, NS B3B 1N7

Cheque payable to: IUPAT - District Council 39 Fund

(c) Apprentice Fund

Address: IUPAT - DC 39 Fund
95 Simmonds Drive
Dartmouth, NS B3B 1N7

Cheque payable to: IUPAT - District Council 39 Fund

(d) Organizing Fund:

Address: IUPAT - DC 39 Fund
95 Simmonds Drive
Dartmouth, NS B3B 1N7

Cheque payable to: IUPAT - District Council 39 Fund

(e) Union Administration Fund:

Address: IUPAT - DC 39 Fund
95 Simmonds Drive
Dartmouth, NS B3B 1N7

Cheque payable to: IUPAT - District Council 39 Fund

(f) Industry Fund (RDTC)

Address: Resource Development Trades Council of
Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque payable to: Resource Development Trades Council Industry Fund

(g) Canadian Building Trades Fund

Address: Resource Development Trades Council of
Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque payable to: Canadian Building Trades Fund

4.0 UNION DUES

4.01 Union Dues shall be forwarded to:

Address: IUPAT – DC 39 Fund
95 Simmonds Drive
Dartmouth, NS B3J 1N7

5.0 APPRENTICE RATES

5.01

1st year	60% of Journeyman Wage plus all benefits
2nd year	75% of Journeyman Wage plus all benefits
3rd year	90% of Journeyman Wage plus all benefits

Full journeyman rates thereafter.

5.02 Apprentices shall be given one year credit for a pre-employment training course at any Newfoundland and Labrador accredited vocational school if course is completed.

6.0 HEIGHT PAY

6.01 If an employee is required to work at a free fall height of 50 feet or above to point of contact, he shall be paid a premium of seventy five cents (75¢) per hour above his rate.

7.0 HEALTH & SAFETY

7.01 The employer shall provide all personal protective equipment including fire retardant coveralls. Employees applying passive fire protection such as Chartek shall be provided with $100.00 towards the cost of boots every 1,000 hours.

International Union of Painters and Allied Trades and Local Union 1984

Schedule "A"

Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Fund	Pension Plan	Apprentice ship Fund	Org. Fund	Union Admin. Fund	**Gross Hourly Package**
		10%	3%						
Group 1 - Painter/Glazier	$ 30.35	3.03	0.91	2.05	4.50	0.65	0.55	0.10	**$ 42.14**
Chargehands & Working Foreperson	$ 31.85	3.19	0.96	2.05	4.50	0.65	0.55	0.10	**$ 43.85**
+1.50 over Group 1									
Non-working Foreperson	$ 32.35	3.24	0.97	2.05	4.50	0.65	0.55	0.10	**$ 44.41**
+2.00 over Group 1									
General Foreperson	$ 32.85	3.29	0.99	2.05	4.50	0.65	0.55	0.10	**$ 44.98**
+2.50 over Group 1									
Group 2 - High Pressure Washer over 10,000 psi, Drywall Taper, Spray Painter, Sand Blaster, Vinyl Hangers, Fireproofers	$ 33.35	3.34	1.00	2.05	4.50	0.65	0.55	0.10	**$ 45.54**
+$3.00 over Group 1									
Chargehands & Working Foreperson	$ 34.85	3.49	1.05	2.05	4.50	0.65	0.55	0.10	**$ 47.24**
+1.50 over Group 2									
Non-working Foreperson	$ 35.35	3.54	1.06	2.05	4.50	0.65	0.55	0.10	**$ 47.80**
+2.00 over Group 2									
General Foreperson	$ 35.85	3.59	1.08	2.05	4.50	0.65	0.55	0.10	**$ 48.37**
+2.50 over Group 2									
Apprentices									
1st Year - 60% Group 1	$ 18.21	1.82	0.54	2.05	4.50	0.65	0.55	0.10	**$ 28.42**
2nd Year - 75% Group 1	$ 22.76	2.28	0.68	2.05	4.50	0.65	0.55	0.10	**$ 33.57**
3rd Year - 90% Group 1	$ 27.32	2.73	0.81	2.05	4.50	0.65	0.55	0.10	**$ 38.71**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Painters and Allied Trades and Local Union 1984

Schedule "A"

Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Fund	Pension Plan	Apprentice ship Fund	Org. Fund	Union Admin. Fund	**Gross Hourly Package**
		10%	3%						
Group 1 - Painter/Glazier	$ 31.54	3.15	0.94	2.15	5.00	0.70	0.55	0.10	**$ 44.13**
Chargehands & Working Foreperson	$ 33.04	3.30	0.99	2.15	5.00	0.70	0.55	0.10	**$ 45.83**
+1.50 over Group 1									
Non-working Foreperson	$ 33.54	3.35	1.01	2.15	5.00	0.70	0.55	0.10	**$ 46.40**
+2.00 over Group 1									
General Foreperson	$ 34.04	3.40	1.02	2.15	5.00	0.70	0.55	0.10	**$ 46.96**
+2.50 over Group 1									
Group 2 - High Pressure Washer over 10,000 psi, Drywall Taper, Spray Painter, Sand Blaster, Vinyl Hangers, Fireproofers	$ 34.54	3.45	1.04	2.15	5.00	0.70	0.55	0.10	**$ 47.53**
+$3.00 over Group 1									
Chargehands & Working Foreperson	$ 36.04	3.60	1.08	2.15	5.00	0.70	0.55	0.10	**$ 49.22**
+1.50 over Group 2									
Non-working Foreperson	$ 36.54	3.65	1.10	2.15	5.00	0.70	0.55	0.10	**$ 49.79**
+2.00 over Group 2									
General Foreperson	$ 37.04	3.70	1.11	2.15	5.00	0.70	0.55	0.10	**$ 50.35**
+2.50 over Group 2									
Apprentices									
1st Year - 60% Group 1	$ 18.92	1.89	0.56	2.15	5.00	0.70	0.55	0.10	**$ 29.87**
2nd Year - 75% Group 1	$ 23.66	2.37	0.70	2.15	5.00	0.70	0.55	0.10	**$ 35.23**
3rd Year - 90% Group 1	$ 28.39	2.84	0.85	2.15	5.00	0.70	0.55	0.10	**$ 40.58**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Painters and Allied Trades and Local Union 1984

Schedule "A"

Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Fund	Pension Plan	Apprentice ship Fund	Org. Fund	Union Admin. Fund	**Gross Hourly Package**
		10%	3%						
Group 1 - Painter/Glazier	$ 33.66	3.36	1.00	2.25	5.00	0.70	0.55	0.10	**$ 46.62**
Chargehands & Working Foreperson	$ 35.16	3.52	1.05	2.25	5.00	0.70	0.55	0.10	**$ 48.33**
+1.50 over Group 1									
Non-working Foreperson	$ 35.66	3.57	1.07	2.25	5.00	0.70	0.55	0.10	**$ 48.90**
+2.00 over Group 1									
General Foreperson	$ 36.16	3.62	1.08	2.25	5.00	0.70	0.55	0.10	**$ 49.46**
+2.50 over Group 1									
Group 2 - High Pressure Washer over 10,000 psi, Drywall Taper, Spray Painter, Sand Blaster, Vinyl Hangers, Fireproofers	$ 36.66	3.67	1.10	2.25	5.00	0.70	0.55	0.10	**$ 50.03**
+$3.00 over Group 1									
Chargehands & Working Foreperson	$ 38.16	3.82	1.14	2.25	5.00	0.70	0.55	0.10	**$ 51.72**
+1.50 over Group 2									
Non-working Foreperson	$ 38.66	3.87	1.16	2.25	5.00	0.70	0.55	0.10	**$ 52.29**
+2.00 over Group 2									
General Foreperson	$ 39.16	3.92	1.17	2.25	5.00	0.70	0.55	0.10	**$ 52.85**
+2.50 over Group 2									
Apprentices									
1st Year - 60% Group 1	$ 20.20	2.02	0.60	2.25	5.00	0.70	0.55	0.10	**$ 31.42**
2nd Year - 75% Group 1	$ 25.25	2.53	0.75	2.25	5.00	0.70	0.55	0.10	**$ 37.13**
3rd Year - 90% Group 1	$ 30.29	3.03	0.90	2.25	5.00	0.70	0.55	0.10	**$ 42.82**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Painters and Allied Trades and Local Union 1984

Schedule "A"

Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Fund	Pension Plan	Apprentice ship Fund	Org. Fund	Union Admin. Fund	**Gross Hourly Package**
		10%	3%						
Group 1 - Painter/Glazier	$ 35.34	3.53	1.06	2.35	5.00	0.70	0.55	0.10	**$ 48.63**
Chargehands & Working Foreperson	$ 36.84	3.68	1.11	2.35	5.00	0.70	0.55	0.10	**$ 50.33**
+1.50 over Group 1									
Non-working Foreperson	$ 37.34	3.73	1.12	2.35	5.00	0.70	0.55	0.10	**$ 50.89**
+2.00 over Group 1									
General Foreperson	$ 37.84	3.78	1.14	2.35	5.00	0.70	0.55	0.10	**$ 51.46**
+2.50 over Group 1									
Group 2 - High Pressure Washer over 10,000 psi, Drywall Taper, Spray Painter, Sand Blaster, Vinyl Hangers, Fireproofers	$ 38.34	3.83	1.15	2.35	5.00	0.70	0.55	0.10	**$ 52.02**
+$3.00 over Group 1									
Chargehands & Working Foreperson	$ 39.84	3.98	1.20	2.35	5.00	0.70	0.55	0.10	**$ 53.72**
+1.50 over Group 2									
Non-working Foreperson	$ 40.34	4.03	1.21	2.35	5.00	0.70	0.55	0.10	**$ 54.28**
+2.00 over Group 2									
General Foreperson	$ 40.84	4.08	1.23	2.35	5.00	0.70	0.55	0.10	**$ 54.85**
+2.50 over Group 2									
Apprentices									
1st Year - 60% Group 1	$ 21.20	2.12	0.63	2.35	5.00	0.70	0.55	0.10	**$ 32.65**
2nd Year - 75% Group 1	$ 26.51	2.65	0.79	2.35	5.00	0.70	0.55	0.10	**$ 38.65**
3rd Year - 90% Group 1	$ 31.81	3.18	0.95	2.35	5.00	0.70	0.55	0.10	**$ 44.64**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Painters and Allied Trades and Local Union 1984

Schedule "A"

Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Fund	Pension Plan	Apprentice ship Fund	Org. Fund	Union Admin. Fund	**Gross Hourly Package**
		10%	3%						
Group 1 - Painter/Glazier	$ 37.46	3.74	1.12	2.45	5.00	0.70	0.55	0.10	**$ 51.12**
Chargehands & Working Foreperson	$ 38.96	3.90	1.17	2.45	5.00	0.70	0.55	0.10	**$ 52.83**
+1.50 over Group 1									
Non-working Foreperson	$ 39.46	3.95	1.18	2.45	5.00	0.70	0.55	0.10	**$ 53.39**
+2.00 over Group 1									
General Foreperson	$ 39.96	4.00	1.20	2.45	5.00	0.70	0.55	0.10	**$ 53.96**
+2.50 over Group 1									
Group 2 - High Pressure Washer 10,000 psi, Drywall Taper, Spray Painter, Sand Blaster, Vinyl Hangers, Fireproofers	$ 40.46	4.05	1.21	2.45	5.00	0.70	0.55	0.10	**$ 54.52**
+$3.00 over Group 1									
Chargehands & Working Foreperson	$ 41.96	4.20	1.26	2.45	5.00	0.70	0.55	0.10	**$ 56.22**
+1.50 over Group 2									
Non-working Foreperson	$ 42.46	4.25	1.27	2.45	5.00	0.70	0.55	0.10	**$ 56.78**
+2.00 over Group 2									
General Foreperson	$ 42.96	4.30	1.29	2.45	5.00	0.70	0.55	0.10	**$ 57.35**
+2.50 over Group 2									
Apprentices									
1st Year - 60% Group 1	$ 22.48	2.25	0.67	2.45	5.00	0.70	0.55	0.10	**$ 34.20**
2nd Year - 75% Group 1	$ 28.10	2.81	0.84	2.45	5.00	0.70	0.55	0.10	**$ 40.55**
3rd Year - 90% Group 1	$ 33.71	3.37	1.01	2.45	5.00	0.70	0.55	0.10	**$ 46.89**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Painters and Allied Trades and Local Union 1984

Schedule "A"

Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Fund	Pension Plan	Apprentice ship Fund	Org. Fund	Union Admin. Fund	**Gross Hourly Package**
		10%	3%						
Group 1 - Painter/Glazier	$ 39.14	3.91	1.17	2.55	5.00	0.70	0.55	0.10	**$ 53.12**
Chargehands & Working Foreperson	$ 40.64	4.06	1.22	2.55	5.00	0.70	0.55	0.10	**$ 54.82**
+1.50 over Group 1									
Non-working Foreperson	$ 41.14	4.11	1.23	2.55	5.00	0.70	0.55	0.10	**$ 55.38**
+2.00 over Group 1									
General Foreperson	$ 41.64	4.16	1.25	2.55	5.00	0.70	0.55	0.10	**$ 55.95**
+2.50 over Group 1									
Group 2 - High Pressure Washer over 10,000 psi, Drywall Taper, Spray Painter, Sand Blaster, Vinyl Hangers, Fireproofers	$ 42.14	4.21	1.26	2.55	5.00	0.70	0.55	0.10	**$ 56.51**
+$3.00 over Group 1									
Chargehands & Working Foreperson	$ 43.64	4.36	1.31	2.55	5.00	0.70	0.55	0.10	**$ 58.21**
+1.50 over Group 2									
Non-working Foreperson	$ 44.14	4.41	1.32	2.55	5.00	0.70	0.55	0.10	**$ 58.77**
+2.00 over Group 2									
General Foreperson	$ 44.64	4.46	1.34	2.55	5.00	0.70	0.55	0.10	**$ 59.34**
+2.50 over Group 2									
Apprentices									
1st Year - 60% Group 1	$ 23.48	2.35	0.70	2.55	5.00	0.70	0.55	0.10	**$ 35.43**
2nd Year - 75% Group 1	$ 29.36	2.94	0.88	2.55	5.00	0.70	0.55	0.10	**$ 42.08**
3rd Year - 90% Group 1	$ 35.23	3.52	1.05	2.55	5.00	0.70	0.55	0.10	**$ 48.70**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

INTERNATIONAL ASSOCIATION OF HEAT AND FROST INSULATORS AND ALLIED WORKERS AND LOCAL UNION 137

1.0 APPLICATION

1.01 Apprentice
Journeyperson Mechanic
Working Foreperson
Non-Working Foreperson
General Foreperson

1.02 Supervisory Pay Rate:

Working Foreperson	$1.25 over Journeyperson Mechanic Rate
Non-Working Foreperson	$2.00 over Journeyperson Mechanic Rate
General Foreperson	$2.50 over Non-Working Foreperson's Mechanic Rate

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be 13% of gross wages including overtime for all employees.

3.0 BENEFIT FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage and Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the month following in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payments shall be made as follows:

(a) Health and Welfare Fund

Address: Benefit Plan Administrators
7001 Mumford Road
Suite 216, Tower 1
Halifax, NS B3L 4N9

Cheque payable to: Heat and Frost Local 137 Trust Fund

(b) Pension Fund

Address: Benefit Plan Administrators
7001 Mumford Road
Suite 216, Tower 1
Halifax, NS B3L 4N9

Cheque payable to: Heat and Frost Local 137 Trust Fund

(c) Training, RSP, Building and Apprenticeship Funds

Address: Heat and Frost Local 137
PO Box 100
Harbour Grace, NL A0A 2M0

Cheque Payable to: Heat and Frost Local 137

(d) Industry Fund (RDTC)

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque payable to: Resource Development Trades Council Industry Fund

(e) Canadian Building Trades Fund

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Canadian Building Trades Fund

4.0 UNION DUES

4.01 Union Dues as per Article 6 shall be forwarded to:

Address: Heat and Frost Local 137
PO Box 100
Harbour Grace, NL A0A 2M0

5.0 TOOLS

5.01 All Journeypersons, 3rd and 4th year Apprentices shall carry a tool box containing the following tools:

Float Trowel	Tinsnips
Pointer Trowel	Punch
Knife	Hammer
Pop Riveting Tools	Pliers
Pruning Saw	Safety Goggles
Screwdriver	Scissors
Rule or Steel Tape Measure	M1 or M2 Metal Cutter, if required

1st and 2nd year Apprentices

Knife	Measuring Tape
Pliers	Scissors
Tinsnips	

5.02 Employees shall be furnished with tools on all foam glass jobs and cutting tools for stainless steel complete with storage box for the same before the job commences. Failure for the employee to return the said tools once the job has been completed, the cost of the same shall be deducted from the employee's paycheque. When required, the employer shall also furnish banding and sealing tools, who shall be held responsible for such tools.

6.0 APPRENTICES

6.01 At the end of an Apprentice period of 8000 working hours, the employee shall be eligible to present himself before an examination board for the purpose of obtaining his competency card as an Insulation Journeyperson.

