From: Tremblay, Jean-Daniel
To: Simard, Gilles
Subject: LCP Basis of Estimate
Date: Monday, October 15, 2012 10:40:00 AM
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Bonjour Gilles,

Tel que discuté, ci-joint la version du 15 décembre 2011 du BOE que j'avais préparé.

Bonne lecture et à bientôt.

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nalcor energy

Lower Churchill Project

DG3 Capital Cost Estimate
BASIS OF ESTIMATE

SLI Document No. 505573-0000-33RA-I-001

Nalcor Reference No. LCP-SN-CD-0000-EP-ES-0002-01

Date: 15-Dec-2011

Revision 00

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REVISION LIST

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1 VOLUME I - CAPITAL COST BASIS OF ESTIMATE - GENERAL CONSIDERATIONS

1.1 PROJECT DESCRIPTION

The Churchill River is located in Labrador in the Province of Newfoundland and Labrador, Canada. The existing 5,428 megawatt (MW) Churchill Falls Generating Station, which began producing power in 1971, harnesses about 65 per cent of the potential generating capacity of the river. The remaining 35 percent is planned to be developed via two sites on the lower Churchill River, known as the Lower Churchill Project (LCP).

1.1.1 Description of the LCP

The LCP consists of two undeveloped hydroelectric sites and associated transmission systems: Gull Island Hydroelectric Development, located 225 kilometres downstream from the existing Churchill Falls Generating Station; and Muskrat Falls Hydroelectric Development, located 60 kilometres downstream from the proposed Gull Island Hydroelectric Development.

The Gull Island Hydroelectric Development will consist of a generating station with a capacity of 2,250 MW, while the Muskrat Falls Hydroelectric Development will consist of a generating station of 824 MW capacity and associated transmission systems.

1.1.2 LCP Phase 1

Phase 1 of the Lower Churchill Project comprises the Muskrat Falls Hydroelectric Plant and associated transmission lines and DC specialties. It is comprised of three discrete physical Components, as follows:

- Component 1: Muskrat Falls Hydroelectric Development
- Component 3: High voltage direct current transmission system specialties
- Component 4: High voltage overhead transmission lines (ac and dc) including:

Sub-component 4A: HVdc overhead transmission lines Muskrat Falls to Soldiers Pond

Sub-component 4B: HVac overhead transmission lines Muskrat Falls to Churchill Falls

1.1.2.1 Component 1 – Muskrat Falls Hydroelectric Development

The Muskrat Falls Hydroelectric Development will include the following sub-components which are broken down under the five principal areas of the development.

Infrastructure

a) 22 km of access roads, including upgrading and new construction, and temporary bridges;

b) A 1,500 person accommodations complex (for the construction period); and

Dams and Spillway

a) A north RCC overflow dam;

b) A south RCC dam;

c) River diversion during construction via the spillway;

d) Gated spillway.

Reservoir

a) Reservoir preparation and reservoir clearing;

b) Replacement fish and of terrestrial habitat;

c) North spur stabilization.

Intake / Powerhouse / Turbine Generator

A close coupled intake and powerhouse, including:

4 intakes with gates and trash racks;

4 turbine/generator units at approximately 206 MW each with associated ancillary electrical/mechanical and protection/control equipment;

5 power transformers (includes 1 spare), located on the draft tube deck of the powerhouse;

2 overhead cranes.

A more detailed Project description of Component 1 is included in document 505573-3000-4000-0001.

1.1.2.2 Component 3 – High Voltage Direct Current Transmission System Specialties

Component 3 consists of the HVdc converter station systems associated with the high voltage direct current (HVdc) transmission system. The Component 3 HVdc facilities will comprise the following:

AC switchyard at Muskrat Falls;

Churchill Falls switchyard extension.

Muskrat Falls HVdc converter station:

HVdc bipolar converter station;

345 kV ac, converted to ±320 kV dc;

Pole capacity of 450 MW; and

Shoreline pond electrode located on the Labrador side of the Strait of Belle Isle.

The shoreline pond electrode will be connected to the converter station at Muskrat Falls with dual overhead conductors supported on a wood pole line. The wood pole line and conductors will form part of Component 4.

a) Soldiers Pond HVdc converter station:

HVdc bipolar converter station;

230 kV ac, converted from ±320 kV dc;

Pole capacity of 450 MW; and

Shoreline pond electrode located on the east shore of Conception Bay.

The shoreline pond electrode will be connected to the converter station at Soldiers Pond with dual overhead conductors supported on a wood pole line. The wood pole line and conductors will form part of Component 4.

HVdc Transition Compounds for the Strait of Belle Isle submarine cable terminations:

One transition compound for each side of the Strait of Belle Isle submarine cable crossing,

Associated switch works to manage the junction of multiple submarine cables and the overhead transmission line.

Telecoms.

For the purposes of the EPCM Contract, the scope of work does not include any infrastructure or services associated with the actual crossing of the Strait of Belle Isle.

1.1.2.3 Component 4 – High Voltage Overhead Transmission Lines

The high voltage overhead transmission lines required for Phase 1 comprise high voltage alternating current (HVac) lines, high voltage direct current (HVdc) lines, and electrode lines described as follows:

Sub-Component 4A: HVdc Overhead Transmission Lines Muskrat Falls to Soldiers Pond

Overhead Transmission Line:

Transmission line from Muskrat Falls converter station to Soldiers Pond converter station (near St. John's, NL):

900 MW, ±320 kV dc, bipole line, single conductor per pole;

Galvanized lattice steel guyed suspension and rigid angle towers;

1100 km long.

Connections to HVdc transmission system specialties installations, as described in Component 3 herein, will be required.

Electrode Lines:

Dual overhead conductors supported on a wood pole line from Muskrat Falls converter station to the shoreline pond electrode located on the Labrador side of the Strait of Belle Isle;

Dual overhead conductors supported on a wood pole line from Soldiers Pond converter station to the shoreline pond electrode located on the east shore of Conception Bay.

Sub-Component 4B: HVac Overhead Transmission Lines Muskrat Falls to Churchill Falls

Churchill Falls

Transmission lines from Muskrat Falls to Churchill Falls:

2 – 345 kV ac, 3 phase lines, double bundle conductor;

Single circuit galvanized lattice steel guyed suspension and rigid angle towers;

265 km long.

1.2 ABBREVIATIONS

NE-LCP – Nalcor Energy - Lower Churchill Project

SLI – SNC Lavalin Inc.

SOBI – Strait of Belle Isle

CCE – DG3 Capital Cost Estimate

ES – Estimating Software (HCSS Heavy Bid estimating software)

BOQ – Bill of Quantities

MTO – Material Take Off

RCC – Roller Compacted Concrete

HADD – Harmful Alteration Disruption or Destruction (of fish habitat)

HVac – High Voltage Alternating Current

HVdc – High Voltage Direct Current

EIA – Environmental Impact Assessment

MF – Muskrat Falls

CF – Churchill Falls

SP – Soldier's Pond

GI – Gull Island

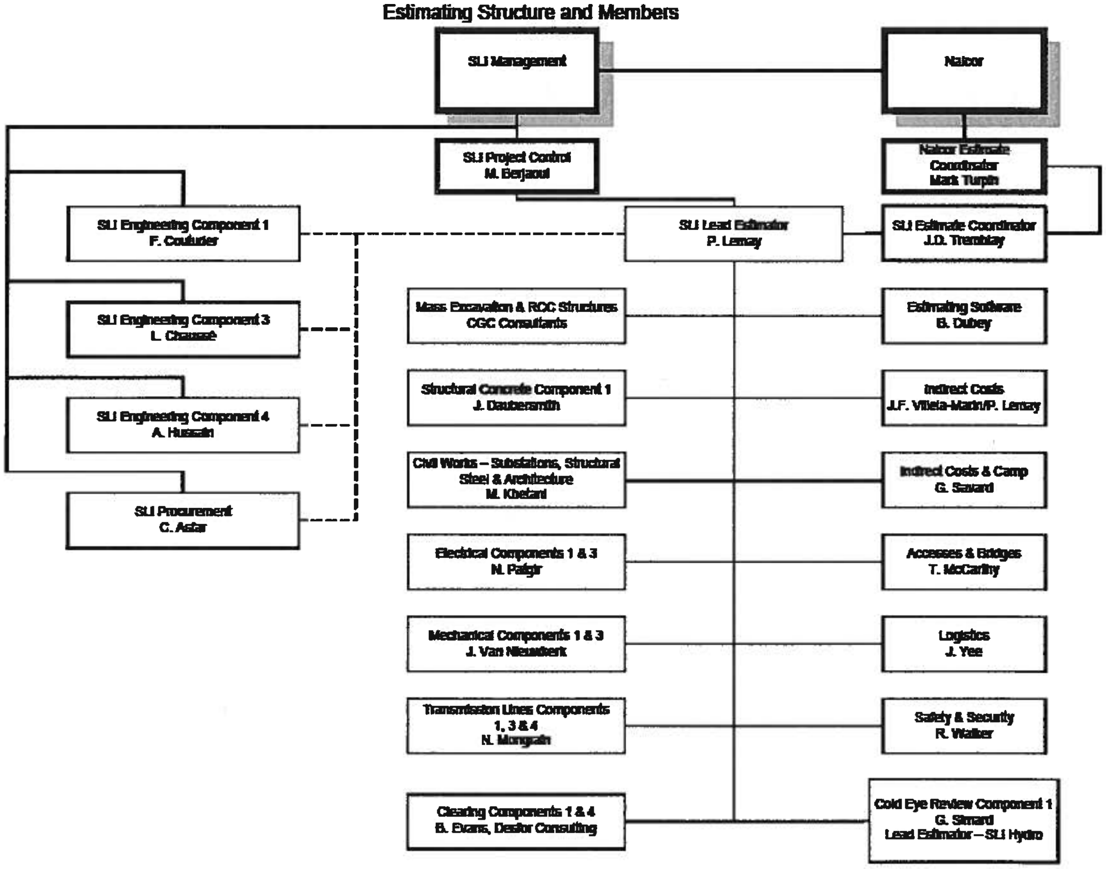
ROW – Right Of Way

PMPC – Project Management / Project Controls

DWSM – Dual Window Single Mode

1.3 ESTIMATING TEAM STRUCTURE AND MEMBERS

Estimating Structure and Members



1.4 TYPE OF ESTIMATE

The DG3 Capital Cost Estimate (CCE) is a Class III AACE 17R-97 estimate. The CCE describes the complete project and installations to be built and provides sufficient scope definition for Management / Board approval, financing, budgeting and control. All costs are expressed in Canadian Q4 of 2011.

Estimate accuracy is suitable for external financing (i.e. bankable document).

1.5 SCOPE OF ESTIMATE

The CCE builds on the estimating work completed since late 2007 for the Project, and reflects the latest project configuration as defined in the latest Basis of engineering document. The CCE was prepared to confirm the business case in order to proceed to Project Sanction.

The CCE was compiled using the latest engineering definition and layout, materials and labour pricing the cost estimate was a bottom up estimate using the four (4) estimate elements:

1. **Project Definition / Scope**: location, plant definition, major equipment, design constraints, materials, and quantities
2. **Construction Methodology**: build sequence, construction equipment, labour demands, trade mix, in-directs, support facilities, seasonality
3. **Price**: labour rates, equipment rates, commodity rates, material costs, and contracting and procurement strategy.
4. **Performance**: labour productivity, mobilization, seasonality impacts, and project management resources.

The following estimating activities were performed by the estimating team and were integrated into the Estimating Software (ES) (HCSS's *Heavy Bid* software version 2010.3):

- Assemble the project MTO's from engineering;
- Perform bottom up estimate on a first principle basis (quantities, crews, production rates and unit costs)
- Perform reasonable evaluation based on past experience for similar projects in comparable conditions if needed;
- Perform all commercial bid evaluations on equipment and bulk materials quotes;
- Compile and use In-House pricing as necessary;

- Prepare Basis of Estimate for estimator-specific scopes;
- Participate in estimate reviews with the engineering and project management team;
- Populate estimating forms for integration of estimates into the ES.
- Joint SLI / Nalcor estimate review meeting from November 15 to 18, 2011 from which an action items list was developed, addressed and integrated into the December 15, 2011 CCE.

The CCE quantities have been developed using the Metric System of measurement. Cable and wire have been measured in American Wire Gauge (WG).

The CCE considers all costs from Project construction initiation to commissioning, including:

- All accesses and ancillary works
- Procurement and logistics
- Camps and living accommodations for all Components
- Camps security and medical services
- Contractor Construction Management (CCM)
- On-site Temporary Construction Facilities
- Construction
- Commissioning
- EPCM Costs

1.6 WORK BREAKDOWN STRUCTURE

The work breakdown structure coding system implemented for the CCE (Appendix 1) is an eight (8) digit coding system that integrates within the first four (4) digits the NALCOR physical components coding structure as provided by NALCOR (Appendix 2). The last four digits of the coding system serve to further breakdown these physical components into estimated work items comprising the actual work activities.

1.7 TIME PHASING METHODOLOGY

The relevant construction portions of the latest Master Project Schedule were provided to each estimator along with the other documents required for them to produce the estimate. Final time phasing was conducted and validated at estimate close-out while producing labour and cash flow curves.

1.8 SPECIAL PROJECT ORDER (CRAFT WAGE RATES) AND LABOUR HOURS

At date of issuance of the CCE, the Lower Churchill Project SPO had not been sanctioned and negotiations between Nalcor and Unions were pending or underway. Craft wage rates used throughout the CCE were provided by Nalcor and reflect the rates of the other unspecified SPO. The CCE labour rates are presented in Appendix 3 and include all shifts, burdens/benefits, and premiums.

For the purpose of producing labour flow curves and indicating the labour requirements over the duration of the Project, the CCE includes all labour hours required to perform the work of all Components of the Project.

- All direct labour hours based on readily available published productivity charts and/or SLI historical data.
- All base hours for electrical, mechanical, structural steel and architectural work estimates are based on USGC to which a site-specific adjustment factor was applied to the chart hours.

- For major items for which a turn-key lump sum budget or bid price was obtained for the purpose of the estimate, an evaluation based on past experience and proxy crews was conducted to establish the total labour hours by trade required for the construction of these items.

1.9 EQUIPMENT RATES

Construction equipment rates taken mainly from WEB based *Equipment Watch* July 2011 (www.equipmentwatch.com). For specialized equipment not present in the *Equipment Watch* tables, rates were developed from past experience on similar project in comparable conditions. Fuel consumption per equipment included in the tables was used to determine the fuel consumption for the Project. The fuel costs reflected in these tables are the following:

- Diesel fuel cost at $1.44/litre
- Gasoline fuel cost at $1.44/litre

The equipment rates used in the CCE are presented in Appendix 4.

1.10 ASSUMPTIONS, EXCLUSIONS AND EXCEPTIONS

- General instructions were provided to estimators prior to commencement of detailed estimating work. These instructions, referred to as the *Estimate Ground Rules,* addressed general assumptions and base rates to be considered for estimating direct costs and construction indirect costs throughout the CCE. The *Estimate Ground Rules* are presented in Appendix 5.
- Room and board provided to Contractors at free issue but considered and estimated for each Component and identified as a Project Indirect Cost in the CCE.
- Labour rotation is 21 days work on site and 7 days off.

- No environmental Assessment report was available at time of CCE issuance. Assumptions and provisions included in the CCE related to environmental impact mitigation (HADD mitigation work) items are based on past experience for similar projects
- The Goods and Services taxes are not included in the estimate.
- All equipment and bulk materials import duties are excluded.
- Brokerage/agents fees for equipment imported into Canada duty free are excluded.
- No provisions or allowances have been included in the CCE to account for the following costs as these are owned by NALCOR:
  - Contingencies and risks allowances
  - Escalation on labour rates and inflation
  - Financing costs
  - Insurance and bonding
  - Land acquisitions
  - Project level governmental permitting
  - Owner costs

1.11 ALLOWANCES

The CCE includes no allowances other than those indicated in the details of the following sections of this Basis of estimate document for specific items for which they were deemed necessary to properly estimate the work item.

1.12 PROJECT AND CONSTRUCTION INDIRECT COSTS

Project indirect costs are incurred on a Project level to support all the construction work package activities whereas the Construction indirect costs are incurred by

Contractors in the effort of executing their awarded construction work package. The basis for the estimation of these costs is presented below.

1.12.1 Project Indirect Costs

1.12.1.1 Main Access Road and Existing Bridges Replacement

The estimated cost of the 22 km main access road from the Trans Labrador Highway to the Muskrat Falls project site was based on the cost of other road work in Labrador factored to project cost.

The cost for the Kenamu Bridge and Paradise Bridge replacements required to increase the load capacity to 250 metric tons are based on the actual cost of the existing bridges adjusted by increases in current labour and material cost.

1.12.1.2 Construction Camps Construction and Operations for the Duration of the Project

Costs of site preparation of the main Camp area at Muskrat Falls include the following:

- Clearing based on a cost per hectare established on a first principal basis developed for clearing highway right of ways in Labrador and applied to the main camp area.
- Civil works and camp infrastructure construction based on similar work being done in Labrador by SLI, factored to project cost.
- A provision for the procurement, installation and operation of a 150 people starter-camp to lodge first workers and staff on site. **The definite scope of this work item still needs to be clarified and agreed by Nalcor.**

Procurement cost of the 1500 people camp facilities as well as administrative and support facilities including transport to site and installation are based on parametric data as well as quotes provided by suppliers and validated by benchmarking with similar projects in comparable conditions. Firm quotes from suppliers are expected in early 2012.

Camp operations include all necessary activities to provide suitable living and working accommodations. Basis of Camp operation costs are as follow:

- Catering costs based on past experience and Nalcor recommendations
- House keeping costs based on past experience
- Facilities maintenance and cleaning based on past experience
- Site maintenance costs based on past experience
- Garbage removal based on past experience

Cost of Transmission lines (TL) camps to be constructed along the TL ROW were estimated by factoring the main camp cost as well as by benchmarking similar project in comparable conditions on a *per bed* basis and adjusted to consider additional operating costs due to lower capacity and increased remoteness.

1.12.1.3 Air Travel and Transportation of Workforces, EPCM and Client Personnel Between Work Areas and Point of Origin

Air travel costs were estimated using a unit value per kilometre travelled provided by local airlines for commercial flights and chartered flights applied to distances between five points of origins and the Muskrat Falls site. Over the duration of the Project, an estimated total of 138 000 trips will be made to the Muskrat Falls site, on 21-7 rotations for craft personnel or 11-3 rotations for staff, from five origins in the following proportions for all Component of the Project:

- St-John's: 25%
- Deer Lake: 25%
- Moncton: 20%
- Montreal: 15%
- Toronto: 15%
- Plane capacity utilization at 75%

- Chartered flights for the St-John's and Deer lake origins
- Commercial flights for Toronto, Montreal and Moncton origins
- Travel time paid to personnel includes only 8hres hire-in and 8hres termination-out for a total 16hrs per turnaround. Assumption for the number of turnarounds is 1000 pers x 3 turnarounds = 3000.
- No travel time is paid on 21-7 rotations
- Hotel & Meals at St-John's and Deer Lake at a cost of 150$ for each rotation
- Hotel & Meals at Toronto, Montreal and Moncton at a cost of 190$ for each rotation
- Transportation expenses (Taxi, bus, etc.) between home and airport at 100$ for each rotation

1.12.1.4 Health and Medical Services

The CCE includes Construction health and medical services for both the Muskrat Falls facilities as well as services to be provided along the TL ROW.

Quantification of the required provision of medical services is based on the assumption that the services include the following:

Component 1:

- a well equipped 24/7 medical facility at the Muskrat Falls construction camp site to cover the camp's medical requirements as well as a portion of the requirement for the reservoir clearing.
- Medical transport vehicles adequate to transport patients to the Happy Valley Goose Bay hospital
- For remainder of reservoir clearing operation, Emergency Medical Technician (EMT) equipped with Mobile Treatment Centers (MTC) which can double as Medical transport vehicles

Component 4:

- EMTs and MTCs in each of the satellite camps
- Provision

Component 3:

- Medical services provided by either Component 1 or Component 4 services in the Labrador portion of the Project and in remote area in Long Range Mountains in Newfoundland
- Medical services will be provided by existing medical facilities in Newfoundland where work areas are relatively close by.

Scope of medical services requirement was developed while preparing the Medical services contract document to be issued for bids in late 2011 and integrate coordinated needs of Components 1, 3 and 4. Cost of medical services was estimated based on estimator experience and input from specialized vendors and service providers.

The CCE also includes the cost for helicopter medical evacuations (medevacs) based on the following assumptions:

- Over the course of the entire project, there will be 1 medevac made per week (both non-work related medical emergencies and work related injuries and illnesses) for a total of 50 medevacs per year for 5 years, resulting in a total of 250 medevacs for the project.
- Each medevac flight will have an average duration of 3 hours
- Average cost for flight hour is $2,200.00

1.12.1.5 Mandatory Pre-Access Drug and Alcohol Testing

All personnel working on any phase of the project outside the project office in St. John's will be required to undergo a Drug and Alcohol Screening Test and have a

Medical Examination completed prior to being dispatched to site. The estimate included in the CCE is based on the current market value of those services and the projected number of personnel anticipated to work on the Project and comprises the following assumptions and rates:

- Cost of Drug and Alcohol Screen using current Urine or Mouth Swab techniques will be $250.00 per test
- Pre access Medical Examination will be $250.00 per test

It is projected that a total of 12,000 personnel (SNC-Lavalin, Nalcor and Contractor personnel) will be engaged over the life of the project. This number also takes into consideration those personnel who will be away from the project for a period of 3 months or more and will require to be retested.

1.12.1.6 Safety and Security Services and Equipment

The CCE includes estimates based on estimator experience and supplier input for the following:

- On site security service including security personnel, vehicles and equipment
- Rescue boat including 1 boat trailer and rescue equipment
- Safety signage on Sites and on access road to Main site
- Security access swipe cards for access to Main site and accommodation complex
- Personal Protection Equipment for EPCM personnel

1.12.2 Construction Indirect Costs

Construction indirect costs included in the CCE are based on typical costs, based on past experience, incurred by Contractors required for executing their awarded construction work packages such as:

- Contractor mobilization and demobilization costs

- Rental, installation and operation of temporary construction site offices and facilities
- Contract administration and management personnel
- Site supervision, health and safety, survey and Contractor quality assurance personnel over viewing work performed by own foremen and direct workforce
- Utility supply such as air, water, electricity, etc.
- Job office expenses
- Administration fees to cover contractor home office expenses, overhead and profits were included to the estimated items as follow:
    - A 10% of direct costs allowance was added to all electrical, mechanical, powerhouse superstructure and architecture as well as substations electrical and civil works
    - A 15% of direct costs allowance was added to the powerhouse concrete works
    - No allowance was included in the mass excavation, dams and cofferdams estimate as direct and indirect values are at cost.
    - All other estimates developed using market pricing or budget quotes are deemed to be inclusive of profit and administration at a reasonable rate.
- Pickups, site communication, heavy equipment repair and maintenance shops and ownership insurance.

1.13 EPCM COSTS

Engineering, Procurement and Construction Management (EPCM) costs were developed using a bottom-up approach for each Component of the Project as well as general items which are not Component specific. The EPCM costs are presented in the estimate as a one line item and estimate details and backup are submitted as a separate document.

1.13.1 Engineering of Components 1, 3 and 4

The engineering of all Project Components was sufficiently developed to allow for the production of Bill of Quantities (BOQ) sufficiently detailed to allow for bottom up estimation for most.

1.14 OWNER COSTS

Owner costs are not included in the scope of the CCE basis of estimate (BOE) document. These costs include:

- All contingencies
- Project risks and exposure
- Land acquisition costs
- Project level permitting costs
- Escalation of labour rates through the duration of the Project
- Inflation in the cost of commodities, materials, and equipment rates
- Financing costs
- All-risk Project insurance
- Costs related to Owner personnel and equipment

2 VOLUME II - COMPONENT 1 DIRECT COSTS DETAILED BASIS OF ESTIMATE

2.1 INTRODUCTION

As described in Volume I, the Project's Component I includes the facilities, installations and equipments relative to infrastructure and main camp accommodations, the reservoir work, the dams and spillway and the powerhouse intake and turbine generators.

The following sections describe the basic assumptions considered as well as the means and methods utilized to develop the relevant cost estimates included in the CCE.

2.2 BASIS OF ESTIMATE – DIRECT COSTS

2.2.1 Reservoir Clearing

2.2.1.1 Scope

- The reservoir will be cleared using the "partial clearing criteria" as defined by Nalcor in their "Design Philosophy for LCP – Reservoir Preparation Plan"
- 40% of the area is located on the North Bank and 60% on the South bank
- the clearing method will be by a mechanical harvesting operation
- total area to be cleared, including reservoir, road rights-of-way and storage yards, is approximately 2200 ha, total merchantable wood is approximately 448,000 m3 which will be trucked out of the reservoir and piled at storage yards
- total road construction will be approx. 152 km. and 99 streams will be crossed

2.2.1.2 Construction Methodology & Timeline Factors

- Mechanical harvesting of merchantable & non-merchantable wood with feller-bunchers and skidded to roadside
- Process merchantable wood at roadside to remove limbs and tops
- Merchantable wood will be trucked to storage yards and piled
- When possible deadfalls will be skidded to roadside as non-merchantable wood
- Non-merchantable wood, including deadfalls, and slash from processing merchantable wood will be mulched at roadside and the mulched fibre will be left
- Any areas of deadfalls not skidded and areas of shrubs (alder and willow) will be mulched wherever they occur within the ice and stickup zones and the mulched fibre will be left
- Clearing of the North Bank is scheduled to start in mid 2012 and will be finished at the end of 2014
- Clearing of the South Bank is scheduled to start towards the end of 2012 and will finish in early 2016
- People employed by the clearing contractor must be very skilled – from operators and mechanics to foremen and supervisors

2.2.1.3 Price Factors

- Labour and equipment rates as per general CCE rates as stated in Volume I
- Materials costs were obtained from suppliers of the various products used for the estimate and were FOB Goose Bay (as examples: bridges, culverts, material to construct bridge abutments, etc.)
- Certain items were estimated from past experience and bench-marking with industry contacts

2.2.1.4 Performance Factors

- Assumed labour productivity at 70% based on rotation times of 21 days work/7days home and evaluated by using industry standard productivity tables.
- Equipment productivity factored to account for operating in sandy soils which offer poor traction and for skidding full-tree uphill to honour Nalcor's requirement that, where possible, roads be constructed 2m below full supply level of 39 masl
- 42 – 43 weeks/year considered as the time frames for clearing operations. Note: there may be times during winter months that operations will be curtailed because of extreme snow depths and the weeks/year will be less than considered average

2.2.2 Mass Excavation

2.2.2.1 Scope

Bills of quantities (BOQ) were issued by engineering and a check BOQ was developed by estimators. Reconciled Engineering and Estimator BOQs revealed no significant differences in quantities. CCE Mass excavation major Quantities are as follow:

- Overburden material at the Powerhouse site: 455 000 m3
- Overburden material at the North Spur site: 600 000 m3
- Rock excavation : total volume 2 092 000m3
    - Powerhouse : 1 590 000 (including rock plugs)
    - Spillway : 250 000m3
    - North Spur : 100 000m3
- 4,0m long Rock bolt quantity : 882 units

Rock bolts were quantified by engineering on the basis of available geotechnical information suggesting that the rock is of "excellent" quality (1 bore hole on North side) to "very good" quality (1 bore hole on South side) and based on rock bolt quantities for similar projects in James Baie with similar rock conditions.

For a Project this size, the number of boreholes (2) is clearly insufficient to properly assess the quality of the rock. An investigation campaign will be required when Project goes forward. There is a provision in the estimate to account for the risk related to the uncertainty of the rock characterization and the possibility that poor undetected geotechnical conditions arise during construction.

- Wire mesh area and pins : 50 000m2
- Costs were included to account for average 500mm thick concrete mud slabs where the Powerhouse and Spillway are to be concreted.

2.2.2.2 Construction Methodology & Timeline Factors

- General assumption is that rock quality is not a concern and Project is standard rock excavation project.
- All excavation activities estimated on a six days per week basis to allow for a buffer for bad weather conditions. A total duration of 200 workdays (end of July 2012 to mid-April 2013) is considered in the estimate for the mass excavation of the powerhouse and spillway
- Rock excavation to start when overburden excavation has exposed sufficient areas to allow drill and blast operations to start.
- Excavation crew :
  - Cat 992K loader
  - 5 Cat 775F off-road dump truck
  - Cat D8 at dump site

- No provision is included for the cost of spare stand-by equipment on site but usually there should be 1 spare equipment for every five.