6.02 The following Apprentice rates shall be in effect for the term of the Agreement:

1st Year Apprentice	60% of Journeyperson Mechanic Rate
2nd Year Apprentice	65% of Journeyperson Mechanic Rate
3rd Year Apprentice	75% of Journeyperson Mechanic Rate
4th Year Apprentice	85% of Journeyperson Mechanic Rate

7.0 OTHER CONDITIONS

7.01 Employees working in conditions where there is a possibility of a free fall drop shall be paid the following premiums:

40 feet and above	$1.00 per hour

7.02 The Contractor will supply gloves and disposable coveralls and will compensate for the clothing ruined on jobs on which excessive amounts of mastic and adhesives are used.

International Association of Heat and Frost Insulators
and Allied Workers and Local Union 137
Schedule "A"
Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training	RSP	Building Fund	Apprentice ship Fund	**Gross Hourly Package**
		10%	3%							
General Foreperson	$ 36.17	3.62	1.09	2.05	5.00	0.15	1.50	0.05	0.05	**$ 49.68**
+2.50 over Non-Working Foreperson										
Non-Working Foreperson	$ 33.67	3.37	1.02	2.05	5.00	0.15	1.50	0.05	0.05	**$ 46.86**
+2.00 over JP										
Working Foreperson	$ 32.92	3.29	0.99	2.05	5.00	0.15	1.50	0.05	0.05	**$ 46.00**
+1.25 over JP										
Journeyperson Mechanic	$ 31.67	3.16	0.95	2.05	5.00	0.15	1.50	0.05	0.05	**$ 44.58**
Apprentices										
1st year - 60% of JP	$ 19.00	1.90	0.57	2.05	5.00	0.15	1.50	0.05	0.05	**$ 30.27**
2nd year - 65% of JP	$ 20.59	2.06	0.62	2.05	5.00	0.15	1.50	0.05	0.05	**$ 32.07**
3rd year - 75% of JP	$ 23.75	2.38	0.71	2.05	5.00	0.15	1.50	0.05	0.05	**$ 35.64**
4th year - 85% of JP	$ 26.92	2.69	0.81	2.05	5.00	0.15	1.50	0.05	0.05	**$ 39.22**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Association of Heat and Frost Insulators
and Allied Workers and Local Union 137
Schedule "A"
Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training	RSP	Building Fund	Apprentice ship Fund	**Gross Hourly Package**
		10%	3%							
General Foreperson	$ 37.94	3.79	1.14	2.05	5.00	0.15	1.50	0.05	0.05	**$ 51.67**
+2.50 over Non-Working Foreperson										
Non-Working Foreperson	$ 35.44	3.54	1.07	2.05	5.00	0.15	1.50	0.05	0.05	**$ 48.85**
+2.00 over JP										
Working Foreperson	$ 34.69	3.47	1.04	2.05	5.00	0.15	1.50	0.05	0.05	**$ 48.00**
+1.25 over JP										
Journeyperson Mechanic	$ 33.44	3.34	1.00	2.05	5.00	0.15	1.50	0.05	0.05	**$ 46.58**
Apprentices										
1st year - 60% of JP	$ 20.06	2.01	0.60	2.05	5.00	0.15	1.50	0.05	0.05	**$ 31.47**
2nd year - 65% of JP	$ 21.74	2.17	0.65	2.05	5.00	0.15	1.50	0.05	0.05	**$ 33.36**
3rd year - 75% of JP	$ 25.08	2.51	0.75	2.05	5.00	0.15	1.50	0.05	0.05	**$ 37.14**
4th year - 85% of JP	$ 28.42	2.84	0.85	2.05	5.00	0.15	1.50	0.05	0.05	**$ 40.91**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Association of Heat and Frost Insulators
and Allied Workers and Local Union 137
Schedule "A"
Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training	RSP	Building Fund	Apprentice ship Fund	**Gross Hourly Package**
		10%	3%							
General Foreperson	$ 40.15	4.02	1.20	2.05	5.00	0.15	1.50	0.05	0.05	**$ 54.17**
+2.50 over Non-Working Foreperson										
Non-Working Foreperson	$ 37.65	3.77	1.13	2.05	5.00	0.15	1.50	0.05	0.05	**$ 51.35**
+2.00 over JP										
Working Foreperson	$ 36.90	3.69	1.11	2.05	5.00	0.15	1.50	0.05	0.05	**$ 50.50**
+1.25 over JP										
Journeyperson Mechanic	$ 35.65	3.56	1.07	2.05	5.00	0.15	1.50	0.05	0.05	**$ 49.08**
Apprentices										
1st year - 60% of JP	$ 21.39	2.14	0.64	2.05	5.00	0.15	1.50	0.05	0.05	**$ 32.97**
2nd year - 65% of JP	$ 23.17	2.32	0.70	2.05	5.00	0.15	1.50	0.05	0.05	**$ 34.99**
3rd year - 75% of JP	$ 26.74	2.67	0.80	2.05	5.00	0.15	1.50	0.05	0.05	**$ 39.01**
4th year - 85% of JP	$ 30.30	3.03	0.91	2.05	5.00	0.15	1.50	0.05	0.05	**$ 43.04**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Association of Heat and Frost Insulators
and Allied Workers and Local Union 137
Schedule "A"
Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training	RSP	Building Fund	Apprentice ship Fund	**Gross Hourly Package**
		10%	3%							
General Foreperson	$ 41.92	4.19	1.26	2.05	5.00	0.15	1.50	0.05	0.05	**$ 56.17**
+2.50 over Non-Working Foreperson										
Non-Working Foreperson	$ 39.42	3.94	1.19	2.05	5.00	0.15	1.50	0.05	0.05	**$ 53.35**
+2.00 over JP										
Working Foreperson	$ 38.67	3.87	1.16	2.05	5.00	0.15	1.50	0.05	0.05	**$ 52.50**
+1.25 over JP										
Journeyperson Mechanic	$ 37.42	3.74	1.12	2.05	5.00	0.15	1.50	0.05	0.05	**$ 51.08**
Apprentices										
1st year - 60% of JP	$ 22.45	2.25	0.67	2.05	5.00	0.15	1.50	0.05	0.05	**$ 34.17**
2nd year - 65% of JP	$ 24.32	2.43	0.73	2.05	5.00	0.15	1.50	0.05	0.05	**$ 36.28**
3rd year - 75% of JP	$ 28.07	2.81	0.84	2.05	5.00	0.15	1.50	0.05	0.05	**$ 40.52**
4th year - 85% of JP	$ 31.81	3.18	0.95	2.05	5.00	0.15	1.50	0.05	0.05	**$ 44.74**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Association of Heat and Frost Insulators
and Allied Workers and Local Union 137
Schedule "A"
Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training	RSP	Building Fund	Apprentice ship Fund	**Gross Hourly Package**
		10%	3%							
General Foreperson	$ 44.13	4.41	1.32	2.05	5.00	0.15	1.50	0.05	0.05	**$ 58.66**
+2.50 over Non-Working Foreperson										
Non-Working Foreperson	$ 41.63	4.16	1.25	2.05	5.00	0.15	1.50	0.05	0.05	**$ 55.84**
+2.00 over JP										
Working Foreperson	$ 40.88	4.09	1.23	2.05	5.00	0.15	1.50	0.05	0.05	**$ 55.00**
+1.25 over JP										
Journeyperson Mechanic	$ 39.63	3.96	1.19	2.05	5.00	0.15	1.50	0.05	0.05	**$ 53.58**
Apprentices										
1st year - 60% of JP	$ 23.78	2.38	0.71	2.05	5.00	0.15	1.50	0.05	0.05	**$ 35.67**
2nd year - 65% of JP	$ 25.76	2.58	0.77	2.05	5.00	0.15	1.50	0.05	0.05	**$ 37.91**
3rd year - 75% of JP	$ 29.72	2.97	0.89	2.05	5.00	0.15	1.50	0.05	0.05	**$ 42.38**
4th year - 85% of JP	$ 33.69	3.37	1.01	2.05	5.00	0.15	1.50	0.05	0.05	**$ 46.87**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Association of Heat and Frost Insulators
and Allied Workers and Local Union 137
Schedule "A"
Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Training	RSP	Building Fund	Apprentice ship Fund	**Gross Hourly Package**
		10%	3%							
General Foreperson	$ 45.90	4.59	1.38	2.05	5.00	0.15	1.50	0.05	0.05	**$ 60.67**
+2.50 over Non-Working Foreperson										
Non-Working Foreperson	$ 43.40	4.34	1.31	2.05	5.00	0.15	1.50	0.05	0.05	**$ 57.85**
+2.00 over JP										
Working Foreperson	$ 42.65	4.27	1.28	2.05	5.00	0.15	1.50	0.05	0.05	**$ 57.00**
+1.25 over JP										
Journeyperson Mechanic	$ 41.40	4.14	1.24	2.05	5.00	0.15	1.50	0.05	0.05	**$ 55.58**
Apprentices										
1st year - 60% of JP	$ 24.84	2.48	0.75	2.05	5.00	0.15	1.50	0.05	0.05	**$ 36.87**
2nd year - 65% of JP	$ 26.91	2.69	0.81	2.05	5.00	0.15	1.50	0.05	0.05	**$ 39.21**
3rd year - 75% of JP	$ 31.05	3.11	0.93	2.05	5.00	0.15	1.50	0.05	0.05	**$ 43.89**
4th year - 85% of JP	$ 35.19	3.52	1.06	2.05	5.00	0.15	1.50	0.05	0.05	**$ 48.57**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

SHEET METAL WORKERS' INTERNATIONAL ASSOCIATION
AND LOCAL UNION 512

1.0 APPLICATION

1.01 This Trade Appendix shall apply to the following:

General Foreperson
Non-working Foreperson
Working Foreperson
Journeyperson (including Welder)
Air Balancing Technicians
Apprentices

1.02 The Rate of Pay for Working, Non-Working and General Forepersons shall be:

Working Foreperson	$2.00 above the Journeyperson's rate of pay
Non-Working Foreperson	$3.00 above the Journeyperson's rate of pay
General Foreperson	$4.00 above the Journeyperson's rate of pay

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations and pay in lieu of recognized holidays shall be 13% of gross wages including over-time for all employees.

3.0 BENEFIT FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage and Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the month following the month in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payment shall be made as follows:

(a) Health and Welfare Fund, Pension Fund

Address: Sheet Metal Workers, Local 512
PO Box 1473
St. John's, NL A1C 5N8

Cheque payable to: Benefit Plan Administrators

(b) Local 512 Industry Fund

Address: Sheet Metal Workers, Local 512
PO Box 1473
St. John's, NL A1C 5N8

Cheque payable to: Sheet Metal Workers, Local 512

(c) Industry Fund (RDTC)

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL CA A1E 3T9

Cheque Payable to: Resource Development Trades Council Industry Fund

(d) Canadian Building Trades Fund

Address: Resource Development Trades Council of Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque Payable to: Canadian Building Trades Fund

(e) Union Dues

Union Dues shall be made payable to:

"Sheet Metal Workers, Local 512"

and mailed to:

Address: Sheet Metal Workers Local 512
PO Box 1473
St. John's, NL A1C 5N8

4.0 APPRENTICES

4.01 All Apprentices shall become indentured as soon as possible and the document of indenture shall not conflict in any with the provisions of this Agreement. Contractors shall not start or indenture new Apprentice while there are any apprentices of that Contractor unemployed. Next consideration shall be given to Local Union 512 apprentices that are unemployed.

4.02 All apprentices shall have a log book from the Department of Labour showing the amount of hours worked at the trade.

4.03 The Contractor will endeavour where practical and economically feasible to expose apprentices to shop time along with field time in order to develop a well versed Journeyperson.

4.04 Apprentices shall not be paid less than the following percentages of a Journeyperson's rate:

First and Second Year.....60%
Third Year 75%
Fourth Year 85%

Full Journeyperson's rate thereafter

5.0 HEIGHT PAY

5.01 The following premium above the regular hourly rate shall be paid to employees required to work at Heights where there is a possibility of a free-fall drop of 50 feet or more.

50 feet and above	$1.00

6.0 WELDERS

6.01 On work requiring Sheet Metal Workers to weld, the rate of pay will increase by $1.00 per hour.

7.0 TOOLS

7.01 All Journeyperson and Apprentices working at the trade shall have the following tools:

1st Year Apprentice

1 Sheet Metal Hammer	1 Straight Shears
1 Rule Tape (Metric)	Aviation Snips (Lefts and Rights)

2nd Year Apprentice

1 pair Pliers 6-8"	1 pair Sheet Metal Tongs
1 Hacksaw	

3rd Year Apprentice

1 – 1" Cold Chisel	1 - % Cold Chisel
1 Stubby Screwdriver	1 Ball pien Hammer
1 – 24" Square	

4th Year Apprentice

1 pair Bull Shears	1 set Phillips Screwdrivers
1 set Robinsons Screwdrivers	1 set Allen Wrenches
1 set Spanners	1 – 6" Stelson Wrench
1 – 12" Stelson Wrench	

The Journeyperson shall have all the above tools and the Contractor retains the right to periodic inspection of an employee's tools provided one (1) weeks' notice is given.

Sheet Metal Workers' International Association and
Local Union 512
Schedule "A"
Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Local 512 Industry Fund	**Gross Hourly Package**
		10%	3%				
Journeyperson	$ 33.16	3.31	0.99	2.00	6.50	0.21	**$ 46.17**
Welder	$ 34.16	3.42	1.03	2.00	6.50	0.21	**$ 47.32**
Working Foreperson	$ 35.16	3.52	1.06	2.00	6.50	0.21	**$ 48.45**
+2.00 over JP							
Non-Working Foreperson	$ 36.16	3.62	1.08	2.00	6.50	0.21	**$ 49.57**
+3.00 over JP							
General Foreperson	$ 37.16	3.72	1.11	2.00	6.50	0.21	**$ 50.70**
+4.00 over JP							
Apprentices							
2nd Year - 60% of JP	$ 19.90	1.99	0.60	2.00	6.50	0.21	**$ 31.20**
3rd Year - 75% of JP	$ 24.87	2.49	0.75	2.00	6.50	0.21	**$ 36.82**
4th Year - 85% of JP	$ 28.19	2.82	0.85	2.00	6.50	0.21	**$ 40.57**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

Sheet Metal Workers' International Association and
Local Union 512
Schedule "A"
Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Local 512 Industry Fund	**Gross Hourly Package**
		10%	3%				
Journeyperson	$ 34.93	3.49	1.05	2.00	6.50	0.21	**$ 48.18**
Welder	$ 35.93	3.59	1.08	2.00	6.50	0.21	**$ 49.31**
Working Foreperson	$ 36.93	3.69	1.11	2.00	6.50	0.21	**$ 50.44**
+2.00 over JP							
Non-Working Foreperson	$ 37.93	3.79	1.14	2.00	6.50	0.21	**$ 51.57**
+3.00 over JP							
General Foreperson	$ 38.93	3.89	1.17	2.00	6.50	0.21	**$ 52.70**
+4.00 over JP							
Apprentices							
2nd Year - 60% of JP	$ 20.96	2.10	0.63	2.00	6.50	0.21	**$ 32.40**
3rd Year - 75% of JP	$ 26.20	2.62	0.79	2.00	6.50	0.21	**$ 38.32**
4th Year - 85% of JP	$ 29.69	2.97	0.89	2.00	6.50	0.21	**$ 42.26**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

Sheet Metal Workers' International Association and
Local Union 512
Schedule "A"
Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Local 512 Industry Fund	**Gross Hourly Package**
		10%	3%				
Journeyperson	$ 37.14	3.71	1.11	2.00	6.50	0.21	**$ 50.67**
Welder	$ 38.14	3.81	1.15	2.00	6.50	0.21	**$ 51.81**
Working Foreperson	$ 39.14	3.91	1.18	2.00	6.50	0.21	**$ 52.94**
+2.00 over JP							
Non-Working Foreperson	$ 40.14	4.01	1.20	2.00	6.50	0.21	**$ 54.06**
+3.00 over JP							
General Foreperson	$ 41.14	4.11	1.23	2.00	6.50	0.21	**$ 55.19**
+4.00 over JP							
Apprentices							
2nd Year - 60% of JP	$ 22.28	2.23	0.67	2.00	6.50	0.21	**$ 33.89**
3rd Year - 75% of JP	$ 27.86	2.79	0.84	2.00	6.50	0.21	**$ 40.20**
4th Year - 85% of JP	$ 31.57	3.16	0.95	2.00	6.50	0.21	**$ 44.39**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