2.2.2.3 Price Factors

- Labour rates considered for this portion of the estimate is as provided by Nalcor.
- Equipment rates are a mix of *Equipment watch* rates with some specialized equipment having been adjusted to reflect actual rates of similar projects with comparable site conditions.

2.2.2.4 Performance Factors

- Haul and dump distance of 2,5km from site to stockpile
- Production drilling at 20m/hr per drill using ROC D7 drills
- Large diameter line drilling performed with three drills at a rate of 15m/hr (re: action itemS1-6).
- Rock excavation drilled and blasted on two work shifts on multiple faces at a daily average of 10000m3 (or 5000m3/shift) to meet the duration in schedule.
- Load and haul production estimated at 250m3/hr per crew and 2 crews are considered.
- Overburden mass excavation production rate = 150 m3/h
- Rock excavation – dry conditions production rate = 250 m3/h
- Drilling are estimated at a rate = 54 m/h
- Dynamite operations are estimated at a rate = 250 kg/h
- Excavated roc will be dump and stock piled at the north shore quarry.

2.2.3 Fill structures

2.2.3.1 Scope factors

The scope of work considered in the CCE was developed by the engineering group who provided bill of quantities to estimators. Quantities were validated by estimators through an independent take-off exercise which revealed minimal differences. The quantities provided by the engineering group were used to develop the fill structures estimate and are as follow:

Powerhouse Downstream Cofferdam

- Compacted Till – Zone 1 : 12 900 m^3
- Compacted Granular – Zone 2C : 3 700 m^3
- Compacted Rockfill – Zone 3C : 12 400 m^3
- Riprap (produced by others) 4 Class 1 : 1 200 m^3

Spillway Upstream Cofferdam

- Compacted Till – Zone 1 : 8 000 m^3
- Compacted Granular – Zone 2C : 5 500 m^3
- Compacted Rockfill – Zone 3C : 43 000 m^3
- Riprap (produced by others) 4 Class 1 : 3 000 m^3

Spillway Downstream Cofferdam

- Compacted Till – Zone 1 : 5 700 m^3
- Compacted Granular – Zone 2C : 4 500 m^3
- Compacted Rockfill – Zone 3C : 33 660 m^3
- Riprap (produced by others) 4 Class 1 : 2 400 m^3

North Downstream Cofferdam

- Compacted Till – Zone 1 : 5 466 m^3

- Compacted Granular – Zone 2C : 2 489 m^3
- Compacted Rockfill – Zone 3C : 2 352 m^3

North Dam Upstream Rockfill Cofferdam

- Dumped Rockfill 0-900mm : 220 000 m^3
- Boulders 1000-1200mm : 20 000 m^3
- Boulders 1200-1500 : 25 000 m^3
- Dumped Granular or Crushed Rock max 300mm Zone 2E : 26 000 m^3
- Compacted Till - Zone 1 : 19 000 m^3
- Compacted Granular - Zone 2C : 14 000m^3
- Compacted Rockfill - Zone 3C (0-450mm) : 35 000m^3
- Compacted Rockfill - Zone 3D (0-900mm) : 38 000m^3
- Riprap (produced by others) 4 Class 1 : 3 200m^3
- Dumped Rockfill (access road) 0-900mm : 75 000 m^3
- Dumped Till : 159 000 m^3

South Rockfill Dam

- Compacted Till – Zone 1 : 22 118 m^3
- Compacted Filter – Zone 2 : 15 373 m^3
- Compacted Rockfill – Zone 3, 3B and 4 : 77 000 m^3

2.2.3.2 Construction Methodology and Timeline Factors

- It is assumed that the main access road from the Trans-Labrador will be available for mobilization and commencement of the work in early summer 2012, that the contractor's pad will be ready, that the soil will be dry (overburden), that the borrow pits are suitable for the production of material.

- The work will be done on a 6 days/week, 10 h/shift, 2 shifts/day schedule.

The heavy equipment considered to develop the fill structures estimate are as follow:

Compacted Till zones heavy equipment:

- CAT 325B Backhoe
- CAT D8N Dozer
- CAT 345B Backhoe
- CAT D5 Dozer
- Vibratory compactor CAT 563
- 13 – 10 wheels dump truck

Compacted Granular zones heavy equipment:

- CAT 966F
- CAT D5G Dozer
- Vibratory Compactor CAT 563
- 6 – 10 wheels truck

Compacted rockfill zones heavy equipment

- CAT 992K
- CAT 365B Backhoe
- CAT D8N Dozer
- 4 CAT 775F Dump Truck
- CAT 325B Backhoe

Riprap zones heavy equipment:

- CAT 365B Backhoe
- 2 CAT 775F Dump Truck

Dumped Rockfill zones heavy equipment:

- CAT 992K
- CAT 365B Backhoe
- 2 CAT D8N Dozer
- 4 CAT 775F Dump Truck
- CAT 325B Backhoe

Boulders zones heavy equipment:

- CAT 992K
- 3 CAT 365B Backhoe
- CAT D8N Dozer
- 4 CAT 775F Dump truck

2.2.3.3 Price Factors

- Labour rates considered for this portion of the estimate is as provided by Nalcor.
- Equipment rates are a mix of *Equipment watch* rates with some specialized equipment having been adjusted to reflect actual rates of similar projects with comparable site conditions.

2.2.3.4 Performance Factors

- Load, haul and placing compacted till production rate = 170 m^3/h
- Load, haul and placing compacted granular production rate = 170 m^3/h
- Load, haul and placing compacted rockfill production rate = 250 m^3/h
- Load, haul and placing riprap production rate = 125 m^3/h
- Load, haul and placing dumped rockfill production rate = 250m^3/h
- Load, haul and placing boulders production rate = 200m^3/h

- Load, haul and placing dumped granular production rate = 170m^3/h

2.2.4 North Spur stabilization work

2.2.4.1 Scope Factors

The scope of work considered in the CCE was developed by the engineering group who provided bill of quantities to estimators. Quantities were validated by estimators through an independent take-off exercise which revealed minimal differences. The quantities provided by the engineering group were used to develop the North Spur Stabilization estimate and are as follow:

- Overburden Excavation: 368 242 m^3
- Overburden Excavation (2F Material): 228 638 m^3
- Till Blanket – Zone 1 North Shore deposit : 171 094 m^3
- Granular Material – Zone 2A: 123 462 m^3
- Granular Material – Zone 2C: 63 513 m^3
- Compacted Granular material – Zone 2F: 228 638 m^3
- Dumped Rockfill – Zone 3: 71 410 m^3
- Compacted Rockfill – Zone 3A: 14 222 m^3
- Compacted Rockfill – Zone 3A South Shore excavation: 14 222 m^3
- Compacted Rockfill – Zone 3B: 57 450 m^3
- Compacted Rockfill – Zone 3B South Shore excavation: 57 450 m^3
- Compacted Rockfill – Zone 3C: 58 115 m^3
- Compacted Rockfill – Zone 3C South Shore excavation: 116 231 m^3
- .Riprap – Zone 4 – North Shore quarry: 22 200 m^3
- Zone 5 Material crushed stone max 31.5mm(permanent road):8 000m^3

- Compacted Rockfill – Zone 3C South Shore excavation (permanent road): 16 000 m^3
- Geotextile: 20 000 m^2
- Geomembrane: 60 000 m^2
- Slurry Cut-Off wall: 41 150 m^2

2.2.4.2 Construction Methodology and Timeline Factors

Work on cofferdam to be performed before the 2014 flood. Borrowed rock will come from the south once the cofferdam is completed. Work schedule: 6 days/week, 10 h/shift, 2 shifts/day.

2.2.4.3 Price Factors

- Labor rates considered for this portion of the estimate are as provided by Nalcor.
- Equipment rates Equipment rates are a mix of *Equipment watch* rates with some specialized equipment having been adjusted to reflect actual rates of similar projects with comparable site conditions.

2.2.4.4 Performance Factors

- Overburden excavation estimated production rate: 100 m^3/h
- Placing compacted materials estimated production rate: 100 m^3/h
- Placing dumped Rockfill materials estimated production rate: 150 m^3/h
- Geotextile and geomembrane installation rate: 250 m^2/h

2.2.5 Roller Compacted Structures

2.2.5.1 Scope

The scope of work considered in the CCE was developed by the engineering group who provided bill of quantities to estimators. Quantities were validated by estimators through an independent take-off exercise which revealed minimal differences. The quantities provided by the engineering group were used to develop the RCC structures estimate and are as follow:

North Dam

- RCC volume: 188 750 m^3
- Total formwork area: 25 000 m2

Riverside Cofferdam

- RCC volume: 37 000 m^3
- Total formwork area: 6 600 m2

2.2.5.2 Construction Methodology and Timeline Factors

- RCC lift height = 300mm/lift
- RCC will be pour by conveyor

Main assumptions are that green cuts will be made when needed by the RCC crew during formwork preparation for the next lift but will be kept to a minimum by the use of a low high paste low water demand (60% fly ash/40% cement) mix allowing for better maneuverability and a 16 to 20 hour setting time.

- Formwork will be fabricated on site by the formwork crew in sufficient quantities to allow continuous operations by jumping lower form panels.
- All formwork activities estimated on a 6 days/week, 10h/day basis.
- RCC activities estimated on a 7days/week, 20h/day basis.
- Foundations ready in 2014, RCC placement will begin in spring 2015

Formwork crews:

- 1 Foreman

- 3 Carpenters
- 3 Laborers
- 1 Welder
- RCC crew:
- 3 Heavy equipment operators
- 1 Backhoe operator
- 1 Dozer operator
- 6 Concrete laborers
- 1 Foreman
- 1 Concrete conveyor operator
- 10 Highway truck operator

RCC heavy equipment:

- CAT 315 DL Backhoe
- CAT D5 Dozer
- CAT D4 Dozer
- CAT 950H
- Vibratory compactor CAT cs 533E
- Boom truck with boom conveyor 100'
- 10 – 10 wheels dump truck
- 2 - twin shaft paddle batch mixer

North Dam

- Total duration of 90 workdays (3,5 months).
- A total of 60 upstream formwork panels will be needed.

- Upstream formwork panels will be used up to 8 times.
- A total of 155 downstream formwork panels will be needed.
- A total of 108 RCC lifts of 300mm high will be made.

Riverside Cofferdam

- Total duration of 52 workdays (2 months).
- A total of 54 formwork panels will be needed.
- Formwork panels will be used up to 7 times.
- A total of 56 RCC lifts of 300mm high will be made.

Price Factors

- Labor rates considered for this portion of the estimate is as provided by Nalcor.
- Equipment rates are a mix of *Equipment watch* rates with some specialized equipment having been adjusted to reflect actual rates of similar projects with comparable site conditions.

2.2.5.3 Performances Factors

- Formwork fabrication rate = 4 m2/h
- Formwork installation rate = 6.30 m2/h
- RCC average production/hauling/placing = 148 m3/h
- 2.5 km from concrete batch plant to RCC dam/cofferdam.

2.2.6 Structural Concrete Structures

Direct costs were determined by a “bottom-up” contractor-style estimate, starting with detailed quantity takeoffs for each structural concrete element. Takeoff quantities were reconciled with BOQ values prior to the Nov 15-18 estimate review meeting later adjusted according to agreed action items identified during review meeting. Crews and productions were assigned to each element of work, and resource requirements (e.g. form fabrication quantities) were also determined for each element of work. Crane layouts were sketched to determine required capacities and number of cranes.

Construction indirect costs related to the subject work scope are included in the estimate. Those costs were estimated up to a "Structure Level", so no "Project Level" (e.g. camp, turnaround, right of way, higher level management) costs are included. In other words, the construction indirect costs included are sufficient to directly plan and supervise the work in the field only, including contractor's quality control personnel, construction engineering, and surveying. The Construction indirect costs were estimated in four groups so as to be able to rationally distribute them to determine total costs for the main components of work estimated: Spillway; Intake; Powerhouse; and Transition Structures.

Construction Materials were estimated based on cost experience and research, unit rates were established for all construction materials required. In general, all construction material rates were determined by side estimate and input to the estimate by m, m2, or m3 as appropriate. Labour related small tools, supplies, and safety equipment were input by the man-hour ($4.00) in the Construction indirect costs.

Included Items:

Supervision – Construction supervision and vehicles; quality control and assurance personnel; surveying; construction engineering. Established indirect wage rates are weighted to account for rotation of personnel.

Temporary Buildings – Office facilities; craft tool rooms/dry shacks; warehouses/shops; stair towers; winter protection enclosures (for Intakes and Powerhouse only). Scaffolding and walkways are included in the direct costs in the various formwork and falsework fabrication items.

Utilities – Power and water hook-ups; water pumping and transportation; sanitary facilities; phone and internet expenses (for site offices and indirect personnel only).

Support Equipment – Crew pickups/flatbeds; hydraulic cranes; boom trucks; labour related small tools, supplies, and safety equipment ($4.00 for every man-hour, including indirect man-hours).

Administration and Profit – 15% contractor mark-up on all costs, including indirect costs. No other adders for bond, liability insurances, home office overhead, etc. are included.

Excluded Items:

Labour Related – No turnaround or rotation transportation (airfare) costs are included in the structural cost estimate as these costs are captured as a Project Indirect Cost detailed in Volume I. No costs for employee training, safety indoctrinations, drug testing, bonuses, or other compensation outside the agreed wage rates are included as these are addressed in the Project Indirect costs. No costs for camp (room and board) or other site services (other than construction office maintenance) are included.

Equipment, Construction Materials, Permanent Materials Related – No exclusions other than it was assumed access roads, equipment pads, yard areas, dewatering, snow removal, signs, barricades, etc. would be provided elsewhere in the estimate. No costs are included for any of these items, **other than** the costs included in the Construction indirect costs for surface water and snow control inside the structure footprints (only).

Contractor Overheads – Other than the 15% contractor mark-up on all costs (included in the Construction indirect costs), there are no other overhead or profit allowances. Separate allowances for items such as Bond, General Liability Insurance, Builders Risk Insurance, Home Office Overhead, etc. are not included.