Sheet Metal Workers' International Association and
Local Union 512
Schedule "A"
Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Local 512 Industry Fund	**Gross Hourly Package**
		10%	3%				
Journeyperson	$ 38.91	3.89	1.17	2.00	6.50	0.21	**$ 52.68**
Welder	$ 39.91	3.99	1.20	2.00	6.50	0.21	**$ 53.81**
Working Foreperson	$ 40.91	4.09	1.23	2.00	6.50	0.21	**$ 54.94**
+2.00 over JP							
Non-Working Foreperson	$ 41.91	4.19	1.26	2.00	6.50	0.21	**$ 56.07**
+3.00 over JP							
General Foreperson	$ 42.91	4.29	1.29	2.00	6.50	0.21	**$ 57.20**
+4.00 over JP							
Apprentices							
2nd Year - 60% of JP	$ 23.35	2.34	0.70	2.00	6.50	0.21	**$ 35.10**
3rd Year - 75% of JP	$ 29.18	2.92	0.88	2.00	6.50	0.21	**$ 41.69**
4th Year - 85% of JP	$ 33.07	3.31	0.99	2.00	6.50	0.21	**$ 46.08**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

Sheet Metal Workers' International Association and
Local Union 512
Schedule "A"
Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Local 512 Industry Fund	**Gross Hourly Package**
		10%	3%				
Journeyperson	$ 41.12	4.11	1.23	2.00	6.50	0.21	**$ 55.17**
Welder	$ 42.12	4.21	1.27	2.00	6.50	0.21	**$ 56.31**
Working Foreperson	$ 43.12	4.31	1.30	2.00	6.50	0.21	**$ 57.44**
+2.00 over JP							
Non-Working Foreperson	$ 44.12	4.41	1.32	2.00	6.50	0.21	**$ 58.56**
+3.00 over JP							
General Foreperson	$ 45.12	4.51	1.35	2.00	6.50	0.21	**$ 59.69**
+4.00 over JP							
Apprentices							
2nd Year - 60% of JP	$ 24.67	2.47	0.74	2.00	6.50	0.21	**$ 36.59**
3rd Year - 75% of JP	$ 30.84	3.08	0.93	2.00	6.50	0.21	**$ 43.56**
4th Year - 85% of JP	$ 34.95	3.50	1.05	2.00	6.50	0.21	**$ 48.21**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

Sheet Metal Workers' International Association and
Local Union 512
Schedule "A"
Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Local 512 Industry Fund	**Gross Hourly Package**
		10%	3%				
Journeyperson	$ 42.89	4.28	1.29	2.00	6.50	0.21	**$ 57.17**
Welder	$ 43.89	4.39	1.32	2.00	6.50	0.21	**$ 58.31**
Working Foreperson	$ 44.89	4.49	1.35	2.00	6.50	0.21	**$ 59.44**
+2.00 over JP							
Non-Working Foreperson	$ 45.89	4.59	1.38	2.00	6.50	0.21	**$ 60.57**
+3.00 over JP							
General Foreperson	$ 46.89	4.69	1.41	2.00	6.50	0.21	**$ 61.70**
+4.00 over JP							
Apprentices							
2nd Year - 60% of JP	$ 25.73	2.57	0.77	2.00	6.50	0.21	**$ 37.78**
3rd Year - 75% of JP	$ 32.17	3.22	0.97	2.00	6.50	0.21	**$ 45.07**
4th Year - 85% of JP	$ 36.46	3.65	1.09	2.00	6.50	0.21	**$ 49.91**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

INTERNATIONAL UNION OF ELEVATOR CONSTRUCTORS
AND LOCAL UNION 125 A

1.0 APPLICATION

1.01 This Trade Appendix shall apply to the following:

Mechanic
Mechanic-in-Charge (Foreperson)
Improver Helper
Helper II
Helper I
Probationary Helper II
Probationary Helper I

2.0 VACATION AND RECOGNIZED HOLIDAY PAY

2.01 Payment for annual vacations shall be eight percent (8%) and pay in lieu of recognized holidays shall be four percent (4%) of gross wages including overtime for all employees.

3.0 BENEFIT FUNDS

3.01 The Contractor shall remit the amounts in the attached Wage and Benefit Schedule for each hour earned. Payments shall be made no later than the 15th of the month following the month in which the hours were earned.

3.02 Each payment shall be accompanied by a statement setting out the names of the employees in respect of whom such payment is made, the amount paid in respect of each employee, and the hours worked by each employee during the calendar month for which payment is being made.

3.03 Payments shall be made as follows:

(a) Welfare Fund

Address: Manion Wilkins & Associates Ltd.
222 Rowntree Dairy Rd., Unit 4, 3rd Floor
Woodbridge, ON L4L 9T2

Cheque payable to: The Canadian Elevator Industry Welfare Plan

(b) Pension Fund

Address: Manion Wilkins & Associates Ltd.
222 Rowntree Dairy Rd., Unit 4, 3rd Floor
Woodbridge, ON L4L 9T2

Cheque payable to: The Canadian Elevator Industry Pension Plan

(c) Education Fund

Address: Manion Wilkins & Associates Ltd.
222 Rowntree Dairy ltd., Unit 4, 3rd Floor
Woodbridge, ON L4L 9T2

Cheque payable to: The Canadian Elevator Industry Education Plan

(d) Industry Fund (RDTC)

Address: Resource Development Trades Council of
Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque payable to: Resource Development Trades Council Industry Fund

(e) Canadian Building Trades Fund

Address: Resource Development Trades Council of
Newfoundland and Labrador
78 Brookfield Road
St. John's, NL A1E 3T9

Cheque payable to: Canadian Building Trades Fund

4.0 UNION DUES

4.01 Union Dues as per Article 6 shall be forwarded to:

Address: International Union of Elevator Constructors Local 125A
Suite 102, 14 McQuade Lake Cres.
Halifax, NS
B3S 1B6

5.0 APPRENTICES

5.01 The wage rates for employees shall be in accordance with the following schedule:

Probationary Helper I	50% of the Mechanic's rate
Probationary Helper II	55% of the Mechanic's rate
Helper I	70% of the Mechanic's rate
Helper II	75% of the Mechanic's rate
Improver Helper	80% of the Mechanic's rate

5.02 It is agreed by the Union that there shall be no restrictions placed on the character of work which a Helper may perform under the direction of a Mechanic.

5.03 The total number of Helpers employed shall not exceed the number of Mechanics on any one job, except on jobs where two teams or more are working, one extra Helper may be employed for the first two teams and an extra Helper for each additional three teams.

Further, the Contractor may use as many helpers as best suits his/her convenience under the direction of a Mechanic in wrecking old plants and in handling and hoisting material; and on foundation work. When removing old and installing new cables on existing elevator installations, a Contractor may use two Helpers to one Mechanic.

6.0 Mechanic-in-Charge

6.01 When four (4) or more employees covered by this Trade Appendix, including the Mechanic-in-Charge, are employed on a new construction or modernization job, the Mechanic-in-Charge of the job shall have his/her hourly rate increased twelve and one-half percent (12 1/2%) for each hour worked.

When thirty (30) or more employees covered by this Trade Appendix are working on a job site, the Mechanic-in-Charge of the job shall have his/her hourly rate increased fifteen percent (15%) for each hour worked.

International Union of Elevator Constructors
and Local Union 125A
Schedule "A"
Effective May 1, 2012

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Education Fund	**Gross Hourly Package**
		8%	4%				
Mechanic	$ 35.72	2.86	1.43	1.18	2.25	0.31	**43.75**
Mechanic-in-Charge	$ 40.19	3.22	1.61	1.18	2.25	0.31	**48.76**
(4 or more) +12.5%							
Mechanic-in-Charge	$ 41.08	3.29	1.64	1.18	2.25	0.31	**49.75**
(30 or more) +15%							
Probationary Helper I (50%)	$ 17.86	1.43	0.71	1.18	2.25	0.31	**23.74**
Probationary Helper II (55%)	$ 19.65	1.57	0.79	1.18	2.25	0.31	**25.75**
Helper I (70%)	$ 25.00	2.00	1.00	1.18	2.25	0.31	**31.74**
Helper II (75%)	$ 26.79	2.14	1.07	1.18	2.25	0.31	**33.74**
Improver Helper (80%)	$ 28.58	2.29	1.14	1.18	2.25	0.31	**35.75**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Elevator Constructors
and Local Union 125A
Schedule "A"
Effective May 1, 2013

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Education Fund	**Gross Hourly Package**
		8%	4%				
Mechanic	$ 37.51	3.00	1.51	1.18	2.25	0.31	**45.76**
Mechanic-in-Charge	$ 42.20	3.38	1.69	1.18	2.25	0.31	**51.01**
(4 or more) +12.5%							
Mechanic-in-Charge	$ 43.14	3.45	1.73	1.18	2.25	0.31	**52.06**
(30 or more) +15%							
Probationary Helper I (50%)	$ 18.76	1.50	0.75	1.18	2.25	0.31	**24.75**
Probationary Helper II (55%)	$ 20.63	1.65	0.83	1.18	2.25	0.31	**26.85**
Helper I (70%)	$ 26.26	2.10	1.05	1.18	2.25	0.31	**33.15**
Helper II (75%)	$ 28.13	2.25	1.13	1.18	2.25	0.31	**35.25**
Improver Helper (80%)	$ 30.01	2.40	1.20	1.18	2.25	0.31	**37.35**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Elevator Constructors
and Local Union 125A
Schedule "A"
Effective May 1, 2014

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Education Fund	**Gross Hourly Package**
		8%	4%				
Mechanic	$ 39.74	3.18	1.59	1.18	2.25	0.31	**48.25**
Mechanic-in-Charge	$ 44.71	3.58	1.79	1.18	2.25	0.31	**53.82**
(4 or more) +12.5%							
Mechanic-in-Charge	$ 45.70	3.66	1.83	1.18	2.25	0.31	**54.93**
(30 or more) +15%							
Probationary Helper I (50%)	$ 19.87	1.59	0.79	1.18	2.25	0.31	**25.99**
Probationary Helper II (55%)	$ 21.86	1.75	0.87	1.18	2.25	0.31	**28.22**
Helper I (70%)	$ 27.82	2.23	1.11	1.18	2.25	0.31	**34.90**
Helper II (75%)	$ 29.81	2.38	1.19	1.18	2.25	0.31	**37.12**
Improver Helper (80%)	$ 31.79	2.54	1.27	1.18	2.25	0.31	**39.34**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Elevator Constructors
and Local Union 125A
Schedule "A"
Effective May 1, 2015

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Education Fund	**Gross Hourly Package**
		8%	4%				
Mechanic	$ 41.53	3.32	1.67	1.18	2.25	0.31	**50.26**
Mechanic-in-Charge	$ 46.72	3.74	1.87	1.18	2.25	0.31	**56.07**
(4 or more) +12.5%							
Mechanic-in-Charge	$ 47.76	3.82	1.91	1.18	2.25	0.31	**57.23**
(30 or more) +15%							
Probationary Helper I (50%)	$ 20.77	1.66	0.83	1.18	2.25	0.31	**27.00**
Probationary Helper II (55%)	$ 22.84	1.83	0.91	1.18	2.25	0.31	**29.32**
Helper I (70%)	$ 29.07	2.33	1.16	1.18	2.25	0.31	**36.30**
Helper II (75%)	$ 31.15	2.49	1.25	1.18	2.25	0.31	**38.63**
Improver Helper (80%)	$ 33.22	2.66	1.33	1.18	2.25	0.31	**40.95**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Elevator Constructors
and Local Union 125A
Schedule "A"
Effective May 1, 2016

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Education Fund	**Gross Hourly Package**
		8%	4%				
Mechanic	$ 43.76	3.50	1.76	1.18	2.25	0.31	**52.76**
Mechanic-in-Charge	$ 49.23	3.94	1.97	1.18	2.25	0.31	**58.88**
(4 or more) +12.5%							
Mechanic-in-Charge	$ 50.32	4.03	2.01	1.18	2.25	0.31	**60.10**
(30 or more) +15%							
Probationary Helper I (50%)	$ 21.88	1.75	0.88	1.18	2.25	0.31	**28.25**
Probationary Helper II (55%)	$ 24.07	1.93	0.96	1.18	2.25	0.31	**30.70**
Helper I (70%)	$ 30.63	2.45	1.23	1.18	2.25	0.31	**38.05**
Helper II (75%)	$ 32.82	2.63	1.31	1.18	2.25	0.31	**40.50**
Improver Helper (80%)	$ 35.01	2.80	1.40	1.18	2.25	0.31	**42.95**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

International Union of Elevator Constructors
and Local Union 125A
Schedule "A"
Effective May 1, 2017

Trade Classification	Basic Hourly Rate	Vacation Pay	Holiday Pay	Health & Welfare Benefit	Pension Plan	Education Fund	**Gross Hourly Package**
		8%	4%				
Mechanic	$ 45.55	3.64	1.83	1.18	2.25	0.31	**54.76**
Mechanic-in-Charge	$ 51.24	4.10	2.05	1.18	2.25	0.31	**61.13**
(4 or more) +12.5%							
Mechanic-in-Charge	$ 52.38	4.19	2.10	1.18	2.25	0.31	**62.41**
(30 or more) +15%							
Probationary Helper I (50%)	$ 22.78	1.82	0.91	1.18	2.25	0.31	**29.25**
Probationary Helper II (55%)	$ 25.05	2.00	1.00	1.18	2.25	0.31	**31.79**
Helper I (70%)	$ 31.89	2.55	1.28	1.18	2.25	0.31	**39.46**
Helper II (75%)	$ 34.16	2.73	1.37	1.18	2.25	0.31	**42.00**
Improver Helper (80%)	$ 36.44	2.92	1.46	1.18	2.25	0.31	**44.56**

NOTES: The following shall be paid in addition to the above wage package

1. Resource Development Council Industry Fund - Contractor shall remit the RDC Industry Fund ($0.30/hour earned) as per Article 28
2. Canadian Building Trades Fund - Contractor shall remit the Canadian Building Trades Fund ($0.05/hour earned) as per Article 29
3. Lower Churchill Project Premium - Contractor shall pay the Lower Churchill Project Premium ($3.50/hour earned, paid weekly, as per Article 27

SCHEDULE “E”

EXTENDED WORK SCHEDULES

WORK SCHEDULE A: TWENTY-ONE (21) DAYS ON/SEVEN DAYS (7) DAYS OFF

The following terms and conditions apply to employees, who work this schedule:

a) The Work Schedule may commence on any day of the week.

b) The Work Schedule will consist of twenty-one (21) consecutive scheduled days of work followed by seven (7) scheduled days of rest. Each work day will consist of a shift of ten (10) regularly scheduled hours of work.

c) The scheduled hours to be worked and the scheduled hours to be paid (straight time and overtime) are detailed in Table E.

d) Work performed outside of the ten (10) regularly scheduled hours of work in a scheduled day of work or on a scheduled day of rest will be paid as per the provisions of this Agreement.

e) An employee, who is transferred to a different Work Schedule, must be provided with notice as per the provisions of this Agreement. If an employee requests a transfer and it is approved, then overtime rates will not apply for days worked in the scheduled seven (7) days of rest, unless any of the ensuing days worked in the new Work Schedule are a Friday, Saturday, Sunday or Recognized Holiday in which case the applicable over-time rate will apply. If the transfer is not as a result of an employee request, overtime provisions will apply for days worked on the scheduled days of rest that the employee would have been entitled to under his/her previous schedule.

f) Overtime meals will be as per the provisions of this Agreement.

g) The hours set forth in this Work Schedule do not constitute a guarantee of hours of work per day.

Table E: Twenty-one and Seven Work Schedule (21 days of 10 hours worked, 7 days off)

Day	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su
ST	10	10	10	10				10	10	10	10				10	10	10	10										
1.5T					10							10							10									
2.0T						10	10						10	10						10	10							

WORK SCHEDULE B: TEN (10) DAYS ON/FOUR (4) DAYS OFF

The following terms and conditions apply to employees, who work this schedule:

a) The Work Schedule may commence on any day of the week.

b) The Work Schedule will consist of ten (10) consecutive scheduled days of work followed by four (4) scheduled days of rest. Each work day will consist of a shift of ten (10) regularly scheduled hours of work.

c) The scheduled hours to be worked and the scheduled hours to be paid (straight time and overtime) are detailed in Table A.

d) Work performed outside of the ten (10) regularly scheduled hours of work in a scheduled day of work or on a scheduled day of rest will be paid as per the provisions of this Agreement.

e) An employee, who is transferred to a different Work Schedule, must be provided with notice as per the provisions of this Agreement. If an employee requests a transfer and it is approved, then overtime rates will not apply for days worked in the scheduled four (4) days of rest, unless any of the ensuing days worked in the new Work Schedule are a Friday, Saturday, Sunday or Recognized Holiday in which case the applicable over-time rate will apply. If the transfer is not as a result of an employee request, overtime provisions will apply for days worked on the scheduled days of rest that the employee would have been entitled to under his/her previous schedule.

f) Overtime meals will be as per the provisions of this Agreement.

g) The hours set forth in this Work Schedule do not constitute a guarantee of hours of work per day.

Table A: Ten and Four Work Schedule (Ten days of 10 hours worked, 4 days off)

DAY	**M**	**T**	**W**	**Th**	**F**	**S**	**Su**	**M**	**T**	**W**	**Th**	**F**	**S**	**Su**
ST	10	10	10	10				10	10	10				
1.5 T					10									
2.0 T						10	10							

WORK SCHEDULE C: FOURTEEN (14) DAYS ON/SEVEN (7) DAYS OFF

The following terms and conditions apply to employees, who work this schedule:

a) The Work Schedule may commence on any day of the week.

b) The Work Schedule will consist of fourteen (14) consecutive scheduled days of work followed by seven (7) scheduled days of rest. Each work day will consist of a shift of ten (10) regularly scheduled hours of work.

c) The scheduled hours to be worked and the scheduled hours to be paid (straight time and overtime) are detailed in Table B.

d) Work performed outside of the ten (10) regularly scheduled hours of work in a scheduled day of work or on a scheduled day of rest will be paid as per the provisions of this Agreement.

e) An employee, who is transferred to a different Work Schedule, must be provided with notice as per the provisions of this Agreement. If an employee requests a transfer and it is approved, then overtime rates will not apply for days worked in the scheduled seven (7) days of rest, unless any of the ensuing days worked in the new Work Schedule are a Friday, Saturday, Sunday or Recognized Holiday in which case the applicable over-time rate will apply. If the transfer is not as a result of an employee request, overtime provisions will apply for days worked on the scheduled days of rest that the employee would have been entitled to under his/her previous schedule.

f) Overtime meals will be as per the provisions of this Agreement.

g) The hours set forth in this Work Schedule do not constitute a guarantee of hours of work per day.

Table B: Fourteen and Seven Work Schedule (14 days of 10 hours worked, 7 days off)

DAY	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su
ST	10	10	10	10				10	10	10	10										
1.5T					10							10									
2.0T						10	10						10	10							

WORK SCHEDULE D: FOURTEEN (14) DAYS ON/FOURTEEN DAYS (14) DAYS OFF

The following terms and conditions apply to employees, who work this schedule:

a) The Work Schedule may commence on any day of the week.

b) The Work Schedule will consist of fourteen (14) consecutive scheduled days of work followed by fourteen (14) scheduled days of rest. Each work day will consist of a shift of ten (10) regularly scheduled hours of work.

c) The scheduled hours to be worked and the scheduled hours to be paid (straight time and overtime) are detailed in Table C.

d) Work performed outside of the ten (10) regularly scheduled hours of work in a scheduled day of work or on a scheduled day of rest will be paid as per the provisions of this Agreement.

e) An employee, who is transferred to a different Work Schedule, must be provided with notice as per the provisions of this Agreement. If an employee requests a transfer and it is approved, then overtime rates will not apply for days worked in the scheduled fourteen (14) days of rest, unless any of the ensuing days worked in the new Work Schedule are a Friday, Saturday, Sunday or Recognized Holiday in which case the applicable over-time rate will apply. If the transfer is not as a result of an employee request, overtime provisions will apply for days worked on the scheduled days of rest that the employee would have been entitled to under his/her previous schedule.

f) Overtime meals will be as per the provisions of this Agreement.

g) The hours set forth in this Work Schedule do not constitute a guarantee of hours of work per day.

Table C: Fourteen and Fourteen Work Schedule (14 days of 10 hours worked, 14 days off)

Day	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su
ST	10	10	10	10				10	10	10	10																	
1.5T					10							10																
2.0T						10	10						10	10														

WORK SCHEDULE E: TWENTY (20) DAYS ON/EIGHT DAYS (8) DAYS OFF

The following terms and conditions apply to employees, who work this schedule:

a) The Work Schedule may commence on any day of the week.

b) The Work Schedule will consist of twenty (20) consecutive scheduled days of work followed by eight (8) scheduled days of rest. Each work day will consist of a shift of ten (10) regularly scheduled hours of work.

c) The scheduled hours to be worked and the scheduled hours to be paid (straight time and overtime) are detailed in Table D.

d) Work performed outside of the ten (10) regularly scheduled hours of work in a scheduled day of work or on a scheduled day of rest will be paid as per the provisions of this Agreement.

e) An employee, who is transferred to a different Work Schedule, must be provided with notice as per the provisions of this Agreement. If an employee requests a transfer and it is approved, then overtime rates will not apply for days worked in the scheduled eight (8) days of rest, unless any of the ensuing days worked in the new Work Schedule are a Friday, Saturday, Sunday or Recognized Holiday in which case the applicable over-time rate will apply. If the transfer is not as a result of an employee request, overtime provisions will apply for days worked on the scheduled days of rest that the employee would have been entitled to under his/her previous schedule.

f) Overtime meals will be as per the provisions of this Agreement.

g) The hours set forth in this Work Schedule do not constitute a guarantee of hours of work per day.

Table D: Twenty and Eight Work Schedule (20 days of 10 hours worked, 8 days off)

Day	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su
ST	10	10	10	10				10	10	10	10				10	10	10	10										
1.5T					10							10							10									
2.0T						10	10						10	10						10								

WORK SCHEDULE F: TWENTY (20) DAYS ON/TEN DAYS (10) DAYS OFF

The following terms and conditions apply to employees, who work this schedule:

h) The Work Schedule may commence on any day of the week.

i) The Work Schedule will consist of twenty (20) consecutive scheduled days of work followed by ten (10) scheduled days of rest. Each work day will consist of a shift of ten (10) regularly scheduled hours of work.

j) The scheduled hours to be worked and the scheduled hours to be paid (straight time and overtime) are detailed in Table D.

k) Work performed outside of the ten (10) regularly scheduled hours of work in a scheduled day of work or on a scheduled day of rest will be paid as per the provisions of this Agreement.

l) An employee, who is transferred to a different Work Schedule, must be provided with notice as per the provisions of this Agreement. If an employee requests a transfer and it is approved, then overtime rates will not apply for days worked in the scheduled ten (10) days of rest, unless any of the ensuing days worked in the new Work Schedule are a Friday, Saturday, Sunday or Recognized Holiday in which case the applicable over-time rate will apply. If the transfer is not as a result of an employee request, overtime provisions will apply for days worked on the scheduled days of rest that the employee would have been entitled to under his/her previous schedule.

m) Overtime meals will be as per the provisions of this Agreement.

n) The hours set forth in this Work Schedule do not constitute a guarantee of hours of work per day.

Table D: Twenty and Eight Work Schedule (20 days of 10 hours worked, 10 days off)

Day	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T
ST	10	10	10	10				10	10	10	10				10	10	10	10												
1.5T					10							10							10											
2.0T						10	10						10	10						10										

WORK SCHEDULE G: TWENTY-EIGHT (28) DAYS ON/FOURTEEN DAYS (14) DAYS OFF

The following terms and conditions apply to employees, who work this schedule:

a) The Work Schedule may commence on any day of the week.

b) The Work Schedule will consist of twenty-eight (28) consecutive scheduled days of work followed by fourteen (14) scheduled days of rest. Each work day will consist of a shift of ten (10) regularly scheduled hours of work.

c) The scheduled hours to be worked and the scheduled hours to be paid (straight time and overtime) are detailed in Table F.

d) Work performed outside of the ten (10) regularly scheduled hours of work in a scheduled day of work or on a scheduled day of rest will be paid as per the provisions of this Agreement.

e) An employee, who is transferred to a different Work Schedule, must be provided with notice as per the provisions of this Agreement. If an employee requests a transfer and it is approved, then overtime rates will not apply for days worked in the scheduled fourteen (14) days of rest, unless any of the ensuing days worked in the new Work Schedule are a Friday, Saturday, Sunday or Recognized Holiday in which case the applicable over-time rate will apply. If the transfer is not as a result of an employee request, overtime provisions will apply for days worked on the scheduled days of rest that the employee would have been entitled to under his/her previous schedule.

f) Overtime meals will be as per the provisions of this Agreement.

g) The hours set forth in this Work Schedule do not constitute a guarantee of hours of work per day.

Table F: Twenty-eight and Fourteen Work Schedule (28 days of 10 hours worked, 14 days off)

Day	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su	M	T	W	Th	F	S	Su
ST	10	10	10	10				10	10	10	10				10	10	10	10				10	10	10	10																		
1.5T					10							10							10							10																		
2.0T						10	10						10	10						10	10						10	10																

LETTERS OF UNDERSTANDING

LETTER OF UNDERSTANDING

Between:

MUSKRAT FALLS EMPLOYERS' ASSOCIATION INC.

And

RESOURCE DEVELOPMENT TRADES COUNCIL OF NEWFOUNDLAND AND LABRADOR

THE PARTIES HEREBY AGREE THAT:

The quarries that provide aggregates or till to the Site shall fall within the scope of this Agreement and such quarries shall be designated prior to their use.

AGREED TO this 14th day of March, 2013 at the City of St. John's, in the Province of Newfoundland and Labrador

(digital copy of signed agreement)
Muskrat Falls Employers' Association Inc.

(digital copy of signed agreement)
Resource Development Trades Council of Newfoundland and Labrador

LETTER OF UNDERSTANDING

Between:

MUSKRAT FALLS EMPLOYERS' ASSOCIATION INC.

And

RESOURCE DEVELOPMENT TRADES COUNCIL OF NEWFOUNDLAND AND LABRADOR

THE PARTIES HEREBY AGREE THAT:

Article 7.08 provides the Contractor with the ability to use working forepersons in situations that would not normally be permitted under the 'usual' arrangements for forepersons in Newfoundland and Labrador. The unique nature of the work and the remote location of the Project have necessitated these arrangements.

The agreement to these arrangements is without prejudice to future assertions of the 'usual' arrangements for foreperson.

AGREED TO this 14th day of March, 2013 at the City of St. John's, in the Province of Newfoundland and Labrador

(digital copy of signed agreement)
Muskrat Falls Employers' Association Inc.

(digital copy of signed agreement)
Resource Development Trades Council of Newfoundland and Labrador

LETTER OF UNDERSTANDING

Between:

MUSKRAT FALLS EMPLOYERS' ASSOCIATION INC.

And

RESOURCE DEVELOPMENT TRADES COUNCIL OF NEWFOUNDLAND AND LABRADOR

THE PARTIES HEREBY AGREE as follows:

a) A fuel depot shall be established on Site as soon as practicable, and no later than six (6) months after the bulk excavation Contractor for the Site commences work.

b) Prior to the installation of a fuel depot on Site, transporting of fuel around the Site and the fueling of vehicles and equipment on the Site may be done by persons who are not members of the bargaining unit.

c) Vehicles picking up or delivering garbage and waste containers on Site may be operated by persons who are not members of the bargaining unit.

d) Courier packages may be delivered or dropped off on Site by persons who are not members of the bargaining unit.

AGREED TO this 14th day of March, 2013 at the City of St. John's, in the Province of Newfoundland and Labrador

(digital copy of signed agreement)
Muskrat Falls Employers' Association Inc.

(digital copy of signed agreement)
Resource Development Trades Council of Newfoundland and Labrador

MEMORANDUM OF UNDERSTANDING

BETWEEN

MUSKRAT FALLS EMPLOYER'S ASSOCIATION INC.
("Association")

- and -

RESOURCE DEVELOPMENT TRADES COUNCIL OF NEWFOUNDLAND AND LABRADOR
("RDTC")

Re: Application of Hiring Priority – Article 7

THE PARTIES AGREE workers shall be dispatched in the following order of priority:

i) Qualified Labrador Innu;
ii) Qualified residents of Labrador who are members of the RDTC;
iii) Qualified residents of Labrador;
iv) Qualified residents of the Island of Newfoundland who are resident members of the RDTC, and
v) Qualified residents of the Island of Newfoundland.

In hiring and making referrals, both the Contractor and Union members of the RDTC will comply with the Benefits Strategy and any employment equity plan that may be applicable to qualified Labrador Innu.

AGREED to this 14th day of March, 2013 in the City of St. John's, in the Province of Newfoundland and Labrador

(digital copy of signed agreement)
Muskrat Fall Employers' Association Inc.

(digital copy of signed agreement)
Resource Development Trades Council of Newfoundland and Labrador

MEMORANDUM OF UNDERSTANDING

BETWEEN

Muskrat Falls Employer's Association Inc.
("Association")

- and -

Resource Development Trades Council
of Newfoundland and Labrador
("RDTC")

Re: Gender Equity and Diversity Implementation

The Association and Council of Unions agree as follows:

1. To support and promote initiatives and plans for employment diversity.

2. To provide full access to employment opportunities for and employment of qualified women and qualified members of underrepresented groups (aboriginals, persons with disabilities and members of visible minorities).

3. To implement proactive programs and practices that contribute to the creation of an inclusive work environment consistent with the policies established for the Project and commitments in the Gender Equity and Diversity Program.

4. To achieve diversity objectives, the Parties have agreed to the name hiring provisions set out in Article 7.07(c) & (d).

5. The Collective Agreement will not frustrate access to employment for underrepresented groups.

AGREED to this 13th day of June, 2013 in the City of St. John's, in the Province of Newfoundland and Labrador

(digital copy of signed agreement)
Muskrat Fall Employers' Association Inc.

(digital copy of signed agreement)

(digital copy of signed agreement)
Resource Development Trades Council of Newfoundland and Labrador

EXHIBIT 12
SITE CONDITIONS

1 CONTRACTOR'S WORK AREA

1.1 Worksite Location

The Worksite location is generally indicated in Part 1, Instruction to Bidders and more fully explained in Exhibit 1, Scope of Work.

1.2 Site Location

The Site location is indicated on the drawings provided in Exhibit 1, Attachment 2 and more specifically on the following drawings:

Nalcor Document No. SNC-Lavalin Document No.	Title
MFA-SN-CD-0000-CV-PL-0004-01 505573-300A-41DD-0003-	Muskrat Falls - Lower Churchill River –Plan and profile
MFA-SN-CD-3000-GT-GA-0001-01 505573-3331-41DD-0100	Muskrat Falls - Intake and Powerhouse, Spillway and Transition Dams - General Layout Plan
MFA-SN-CD-2000-CV-GA-0001-01 505573-300A-41DD-0012	Muskrat Falls - Access Roads, Accommodations and Laydown Areas

1.3 Area for Contractor Site Administration Office

The Company will provide the Contractor with an area adjacent to the Administration Complex, for the installation of the Contractor's main Site administration office. Utilities, such a potable water, sewage and electrical services will be made available for this office. It is the Contractor`s responsibility to hook up these services except for electrical power hook-up which will be performed by the Company.

1.4 Contractor Laydown Area

The Company will provide a laydown area to the Contractor in the Company Laydown Area, with an area of approximately five thousand square meters (5,000 m^2), to install its temporary facilities and storage. The Company Laydown Area is shown on the Drawings in Exhibit 1, Attachment 2. The precise locations available for the Contractor's use will be subject to the Engineer's approval.

1.5 **Work Area**

The Contractor will be permitted to install its trailers, containers and other temporary buildings for its own use in close proximity of its work areas. The precise locations will be subject to the Engineer's approval.

1.6 **Work Areas Free of Obstruction and Maintained**

1.6.1 During the execution of the Work, the Contractor shall keep the Site reasonably free from all unnecessary obstruction and shall store or dispose of any Contractor's equipment and surplus materials and clear away and remove from the Site any wreckage, rubbish or temporary works no longer required.

Unless otherwise provided elsewhere in the Agreement, the Contractor shall, throughout the construction period, maintain its work area, laydown areas and passage ways in order to permit the safe movement of pedestrians and vehicles at all times.

1.6.2 The Company will maintain all main access roads, including occasional grading of roads, snow removal and sanding of permanent access roads. The limits of the main permanent access road are provided for on the drawings. The Company accepts no responsibility with regards to the quality of the services.

1.6.3 All maintenance and snow removal within the Contractor's work area and in the immediate vicinity of its temporary facilities and storage areas in the Company's Laydown Area shall be the Contractor's responsibility. The Contractor will obtain materials for sanding from designated sand and gravel deposits located within the Site Area as directed by the Engineer.

1.7 **Signage**

The Contractor shall be responsible to install on its temporary roads all the traffic signs to inform road users, ensure their safety and facilitate traffic. The signage shall comply with the requirements of the Technical Specification, Section 01 55 00 "Roads and Contractor's Laydown Area".

Only standard safety bulletin boards and safety signs used to identify the LCP, Company, designated representatives and the Contractor, shall be allowed on the Site, with prior approval of the Engineer.

1.8 **Construction Services**

The Contractor shall operate and maintain construction services on the basis of seven (7) days a week, 24 hours a day for the duration of his contract. At the end of the Agreement, all the facilities of construction services shall be dismantled by the Contractor and remain its property, unless otherwise indicated. The Engineer has, at any time, the right to inspect the provisional facilities of the Contractor and require changes as he deems necessary, at the expense of the Contractor. The Contractor shall submit to the Engineer, for acceptance, drawings and specifications of any construction services or installations that it intends to install in its working areas twenty (20) working days before the commencement of their installation, or as agreed upon with the Engineer.

1.9 Clearance of Site on Completion

Upon Substantial Completion of the Work, the Contractor shall clear away and remove from that part all Contractor's Equipment, surplus material, rubbish and temporary Works of every kind, and leave such part of the Site and Works clean and in a workmanlike condition to the satisfaction of the Engineer.