Subcontractor Mark-ups – The assumption is that all the work is to be self-performed; hence any additional mark-ups due to subcontracted work are not included. If, for example, the contractor elects to subcontract the furnishing and placement of reinforcing steel on the project, a substantial mark-up would be required by the subcontractor (on approximately $100M worth of work).

2.2.6.1 Scope

Structural concrete estimate includes the direct and indirect costs for the following structural concrete elements of the project:

- Powerhouse Concrete Cofferdam
- Spillway Concrete Structure
- Spillway Centre Pier for temporary construction bridge
- Intake Concrete Structure
- Powerhouse Substructure
- North Transition Structure
- Centre Transition Structure
- South Transition Structure (estimated as part of the Powerhouse)

Structural concrete estimate includes costs for furnishing, forming, placing, finishing, and curing the structural concrete for the above listed elements. It includes installation of all scaffolding and shoring for concrete as well as furnishing and installing reinforcing steel and waterstops for those elements. It also includes installation only of primary anchors only for gate, stoplog, and trashrack assemblies as well as supply and install of miscellaneous embedded metals.

The structural concrete estimate does not include any other structural concrete elements (e.g. RCC dam facing, temporary structures other than the Spillway Centre

Pier), structural steel, or grouting. It does not include embedded guides for gate, stoplog, and trashrack assemblies.

The quantities considered were provided to estimating by engineering and are derived from the CATIA model developed for the Project. An independent take-off by estimating revealed no significant differences with quantities provided by engineering.

The major quantities for the concrete estimate are presented in table below:

2.2.6.2 Construction Methodology & Timeline Factors

General considerations and recommendations pertaining to the Schedule:

In the CCE, the basic assumption is that the Intake-Powerhouse-Draft tube structures are to be constructed concurrently along with the Spillway and transition structures all in accordance to the master Project schedule provided to the estimating team. In effect, the sequencing of the work and the volumes of the components to be poured dictate the required monthly production rates.

However, following the above mentioned assumption, the monthly placement volumes obtained using the resulting production rates are quite high. In effect, 16 months are required to pour 284 000m3 which represent two thirds of the structural concrete for all the structures resulting in an average of 17 775m3 per month or roughly 585m3 per day every day. Furthermore, in order to achieve this production, it is estimated that the necessary work schedule involves working 2 shifts, 7 days a week. **In these conditions there is no float or margin to account for any unexpected events.**

Sustaining such a high level of production for such an extended period of time will be quite challenging if not overly optimistic. As the critical path of the Project is generally through the centerline of the turbine/generator units, SLI's recommendation to alleviate the scheduling pressure on the structural concrete operations would be to remove from the critical path a portion of the concrete to be poured. This could be achieved by adding a construction joint upstream and downstream of the center portion of the Powerhouse, where the units are housed and pouring the Intake and Draft tube later.

Another way to reduce the required monthly pouring rate would be to extend the schedule to better spread over time the required volumes of concrete to be poured.

In any case, SLI has been instructed by Nalcor, in a meeting held on Friday November 18, 2011 to maintain as they are the current assumptions carried in the CCE.

Cold Weather Concreting – costs are included for heating concrete during winter months (generally ½ of each year) as well as a provision for a temporary building enclosure for the Intakes and Powerhouse only at a cost of $1320/m2 (plus heating and lighting costs) for a "substantial" building that would be insulated and structurally capable of supporting gantry cranes for work inside.

Remote Site –long truck hauls were considered necessary for mob/demob as well as the furnishing of all permanent and temporary materials and supplies.

Labour – Labour crafts were assigned by type of work as follow:

- Carpenters for formwork
- Labourers for concrete placing
- Operators for equipment
- Teamsters for trucking
- Cement masons for concrete finishing.

Crew sizes and makeups were established based on the elements of work.

Equipment – Equipment is included in each crew. Cranes, forklifts, generators, compressors, welding machines, concrete pumps, manlifts, etc. are all included in the direct cost of each element of the work. Only pickups and limited support equipment such as hydraulic cranes and boom trucks are included in the construction indirect costs.

Concrete Placing – The cost of the work was estimated under the assumption that all concrete would be pumped, and the average pump boom size would be 52m. There is a good chance that a contractor would place at least some of the concrete by other means, but an overall unit placing cost derived from pumping all concrete with a 52m pump adequately meets the required precision of this estimate.

Mob & Demob – Included in the estimate is the employee travel time (not including bus and driver costs) to/from site one-way from camp (1/2 hour on top of each 10 hour shift); equipment transportation and setup/down; site facilities setup/down.

2.2.6.3 Price Factors

All direct costs, including labour, equipment, construction materials, and permanent materials are included. All work was assumed to be self-performed; no subcontractor costs are included (with the exception of provisions for mob/demob trucking). The potential (likely) added project cost due to mark-ups on subcontracted work could be significant but is not included in the structural concrete estimate.

- Labour rates are agreed "all-in" rates for each craft based on 10 hours a day 7 days a week.
- Equipment rates are agreed "all-in" rates for each equipment resource as stated in Volume I.

Permanent Materials – Unit rates considered are as follows:

- Supply only of Concrete (all) $235/m3
- Waterstop (all) $15/m
- Liquid Expansion Joint Filler $11/m2
- Rebar (all, black) $2.00/kg

- Concrete material unit cost does not include transportation costs from the batch plant, which was estimated separately and included in the various items of work at a rate of 8m3 per hour per truck and driver.

2.2.6.4 Performance Factors

Labour Productivity was factored to take into account remoteness, climate, pace of work, large crew sizes, multiple shifts, and long work weeks resulting in labour not being as productive as it could be otherwise. Quantifying reduced productivity is subjective, but 60% to 80% of what could be expected under more favourable conditions is a reasonable estimate of what was assumed for hourly labour productivity. More favourable conditions would be: closer to metropolitan area; not as adverse climate conditions; 40 hours per week; single shift; smaller crew size; slower build-up to maximum crew size.

However, prior to CCE close-out, SLI has conducted a further review of the structural concrete component of the Project with respect to, amongst others, the aggressiveness of the concreting schedule, as described in the Construction Methodology & Timeline Factors section above. As a result of this review and not withstanding Nalcor's directive to maintain unchanged the initial estimate assumptions, SLI has elected to carry in the CCE and additional 200 000 labour hours to cover for the inherent loss of labour productivity that will result from the congestion of the concreting work areas and the strain on the supply chain of materials to the worksite..

2.2.7 Powerhouse and Spillway Heavy mechanical systems

2.2.7.1 Scope factors

The Powerhouse Heavy Mechanical and the Spillway Heavy Mechanical systems have been divided into two packages due to schedule requirements and the need for the spillway to be operational for river diversion two years before the powerhouse is complete.

The scope of work for the Powerhouse Heavy Mechanical includes the following:

- Twelve intake vertical emergency closure head gates, including embedded guides and wire rope hoists, for reach water passage;
- One set of five bulkhead gate s section for one water passage, including twelve sets of embedded guides, for each water passage, and one lifting beam designed to install and remove the bulkhead gates with a mobile crane;
- Twelve sets of trashracks, including embedded guides, for each water passage;
- Four sets of draft tube stoplogs, two sets per unit, with eight sets of embedded guides, for each water passage;
- One draft tube stoplog handling overhead crane.

The scope of work for the Spillway Heavy Mechanical includes the following:

- five spillway vertical gates, including three vertical surface gates, and two low level outlet gates;
- two set of temporary upstream stoplogs needed for construction which will be modified to one set of permanent upstream stoplogs;
- two sets of temporary downstream stoplogs needed for construction;
- three hoist houses with two wire rope hoists, steel towers and two stairs for the vertical surface gates;
- two hoist houses with two wire rope hoists for the low level outlet gates;
- one monorail hoist for handling the permanent stoplogs;
- eighteen set of vertical embedded guides for the gates and stoplogs.

2.2.7.2 Construction methodology and timeline factors

The installation crew for the Powerhouse Heavy Mechanical is estimated at 10 total staff working 13 hour days on a 20/8 rotation for 36 months. The installation crew for the Spillway Mechanical is estimated at 10 total staff working 10 hour days on a 20/8 rotation for 28 months.

The Schedule was discussed with the two fabricators who supplied budget prices, and both agreed lead times were acceptable for fabrication and installation

2.2.7.3 Price Factors

Direct costs include the design, supply, transportation, installation and commissioning of the above listed packages.

For the direct cost estimate, preliminary design was completed to determine weights of all components, and the costs were estimated from other comparable hydroelectric projects on a cost per kilogram basis. The estimate weights of all mechanical components for the Powerhouse Heavy Mechanical equipment is 7,726 tonnes, and for the Spillway Mechanical equipment is 2,843 tonnes.

Preliminary drawing and a summary specification were produced, and these were provided to three fabricators who were chosen as they had in house design capabilities and these companies were considered experienced in gate design and fabrication, and have participated in similar installations in remote sites similar to Labrador.

Budget prices were received from two of the three fabricators, and these prices were considered as acceptable as they were within 12% on the total price, so the higher of the two prices were used in the Gate 3 Estimate. On a price per kilogram basis, the budget prices were considered reasonable.

Indirect costs were not included in the estimate, but one fabricator provided a man-hour estimate for the installation from which the SLI estimators produced indirect costs for these two packages.

The project should realize a saving if both of these packages are awarded to one contractor, but these two packages cannot be awarded simultaneously as the start times for each project are offset by six to nine months depending on how the packages are finally assembled. The start times will be finalized if the Draft Tube

Stoplogs and embedded steel is included in the Powerhouse Heavy Mechanical or the Spillway Mechanical packages, and will depend on the final construction sequence for the powerhouse civil contract.

2.2.8 Powerhouse Intake Trash Cleaning System

2.2.8.1 Scope factors

The Powerhouse Intake Trash Cleaning System was provided in the Gate 3 Estimate, but the requirement for this system is not yet finalized.

The scope of work for the Powerhouse Intake Trash Cleaning System includes the one purpose built trash cleaning system:

- capable of cleaning floating debris in front of the intake;
- capable of cleaning the trashracks; and capable of cleaning debris from the rock; and
- capable of cleaning sediment trap in from of the intake trashracks.

The only system available that has the above three capabilities is a purpose built trash cleaner built in Germany by Muhr and distributed in North America by Lakeside Industries. Construction methodology and timeline factors

2.2.8.2 Construction methodology and timeline factors

Installation of this contract would take about six weeks for 8 workers working 10 hour days on a 20/8 rotation, and indirect costs such as accommodation and site transport were included in the direct costs.

2.2.8.3 Price Factors

Prices from Muhr were provided for design, fabrication, transportation, installation, and commissioning of the Trash Cleaning System.

Costs for the supply and installation of the rails on the intake deck were included in the Powerhouse General Civil Contract.

2.2.9 Powerhouse Bridge Cranes

2.2.9.1 Scope factors

The Powerhouse bridge cranes are required for installation and maintenance of the generating units. The arrangement used is two bridge cranes rated at 380 tonnes with two trolleys on each rated at 190 tonnes. Each of the cranes will be supplied with a lift beam to lift 360 tonnes; and another lift beam to connect both cranes to lift 680 tonnes which is estimated to be the largest single piece for assembly of the generating units.

Cranes weights received from one of the three suppliers was estimated at 212 tonnes each, or 472 tonnes for both cranes with lifting beams.

2.2.9.2 Construction methodology and timeline factors

Installation of this contract would take about three weeks with 10 workers working 10 hour days on a 20/8 rotation, and indirect costs such as accommodation and site transport were included in the direct costs.

2.2.9.3 Price factors

Prices were received from three crane suppliers for supply, transport, and installation of the cranes including start up, commissioning and load testing. Prices received are within 15% and considered consistent with industry prices for this equipment.

Costs for the supply and installation of the rails on the powerhouse superstructure steel were included in the Powerhouse General Civil Contract.

2.2.10 Powerhouse Elevator

2.2.10.1 Scope factors

The powerhouse elevator is a passenger/freight elevator designed for access at seven landings from the drainage sump at EL.-20.2 m up to the Intake deck at El.45.5 m.

2.2.10.2 Construction methodology and timeline factors

Installation of this contract would take about 20 weeks with two workers working 10 hour days on a 20/8 rotation, and indirect costs such as accommodation and site transport were included in the direct costs.

2.2.10.3 Price factors

Budget prices were received from two suppliers, but only one elevator system complied with the specified requirements for the size of the cab and doorway. although higher priced it was carried in the CCE.

Costs for the concrete structure were included in the Powerhouse General Civil Contract.

2.2.11 Steel Superstructure and Architecture

2.2.11.1 Scope

The scope includes Construction of Steel Structure for Powerhouse Superstructure, 46.965 m width, 198.840 m length and 27.80 m height (from +15.50 m to + 43.30 m). It also includes construction of two mezzanine floors at +25.00 and +34.47 m level, made of concrete floor over metal decking. Structural Steel for roof over mezzanine floors and catwalk access is also included as well as the steel columns and beams required to carry the loads of the two heavy overhead cranes in the Powerhouse. The scope also includes Metal access Doors, Ladders, Handrails, Guard Rails, Removable Handrails and Crane rails at Intake Deck.

Extension of the powerhouse structure by 2 bays for construction purpose is considered as an optional item (Option 1) and estimated separately as standalone case.

Use the 2 units of steel superstructure as winter protection shelter is considered as an optional item (Option 2) and estimated separately as standalone case.

In-House pricing was used to estimate the majority of Architectural items and benchmarked with other projects using similar architectural systems as well as specialized supplier input. For very few of these items, information from Richardson Cost Data was used. Wherever no information was available, a lump sum provisional amount was provided. The final architectural cost included in the CCE was adjusted to reflect architectural costs encountered in similar projects in comparable conditions.

- Quantities are based on 40% engineering progress, as of 24 November, 2011. Any changes resulting from development thereafter are excluded.
- Bill of quantities were issued by engineering on a basis of heavy, medium and light profiles for an approximate total of 3 200 tonnes.
- Quantities include connection allowance of 10% and quantity growth allowance of 10%.
- All structural steel is generally painted, except specified otherwise.
- Concrete for mezzanine floor is included in concrete works for powerhouse.
- All miscellaneous embedded steel is included in concrete works for powerhouse.
- No additional allowance needs to be added.
- Any changes resulting from development thereafter like addition of roofs over mezzanine floors are excluded.
- Costs and labour productivity included in the CCE have also been benchmarked with similar projects in comparable conditions.

Miscellaneous exterior steel guardrails (WBS30002100)

The scope includes guardrails along the south RCC dams, the intake, the center dam, the permanent access road and the tailrace deck.

- Foundation of the Guardrails is included in Civil / Concrete works of Powerhouse and is assumed to consist only of drilled holes for expansion anchors.

- Quantities are neat and do not include any kind of allowance what so ever.

2.2.11.2 Construction Methodology & Timeline Factors

Construction will be carried out by multiple sub-contractors to the prime EPCM which will be chosen to perform the work under a competitive bidding process.

Sub-contractor will be given responsibility for the supply, construct, manage, perform and deliver the following on site construction activities in general:

- Craft Labour, Discipline foremen and for all construction / installation activities;
- Construction Equipment for all construction / installation activities;
- Permanent materials and associated bulks;
- Small tools, consumables and supplies;
- Scaffolding;
- Construction supervision and management;
- Temporary facilities & offices and expenses;
- Personnel transportation;
- Mob / Demob of Personnel, Equipment and all facilities
- Construction Equipment requirements have been identified on an as needed basis for individual crews;
- An average of $8.00 per Direct Labour Hour has been considered. On average the following breakdown applies;
  - Small Tools 4 – 5 % of DFL Cost.
  - Consumables 3 – 4 % of DFL Cost.
  - PPE 2 – 3 % of DFL Cost.

Any kind of pre-assembly / dry assembly at site is not envisaged. All structural steel components are stick built for erection purpose. Roof truss is assembled at shop and delivered in two parts.

Duration based on schedule PCS – Oct 6.pdf supplied by the Project Controls group.

2.2.11.3 Price Factors

Budgetary Offers from fabricators were invited for supply, fabricate (including shop drawing), paint and delivery at site of structural steel components. Offers were received from OCEAN STEEL of New Brunswick, SUPER METAL of Quebec and DAERONG of South Korea. Detailed bid evaluation was not carried out and it is assumed the bids are within the acceptable limits of exclusions. An average price of all three bids is considered for present estimation.

- All direct labour hours for Civil / Concrete / Steel are based on readily available USGC (United States Gulf Coast) charts and/or SLI historical data.
- Construction Equipment rates are based on blue book hourly rates provided with the *Estimate Ground Rules*– September 12th 2011; and is inclusive of Fuel, Lubricants and Periodic routine maintenance but excludes operating personnel.

2.2.11.4 Performance Factors

- All direct labour hours based on readily available published charts and/or SLI historical data.
- All base hours based on USGC.
- A site-specific adjustment factor 1.25 for Structural Steel by prime account was applied to the chart hours.
- Factors that were considered for site conditioning include; Work week, Project Size, Plant Type, Work Space per Man, & Climate.
- Factors not considered for site conditioning include; Craft Availability, Craft Skill, Quality of Craft Supervision, & Union Influence.

-

2.2.12 Power Generation

A complete bid package has been issued to Alstom, Andritz and Voith on October 14, 2011 with expected return date of quotation of January 27, 2012. The scope of the work includes the supply, installation testing and commissioning of four (4) 206 MW Kaplan units including the following for each unit:

- Turbine
- 229 MVA Generator
- Governor
- Static excitation system

As the actual quoted cost was not available at the time of the CCE, a provision based on similar projects in comparable conditions was included. **In order to meet Project schedule, it is most critical that the Power Generation Contract be awarded in early spring of 2012**

2.2.13 Auxiliary Mechanical Works

2.2.13.1 Scope

The Mechanical Equipment Bill of Quantities received from project engineering is the basis for the scope of the Mechanical Equipment estimate and cover the following Powerhouse systems:

- Raw and cooling water system
- Fire protection system
- Service water system
- Shaft seal water system
- Dewatering system
- Drainage system

- Oily water drainage system
- Domestic water and Wastewater systems exclusive of appliances carried in architecture estimate
- High and low pressure compressed air systems
- Lubricating and hydraulic oil handling system
- Piezometer and water level system
- Powerhouse HVAC as well air fans in inspection gallery of main RCC dam
- Instrumentation and related piping systems
- Miscellaneous small hoist and handling systems
- Machine shop equipment

Mechanical Engineering Group also added a number of control panels required into BOQ to facilitate the electrical needs for the mechanical equipment material and labour cost calculation.

- Individual datasheets with applicable Codes and NALCOR standards to solicit the Vendor Bids for individual equipment were not received.
- Portable pumps assumed to be un-crated and stored in warehouse. No additional hours for permanent installation.
- Pre-commissioning spares have not been considered.
- Cost of Vendor Representatives has been excluded.
- No Material Take off Allowance was added.
- No Design Development Allowance was added.

HVAC:

HVAC BOQ received from project engineering department is the basis of mechanical HVAC account. Mechanical Engineering Group also added number of control panels required into BOQ to facilitate the electrical needs for the mechanical equipment material and labour cost calculation.

- Individual datasheets with applicable Codes and NALCOR standards to solicit the Vendor Bids for individual equipment were not received.
- Take off is measured through fittings.
- HVAC duct estimated by hrs per lb. Assumed fitting mix is 20 – 30% of weight.
- 20% waste included in weight.
- Pre-commissioning spares have not been considered.
- Cost of Vendor Representatives has been excluded.
- No Material Take off Allowance was added.
- No Design Development Allowance was added.

Piping:

- The BOQ has been verified by engineering against the P&ID's.
- BOQ includes all large bore, small bore piping and valves.
- Assumed local fabrication of piping spools.
- Pipe Insulation requirements were indicated on the insulation specifications.
- Pipe Paint requirements were indicated on the painting specifications.
- The piping layout is based on the 3D model.
- High point vents and low point drains captured on BOQ were developed by estimating, one vent or drain for every 150 LM of large bore piping.
- Assumed 5 - 10% of welds require NDE testing.
- Assumed 30% of welds on site and 70% shop welds where shop rates were estimated through contacting east coast suppliers

- Additional man-hours included for hydro testing and air blowing.
- Additional hours for material handling (prorated on LM of pipe).
- No Material Take Off allowance was added.
- No Design Development allowance was added.
- An allowance for Standard Pipe supports has been included. This includes man-hours as well as material cost.
- All BOQ quantities are "neat"
- No allowances were considered by engineering.

Instrumentation:

Instrumentation cable & bulks for the Auxiliary Mechanical Package were defined by estimation. An allowance including man-hours and material cost has been included in the estimate.

- Instrumentation items for the Auxiliary Mechanical Package have been defined by SNC engineering. No additional instrumentation items have been added by estimating.

Insulation:

- Piping systems requiring insulation have been identified in the project Insulation specifications.
- Insulation quantities have been calculated based on pipe and fitting length using the Denis formula.

Electrical:

- Electrical bulks for the Auxiliary Mechanical Package were defined by estimation.

- Electrical control panels for the Auxiliary Mechanical Package have been defined by SNC engineering. Control Panel assumed to have 50 LM Control Cable, 50 LM Power Cable, 25 LM Conduit & 12.5 LM of Tray.
- An allowance for cable, conduit, & tray for the Auxiliary Mechanical Package has been included. This includes man-hours as well as material cost.

Paint:

- Piping systems requiring painting have been identified in the project paint specifications provided by engineering.
- An allowance for paint material and labour has been included based upon system requirements as well as field touch-ups after welding

Also, the Mechanical Equipment Bill of Quantities received from project engineering is the basis for the scope of the Mechanical Equipment estimate and cover the following North Spur systems:

- Refurbish existing pump wells including pump removal, inspection, cleaning and reconnection.

2.2.13.2 Construction Methodology & Timeline Factors

As a result of mechanical construction sequence prior and after installation of Power generation units, the estimate considers a 6 month period where little or no mechanical work is performed which extends the duration for which the temporary contractor installations would be required. For the calculation of the construction indirect costs it was assumed that two packages would be included in one contract.

Mechanical work was assumed to be performed using shared supervision of multiple crews as well as shared service and access equipment.

Scaffolding was estimated by applying an allowance of 17% of direct labour costs and 25 00 of labour hours

2.2.13.3 Price Factors

Detailed Technical bid evaluation (TBE) was not carried out for budget quotes; it is assumed the bids were within the acceptable limits of exclusions.

- All Items were sent for budget pricing through the SNC Procurement group.
- Mechanical and Piping packages were sent to multiple Vendors. When vendor response was limited In house pricing was used to estimate the remaining items.
- Those items that did not receive a budget quote were priced in house using data from similar major projects from the last eighteen months.
- Supply of piping and fittings, valves, accessories have been quoted by vendor or in house priced
- Shop Fabrication of spools pricing is based on multiple offers from East Coast Fabricators.
- HVAC equipment has been quoted by vendor or in house.
- Major Equipment has been quoted by vendor or in house.
- Electrical equipment for power and control of Aux Mechanical package was priced in house.
- Instrument cable for Aux Mechanical package was priced in house.
- Instrument hardware for Aux Mechanical package was vendor quoted.
- Insulation material has been quoted in house.
- An allowance for Standard Pipe supports has been included. This includes man-hours as well as material cost.

Budget quotes were obtained from suppliers for (or part of) the following systems:

- Mechanical system and equipment
- Piping bulks.

- Fire protection items.
- Sand filter.
- Mobile oil purifying unit.
- Oil storage tank
- Oil Water Separator
- Fans, diffusers, coils
- Shop Fabrication

Freight

In-house prices were carried for:

- Construction materials, mechanical equipment, electrical equipment and instruments not mentioned above and for which, generally, an 8% allowance was carried for freight.

2.2.13.4 Performance Factors

Labour productivity assumptions are as follow:

- All direct labour hours are based on readily available USGC (United States Gulf Coast) charts and/or SLI historical data.
- The following productivity factors were added to the chart to account for the location of the Project:
  - 1.13 for Mechanical and HVAC systems man hours.
  - 1.55 for Piping / Insulation systems man hours.
- A 6% allowance was added to direct labour costs to account for congestion of the worksite

2.2.14 Auxiliary Electrical Works

2.2.14.1 Scope

The Auxiliary Electrical work estimate includes the direct and construction indirect costs for the following elements of the project:

- Spillway Electrical Works
- North Spur pumping system upgrade Electrical Works
- RCC inspection gallery Electrical Works
- Building Electrical Services
- Electrical Ancillary / Auxiliary Systems
- Powerhouse Grounding Works
- Protection, Control and Monitoring
- Generator Transformers (4 working and 1 standby)
- Emergency Diesel generator
- Spare Parts and Special Tools
- Operations Telecommunication System - Muskrat Fall

All material take-off quantities were developed based on the single-line-diagram and drawings prepared by engineering. Cable lengths were estimated by evaluating horizontal and vertical runs throughout the Powerhouse along with the cable tray layout drawings.

Quantities are neat from engineering and no quantity allowance is considered at this stage of estimate.

This applies to the following WBS BOQ's:

- Powerhouse Station AC/DC Electrical Auxiliaries
- Generator Step-up (GSU) Transformers

- Generator Circuit Breakers
- Station Auxiliary Service Transformers
- Isolated Phase Bus
- MF Power Station BOQ Telecom, CCTV, PA, SACS, TELEPHONY
- MF Spillway BOQ Telecom, CCTV, PA, SACS, TELEPHONY

For the HV Power Transformers elements of the Electrical Works, an estimate validation check for Labour hours was performed using the Aspen Capital Cost Estimator estimating software.

2.2.14.2 Construction Methodology & Timeline Factors

No heavy lifting equipment has been considered as it is assumed all heavy permanent equipment such as the generator transformers are directly off loaded onto foundation by others.

As the duration of the Electrical Works for the Powerhouse and area considered in the CCE extends from mid 2014 to 2016, the construction indirect costs are calculated accordingly. The contracting packaging strategy to be developed with respect to Electrical Works could alleviate these costs be optimizing and possibly decreasing the overall duration of the electrical contractors need to be on site.

Scaffolding and accesses

- A provision of 5 % of total direct Labour hours for Scaffolding labour and 3 % of total direct Labour cost for scaffolding materials cost are included in the estimate.

Construction equipment

- Diesel Generators are used to provide requisite electrical supply to construction works

- Lifting and carrying equipment like forklifts, small cranes, pickup trucks, welding machines, etc are estimated to be mobilized for the construction duration as required

Congestion of work site

- A small percentage of 4-5% idle time is assumed to account for site congestion
- Its assumed the work front from other disciplines will be available as per schedule

2.2.14.3 Price Factors

- Majority of Items were sent for budget pricing through the project Procurement group.
- For some of the high value items average costs of two higher quotes are considered.
- Those items that did not receive a budget quote were priced in house using data from similar major projects from the last eighteen months.
- DC portion of cost will be provided by engineering discipline as a Sub Contract all inclusive cost.
- Telecommunication portion of cost will be provided by engineering discipline as a Sub Contract all inclusive cost.
- For the accessories which were not quantified by engineering an allowance was used.

Freight

In-house prices were carried for:

- Construction materials.
- Mechanical equipment, electrical equipment and instruments.

Generally an 8% allowance was carried for freight.

2.2.14.4 Performance Factors

Labour productivity assumptions are as follow:

- All direct labour hours are based on readily available USGC (United States Gulf Coast) charts and/or SLI historical data.
- A productivity factor of 1.44 over Richardson was added to the chart to account for the location of the Project
- A 6% allowance was added to direct labour costs to account for congestion of the worksite

3 VOLUME III - COMPONENT 3 DETAILED BASIS OF ESTIMATE

3.1 INTRODUCTION

As described in Volume I, the Project's Component 3 includes the facilities, installations and equipments relative to the Churchill Falls, Muskrat Falls and Soldier's Pond Switchyards, the Muskrat Falls Tap, the Muskrat Falls and Soldier's Pond AC/DC Converters, the SOBI Transition Compounds and Pond Electrodes, the Soldier's Pond Synchronous Condenser and the Telecommunication System.

The following sections describe the basic assumptions considered as well as the means and methods utilized to develop the relevant cost estimates included in the CCE.

3.2 BASIS OF ESTIMATE – DIRECT COSTS

The following general assumptions were considered for estimating the above mentioned work items of Component 3.

For each of the sites, engineering was developed to provide sufficiently detail material take off quantities for the CCE. Approximately 130 drawings were issued including site layouts and line diagrams.

Approximately 25 short-term specifications were issued by Engineering and provided to Procurement for the costing of the major equipments.