2 SERVICES PROVIDED TO AND BY THE CONTRACTOR AND/OR ENGINEER

2.1 Electrical Power Supply

2.1.1 Services Provided by the Company

Engineer will provide electrical power to the Worksite. The Contractor will be provided free of cost with electrical power supply at the following sites for the execution of its work:

1. One in close proximity of the Company's Laydown Area (three-phase 600 V supply);
2. One at the Powerhouse area (three-phase 600 V supply);
3. One at the Spillway (three-phase 600 V supply);

The Contractor's total electrical load shall not exceed 500 kW.

The Contractor shall limit voltage dip on starting motors to 20% at the supply point based on Company supplied transformers listed above with standard impedance.

The Contractor shall provide, install, maintain and remove upon completion of the Work at Contractor's cost all necessary equipment for Contractor's temporary electrical power requirements in the Work from the three (3) power supply points indicated above.

The Contractor shall show at any time to the Engineer that it shall not exceed a power load factor of zero point nine (0.9), either by measurement or by the installation of adequate protective devices. The Contractor shall make all necessary arrangements with the Engineer for its connections to those 3 power points. The work associated with the initial connection and final disconnection will be made by the Company at the expense of the Company. The Contractor shall supply to the Engineer the following information prior to connection to the main power system:

1. Single line diagrams
2. Protection systems on equipment and lines (relays, fuses, etc. with calculations and calibrations)
3. Cabling sizes and calculations

The Company will make every effort to maintain an uninterrupted supply of electric power, but Company cannot guarantee that there will be no interruption during the duration of the Work. Company will not be responsible for any cost to Contractor for such interruptions, variations in voltage or frequency or damage arising thereof. The Contractor shall take the necessary measures to meet its needs in case of emergency.

2.1.2 **Services Provided by the Contractor**

The Contractor shall be responsible to provide its own power supply over and above the quantity supplied by the Company, as necessary to execute its work and to provide power to its facilities, such as offices, workshops, etc. and sub-contractors' (if any) needs. The Contractor shall include the costs thereof in its lump sum prices.

2.2 **Lighting**

The Contractor shall be responsible to provide all lighting required for its work areas.

When work is done at night or when the day light is down, the contractor shall provide a minimum of 300 Lux, and the Contractor shall ensure sufficient lighting for the execution of the Work in satisfactory, efficient and secure conditions or as specified from time to time in the Technical Specifications, Exhibit 1, Attachment 1. All ducts and power lines for lighting and other electrical services shall be installed and maintained in a safe manner, fixed securely and placed as far as possible from transmission cables.

2.3 **Potable Water**

Potable water will be supplied by the Company to the Contractor at a central location inside the Accommodation Complex. The Contractor shall be responsible to pick-up the water at this point and provide all necessary equipment to distribute to the different places at the Work site. The Contractor shall be responsible to meet all standards as per the Project's Health and Safety Plan.

2.4 **Industrial Water**

The Contractor shall be responsible to provide its own supply of industrial water, either by pumping from rivers or streams or by wells.

2.5 **Heating and Ventilation**

The Contractor shall be responsible for the heating and ventilation of its facilities and for any other heating required for the execution of its work. The thermal environment and ventilation of its facilities shall be in accordance with Occupation Health and Safety Regulations.

2.6 **Dewatering and Sediment Control**

The civil contractor (CH0007) maintains its own pumping and dewatering systems in its work areas. This includes the construction, operation and maintenance of sedimentation ponds.

The Contractor shall manage, in its work areas, the rain and snow melting water, and any water the Contractor might generate by its Work, but only during installation of the sill plates and modifications of the spillway rollways for the block outs. The Contractor shall pump such water out of its work areas towards wells (not to Company's civil contractor's sediment ponds) provided by Company (or Company's other contractors) located in proximity to each of Contractor's work areas. The Contractor shall not perform any sediment control. For the purpose of this section, a Contractor work area is where the

Contractor is actually performing the type of work described above. At any other time, the Contractor shall have no responsibility to manage any water. Furthermore, the Contractor shall have no responsibility to control any other source of water, including leakage of the cofferdams installed by Company (or Company's other contractors). Company or Company's other contractor shall turn over each of Contractor's work areas in a sufficiently dry condition to allow uninhibited access to Contractor for the installation of temporary facilities and execution of the Work according to Contractor's procedures.

2.7 **Sanitary Facilities**

The Company will provide wash cars in sufficient quantities. The Contractor shall locate such facility at the most convenient place(s) in Contractor's Site and relocate them from time to time as the need arises. The Company will provide all waste collection, all stipulated sanitary cleaning required and all associated consumables and water supply.

2.8 **Cleaning of Lunch Rooms and Offices**

The Contractor shall be responsible for all the cleaning of its offices, lunchrooms, workshops and all other workplaces under its responsibility on a regular basis. Lunchroom, however, shall be cleaned after each meal or break. Such services may be subcontracted by the Contractor, at his own expenses, to the on-site Company's catering contractor, subject to the Engineer's approval.

2.9 **Waste Management**

Reference is made to the Waste Management Plan Doc No: LCP-SN-CD-0000-EV-PL-0005-01 for a detailed description.

The Contractor shall investigate the availability of local solid and liquid waste collection and disposal services. The Contractor shall ensure their waste management program has integrated the availability these services.

The Company will provide domestic trash containers to be placed at the Company's Laydown Area on the Site. The Company is responsible for the supply, installation and periodic replacement as required.

The Contractor shall be responsible for collecting all recoverable waste refuse and packing material the Contractor generates, and for disposing it within the appropriate containers (clearly identified as to its restricted content) provided by the Contractor. If the Contractor fails to take the necessary measures to comply with and/or fulfill this obligation, the Company will notify the Contractor in writing to take immediate corrective action. If the Contractor does not comply after notification by the Company, the Company will have these task completed and back-charge the costs to the Contractor.

The Contractor shall be responsible for:

Disposal of materials from the Hazardous Waste Storage Area (HWSA) to approved facilities;

Diversion of Recyclable metals from landfill disposal, collection and pickup by metals recycler and;

Collection, storage, and subsequent disposal at approved facilities of Construction waste and demolition debris.

Solid and liquid waste management is an important component of the Contractors performance. Solid and liquid waste management is a challenge in Labrador as a result of the climate, and limited management and disposal options. The Contractor must plan their solid and liquid waste management programs carefully. Provided below is a partial list of potential waste management resources. It is the Contractor's responsibility to ensure its solid and liquid waste management programs are complete.

- Potential Waste Management Resources Town of Happy Valley – Goose Bay , Municipal Landfill (4 km from town on Northwest River Road : 709 896-3321
- Pardy's Waste Management - 84A Glencoe Drive, Mount Pearl NL: 709-782-2003
- Hickey's Construction – 5 Broomfield Ave. Happy Valley Goose Bay: 709-896-3250
- J.J.' s Trucking – 16 Hillcrest Road Happy Valley Goose Bay: 709-896-5552
- Roger's Group -15 Churchill Dr. Happy Valley Goose Bay: 709-896-5041
- Woodward's – 16 Loring Dr. Happy Valley Goose Bay: 709-896-2421
- Recyclex Inc. (Hazardous Waste) – Montreal QC: 514-355-4148

2.10 Operation and Maintenance of Temporary Construction Services

The Contractor shall operate and maintain temporary construction services (such as, but not limited to, dewatering, electrical power , etc.) on the basis of seven (7) days a week, 24 hours a day for the duration of his contract. At the end of the contract, all the facilities of construction services shall be dismantled by the Contractor and remain its property, unless otherwise indicated. The Engineer has, at any time, the right to inspect the provisional facilities of the Contractor and require changes, for safety or environmental reasons as he deems necessary, at the expense of the Contractor. The Contractor shall submit to the Engineer, for acceptance, drawings and specifications of any construction services or installations that it intends to install in its working areas twenty (20) working days before the commencement of their installation, or as agreed upon with the Engineer.

3 FUEL AND FUEL MANAGEMENT

3.1 Fuel Supply

A fuel station for vehicles will be located at the Company's Laydown Area. Diesel fuel and gasoline will be available. Contractor will be charged the actual market rates at the time of the purchase.

The Contractor shall on a monthly basis and at the 1st of every month, submit to the Engineer its estimated fuel needs for the next 3 months, in order to ensure adequate supply.

The Contractor shall make arrangements with the onsite fuel supplier for its terms of payment for fuel purchased at the Site.

During the execution of the Work, the Contractor shall be responsible for its own fuel needs. The Company assumes no liability and the Contractor is responsible for all cost associated with its fuel requirements.

3.2 Fuel Management

The Contractor shall submit a monthly fuel delivery report on all fuel consumed during the month. Refer to Exhibit 6, Appendix C for the report format. The report shall be submitted to the Engineer no later than 7 days following the end of the month.

4 TELECOMMUNICATIONS

Company will provide Contractor with access to telecommunication systems and services at the Muskrat Falls construction site for business requirements. Telecommunication systems and services include, but not limited to, the following:

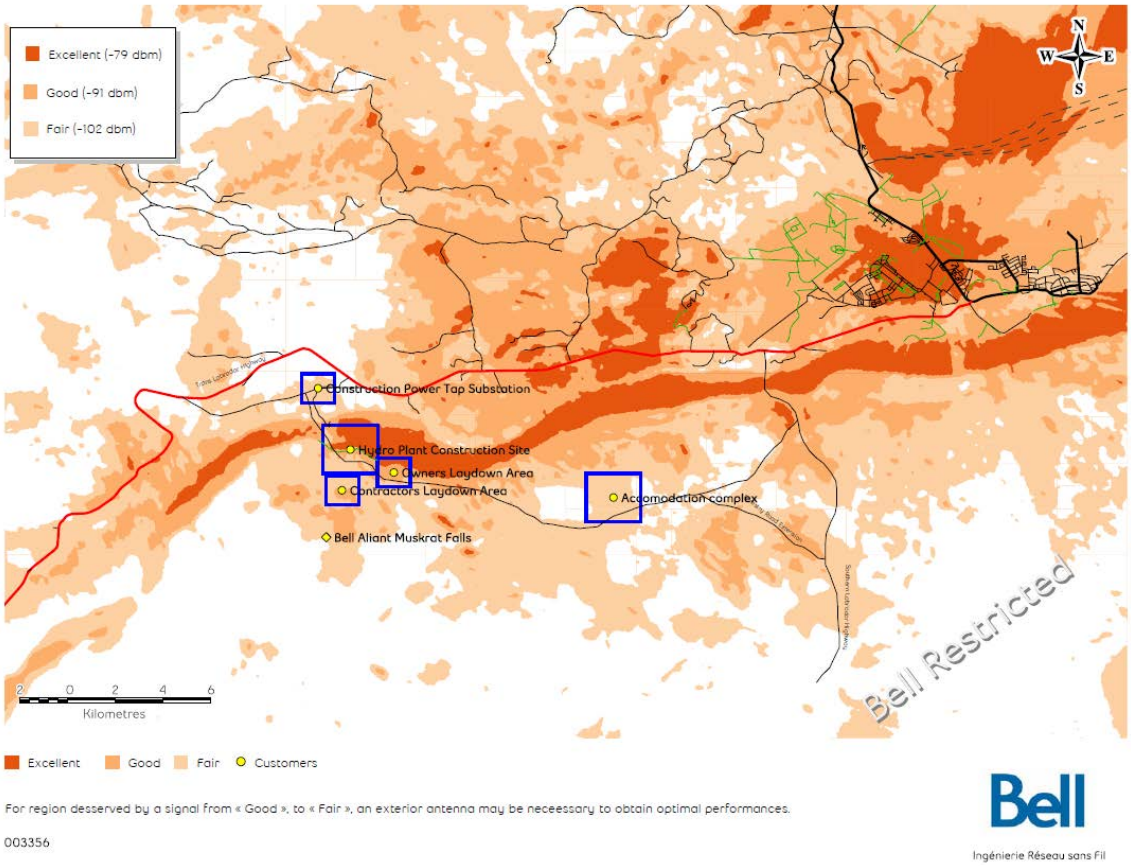
- Land Mobile Radio System (LMRS): Company will deploy a single LMRS for use by Company, Engineer, and all Contractors and Subcontractors at the Muskrat Falls construction site. The Company will grant access to the Contractor and Subcontractors to the infrastructure of the radio communications system. It will be the responsibility of the Contractor and its Subcontractors to acquire at its own cost the mobile and portable equipment and accessories (portable radios portable mobile radios, antennas, chargers, etc). The mobile and portable radios will be available from the same Telecommunications Services Provider (TSP) appointed by the Company for the LMRS.
- Telephone Services: Company will deploy a single wire based Telephone System at the Muskrat Falls construction site. The Contractor shall advise Company of the required number of offices it will utilize at site and Company will provide one telephone for every Contractor Office. Contractor shall provide Company with a Contractor office forecast on a monthly basis for the duration of the Contractors contract.
- Cellular and Mobile Internet Services: The Company is not deploying a cellular and mobile internet solution. However, the local telecommunication company has some cellular coverage at the Muskrat Falls construction site.
- Internet Services: Company will provide Contractor with a single wired Internet connection at the Contractor's designated office area. It is the Contractors

responsibility to distribute this Internet connection to individual Contractor's offices and devices. The Contractor is also responsible for Operation, Administration, Maintenance and Provisioning of its internal Local Area Network and end user devices, such as computers and printers, in its designated office area.

Company will provide Contractor staff with Quality of Life telecommunication systems and services during non-work hours. Recreational systems and services will include, but not limited to, the following:

- Television Services: A television will be provided in each dormitory room and designated public areas of the accommodations complex.
- Telephone Services: A wired telephone will be provided in each dormitory room and designated public areas of the accommodations complex.
- Internet Services: A physical internet connection will be provided in each dormitory room, and wireless internet will be provided in the dormitory modules and designated public areas of the accommodations complex.

HSPA Coverage Map - MF Area



For region desserved by a signal from « Good », to « Fair », an exterior antenna may be neceessary to obtain optimal performances.

003356

Bell

Ingénierie Réseau sans Fil

5 ACCOMODATION COMPLEX

5.1 Accommodations

5.1.1 General

The Company will provide an Accommodation Complex, located approximately 10 km from the Muskrat Fall Site. At the Accommodation Complex the Company will provide room and board free of charge for the mandatory use by the Contractor's staff and its Personnel, as authorized by the Engineer. The number of employees eligible for lodging services is limited to the resources indicated in the Construction Schedule submitted by the Contractor in its Proposal. The Contractor shall submit to the Engineer at least thirty (30) days in advance, all reasons for any forecasted increases in manpower. The Engineer does not undertake to accept such requests, however, the Engineer may, at its sole discretion and subject to availability, approve these forecasted increases in manpower.

The Contractor`s Personnel will be mobilized at the Muskrat Site in compliance with Company Policy.

Employees are to be provided with identification card with photograph issued by the Engineer on their first day on site. This will then permit camp registry and room assignment, free access to the camp cafeteria and main gate ingress and egress when required.

5.1.2 Rooms

The Contractor`s Personnel will be housed in dormitories with rooms for single occupancy, including toilet, washbasin and a double occupancy (shared) shower. Each dormitory is supplied with heating and indoor and outdoor lighting and is equipped with washers and dryers placed at the disposal of its occupants. The occupants may, however, not use the washer and dryers for cleaning work clothes. Contractor is responsible for providing washers and dryers for cleaning work clothes of its Personnel. The Company provides free cable services, local phone services, internet services and a television set for each room. No private satellite antenna is permitted. The costs of long distance telephone calls shall be the responsibility of each Contractor`s Personnel.

5.1.3 Board

Two (2) hot meals are served every day in the cafeteria (breakfast and supper). The cold meal for the middle of the work shift is available to the Contractor`s Personnel during the previous meal at the cafeteria.

5.2 Emergency Services

The company will provide a third party medical service provider, fully-equipped first aid room and emergency vehicles for contractors' access, free of charge.

The Company will provide an emergency vehicle on the Site. The emergency vehicle will be operated and maintained by the Company.

5.3 Security Services

The Company will maintain a security service for the protection of all facilities and property. Regular security patrols will take place within the camp boundaries to protect its facilities, equipment and residents.

The Company takes no responsibility for any loss or damage of any kind incurred by Contractor's Personnel.

5.4 Fire Protection

The Company will provide overall fire-fighting capacity for the Worksite, while Contractor shall be responsible for fire prevention and fire watch activities for the Work.

5.5 Recreation

Recreation facilities will be made available to the Contractor`s Personnel.

5.6 Banking Services

An ATM banking machine will be made available to the Contractor`s Personnel.

5.7 Convenience Store

The Contractor`s Personnel will have access to a small convenience store offering variety items deemed appropriate for construction site. The Contractor`s Personnel are responsible for the cost of all purchases.

5.8 Drugs and Alcohol

The Site shall be drug and alcohol free, in accordance with the requirements of LCP-PT-MD-0000-LR-SD-0001-01, Standard for Drug and Alcohol.

Every employee of the Contractor shall be drug and alcohol free while at work.

In addition, employees and Contractor shall not be permitted to possess or sell prohibited drugs or alcohol or, be in possession of any item or piece of equipment for the use of or administration of a prohibited drug at the Site.

The objective of the requirements contained in this Policy is to improve the safety of staff, Contractors and customers through reducing the risk created by the use of drugs and alcohol in the workplace.

6 PROHIBITION OF COMMERCIAL TRADE

Commercial activities are prohibited on the Site.

7 RESPONSIBILITY OF THE CONTRACTOR

The Contractor is responsible for any and all replacement costs of items assigned to the Contractor's Personnel during their assignment at the Site.

8 TRANSPORT

8.1 Private Vehicles

Private vehicles are not allowed on the Site or Accommodation complex.

8.2 Access to Site

The Site is accessible as follows:

8.2.1 By Road

The Site is located approximately thirty (38) km from the town of Happy Valley-Goose Bay (HV-GB). The route follows the Trans Labrador Highway for approximately ten (10) km south of HV-GB and a gravel road of approximately twenty (20) km which leads to the Company's Laydown Area.

8.2.2 Port Facilities

The Happy Valley-Goose Bay and Cartwright port facilities are accessible by road to Site. Contractor is responsible for obtaining, from the appropriate Authority, the restrictions and requirements in using those facilities and associated services.

8.2.3 Bridges

The Contractor is responsible for completing a logistics study to determine any restrictions in shipping material and equipment to and from the Site.

8.2.4 By Air

The Site is serviced by the Happy Valley - Goose Bay airport. Air transport of passengers is provided by various commercial airlines such as:

1. Air Canada
2. Air Labrador
3. INNU Mikun Airlines
4. PAL (Provincial Airlines)

The Contractor shall be responsible for all airline bookings for all travel needs of the Contractor's personnel.

The Contractor shall be responsible for all transportation cost and expenses of the Contractor's personnel to and from Goose Bay Airport and other destinations, wherever they may be located.

8.3 Transportation to the Site

The Company will provide mandatory scheduled bus service between Goose Bay, North West River and Sheshatshiu and between Goose Bay, Goose Bay Airport and the

Accommodation Complex to transport all Contractor's Personnel and their personal belongings.

Company takes no responsibility for any inconvenience that may be caused due to normal mechanical failure, adverse weather conditions or other causes out of its control.

The Contractor shall be responsible for transportation between the Goose Bay or other place and the Site for any material, equipment, tools, or other requirements associated with the Work.

8.4 **Transportation between the Accommodations Complex and Work Locations.**

The Contractor is responsible to provide the necessary transportation of the Contractor`s Personnel between the Accommodations Complex and Work locations on the Site.

EXHIBIT 13

PROVINCIAL BENEFITS

1.0 Scope

Company has agreed to a Lower Churchill Construction Project Benefits Strategy (http://www.nr.gov.nl.ca/nr/energy/lcp_benefits_strategy.pdf) with the Province of Newfoundland and Labrador. This Benefits Strategy outlines all contracts, purchasing, and employment benefits objectives for the Lower Churchill Project (LCP). As well, Company has signed the Lower Churchill Innu Impacts and Benefits Agreement (IBA) with Innu Nation. Contractors are required to adhere to applicable obligations contained in this agreement.

Also the Government of Newfoundland and Labrador has entered into a Memorandum of Understanding (MOU) with the Government of Nova Scotia regarding industrial and employment benefits respect to the Maritime Link transmission project. Details of these MOU can be found at (http://www.releases.gov.nl.ca/releases/2011/nr/1128n06.htm).

In this MOU the parties agree that the Company will meet the following commitments in regard to the construction of the Muskrat Falls Plant and the Labrador-Island Link:

1. Provide Nova Scotia contractors, service providers, consultants, and suppliers with open, timely and transparent access to procurement opportunities and activities in relation to the projects;
2. Provide reasonable advance notice to the Nova Scotia supply and service community of all procurement opportunities;
3. Conduct a supplier information workshop in Nova Scotia;
4. Communicate with unsuccessful Nova Scotia proponents, when requested, to help the proponents better prepare for future opportunities.

Successful Bidder must agree to the following:

- To support the objectives and principles as committed to by Company as per the Lower Churchill Construction Project Benefits Strategy.
- To support the relevant objectives and principles contained in the IBA.
- To support the objectives and principles as committed to by Company as per the MOU.
- To make best efforts to obtain Newfoundland and Labrador Benefits content as outlined in the submitted bid. If this content can not be met, Contractor must inform Company as early as possible and provide Company with rational and mitigation strategy.

2.0 Contractor's Obligations

Contractor Shall:

- Execute commitments to Lower Churchill Construction Project Benefits Strategy and IBA as outlined in Bidder's submission.
- Provide NL companies and suppliers with full and fair opportunity to participate on a competitive basis in the supply of goods and services as per Section 2.1 of Attachment 1 – Completed Benefits Questionnaire.
- Comply with the hiring protocol as outlined in the Benefits Strategy for work performed on

the generation and transmission sites.

- Support LCP's Gender Equity and Diversity initiatives.
- Submit data reports on a monthly basis regarding employment and expenditures. Reporting tables to be supplied by Company.
- Make best efforts to fulfill commitments regarding NL bid content as stated in Attachment 1 – Completed Benefits Questionnaire.

3.0 Company Responsibilities

Company shall:

- Provide Contractor with data collection and system requirements relating to monthly Benefits Reporting.

ATTACHMENT 1

COMPLETED PROVINCIAL BENEFITS QUESTIONNAIRE

ANDRITZ Hydro

1.0 INTRODUCTION

This questionnaire is used to assess the Provincial Benefits content contained in Bidder's Proposal for the Lower Churchill Project (LCP).

Bidder is required to respond to the questions/statements outlined in this questionnaire in the format presented in the various sections herein. Accurate information, consistent with Canadian General Standards Board, is imperative. Failure to provide the information required may result in its Proposal being rejected. Information provided is subject to audit by Company. Extracts from this submission will be included in the final agreement with the Successful Bidder. Company has agreed to a Lower Churchill Construction Project Benefits Strategy (http://www.nr.gov.nl.ca/nr/energy/lcp_benefits_strategy.pdf) with the Province of Newfoundland and Labrador. This Benefits Strategy outlines all contracting, purchasing, and employment benefits objectives for the Lower Churchill Project (LCP). This strategy also outlines Company's commitments to gender equity and diversity. Successful Bidder will be required to undertake a commitment to support gender equity and diversity in the execution of Work on the LCP. All contractors are required to adhere to applicable principles and commitments contained in this strategy.

Company has signed the Lower Churchill Innu Impacts and Benefits Agreement (IBA) with Innu Nation. Bidders are required to respond to questions relating to Innu employment and procurement content. Although not a condition precedent to award, Innu content will be a consideration in the overall evaluation of bids to the degree the opportunity for Innu content exists.

Also the Government of Newfoundland and Labrador has entered into a Memorandum of Understanding (MOU) with the Government of Nova Scotia regarding industrial and employment benefits with respect to the Maritime Link transmission project. Details of this MOU can be found at (http://www.releases.gov.nl.ca/releases/2011/nr/1128n06.htm).

In this MOU the parties agree that the Company will meet the following commitments in regard to the construction of the Muskrat Falls Plant and the Labrador-Island Link:

1. Provide Nova Scotia contractors, service providers, consultants, and suppliers with open, timely and transparent access to procurement opportunities and activities in relation to the projects;
2. Provide reasonable advance notice to the Nova Scotia supply and service community of all procurement opportunities;
3. Conduct a supplier information workshop in Nova Scotia;
4. Communicate with unsuccessful Nova Scotia proponents, when requested, to help the proponents better prepare for future opportunities.

ANDRITZ Hydro

2.0 BIDDER'S UNDERSTANDING AND COMMITMENT TO NEWFOUNDLAND AND LABRADOR BENEFITS AND IBA COMMITMENTS

2.1 Contracting and Procurement

The LCP is committed to supporting the accrual of benefits for the people of Newfoundland and Labrador, while executing the LCP on an economic basis adhering to competitive business practices. In support of this commitment, Bidder shall work to promote opportunities in Newfoundland and Labrador while maintaining the economic viability of the LCP through application of best value in the acquisition of goods and services. For purposes of this Appendix, best value is defined as a blend of total cost, quality, commitment to safety, technical suitability, credit worthiness, delivery and continuity of supply and services, where total cost is comprised of initial purchase price plus operation and maintenance costs. Within this framework, if successful, Bidder shall with respect to services and Work being performed for the LCP:

(a) provide suppliers and contractors in Newfoundland and Labrador with full and fair opportunity to participate on a competitive basis in the supply of goods and services;

(b) become familiar with Newfoundland and Labrador contractor/supplier capabilities, and size and design packages in a manner that recognizes these capabilities;

(c) make the request for proposal processes, names and locations of key procurement personnel available to potential Newfoundland and Labrador suppliers and contractors where appropriate; and

(d) require benefits information as part of the request for proposal processes in sufficient detail to assess the benefits to be derived from a proposal, including requiring bidders to complete a Provincial Benefits questionnaire as part of that process.

Bidders are asked to respond to the following:

2.1 a) Describe Bidder's experience with implementing local benefits strategies and agreements

2.1 b) Describe Bidder's procurement policies and procedures that will ensure reasonable advance notice to Newfoundland and Labrador (NL) supply community of all procurement opportunities

2.1 c) Describe Bidder's familiarity with NL contractor/supply capabilities. If Bidder is not currently familiar with these capabilities, describe proposed steps to ensure familiarity

2.2 Employment

A hiring protocol, consistent with the Canadian Charter of Human Rights and Freedoms, has been established for the LCP as outlined below.

For work at the Generation Site (Muskrat Falls hydroelectric generating facility, HVac transmission line to Churchill Falls) the protocol is as follows:

- Qualified and Experienced Members of Innu Nation
- Qualified and Experienced Residents of Labrador
- Qualified and Experienced Residents of Newfoundland
- Qualified and Experienced Canadians
- Qualified and Experienced Non-Canadians

For work on the HVdc Transmission system the protocol is as follows:

- Qualified and Experienced Residents of Newfoundland and Labrador
- Qualified and Experienced Canadians
- Qualified and Experienced Non-Canadians

Bidders are asked to respond to the following:

2.2 a) Describe Bidder's familiarity with the Newfoundland and Labrador workforce

2.2 b) Describe Bidder's human resource policies that will optimize NL employment benefits

2.3 Gender Equity and Diversity

Gender Equity and Diversity plans are being developed. These plans will address employment equity, including access to employment opportunities for qualified members of under-represented groups. For the purpose of this bid, under represented groups are defined as women, aboriginal people, persons with disabilities and visible minorities.

Bidders are asked to respond to the following:

2.3 a) Does Bidder have gender equity and diversity plans? If so, describe Bidder's policies, including harassment and discrimination policies that support gender equity and diversity.

2.3 b) Does Bidder's human resource policies enable the voluntary identification of members of under represented groups.

2.4 Benefits Reporting

Company will be required to monitor and report on certain LCP activities relating to employment and procurement. To assist in this effort, Successful Bidder will be required to submit data reports on a monthly basis regarding employment and expenditures. Company will provide a mechanism for submitting this information.

Employment data reporting is required for direct labour associated with the Work. Work is defined as the following:

1. Labour performed at the hydro-electric generating station located at Muskrat Falls plus HVac transmission.

2. Direct labour associated with the construction of a HVdc system comprised of high voltage overhead lines from central Labrador to Soldiers Pond or vicinity on the Island of Newfoundland.

It does not include labour associated with procured or manufactured items. Information collected will include the workforce to be broken out by occupation, work location, residency of worker, aboriginal affiliation and gender. Category classifications to be provided by Company. Expenditure data will also be collected. This will include total value of goods and services purchased from business within the province as well as value of goods and services purchased from Innu businesses.

Bidder is asked to respond to the following:

2.4 a) Indicate Bidder's previous experience at capturing employment and expenditure data as they relate to local benefits monitoring.

2.4 b) Identify who, within Bidders organization, will be responsible for benefits monitoring and reporting.

3.0 Impacts and Benefit Agreement with Innu Nation

Company has signed an Impact and Benefits Agreement with Innu Nation. This agreement includes obligations relating to employment, training, procurement and workplace polices. Although not a condition precedent to award, Innu content will be a consideration in the overall evaluation of bids to the degree the opportunity for Innu content exists.

It is on this basis that Bidders are to respond to the following:

3.0 a) Is the bidder registered as an Innu Company with the Innu Business Development Corporation (IBDC)?

3.0 b) List any intended subcontractors/ suppliers that are currently IBDC registered Innu companies.

3.0 c) Identify who, within Bidders organization, will be responsible for benefits monitoring and reporting and communication of procurement opportunities to the IBDC.

3.0 d) Identify the number, if any, of personnel submitted with this bid who are members of Innu Nation.

3.0 e) Provide any other relevant information relating to Innu content and this RFP, including Bidder's experience with Aboriginal IBAs.

4.0 NEWFOUNDLAND AND LABRADOR BENEFITS CONTENT – PERSON HOUR ESTIMATE

Bidder is required to provide, where applicable, an estimate of the direct labour (in person hours) used to complete the Work. Information should be categorized in terms of work location and residency of the workers, as outlined in the tables below.

Bidder is asked to complete the following:

ANDRITZ Hydro

4.0 a) Employment Estimate by Residency

Employment Category	NL (Hours)	Other Canada (Hours)	Foreign (Hours)	Total (Hours)
Management / Staff	0%	95%	5%	100%
Engineering	0%	10%	90%	100%
Procurement and Contracting	0%	55%	45%	100%
Construction and Assembly	183,710	367,420	0	551,130
Other (Fabrication shops)	0%	10%	90%	100%
Total (hours)	183,710	n/a	n/a	n/a

4.0 b) Employment Estimate by Location of Work

Employment Category	Labrador (Hours)	Island of Newfoundland (Hours)	Other Canada (Hours)	Foreign (Hours)	Total (Hours)
Management / Staff	102,375	0%	20%	5%	100%
Engineering	0%	0%	10%	90%	100%
Procurement and Contracting	9,013	0%	5%	45%	100%
Construction and Assembly	551,130	0	0	0	551,130
Other (Fabrication shops)	0%	0%	10%	90%	100%
Total (hours)	662,518	0	n/a	n/a	n/a

5.0 NEWFOUNDLAND AND LABRADOR BENEFITS CONTENT – EXPENDITURE ESTIMATE

Bidder is required to provide an estimate of the expenditure percentages associated with the Work. Information should be categorized as Newfoundland and Labrador, Other Canadian and Foreign Content using the Expenditure Table below.
Bidder is asked to complete the following:

5.0 a) Expenditure Estimate Table

	NL	Other Canadian	Foreign	Total
Materials and Equipment	1%	9%	30%	40%
Direct Labour and Staff	22%	3%	5%	30%
Services	5%	10%	2%	17%
Overhead and Profit "Included in the other numbers"	n/a	n/a	n/a	n/a
Other	1%	10%	2%	13%
Total	29%	32%	39%	100%

ANDRITZ Hydro

Andritz Hydro comments:

The above figures are indicative only and are only provided to help Nalcor Energy in their assessment of our offer.

The breakdown of the numbers in the table above is provided for information only and is based on our best estimation of the various categories listed in the table.

On top of complying with the statements made at section 2.0, please find on next page the equipment/services we intend to purchase locally for our site work needs.

MATERIAL / EQUIPMENT	NAME AND ADDRESS OF SUPPLIER	APPROXIMATIVE VALUE ($)
Consumable/Equipment	Acklands Grainger, 1142 Topsail Rd, St. John's	>55,000$
Vehicle maintenance	Labrador Motors Limited, Goose Bay	>50,000$
Wood & lumber	Goose Bay Lumber 16 Hillcrest Rd, Happy Valley-Goose Bay	>25,000$
Office equipment	Officeworks Inc, 135 Avalon Dr, Labrador City, NL A2V 2Z2	>15,000$
Welding material	Air Liquide Canada, Avalon Drive, LABRADOR CITY	>50,000$
Consumable/Equipment	Rona Home Centre, Wabush, NL	>25,000$
Concrete	On-site batch plant	Package A > 1,200,000$ Package B > 600,000$
Fuel	On-site fuel supplier	>500,000$

EXHIBIT 14

PERFORMANCE SECURITY

PERFORMANCE BOND

No. _____ $

KNOW ALL MEN BY THESE PRESENTS THAT

_____ as Principal, hereinafter called the Principal, and _____, a corporation created and existing under the laws of _____ , and duly authorized to transact the business of Suretyship in , as Surety, hereinafter called the Surety, are held and firmly bound unto _____ as Obligee, hereinafter called the Obligee, in the amount of _____ Dollars, ($_____) lawful money of Canada, for the payment of which sum, well and truly to be made, the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a written contract with the Obligee, dated the _____ day of _____, for _____ in accordance with the contract documents submitted therefore which are by reference made part hereof and are hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Principal shall promptly and faithfully perform the Contract then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Whenever the Principal shall be, and declared by the Obligee to be, in default under the Contract, the Obligee having performed the Obligee's obligations thereunder, the Surety may promptly remedy the default, or shall promptly

1. complete the Contract in accordance with its terms and conditions or
2. obtain a bid or bids for submission to the Obligee for completing the Contract in accordance with its terms and conditions, and upon determination by the Obligee and the Surety of the lowest responsible bidder arrange for a contract between such bidder and the Obligee and make available as work progresses (even though there should be a default, or a succession of defaults, under the contract or contracts of completion, arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the Contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of the Contract price", as used in this paragraph, shall mean the total amount payable by the Obligee to the Principal under the Contract, less the amount properly paid by the Obligee to the Principal.