3.2.1 Scope Factors

The scope of work includes, for each of the sites, all clearing and grubbing, cut & fill for site grading, fencing, slope protection, access roads, cable trenches and duct banks, concrete foundations, galvanized steel gantries and supports, pre engineered buildings, Supply and Installation of all electrical equipment, auxiliary building mechanical works as well as mechanical handling equipment and operation and maintenance shops where required.

- Quantities are based on 40% engineering progress, as of 5 December, 2011.

- Quantities are neat and do not include any kind of allowance what so ever.
- The preliminary civil/structural design is based on the National Building Code of Canada.
- In the absence of geotechnical information, shallow footing with allowable soil bearing capacity of 150 kPa and a frost depth of 2.40 meters is considered for all the foundations.
- Site grading design is based on balanced cut and fill with site specific assumptions for overburden / rock ratios
- Piling for foundations not envisaged.
- Civil works related to Cathodic Protection are excluded.
- Requirement of fire protection of the power transformers at the Churchill Falls and Muskrat Falls Tap have been excluded following consultation with Nalcor.
- For miscellaneous works where quantities were not available estimating has assumed a quantity

3.2.1.1 Civil Works

All the site locations are considered as green field locations and any kind of demolitions are not envisaged with the exception of the existing Churchill Falls 230/138 kV switchyard and the existing 138/25kV Construction Power installations at Muskrat Falls 315/138 kV switchyard. All civil works are considered to be performed during summer and no provision has been added for winter works.

- Access roads / approach roads are included.
- Ditches/Swales along periphery of the plot are considered as un-lined ditches and are part of site grading activities. No additional quantities are considered.
- Buried Cable Trenches are not envisaged. Precast Polymer Concrete cable trenches are considered.

- Excavation in rock is considered at some of the location as per information available at this point in time and agreed assumptions as to the presence of rock are carried in the CCE.

3.2.1.2 Concrete

- Manholes / Cable Pull Pits are not envisaged at this time. If required to be placed outside the control buildings and between cable run, shall be included at a later date.
- Transformer blast/fire wall is considered in the BOQ.

3.2.1.3 Steel

- All Steel structures like Gantries and Support steel are considered as galvanized, unless specified otherwise.

3.2.1.4 Buildings

- All buildings are considered as Pre-Engineered Buildings.
- Civil / Concrete works up to grade are part of Civil/Concrete BOQ.
- Building wall acting as Firewall, if required is under concrete BOQ.
- Building includes electromechanical works like HVAC, Plumbing, and Lighting etc.
- Over Head Cranes, Handling equipment, Shop equipments etc are quantified and included in estimate.
- Building Includes Furniture, Furnishings and Kitchen / Washroom fittings / appliances.
- Tie in points for Potable Water, Sanitary Drainage, Lighting are considered available near building.

3.2.1.5 Electrical Works

- All required supply and installation of electrical equipment including:

- Circuit breakers
- Disconnect switches
- Capacitor voltage transformers
- Current transformers
- Surge arresters
- Power transformers
- Batteries and chargers
- Busbars and overheard connections
- Grounding
- Control system (panels)

- Lighting and building electrical services
- Operations Telecommunication System - Island Link
- Tie in for Small Power for Lighting etc are considered available near building.
- Cathodic Protection works are not included.

3.2.2 Construction Methodology & Timeline Factor

Standard construction methods have been considered for of each of the facilities and installations of Component 3. Productivity factors by discipline have been applied as indicated in the Performance factors section below.

Where the remoteness of the site requires the provision of a camp to lodge workers and staff during construction, an estimate has been included in the CCE. The sites where such camps are required are indicated in the site-specific considerations below.

3.2.3 Price factors

- Following the issuance of a short-term specification, two turn-key budget quotes were received for the Synchronous Condenser from the following suppliers:
    - Alstom for a 3 unit +150/-100 MVAr
    - Toshiba for a 2 unit +300/-200 MVAr

For the purpose of the CCE, the Alstom budget quote was considered.

- Following the issuance of a short-term specification, three turn-key budget quotes were received for the Muskrat Falls and Soldiers Pond Converter stations from the following suppliers:
    - ABB
    - Siemens
    - Alstom

For the purpose of the CCE, the ABB budget quote was considered.

- Following the issuance of a short-term specification, three (3) turn-key budget quotes were received for the Shoal Cove and Forteau Point Transition Compounds from the following suppliers:
    - ABB
    - Siemens
    - Alstom

For the purpose of the CCE, the ABB budget quote was considered.

- Pre-engineered building were estimated on a unit cost per area basis in using the following assumptions:
    - 1 level standards height : 1,800$ / m^2

- 1 level "tall" building : 2,000$ / m^2
- 2 levels standard building: 2,700$ / m^2
- Foundation works for all buildings 600$ / m^2

- All other standards electrical equipment were priced through issuance of short-form technical specifications for the purpose of obtaining budget prices from suppliers. Generally, and where applicable, the average of two highest submitted prices were considered. Where not applicable an estimator judgement call was applied based on past experience.
- For site Testing, Commissioning and Training work of substation electrical equipment approximately 12% of total material costs is assumed.

3.2.4 Performance Factors

Labour productivity assumptions are as follow:

- All direct labour hours are based on readily available USGC (United States Gulf Coast) charts and/or SLI historical data.
- For civil works, productivity factor of 1.31 over Richardson was added to the chart to account for the location of the Project
- For electrical works, productivity factor of 1.44 over Richardson was added to the chart to account for the location of the Project
- For mechanical Works, productivity factors over Richardson were added to the chart to account for the location of the Project:
  - 1.13 for Mechanical and HVAC systems man hours.
  - 1.55 for Piping / Insulation systems man hours.
- A 6% allowance was added to direct labour costs to account for congestion of the worksite

3.3 SITE-SPECIFIC CONSIDERATIONS

For each of the Component 3 facilities and installations, some site-specific assumptions were made to adequately capture costs that relate to conditions that apply to these sites only. These site-specific considerations are indicated in the following sections.

3.3.1 New Churchill Falls Switchyard 735/315Kv

The remoteness of this site will require the construction of a 150 person camp for the 46 months duration of this portion of the Project. Two (2) new 735kV interconnections lines will need to be built from the existing CFLCO switchyard to feed the new Churchill Falls switchyard. Some work will need to be performed within the existing CFLCO switchyard and it is assumed that all required permits and authorizations will have been secured by Nalcor at commencement of the Works.

3.3.1.1 Site Preparation and Access

Minimal access roads are required for this site as it next to the existing Trans Labrador Highway. Clearing and soil stripping works are included in the CCE.

3.3.1.2 Civil Works

As no geotechnical information was available for this site an agreed assumption of balanced cut and fill mass excavation work, comprising 50% overburden and 50% rock was considered in the CCE.

The switchyard area of the 735kV portion of the switchyard is 300m x 246m. The area of the 315kV portion of the switchyard is 192m x 175m. In order to reduce the earthworks it is considered in the CCE that the 735kV portion of the switchyard will be at a level 3m higher than the 315kV portion.

All earthworks including final grade using crushed stone as well as fencing around the full extents of the switchyard are included in the CCE including the oil containment and fire wall structure around the power transformers.

All concrete foundations work for circuit breakers, disconnect switches, capacitor voltage transformers, current transformers, surge arresters, power transformer, gantries, etc. are included in the CCE.

3.3.1.3 Electrical Equipment

No backup 735/230kV transformer is included in the estimate as this option was not retained.

3.3.1.4 Other Works

An 11m x 30m meter pre-engineered type maintenance and operations building complete with a 5 tonnes overhead crane and all tools and equipment are included in the CCE. There are no provisions for cabinets, tool chests or heavy shelving.

A control building housing 44 control panels, batteries, chargers is also included.

3.3.2 Construction Power

The supply of Construction Power to the Project will be provided by a new 138/25kV terminal station at Muskrat Falls with a tap to the existing 138kV transmission line between Churchill Falls-Happy Valley substations. This tap station will be located on the North side of the Churchill River with access from Trans Labrador highway. The construction power will be extended to the construction site and camp site through a 25 kV transmission line approximately 17km long crossing the Churchill River to the south side.

The new tap substation at Muskrat Falls and an extension by third transformer at Churchill Falls substation is required as supporting infrastructure for the construction of the Muskrat Falls power generation and the camp facilities.

3.3.2.1 Site Preparation and Access

Minimal access roads are required at this site as it is next to an existing road

3.3.2.2 Civil Works

The area of the Muskrat Falls construction power substation is 100m x 100m. All earthworks including final grade using crushed stone as well as fencing around the full extents of the substation are included in the CCE.

All concrete foundations work for circuit breakers, disconnect switches, capacitor voltage transformers, current transformers, surge arresters, power transformer, gantry, etc. are included in the CCE.

A provision for the demolition of the temporary Muskrat Falls Construction Power substation following completion of the works is included in the CCE.

3.3.2.3 Electrical Equipment

Supply and Installation of all electrical equipment required for Construction Power have been estimated using budget quotes provided by suppliers and in-house estimating.

3.3.2.4 Other Works

A 17 km wood pole 25kV transmission line will connect the new tap substation to the Muskrat Falls powerhouse construction site and the camp site. A provision of 100 000$ per km was made for the construction of the power line

3.3.3 Muskrat Falls TAP 315/138kV

This substation will be fed by two new 315kV lines from Churchill Falls and will supply Happy Valley at 138kV.

3.3.3.1 Site Preparation and Access

Minimal access roads are required at this site as it is next to an existing road

3.3.3.2 Civil Works

The area of the Muskrat Falls TAP 315/138kV is 175m x 275m. As no geotechnical information was available for this site an agreed assumption of balanced cut and fill mass excavation work, comprising 100% overburden was considered in the CCE.

All earthworks including final grade using crushed stone as well as fencing around the full extents of the switchyard are included in the CCE including the oil containment and fire wall structure around the power transformers.

All concrete foundations work for circuit breakers, disconnect switches, capacitor voltage transformers, current transformers, surge arresters, power transformer, gantry, etc. are included in the CCE.

3.3.3.3 Other Works

A control building housing 42 control panels, a telecommunications room, batteries, and chargers is also included in the CCE.

3.3.4 Muskrat Falls Switchyard 315kV and Converter Station 350kV DC

As this site is located next to the Muskrat Falls Main Camp facilities, it is assumed in the CCE that all workers and staff for this portion of the Project will be lodged at this Camp. For the 34 months duration of the construction work at this site it is expected that accommodations for a peak of 276 workers will be required.

3.3.4.1 Site Preparation and Access

Minimal access roads are required at this site as it is next to an existing road

3.3.4.2 Civil Works

The extents of the Muskrat Switchyard area are 187m x 252m. No rock excavation is anticipated at this site as the area will consist mainly of fill laid down in 2013 during the Powerhouse mass excavation activities and used as a lay down area until the substation work begins.

All earthworks including final grade using crushed stone as well as fencing around the full extents of the switchyard are included in the CCE including the oil containment and fire wall structure around the power transformers.

315kV Switchyard

All concrete foundations work for circuit breakers, disconnect switches, capacitor voltage transformers, current transformers, surge arresters, gantries, etc. are included in the CCE.

A control building housing 60 control panels, batteries, chargers is also included.

Converter 350 Kv DC

All concrete foundations work for circuit breakers, disconnect switches, capacitor voltage transformers, current transformers, power transformers, surge arresters, filters, gantries, etc. are included in the CCE.

For the valves control building, typical engineering referenced with similar projects was performed. A provision of 2,700$+600$ / m2 was considered in the CCE.

3.3.4.3 Electrical Equipment

Switchyard

All standard electrical equipment was priced through issuance of short-form technical specifications for the purpose of obtaining budget prices from suppliers. Generally, and where applicable, the average of two highest submitted prices were considered. Where not applicable an estimator judgement call was applied based on past experience.

Converter 350 Kv DC

For the converter's specialized electrical equipment a short-form technical specifications was issued for the purpose of obtaining budget prices from suppliers. This specification stated that Supply of equipment needed to include the design, manufacturing, quality control, transportation to site, storage and documentation. The supply is to include all equipment and materiel, required to provide a complete and operational converter station. The main equipments included in the Converters station are as follow:

- Thyristor valves and valve cooling system

- Converter transformer
- Smoothing reactors
- Surge arresters
- AC filters
- DC filters
- Measuring devices
- Control and protection system
- DC switching Device
- AC breakers and switching devices
- Busworks and insulators
- AC/DC station auxiliary power supply
- Smoke detectors in valve hall
- CCTV (camera system)
- Steel structures

3.3.4.4 Other Works

An 20m x 50m meter pre-engineered type maintenance and operations building complete with a 5 tonnes overhead crane and all tools and equipment are included in the CCE. There are no provisions for cabinets, tool chests or heavy shelving.

3.3.5 Forteau Point and Shoal Cove Transition Compounds

The remoteness of these sites will require the construction of 80 person camps at each location for the 28 months duration of these portions of the Project, the cost of these camps are included in the CCE. **However, as these facilities are located in the Transmission Line ROW, there could be an opportunity to save the mobilization and demobilization costs of the Transition Compound camp facilities, mainly the Forteau camp, if the personnel required for this work**

could be lodged at the camp required for the construction of the Transmission lines. The CCE currently carries distinct camp facilities.

The transition compounds are required to interface the submarine/land cable terminated at both transitions compounds through air-bushing cable sealing ends and the DC transmission lines. However, the CCE includes no provision whatsoever for any interface with the SOBI Directional Drilling Contractor at these locations.

3.3.5.1 Site Preparation and Access

Access roads to both these sites are included in the CCE.

3.3.5.2 Civil Works

The extents of the Transition compounds area are 100m x 100m. As no geotechnical information was available for this site an agreed assumption of balanced cut and fill mass excavation work, comprising 100% overburden was considered in the CCE.

All earthworks including final grade using crushed stone as well as fencing around the full extents of the switchyard are included in the CCE including the oil containment and fire wall structure around the power transformers.

All concrete foundations work for circuit breakers, disconnect switches, capacitor voltage transformers, current transformers, surge arresters, transformer, gantries, etc. are included in the CCE.

A 14m x 24m control building is also included in the CCE housing the control equipment provided by the Turnkey contractor.