Any suit under this Bond must be instituted before the expiration of two (2) years from the date on which final payment under the Contract falls due.

The Surety shall not be liable for a greater sum than the specified penalty of this Bond.

The attached Rider, signed by the Principal and the Surety, is part of and incorporated into this Bond.

No right of action shall accrue on this Bond, to or for the use of, any person or corporation other than the Obligee named herein, or the heirs, executors, administrators, assigns or successors of the Obligee.

IN WITNESS WHEREOF, the Principal and the Surety have Signed and Sealed this Bond this day of _____ .

SIGNED AND SEALED in the presence of:

)
) **[*NAME OF PRINCIPAL]** **(SEAL)**
_____)
Witness)
) **[*NAME OF SURETY]** **(SEAL)**
_____)
Witness

RIDER TO PERFORMANCE BOND NO.

TO BE ATTACHED TO AND FORM PART OF PERFORMANCE BOND NO._____ , dated concurrently with the execution of this Rider, issued by the _____ , as Surety, on behalf of _____ , as Principal, and in favour of _____, as Obligee.

WHEREAS, upon the request of the Principal and Obligee, and in consideration of $1.00 and other valuable consideration the receipt and sufficiency of which is acknowledged by the Surety, **IT IS UNDERSTOOD AND AGREED THAT** the above described bond is hereby amended to include the following paragraphs:

1. Surety hereby waives notice of any change to the Contract or the related subcontracts, including changes to time of performance, scope of work and price.
2. No waiver by the Obligee of any provision of the Contract shall release the Surety of its obligations given under this Bond although in no event shall the obligations of the Surety under the Bond exceed those of the Principal.
3. To the limit of the amount of this Bond, if there is a failure by the Principal to perform or otherwise to fulfil its obligations under and comply with the terms of the Contract which has neither been remedied by the Principal or expressly waived by the Obligee in writing, and if the Principal is declared in default and the Surety is called upon under this Bond, then the Surety is obligated to the Obligee for all obligations of the Principal under the Contract, including:
   (a) the responsibilities of the Principal for correction of defective design, work and materials, and for completion of the Contract;
   (b) the fulfilment by the Principal of all Performance Guarantees, as defined and specified in the Contract; and
   (c) the obligation to pay liquidated damages, as specified in the Contract.
4. For purposes of any suit under this Bond, final payment shall be deemed to fall due on the date of Final Completion as shown on the Final Completion Certificate, as defined in the Contract.
5. This Performance Bond shall expire two (2) years after the date of Final Completion as shown on the Final Completion Certificate, as defined in the Contract.

IT IS FURTHER UNDERSTOOD AND AGREED THAT nothing herein shall be held to change, alter or vary the terms of the above described Bond except as hereinbefore set forth.

IN WITNESS WHEREOF, the Principal and the Surety have Signed and Sealed this Performance Bond Rider this_____day of_____.

SIGNED AND SEALED in the presence of:

)
) **[*NAME OF PRINCIPAL]** **(SEAL)**
_____)
Witness)
) **[*NAME OF SURETY]** **(SEAL)**
_____)
Witness

(date of issue)

To: *(COMPANY'S LEGAL NAME)*
(address)

From: *(ISSUING BANK)*
(address)

Subject: Our Irrevocable Standby Letter of Credit - Performance Number *(#)*

WHEREAS *(legal name of Contractor)* having its head office at *(address of Contractor)* (hereinafter referred to as the "Applicant"), has signed a contract bearing the effective date of *(insert date)*, and reference number *(insert number)* with **Muskrat Falls Corporation** having its head office at 500 Columbus Drive, St. John's, NL A1B 0C9 (hereinafter referred to as the "Beneficiary"), for the Supply and Installation of Powerhouse Hydro/Mechanical Equipment (hereinafter referred to as the "Contract");

WHEREAS under Article 7 of the Contract, the Applicant is required to provide to the Beneficiary an Irrevocable Standby Letter of Credit - Performance in the amount of **(10)** % of the Contract Price, which amount being *(insert)* Dollars *($*****)* to secure the performance of its obligations under the Contract;

We, (*name and address of bank)* (hereinafter referred to as the "Bank"), for the account of the Applicant, hereby issue in favor of the Beneficiary our transferable Irrevocable Standby Letter of Credit – Performance in the amount of *(insert)* Dollars *($****)* (hereinafter referred to as the "Credit"). We hereby irrevocably and unconditionally undertake to pay to the Beneficiary at sight, without protest or notification, and without inquiring any further proof or conditions, and without consideration for any objections or protests which the Applicant may make, any sum or sums not exceeding the aggregate sum of *(insert)* Dollars *($****)*, free of all imposts, taxes, duties, charges, fees, withholdings and/or deductions whatsoever both present and future, of any nature whatsoever and by whomsoever imposed, and without set-off or counterclaim, upon presentation to the Bank of a demand in writing duly signed by two (2) Beneficiary's officers against this Credit, provided the demand is in the form set out in Exhibit "**A**" hereto, which forms an integral part of this Credit, and that such demand is made no later than on the *(insert)* day of *(insert month, year)* (hereinafter referred to as the "Expiry Date") or any new expiry date (as defined below). Only the Beneficiary or a transferee may make drawings under this Credit.

This Credit shall be automatically extended for one (1) year periods from the Expiry Date or from any subsequent expiry date (hereinafter referred to as "New Expiry Date") successively, unless the bank sends by express courier to the Beneficiary at the above-mentioned address, with a copy to the Applicant, a written notice at least sixty (60) days prior to the Expiry Date or a New Expiry Date, stating that the Bank elects not to extend this Credit for any such additional period. In the event the Bank elects not to extend the Expiry Date or any New Expiry Date of

this Credit, then the Bank hereby unconditionally and irrevocably undertakes to pay to the Beneficiary the total amount then outstanding under this Credit upon presentation to the Bank by the Beneficiary, prior to the Expiry Date or the New Expiry Date, of a demand for payment stating that the Bank has elected not to extend this Credit and that the Beneficiary is therefore entitled to such payment, provided the demand is in the form set out in Exhibit "**B**" attached hereto, which forms an integral part of this Credit.

Notwithstanding the foregoing, in no event will this Credit extend beyond *(insert date)* (hereinafter referred to as the "Final Expiry Date").

This Credit may be automatically reduced by a certificate issued by the Beneficiary to the Bank stating the amount of reduction applicable to this Credit and presented to the Bank by the Applicant or the Beneficiary.

The terms of this Credit set forth in full the terms of our undertaking and this undertaking is not in any way modified, amended or amplified by reference to any document, instrument referred to in this Credit, or in which this Credit is referred to, or to which this Credit is related, and any such reference does not incorporate by reference any document, instrument or agreement.

Partial drawings are authorized. All costs related to this Credit are for the account of the Applicant.

THIS CREDIT IS TRANSFERABLE IN WHOLE BUT NOT IN PART TO ONE OR MORE NOMINATED TRANSFEREE THAT IS THE SUCCESSOR IN INTEREST TO THE BENEFICIARY. EACH TRANSFER MUST BE ISSUED BY ROYAL BANK OF CANADA, GLOBAL LOANS ADMINISTRATION, 4TH FLOOR, 20 KING STREET WEST, TORONTO, ONTARIO, M5H 1C4, UPON RECEIPT OF THE ORIGINAL IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE AND BENEFICIARY'S SIGNED LETTER OF TRANSFER IN THE FORM SET OUT IN EXHIBIT 'C' ATTACHED HERETO (SIGNATURE(S) VERIFIED BY A BANK) AND OUR TRANSFER CHARGES PAID BY THE BENEFICIARY. WE WILL EFFECT THE TRANSFER, PROVIDED THAT THE TRANSFER COMPLIES WITH APPLICABLE LAW AND IS NOT A TRANSFER TO AN ENTITY THAT THE BANK IS PROHIBITED TO DEAL WITH.

This Letter of Credit is subject to the Uniform Customs and Practice for Documentary Credits (2007 Revision) of the International Chamber of Commerce (ICC Publication no. 600) and for matters not covered by the Uniform Customs and Practice for Documentary Credits (2007 Revision) of the International Chamber of Commerce, (ICC Publication no. 600) it shall be governed by and interpreted in accordance with the laws of the Province of Newfoundland and Labrador and the laws of Canada, applicable therein.

(NAME OF BANK)

per: _____

EXHIBIT "A"

(date)

To: *(full name & address of the issuing bank)*

From: *(full name & address of Company)*

Subject: This is the form of demand specified in the Irrevocable Standby Letter of Credit - Performance number *(number)* issued on the *(date)* by *(name of the issuing bank)*

Dear Sirs,

We, the undersigned, being the Beneficiary under the above captioned Irrevocable Standby Letter of Credit – Performance (hereinafter referred to as the "Credit") issued by *(name and address of the issuing bank)* on the instructions of *(name of the Contractor)* the Applicant, hereby request you to pay to us on receipt by you of the present demand the amount of *(currency and amount in figures and letters)*.

We state and declare:

that the Applicant is an Insolvent Party as defined in Contract number *(insert)*, or is a Defaulting Party as defined in Contract number *(insert)* and has failed to rectify or taken reasonable steps to rectify the default or breach;

and

that the Beneficiary has sent by facsimile at *(insert fax number)* and by express courier to the Applicant, attention of *(insert name)* a written notice of default, specifying the nature of default, at least fifteen (15) working days prior to this demand;

that as a result thereof, we have become entitled under the terms of the Contract number *(insert)* to be paid the amount claimed above;

and

that said amount has not otherwise been paid to us, whether directly or indirectly, by or on behalf of the Applicant.

(name of Company)
(address of Company)

per: _____ per: _____
Name:_____ Name:_____
Title: _____ Title: _____

EXHIBIT "B"

This is the form of demand specified in Irrevocable Standby Letter of Credit – Performance number *[#]* issued on the *[date]*, by *[name of the issuing bank]*

[date]

To: *(ISSUING BANK'S NAME)*
(address)

From: *(COMPANY'S NAME)*
(address)

Subject: This is the demand specified in Irrevocable Standby Letter of Credit – Performance number *[#]* issued on the *[date]*, by *[name of the issuing bank]*

Dear Sirs,

We, the undersigned, being the Beneficiary under the above captioned Irrevocable Standby Letter of Credit – Performance issued by *[issuing bank's name and address]* on the instructions of *[Contractor's name]* (the "Applicant"), hereby request you to pay to us on receipt by you of the present demand the amount of *[currency and amount in figures and letters]* only.

We state and declare:

that the Beneficiary has been notified by the Bank of its election not to extend the Credit; and

that as of the date of the present demand for payment the Applicant has not provided the Beneficiary with a satisfactory substitute irrevocable standby letter of credit – performance or alternate satisfactory security.

[Company's name and address]

per: _____ per: _____
Name:_____ Name:_____
Title: _____ Title:_____

cc to the Applicant

EXHIBIT "C"
TO LETTER OF CREDIT

FORM FOR FULL TRANSFER OF LETTER OF CREDIT

_____, 20___

Name and Address of Issuing Bank:

_____
_____
_____
_____

Attention:

Re: Your Letter of Credit ("Letter of Credit") No. _____ in favour of **[insert Company name]**

GENTLEMEN :

FOR VALUE RECEIVED, THE UNDERSIGNED BENEFICIARY HEREBY IRREVOCABLY TRANSFERS TO:

_____
(NAME OF TRANSFEREE)

_____
(ADDRESS)

ALL RIGHTS OF THE UNDERSIGNED BENEFICIARY TO DRAW UNDER THE ABOVE IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE IN ITS ENTIRETY.

BY THIS TRANSFER, ALL RIGHTS OF THE UNDERSIGNED IN THE ABOVE IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE ARE TRANSFERRED TO THE TRANSFEREE AND THE TRANSFEREE SHALL HEREAFTER HAVE THE SOLE RIGHTS AS BENEFICIARY THEREOF.

THE ABOVE IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE IS RETURNED HEREWITH AND IN ACCORDANCE THEREWITH WE ASK YOU TO ISSUE A NEW IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE IN FAVOUR OF THE TRANSFEREE ON THE SAME TERMS AND CONDITIONS AS THOSE CONTAINED IN THE ABOVE IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE.

ENCLOSED IS REMITTANCE OF CAD ** IN PAYMENT OF YOUR TRANSFER COMMISSION AND IN ADDITION THERETO WE AGREE TO PAY TO YOU ON DEMAND ANY EXPENSES WHICH MAY BE INCURRED BY YOU IN CONNECTION WITH THIS TRANSFER

WE HEREWITH WAIVE OUR RIGHT TO REFUSE ANY AMENDMENTS UNDER THE STANDBY PERFORMANCE LETTER OF CREDIT, WHICH MAY BE DIRECTLY ADVISED TO THE TRANSFEREE.

[NAME OF TRANSFEROR]		[NAME OF TRANSFEREE]	
Per:	_____	Per:	_____
Name:	_____	Name:	_____
Title:	_____	Title:	_____
and Per:	_____	and Per:	_____
Name:	_____	Name:	_____
Title:	_____	Title:	_____

RBC Royal Bank®

GLOBAL LOANS ADMINISTRATION
4TH FLOOR
20 KING STREET WEST
TORONTO, ONTARIO, M5H 1C4
CANADA

DATE OF ISSUE: JANUARY 15, 2013

OUR IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE NUMBER: 10000753

DATE OF EXPIRY: JANUARY 14, 2014
PLACE OF EXPIRY: TORONTO, ONTARIO

BENEFICIARY:
NALCOR ENERGY
500 COLOMBUS DRIVE
ST. JOHN'S, NL
A1B 0C9, CANADA

APPLICANT:
ANDRITZ HYDRO CANADA INC.
6100 AUT. TRANSCANADIENNE
POINTE-CLAIRE, QC
H9R 1B9, CANADA

AMOUNT: CAD25,045,360.00
TWENTY FIVE MILLION FORTY FIVE THOUSAND THREE HUNDRED SIXTY AND 00/100'S CANADIAN DOLLARS

SUBJECT: OUR IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE NUMBER 10000753.

PROJECT NAME: MUSKRAT FALLS CH0030
PROJECT DESCRIPTION:
A) DESIGN, SUPPLY AND INSTALL (4 UNITS):
- KAPLAN TURBINES, VERTICAL AXIS UNITS;
- SYNCHRONOUS GENERATORS;
- DIGITAL GOVERNOR SYSTEMS;
- STATIC EXCITATION SYSTEMS;
- CONTROL, PROTECTION AND MONITORING SYSTEMS.
B) TRANSPORTATION
C) PRE-COMMISSIONING AND COMMISSIONING (DRY AND WET WITH 72 HOURS TRIAL RUN)
D) PERFORMANCE TEST
E) TRAINING OF OPERATORS (2 SESSIONS FOR 15 OPERATORS EACH)
F) SPARE PARTS (ONLY CAPITAL SPARES; OPTIONAL SPARES NOT YET SELECTED)

WHEREAS, ANDRITZ HYDRO CANADA INC., HAVING ITS HEAD OFFICE AT 6100 AUT. TRANSCANADIENNE, POINTE-CLAIRE, QUEBEC, H9R 1B9 (HEREINAFTER REFERRED TO AS THE "APPLICANT"), HAS SIGNED A CONTRACT BEARING THE EFFECTIVE DATE OF JANUARY 2, 2013, AND REFERENCE NUMBER CH0030 WITH NALCOR ENERGY HAVING ITS HEAD OFFICE AT 500 COLOMBUS DRIVE, ST. JOHN'S, NEWFOUNDLAND AND LABRADOR, A1B 0C9 (HEREINAFTER REFERRED TO AS THE "BENEFICIARY"), FOR THE MUSKRAT FALLS CH0030 PROJECT (HEREINAFTER REFERRED TO AS THE "CONTRACT");

WHEREAS UNDER ARTICLE 7 OF THE CONTRACT, THE APPLICANT IS REQUIRED TO PROVIDE TO THE BENEFICIARY AN IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE IN THE AMOUNT OF 15% OF THE CONTRACT PRICE, BEING CAD25,045,360.00 (TWENTY FIVE MILLION FORTY FIVE THOUSAND THREE HUNDRED SIXTY AND 00/100'S CANADIAN DOLLARS) TO SECURE THE PERFORMANCE OF ITS OBLIGATIONS UNDER THE CONTRACT;

WE, ROYAL BANK OF CANADA, GLOBAL LOANS ADMINISTRATION, 4TH FLOOR, 20 KING STREET WEST, TORONTO, ONTARIO, M5H 1C4 (HEREINAFTER REFERRED TO AS THE "BANK"), FOR THE ACCOUNT OF THE APPLICANT, HEREBY ISSUE IN FAVOR OF THE BENEFICIARY OUR TRANSFERABLE IRREVOCABLE STANDBY

LETTER OF CREDIT - PERFORMANCE IN THE AMOUNT OF CAD25,045,360.00 (TWENTY FIVE MILLION FORTY FIVE THOUSAND THREE HUNDRED SIXTY AND 00/100'S CANADIAN DOLLARS) (HEREINAFTER REFERRED TO AS THE "CREDIT").