3.3.5.3 Electrical Equipment

The transition compounds will be provided with all required switching equipment, including:

- 350 KV dc switchyard including all necessary disconnecting and ground switches, surge arresters, post isolator, bushings, voltages dividers, DC current transducers and busworks
- Gantries and steel structures for supporting the equipment on its foundations

- Auxiliary power supply: one 14.4 Kv transformer and one 150 KW diesel generator
- LV and telecommunication
- Control and protection equipment
- Electrode line monitoring equipment

3.3.5.4 Other Works

In order to protect the Transition Compounds' electrical equipment from the salt spray inherent to their location near the SOBI, a 28m x 43,2m x 13,5m high pre-engineered building is included in the CCE for each site. These building will consist mainly in a steel shell to house the cable sealing end, circuit breakers, surge arresters, current transformers, disconnect switches, etc. Main access doors will enable service vehicles to access the building and proceed to any assembly or maintenance work from within the building.

3.3.6 Soldier Pond Converter Station 350kV, Switchyard 230kV and DC Synchronous Condensers

3.3.6.1 Site Preparation and Access

An access road connecting the site to the Trans-Canada Highway is included in the CCE.

3.3.6.2 Civil Works

The extents of the Soldier Pond Switchyard area are 314m x 500m. For the synchronous condenser, the yard area is 150m x 300m.

Following review of a 2008 report relative to a geotechnical study conducted at this site, an agreed assumption of balanced cut and fill mass excavation work, comprising 85% overburden and 15% rock was considered in the CCE excluding the synchronous condenser portion of the site.

In order to avoid disrupting an existing small pond near the Soldier Pond Project site, the Synchronous Condenser was detached from the main facilities and located approximately 140 meters to the (South-East). The assumption considered for the synchronous condenser site excavation work is 100% rock.

315kV Switchyard

All concrete foundations work for circuit breakers, disconnect switches, capacitor voltage transformers, current transformers, surge arresters, gantries, etc. are included in the CCE.

A control building housing 72 control panels, batteries, chargers is also included.

Converter 350 Kv DC

All concrete foundations work for circuit breakers, disconnect switches, capacitor voltage transformers, current transformers, power transformers, surge arresters, filters, gantries, etc. are included in the CCE.

For the valves control building, typical engineering referenced with similar projects was performed. A provision of 2,700$+600$ / m2 was considered in the CCE.

3.3.6.3 Electrical Equipment

Switchyard

All standard electrical equipment was priced through issuance of short-form technical specifications for the purpose of obtaining budget prices from suppliers. Generally, and where applicable, the average of two highest submitted prices were considered. Where not applicable an estimator judgement call was applied based on past experience.

Converter 350 Kv DC

For the converter's specialized electrical equipment a short-form technical specifications was issued for the purpose of obtaining budget prices from suppliers. This specification stated that Supply of equipment needed to include the design, manufacturing, quality control, transportation to site, storage and documentation. The supply is to include all equipment and materiel, required to provide a complete and operational converter station. The main equipments included in the Converters station are as follow:

- Thyristor valves and valve cooling system
- Converter transformer
- Smoothing reactors
- Surge arresters
- AC filters
- DC filters
- Measuring devices
- Control and protection system
- DC switching Device
- AC breakers and switching devices
- Busworks and insulators
- AC/DC station auxiliary power supply
- Smoke detectors in valve hall
- CCTV (camera system)
- Steel structures

In order to perform the work related to the AC/DC Switchyard and Converter stations, the displacement and diversion of the LT-218 Hollyrood existing line is required prior to commencement of the Work in 2013. These costs are included in the Component 4 – Transmission Lines portion of the CCE.

Furthermore, if, following detailed engineering studies, the location of the facilities was to change from what is currently assumed in the CCE, it could be required to relocate the TL-242 Hollyrood line as well.

3.3.6.4 Other Works

An 20m x 50m meter pre-engineered type maintenance and operations building complete with a 5 tonnes overhead crane and all tools and equipment are included in the CCE. There are no provisions for cabinets, tool chests or heavy shelving.

For integration into existing Power Grid modifications and upgrades to protection systems will be required at in the following Substations:

- Holyrood
- Wester Avalon
- Oxen Pond
- Hardwood

3.3.7 L'anse-au-Diable and Dowden's Point Shoreline Pond Electrodes

Estimate is a unit Rate Based estimate based on scope, design and bulk quantities developed from the concept designs as detailed in the *Shoreline Pond Electrodes - Design Brief* SLI doc no. 505573-480B-47EM-0004 (the Design Brief)

All construction work, with the exception of the Dowden's Point dredging activities can be performed from shore.

L'anse-au-Diable Pond electrode

This proposed site at L'Anse-au-Diable is in a south facing cove with somewhat rectangular dimensions of 130 m to 150 m wide and length of approximately 150 m. It is assumed that no excavation will be needed at this site as it is exposed rock.

The construction of this facility will occur over a 6 to 8 month period. The facility is close to existing access roads and will use standard civil equipment for construction. It is not anticipated that the contractor would need to mobilize any marine based equipment.

Approximately 400m of access road will be required to access the site; there will be a small lay down construction area constructed at the approach for the new breakwater. All material will be end dumped into the ocean and shaped with a long reach backhoe. Armour stone will be dumped on the slope and repositions with a crane or long reach backhoe.

- Rates are based on non union sites. (Marine Contractors are generally non-union
- No dredging is anticipated at L'Anse-au-Diable
- Sheet pile cut-off wall work has been included to avoid silting of the permeable material during breakwater construction
- There is no allowance for winter construction.
- Armour stone in the sizes required is readily available within a 10 km radius.
- Service Building is prefabricated off site.

Dowden's Point Pond electrode

At the Dowden's Point Shoreline Pond Electrode, the crest of the breakwater aligns with the top of the existing bank and the sea side toe line coincides with the existing low tide shoreline. The depth of the soil above the bedrock at Dowden's Point is anticipated to be approximately 30 m, which would permit excavation without the need to blast bed rock.

The construction of this facility will occur over a 6 to 8 month period. The facility is close to existing access roads and will use standard civil equipment for construction. The current concept required that the contractor will mobilize marine based equipment for a dredging operation. Dredging costs are based on ocean dumping

Approximately 400m of access road will be required to access the site; there will be a small lay down construction area constructed at the approach for the new breakwater. All material will be end dumped into the ocean and shaped with a long reach backhoe. Armour stone will be dumped on the slope and repositions with a crane or long reach backhoe

- Unit Rates are based on historical data for Marine Construction in Atlantic Canada and Newfoundland.
- Dredging rates for Dowdens Point location assumed dredged spoils from dredging operations use disposal at sea.
- Rates assume availability of Marine contractors and competitive bidding.
- Rates are based on non union sites. (Marine Contractors are generally non-union)
- Disposal of mass excavation from Dowdens Point assumes a haul distance of 2 km.
- There is no allowance for winter construction.
- Service Building is prefabricated off site.
- Provisions have been included in the CCE for the relocation of the east coast trail at the Dowden's Point location.
-

3.3.7.1 Site Preparation and Access

Access roads

For both sites, access roads to the site will be constructed to link with existing local roads (approximately 400 m). From the entrance to the site, the road will extend along the inside of the breakwater to provide access for maintenance of the shoreline pond electrodes. The width of the access road is assumed to be 6.0 m

3.3.7.2 Civil Works

Marine Structures (Breakwater)

The breakwater is designed to withstand the expected worst case site conditions, including wave action, tidal effects, pack ice and freezing inside the shoreline pond. Wave height is assumed to be 6.0 m and this is the basis for sizing and pricing the armour stone. Armour stone has a maximum size of 10 tonnes that will need to placed on the ocean side at a shallower slope than the natural angle of repose of the material which implies increased construction cost that has been considered in the CCE. The core material is a uniformly sized material to allow maximum water permeability through the breakwater berm. This material will need to be selected and treated to meet these requirements and has been estimated accordingly.

Only preliminary topographical and bathymetric mapping of the site area was available at time of the CCE.

Electrode Supports and Protection

The structural supports and protection for electrode and cables are designed utilizing concrete to withstand the expected worst case site conditions, including freezing spray, tidal effects, and freezing inside the shoreline pond. Fibre reinforced plastic (FRP) reinforcements will be used to eliminate corrosion problems due to currents.

The CCE caries minimal cast in place concrete as most of the concrete elements will be prefabricated

Relatively small quantities of cast in place concrete will be required to encase electrical ducts element at both Pond electrode locations. These quantities are assumed to be mixed and placed using portable mixers using hand fed bagged concrete

3.3.7.3 Electrical Equipment

The electrical work for the pond electrodes includes the following:

- The threading of the electrodes from the surface through a 300mm protective concrete pipe reaching 1,5m below the low water level and depositing the electrode in a submerged PVC saddle supported on concrete blocks with the help of divers.
- Anotec electrodes type 4884H priced through budget quotes from specialized suppliers, Anotec
- Electrode main feeder cable, of 750 mm^2, Single core XLPE electrical cable at each location, estimated using load current bearing capacity and layout drawings
- 1 set of Telecommunication Service Panel and Optical Distribution Panel
- 1 set each of Service panel, Protection and Monitoring panel, 48 VDC battery chargers, 48 VDC battery bank, 120-240 V AC distribution panel, DC distribution panel, lighting control panel.
- The Electrode main feeder cable shall be laid in cable trench
- A small control building for which a provision has been included in the CCE

3.3.7.4 Other Works

Fencing

The site will be fenced on all sides by chain link fencing to prevent public access to the pond. The fencing in contact with the berm needs to be a special isolated fence comprised of timber posts with isolators between each panel of chain link fence

4 VOLUME IV - COMPONENT 4 DETAILED ESTIMATE ASSUMPTIONS

4.1 INTRODUCTION

The Component 4 estimate assumptions were developed by the SLI transmission lines Group and are included in document 505573-4600-33RA-0002 entitled GATE 3 ESTIMATE ASSUMPTIONS Component 4 - Transmission Lines. This document is presented herein as an integral part of the CCE.

4.2 DOCUMENT 505573-4600-33RA-0002-GATE 3 ESTIMATE ASSUMPTIONS COMPONENT 4 – TRANSMISSION LINES

See below.

LOWER CHURCHILL PROJECT

GATE 3 ESTIMATE ASSUMPTIONS

Component 4 - Transmission Lines

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Revision					Remarks
N°	By	Ver.	Appr.	Date	
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1 ABBREVIATIONS

NE-LCP – Nalcor Energy - Lower Churchill Project

SLI – SNC Lavalin Inc.

EPCM – Engineering Procurement and Construction Management

HVac – High Voltage Alternating Current

HVdc – High Voltage Direct Current

EIA – Environmental Impact Assessment

MF – Muskrat Falls

CF – Churchill Falls

SP – Soldier's Pond

GI – Gull Island

ROW – Right Of Way

PMPC – Project Management / Project Controls

DWSM – Dual Window Single Mode

2 REFERENCES

This document is based on:

- LCP-PT-ED-0000-EN-PH-0021-01 – "Design Philosophy for HVac Transmission Lines".
- LCP-PT-ED-0000-EN-PH-0022-01 – "Design Philosophy for HVdc Transmission Lines".
- MFA-PT-ED-6200-TL-DC-0001-01 – "Meteorological Loading 315 kV Transmission Lines Muskrat Falls to Churchill Falls".

- MFA-PT-ED-6200-TL-DC-0002-01 – "Overhead Transmission Meteorological Loading for the Labrador - Island Transmission Link".
- LCP-PT-ED-0000-EN-RP-0001-O1 – "Basis of Design".
- File No. TF1116574 – "315 kV HVac Transmission Line Foundations, Muskrat Falls to Churchill Falls: Geotechnical Design Parameters"
- 505573-361A-4ZEC-0001 – "315 kV HVac Route Selection Criteria"
- 505573-361B-44ER-0001 – "315 kV HVac Geotechnical Baseline"
- 505573-361B-43EC-0001 – "315 kV HVac Tower Design Criteria"
- 505573-361B-42EC-0001 – "315 kV HVac Foundation Design Criteria"
- 505573-462B-43ER-0001 – "315 kV HVac and 350 kV HVdc Cascading Assumptions"
- 505573-462C-4ZEC-0008 – "350 kV HVdc Line Design Criteria"
- 505573-462B-43EC-0001 – "350 kV HVdc Tower Design Criteria"
- 505573-462B-44ER-0001 – "350 kV HVdc Geotechnical Baseline"
- 505573-462B-43ER-0002 – "Assessment of Installing the HVdc Ground Return on a Separate Wood Pole Line"
- 505573-462B-43ER-0002 – "350 kV HVdc Foundation Design Criteria"
- 505573-462A-4ZEC-0002 – "Electrode Lines – Route Selection Criteria"
- 505573-463C-4ZEC-0001 – "Electrode Lines on Wood poles – Design Criteria"
- 505573-362C-4ZEC-0001 – "25 kV construction Power Line & 138 kV tap Design Criteria"

3 MAJOR EXCLUSION PRIOR TO ENVIRONMENTAL ASSESSMENT APPROVAL

This estimate does not include the costs associated with:

- Consultation: Nalcor Energy is responsible for consultations and open houses. SNC Lavalin Inc. (SLI) will provide technical support to Nalcor.

- Environmental: Nalcor is responsible for environmental permits. SLI will provide engineering support to Nalcor.
- Regulatory: Nalcor is responsible for all costs associated with the regulatory process. SLI will provide engineering support to Nalcor.
- Land: Nalcor is responsible for land negotiations and easement acquisitions.

4 TRANSMISSION LINE GENERAL SCOPE OF WORK

The LCP line project includes:

- The Engineering, Procurement, and Construction Management (EPCM) of two new 315 kV single circuit HVac transmission lines, each approximately 250 km in length. The south transmission line and the north transmission line between Muskrat Falls (MF) and Churchill Falls (CF) consider a 50 m Right of Way (ROW) each. A 50 m distance between centerlines will be used when the lines are parallel to one another. See section 4.1 of this document for the outline of engineering assumptions for the HVdc line.
- The EPCM of a new ± 350 kV bi-pole HVdc transmission line, approximately 1100 km in length. The future HVdc line from MF to SP considers a 60 m ROW; see section 4.2 of this document for the outline of engineering assumptions for the HVdc line.
- The EPCM of approximately 35 km of electrode lines on wood pole structures, see section 4.3 of this document for the outline of engineering assumptions for the electrode line.
- The EPCM of approximately 17 km of 25 kV distribution lines to supply power to the accommodation complex and camp. See section 4.4 of this document for the outline of engineering assumptions for the 25 kV construction power line.
- The EPCM for the modification to six existing transmission lines to accommodate the new ± 350 kV HVdc crossings. See section 4.5 of this document for the outline of engineering assumptions for the HVdc crossings.