WE HEREBY IRREVOCABLY AND UNCONDITIONALLY UNDERTAKE TO PAY TO THE BENEFICIARY AT SIGHT, WITHOUT PROTEST OR NOTIFICATION, AND WITHOUT INQUIRING ANY FURTHER PROOF OR CONDITIONS, AND WITHOUT CONSIDERATION FOR ANY OBJECTIONS OR PROTESTS WHICH THE APPLICANT MAY MAKE, ANY SUM OR SUMS NOT EXCEEDING THE AGGREGATE SUM OF CAD25,045,360.00 (TWENTY FIVE MILLION FORTY FIVE THOUSAND THREE HUNDRED SIXTY AND 00/100'S CANADIAN DOLLARS), FREE OF ALL IMPOSTS, TAXES, DUTIES, CHARGES, FEES, WITHHOLDINGS AND/OR DEDUCTIONS WHATSOEVER BOTH PRESENT AND FUTURE, OF ANY NATURE WHATSOEVER AND BY WHOMSOEVER IMPOSED, AND WITHOUT SET-OFF OR COUNTERCLAIM, UPON PRESENTATION TO THE BANK OF A DEMAND IN WRITING DULY SIGNED BY TWO (2) BENEFICIARY'S OFFICERS AGAINST THIS CREDIT, PROVIDED THE DEMAND IS IN THE FORM SET OUT IN EXHIBIT 'A' HERETO, WHICH FORMS AN INTEGRAL PART OF THIS CREDIT, AND THAT SUCH DEMAND IS MADE NO LATER THAN ON JANUARY 14, 2014 (HEREINAFTER REFERRED TO AS THE "EXPIRY DATE") OR ANY NEW EXPIRY DATE (AS DEFINED BELOW). ONLY THE BENEFICIARY OR A TRANSFEREE MAY MAKE DRAWINGS UNDER THIS CREDIT.

THIS CREDIT SHALL BE AUTOMATICALLY EXTENDED FOR ONE (1) YEAR PERIODS FROM THE EXPIRY DATE OR FROM ANY SUBSEQUENT EXPIRY DATE (HEREINAFTER REFERRED TO AS "NEW EXPIRY DATE") SUCCESSIVELY, UNLESS THE BANK SENDS BY EXPRESS COURIER TO THE BENEFICIARY AT THE ABOVE-MENTIONED ADDRESS ALSO COPY TO THE APPLICANT, A WRITTEN NOTICE AT LEAST SIXTY (60) DAYS PRIOR TO THE EXPIRY DATE OR A NEW EXPIRY DATE, STATING THAT THE BANK ELECTS NOT TO EXTEND THIS CREDIT FOR ANY SUCH ADDITIONAL PERIOD. IN THE EVENT THE BANK ELECTS NOT TO EXTEND THE EXPIRY DATE OR ANY NEW EXPIRY DATE OF THIS CREDIT, THEN THE BANK HEREBY UNCONDITIONALLY AND IRREVOCABLY UNDERTAKES TO PAY TO THE BENEFICIARY THE TOTAL AMOUNT THEN OUTSTANDING UNDER THIS CREDIT UPON PRESENTATION TO THE BANK BY THE BENEFICIARY, PRIOR TO THE EXPIRY DATE OR THE NEW EXPIRY DATE, OF A DEMAND FOR PAYMENT STATING THAT THE BANK HAS ELECTED NOT TO EXTEND THIS CREDIT AND THAT THE BENEFICIARY IS THEREFORE ENTITLED TO SUCH PAYMENT, PROVIDED THE DEMAND IS IN THE FORM SET OUT IN EXHIBIT 'B' ATTACHED HERETO, WHICH FORMS AN INTEGRAL PART OF THIS CREDIT. NOTWITHSTANDING THE FOREGOING, IN NO EVENT WILL THIS CREDIT EXTEND BEYOND FEBRUARY 10, 2018 (HEREINAFTER REFERRED TO AS THE "FINAL EXPIRY DATE").

THIS CREDIT MAY BE AUTOMATICALLY REDUCED BY A CERTIFICATE ISSUED BY THE BENEFICIARY TO THE BANK STATING THE AMOUNT OF REDUCTION APPLICABLE TO THIS CREDIT AND PRESENTED TO THE BANK BY THE BENEFICIARY.

THE TERMS OF THIS CREDIT SET FORTH IN FULL THE TERMS OF OUR UNDERTAKING AND THIS UNDERTAKING IS NOT IN ANY WAY MODIFIED, AMENDED OR AMPLIFIED BY REFERENCE TO ANY DOCUMENT, INSTRUMENT REFERRED TO IN THIS CREDIT, OR IN WHICH THIS CREDIT IS REFERRED TO, OR TO WHICH THIS CREDIT IS RELATED, AND ANY SUCH REFERENCE DOES NOT INCORPORATE BY REFERENCE ANY DOCUMENT, INSTRUMENT OR AGREEMENT.

PARTIAL DRAWINGS ARE AUTHORIZED. ALL COSTS RELATED TO THIS CREDIT ARE FOR THE ACCOUNT OF THE APPLICANT.

THIS CREDIT IS TRANSFERABLE IN WHOLE BUT NOT IN PART TO ONE OR MORE NOMINATED TRANSFEREE THAT IS THE SUCCESSOR IN INTEREST TO THE BENEFICIARY. EACH TRANSFER MUST BE ISSUED BY ROYAL BANK OF CANADA, GLOBAL LOANS ADMINISTRATION, 4TH FLOOR, 20 KING STREET WEST, TORONTO, ONTARIO, M5H 1C4, UPON RECEIPT OF THE ORIGINAL IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE AND BENEFICIARY'S SIGNED LETTER OF TRANSFER IN THE FORM SET OUT IN EXHIBIT 'C' ATTACHED HERETO (SIGNATURE(S)VERIFIED BY A BANK) AND OUR TRANSFER CHARGES PAID BY THE

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10000753 PAGE: 3

BENEFICIARY. WE WILL EFFECT THE TRANSFER, PROVIDED THAT THE TRANSFER COMPLIES WITH APPLICABLE LAW AND IS NOT A TRANSFER TO AN ENTITY THAT THE BANK IS PROHIBITED TO DEAL WITH.

THIS LETTER OF CREDIT IS SUBJECT TO THE UNIFORM CUSTOMS AND PRACTICE FOR DOCUMENTARY CREDITS (2007 REVISION) OF THE INTERNATIONAL CHAMBER OF COMMERCE (ICC PUBLICATION NO. 600) AND FOR MATTERS NOT COVERED BY THE UNIFORM CUSTOMS AND PRACTICE FOR DOCUMENTARY CREDITS (2007 REVISION) OF THE INTERNATIONAL CHAMBER OF COMMERCE, (ICC PUBLICATION NO. 600) IT SHALL BE GOVERNED BY AND INTERPRETED IN ACCORDANCE WITH THE LAWS OF THE PROVINCE OF NEWFOUNDLAND AND LABRADOR AND THE LAWS OF CANADA, APPLICABLE THEREIN.

ROYAL BANK OF CANADA

ORIGINAL SIGNED BY
AURELIEN KEVIN LABURTE

AUTHORIZED SIGNATURE

ORIGINAL SIGNED BY
W. LOBO

AUTHORIZED SIGNATURE

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10000753 PAGE: 4

EXHIBIT 'A'

(INSERT DATE)

TO: ROYAL BANK OF CANADA
GLOBAL LOANS ADMINISTRATION
4TH FLOOR, 20 KING STREET WEST
TORONTO, ONTARIO, M5H 1C4

FROM:
NALCOR ENERGY
500 COLOMBUS DRIVE
ST. JOHN'S, NEWFOUNDLAND AND LABRADOR, A1B 0C9

SUBJECT: THIS IS THE FORM OF DEMAND SPECIFIED IN IRREVOCABLE STANDBY LETTER OF CREDIT PERFORMANCE NUMBER 10000753 ISSUED ON JANUARY 15, 2013 BY ROYAL BANK OF CANADA, GLOBAL LOANS ADMINISTRATION, 4TH FLOOR, 20 KING STREET WEST, TORONTO, ONTARIO, M5H 1C4, CANADA.

DEAR SIRS,

WE, THE UNDERSIGNED, BEING THE BENEFICIARY UNDER THE ABOVE CAPTIONED IRREVOCABLE STANDBY LETTER OF CREDIT PERFORMANCE ISSUED BY ROYAL BANK OF CANADA, GLOBAL LOANS ADMINISTRATION, 4TH FLOOR, 20 KING STREET WEST, TORONTO, ONTARIO, M5H 1C4, CANADA, ON THE INSTRUCTIONS OF ANDRITZ HYDRO CANADA INC., (THE 'APPLICANT'), HEREBY REQUEST YOU TO PAY TO US ON RECEIPT BY YOU OF THE PRESENT DEMAND THE AMOUNT OF CAD _____ (_____ AND __/100'S CANADIAN DOLLARS).

WE STATE AND DECLARE:

THAT THE APPLICANT IS AN INSOLVENT PARTY AS DEFINED IN CONTRACT NUMBER CH0030, OR IS A DEFAULTING PARTY AS DEFINED IN CONTRACT NUMBER CH0030, AND HAS FAILED TO RECTIFY OR TAKEN REASONABLE STEPS TO RECTIFY THE DEFAULT OR BREACH; AND

THAT THE BENEFICIARY HAS SENT BY FACSIMILE AT + 1 (514) 428-6713 AND BY EXPRESS COURIER TO THE APPLICANT, ATTENTION OF JOANNE RADDATZ, PROJECT MANAGER, A WRITTEN NOTICE OF DEFAULT, SPECIFYING THE NATURE OF DEFAULT, AT LEAST FIFTEEN (15) WORKING DAYS PRIOR TO THIS DEMAND; AND

THAT AS A RESULT THEREOF, WE HAVE BECOME ENTITLED UNDER THE TERMS OF THE CONTRACT NUMBER CH0030 TO BE PAID THE AMOUNT CLAIMED ABOVE; AND

THAT SAID AMOUNT HAS NOT OTHERWISE BEEN PAID TO US, WHETHER DIRECTLY OR INDIRECTLY, BY OR ON BEHALF OF THE APPLICANT.

NALCOR ENERGY
PER

_____

AUTHORIZED SIGNATURE
NAME: _____
TITLE: _____

PER

_____

AUTHORIZED SIGNATURE
NAME: _____
TITLE: _____

RBC Royal Bank®

10000753 PAGE: 5

EXHIBIT 'B'

THIS IS THE FORM OF DEMAND SPECIFIED IN IRREVOCABLE STANDBY LETTER OF CREDIT PERFORMANCE NUMBER 10000753 ISSUED ON JANUARY 15, 2013 BY ROYAL BANK OF CANADA, GLOBAL LOANS ADMINISTRATION, 4TH FLOOR, 20 KING STREET WEST, TORONTO, ONTARIO, M5H 1C4, CANADA.

(INSERT DATE)

TO: ROYAL BANK OF CANADA
GLOBAL LOANS ADMINISTRATION
4TH FLOOR, 20 KING STREET WEST
TORONTO, ONTARIO, M5H 1C4

FROM:
NALCOR ENERGY
500 COLOMBUS DRIVE
ST. JOHN'S, NEWFOUNDLAND AND LABRADOR, A1B 0C9

SUBJECT: THIS IS THE FORM OF DEMAND SPECIFIED IN IRREVOCABLE STANDBY LETTER OF CREDIT PERFORMANCE NUMBER 10000753 ISSUED ON JANUARY 15, 2013 BY ROYAL BANK OF CANADA, GLOBAL LOANS ADMINISTRATION, 4TH FLOOR, 20 KING STREET WEST, TORONTO, ONTARIO, M5H 1C4, CANADA.

DEAR SIRS,

WE, THE UNDERSIGNED, BEING THE BENEFICIARY UNDER THE ABOVE CAPTIONED IRREVOCABLE STANDBY LETTER OF CREDIT PERFORMANCE ISSUED BY ROYAL BANK OF CANADA, GLOBAL LOANS ADMINISTRATION, 4TH FLOOR, 20 KING STREET WEST, TORONTO, ONTARIO, M5H 1C4, CANADA, ON THE INSTRUCTIONS OF ANDRITZ HYDRO CANADA INC., (THE 'APPLICANT'), HEREBY REQUEST YOU TO PAY TO US ON RECEIPT BY YOU OF THE PRESENT DEMAND THE AMOUNT OF CAD _____ (_____ AND __/100'S CANADIAN DOLLARS) ONLY.

WE STATE AND DECLARE:

THAT THE BENEFICIARY HAS BEEN NOTIFIED BY THE BANK OF ITS ELECTION NOT TO EXTEND THE CREDIT; AND

THAT AS OF THE DATE OF THE PRESENT DEMAND FOR PAYMENT THE APPLICANT HAS NOT PROVIDED THE BENEFICIARY WITH A SUBSTITUTE ON IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE OR ALTERNATE SATISFACTORY SECURITY.

NALCOR ENERGY
PER

_____

AUTHORIZED SIGNATURE
NAME: _____
TITLE: _____

PER

_____

AUTHORIZED SIGNATURE
NAME: _____
TITLE: _____

RBC Royal Bank®

10000753 PAGE: 6

EXHIBIT 'C'

THIS IS THE LETTER OF TRANSFER SPECIFIED IN IRREVOCABLE STANDBY LETTER OF CREDIT PERFORMANCE NUMBER 10000753 ISSUED ON JANUARY 15, 2013 BY ROYAL BANK OF CANADA, GLOBAL LOANS ADMINISTRATION, 4TH FLOOR, 20 KING STREET WEST, TORONTO, ONTARIO, M5H 1C4, CANADA.

INSTRUCTION TO TRANSFER IN ENTIRETY

DATE: _____

TO: ROYAL BANK OF CANADA
GLOBAL LOANS ADMINISTRATION
4TH FLOOR, 20 KING STREET WEST
TORONTO, ONTARIO, M5H 1C4

RE: IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE NUMBER 10000753.

GENTLEMEN:

FOR VALUE RECEIVED, THE UNDERSIGNED BENEFICIARY HEREBY IRREVOCABLY TRANSFERS TO:

_____
(NAME OF TRANSFEREE)

_____
(ADDRESS)

ALL RIGHTS OF THE UNDERSIGNED BENEFICIARY TO DRAW UNDER THE ABOVE IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE IN ITS ENTIRETY.

BY THIS TRANSFER, ALL RIGHTS OF THE UNDERSIGNED IN THE ABOVE IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE ARE TRANSFERRED TO THE TRANSFEREE AND THE TRANSFEREE SHALL HEREAFTER HAVE THE SOLE RIGHTS AS BENEFICIARY THEREOF.

THE ABOVE IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE IS RETURNED HEREWITH AND IN ACCORDANCE THEREWITH WE ASK YOU TO ISSUE A NEW IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE IN FAVOUR OF THE TRANSFEREE ON THE SAME TERMS AND CONDITIONS AS THOSE CONTAINED IN THE ABOVE IRREVOCABLE STANDBY LETTER OF CREDIT - PERFORMANCE.

ENCLOSED IS REMITTANCE OF CAD_____** IN PAYMENT OF YOUR TRANSFER COMMISSION AND IN ADDITION THERETO WE AGREE TO PAY TO YOU ON DEMAND ANY EXPENSES WHICH MAY BE INCURRED BY YOU IN CONNECTION WITH THIS TRANSFER.

WE HEREWITH WAIVE OUR RIGHT TO REFUSE ANY AMENDMENTS UNDER THE STANDBY PERFORMANCE LETTER OF CREDIT, WHICH MAY BE DIRECTLY ADVISED TO THE TRANSFEREE.

RBC Royal Bank®

NON-NEGOTIABLE

10000753 PAGE: 7

** 0.15% (MINIMUM CAD250.00)

SIGNATURE/S OF

YOURS TRULY,

NAME OF BENEFICIARY

(NAME OF COMPANY OR INDIVIDUAL)

AUTHORIZED SIGNATURE

(NAME OF COMPANY OR INDIVIDUAL)

AUTHORIZED SIGNATURE

AUTHENTICATED BY: (BANK)

AUTHORIZED SIGNATURE