- The EPCM for the re-termination of four 230 kV transmission lines into the future Soldier's Pond Substation. See section 4.6 of this document for the outline of engineering assumptions for the re-termination of the 230 kV transmission lines.
- The EPCM of approximately 600 m of two new single circuit 735 kV HVac transmission lines at the Churchill Falls Substation. See section 4.7 of this document for the outline of engineering assumptions for the 735 kV HVac transmission line.
- The EPCM of approximately 500 m of four new 315 kV HVac transmission lines to interconnect the Muskrat Falls Powerhouse to the new Switchyard. See section 4.8 of this document for the outline of engineering assumptions for the 315 kV HVac interconnection.

5 ENGINEERING ASSUMPTIONS

5.1 315 KV HVac TRANSMISSION LINE

5.1.1 Tower Design and Testing

- The 315 kV lattice steel tower families are developed specifically for the LCP project. The tower design criteria is based on criteria document "315 kV HVac Tower Design Criteria (SLI No. 505573-361B-43EC-0001)" and "315 kV HVac and 350 kV HVdc Cascading Assumptions (SLI No. 505573-462B-43ER-0001)".
- The two transmission lines are estimated based on the 35 mm radial ice loading zone.
- OPGW dead-ending on suspension structures is considered.
- All tower weights are estimated based on the preliminary tower designs completed by SLI.
- The design of the tower family and associated foundations are engineered by SLI. The tower detailing and the prototype testing will be by the supplier.
- Tower Types A and B are guyed mast structures and tower types C, D and E are rigid self supporting towers with four legs.
- No long-span or special crossing structures have been considered.

- Phase transposition is assumed to take place near existing dead-end structures using additional insulators and hardware to facilitate the transposition. This estimate assumes that phase transposition will occur at three locations along each HVac line.
- Tower testing is included for the A and D type towers only. Tower types B, C and E will not be tested.

5.1.2 Hardware Assemblies and Testing

- The creation of 315 kV hardware assembly design requirement drawings for the tower family is included (i.e. assemblies for conductors, counterpoise, OHSW, and OPGW, etc.).
- All 315 kV assemblies will use reduced-corona hardware.
- Hardware assembly prototype testing is included, along with test witnessing by SLI.
- Third party inspection during manufacturing has been included.

5.1.3 Centerline / Layout

- This estimate is based on the center line and layout on the route map drawings (SLI Doc. 505573-361A-4ZDD-0022-PA).
- The centreline for the estimate has been established based on document "315 kV HVac Route Selection Criteria (SLI Doc. 505573-361A-4ZEC-0001)".
- It is assumed that there is some flexibility to modify the centerline and PI (Point of Inflection) location in an effort to optimize the line layout.
- The survey data used for the preliminary layout was provided by Nalcor and based on 2010 LiDAR survey and orthophotography.
- The layout was completed based on document "315 kV HVac Line Design Criteria (SLI Doc. 505573-361C-4ZEC-0001)" as well as 40% completion of detailed engineering.

5.1.4 Quantities of Towers and Foundation Steel

- The quantity of towers estimated includes all basic/standard towers, body extensions, and leg/mast extensions, including nuts, bolts, plates, washers, and attachment vangs, as per the design drawings, specifications and other contract documents.
- The quantity of towers is based on preliminary (40% completed engineering) tower spotting using PLS-CADD.
- The material extras for spares, un-foreseen re-routes, structure additions, design changes, etc. are not included.
- Four types of foundations are considered:
  - Type 1 for granular soil with a net allowable bearing capacity of 250 kPa,
  - Type 2 for granular soil with a net allowable bearing capacity of 100 kPa,
  - Type 3 for rock foundations, and
  - Type 4 for a deep foundation using screw piles or driven steel piles.
- Two types of materials have been defined in the "315 kV HVac Geotechnical Baseline (SLI No. 505573-361B-44ER-0001)" as acceptable for the backfill to be installed for the steel grillage for the type 1 and type 2 foundations.
- Four types of guy wire anchors are defined:
  - Soil anchors for granular soil with a net allowable bearing capacity of 250 kPa,
  - Soil anchors for granular soil with a net allowable bearing capacity of 100 kPa,
  - Rock anchors, and
  - Steel pile anchors for weak soil conditions.
- The quantities of guy wire anchors are estimated based on the structure quantities from the preliminary design and layout. The guy wire length is assumed to be 40 m per guy, four guys per tower.
- The foundation types will be derived from the results of the geotechnical assessment completed by AMEC entitled "315 kV HVac Transmission Line Foundations, Muskrat Falls to Churchill

Falls: Geotechnical Design Parameters" and the "315 kV HVac Geotechnical Baseline (SLI No. 505573-361B-44ER-0001)".

5.1.5 Quantities for Conductor, OHSW and OPGW Hardware Assemblies

- The quantity of hardware assemblies is based on total tower quantities, from the preliminary centerline and layout.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.1.6 Quantities of Insulators

- The quantities of insulators are based on the total tower quantities derived from the preliminary centerline and layout.
- Porcelain or toughened glass insulators are assumed to be acceptable in this estimate. The quantity and strength of insulators per tower is based on the document "315 kV HVac Line Design Criteria (SLI Doc. 505573 - 361C - 4ZEC - 0001)".
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.1.7 Quantities of Conductor and OHSW / OPGW

- Two-bundle, 795 kcmil, 26/7 ACSR "Drake", will be used as the phase and jumper conductor. The quantity is based on the linear line length, with an additional 4% included for sag and wastage.
- One OHSW will be installed using ½" grade 220 steel. The quantity is based on the linear line length, with an additional 2% included for sag and wastage.
- One OPGW will be installed using fibre type DWSM based on standard ITU-T6.654. The quantity is based on the linear line length, with an additional 5% extra included for sag, down leads, splices, and wastage.

- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.1.8 Quantities of Conductor Accessories

- Spacer dampers are assumed to be installed every 60 m, per phase, and are assumed to be adequate for the damping requirements of the line.
- 100% of the line has been considered for compression type splices, dead-ends and jumper connectors.
- Conductor splices are assumed to be installed approximately every 3000 m.
- Each 315 kV HVac line will have approximately five structures that will require the use of counter weights (25 kg each), considering four weights per phase. The quantities are based on the preliminary layout.
- Rigid spacers will be used on jumper conductors, assuming 6 spacers, per phase, per jumper.
- One jumper assembly per phase, per tower type C, D and E is considered.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.
- Three aerial marker cones (1 white and 2 orange) will be included per crossing. They will be installed on the appropriate wire for each respective crossing. The estimate considers 35 crossings for each 315 kV HVac Line (20 highway crossings, 5 transmission line crossings, 10 river crossings).

5.1.9 Quantities of OPGW Accessories

- Two spiral vibration dampers per structure will be used on the OPGW as per the tower quantity estimation.
- OPGW splice boxes will be installed approximately every 6000 m and on the first structure outside of each substation.

- The OPGW down lead clamps will be installed every 3 m.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.1.10 Quantities of OHSW Accessories

- Two spiral vibration dampers per structure will be used on the OHSW as per the tower quantity estimation.
- The bonding conductor is assumed to be #2 ACSR "Sparrow" and the length is estimated to be 1.5 m for suspension towers and 2.0 m for dead-end structures.
- Splices will be installed approximately every 3000 m on the OHSW.
- 100% of the line has been considered for compression type splices.
- Bird diverters are not required and not included in the estimate.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.1.11 Counterpoise

- The counterpoise length is estimated as the linear line length plus an additional 2% for wastage.
- A bonding conductor of 10 m, the same material as the counterpoise, is included per tower.

5.1.12 Quantities of Miscellaneous Hardware and Material

- The hardware required for tower grounding is included.
- Aerial structure number boards will be installed on every 10th structure.
- One structure number tag will be installed on every structure.
- Two danger signs will be installed on every structure.

- Six aerial line number boards will be included per line, and will be installed on the first structure outside each substation.
- Phasing signs will be installed on every 10th structure.

5.1.13 Geotechnical Investigations

- The document "315 kV HVac Geotechnical Baseline (SLI No. 505573-361B-44ER-0001)" includes:
    - The geotechnical report based on references from past soil investigations.
    - Assessment of the foundation types to be used for each of the new 315 kV HVac towers.
    - The selection criteria for the design parameters of soil and rock for each of the foundation types (1, 2, 3 and 4).
    - The detail of the additional geotechnical investigations necessary to confirm the selection of the foundation types, including the location, type of investigation, and the estimated cost for those additional soil tests.

5.1.14 Electrical Effects / Considerations

- The transmission line ROW is 50 m, which is assumed to be within the acceptable limits for:
    - Edge of right of way electric / magnetic field levels,
    - Edge of right of way audible noise levels, and
    - Edge of right of way radio and television interference.

5.1.15 Distribution and Transmission Line Conflicts

- Crossing line modifications for the HVac lines are not included in this estimate.

5.2 ± 350 kV HVdc TRANSMISSION LINE

5.2.1 Tower Design and Testing

- The ± 350 kV lattice steel tower families are developed specifically for the LCP project. The tower design criteria is based on criteria document "350 kV HVdc Tower Design Criteria (SLI Doc.505573-462B-43EC-0001)" and "315 kV HVac and 350 kV HVdc Cascading Assumptions (SLI No. 505573-462B-43ER-0001)".
- These steel towers will be designed for the combination of the meteorological loading zones (50 mm ice, Alpine [135 mm rime ice] and 75 mm ice); the different pollution levels (Inland and Coastal) and with and without electrode conductors, giving a total of ten different tower families.
- OPGW dead-ending on suspension structures is considered.
- The majority of towers used in the Labrador segment will be designed and constructed to support the electrode conductors from the Muskrat Falls substation to the grounding site at L'Anse-au-Diable.
- The design of the tower family and its foundations are to be done by SLI. Tower detailing and the prototype testing are by the supplier.
- Suspension tower types A and B are guyed mast structures, dead-end tower types C, D and E are rigid self supporting four leg towers.
- Neither long-span, nor special crossing structures have been considered.
- All tower weights are estimated based on tower designs by SLI for tower types A and D of the F1, F2, F4, F6 and F7 families. These ten towers represent more than 85% of the towers for the 350 kV HVdc line.
- The geometry and weights of the remaining tower families and types were extrapolated based on the design of those ten tower types and based on the relative weights of the 315 kV HVac tower weights already defined for tower types A, B, C, D and E.
- Tower testing is included for six towers (four suspension towers and two dead-end towers); detailing is considered for twenty towers.

5.2.2 Hardware Assemblies and Testing

- The estimate includes the creation of the ± 350 kV hardware assembly design requirement drawings for the tower family (i.e. assemblies for conductors, electrode, OPGW, etc.).
- All pole conductor assemblies will use reduced-corona hardware.
- The hardware assembly prototype testing is included, along with witness testing by SLI.
- Third party inspection during manufacturing has been included.

5.2.3 Centerline / Layout

- The estimate is based on the center line and layout shown on the alignment sheet drawings (SLI Doc. 505573-462A-4ZDD-0001, 0002, 0003, 0004, 0005, and 0016).
- It is assumed that there is flexibility to modify the centerline and PI location in an effort to optimize the line layout.
- The survey data used for preliminary layout was provided by Nalcor and based on 2010 LiDAR survey and orthophotography.
- The centreline for the estimate has been established based on the document "± 350 kV HVdc Muskrat Falls to Soldier's Pond Transmission Line – Route Selection Design Criteria (SLI Doc. 505573-462A-4ZEC-0001)".
- The layout was completed based on the document "350 kV HVdc Line Design Criteria (SLI Doc. 505573-462C-4ZEC-0008)".

5.2.4 Quantities of Towers and Foundation Steel

- The quantity of towers estimated includes all basic / standard towers, body extensions, and leg/mast extensions, including nuts, bolts, plates, washers, and attachment vangs, as per the design drawings, specifications, and other contract documents.
- The quantities of steel towers are based on preliminary (40% complete engineering) tower spotting using PLS-CADD.

- Material extras for spares, un-foreseen re-routeing requirements, structure additions, design changes, etc. are not included.
- The quantities of guy wire anchors are estimated based on the preliminary design and layout. Guy wire length is assumed to be 40 m per guy, four guys per steel tower.
- Four types of foundations are defined:
    - Type 1 for granular soil with a net allowable bearing capacity of 250 kPa,
    - Type 2 for granular soil with a net allowable bearing capacity of 100 kPa,
    - Type 3 for rock foundations, and
    - Type 4 for a deep foundation using screw piles or driven steel piles.
- Two types of material have been defined in the "350 kV HVdc Geotechnical Baseline (SLI No. 505573-462B-44ER-0001)" as acceptable for the backfill to be installed for the steel grillages of type 1 and type 2 foundations.
- Four types of guy wire anchors are defined:
    - Soil anchors for granular soil with a net allowable bearing capacity of 250 kPa,
    - Soil anchors for granular soil with a net allowable bearing capacity of 100 kPa,
    - Rock anchors, and
    - Steel pile anchors for weak soil conditions.
- The quantity and weight of each of the foundation types are based on the relative quantities and weights of the foundation types for each tower type as defined for the HVac Lines.

5.2.5 Quantities for Conductor and OPGW Hardware Assemblies

- The quantities of hardware assemblies are based on the total tower structure quantities from the preliminary centerline/layout.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.2.6 Quantities of Insulators

- The quantities of insulators are based on total structure quantities, from the preliminary centerline/layout.
- Porcelain or toughened glass insulators are assumed to be acceptable in this estimate. The quantity and strength of insulators per structure is based on the document "350 kV HVdc Line Design Criteria (SLI Doc.505573-462C-4ZEC-0008)".
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.2.7 Quantities of Electrode conductor

- Two types of electrode conductor are used depending on the loading zone:
  - Single 1192.5 kcmil ACSR "Grackle" is considered for the 50 mm and 75 mm ice load zones, and
  - Single 1510.5 kcmil ACSR "Parrot" is considered for the 135 mm ice Alpine load zone.
- The quantity is based on the linear line length, with an additional 4% included for sag and wastage.

5.2.8 Quantities of Conductor and OPGW

- A single 3640 kcmil, 91/0 Strand, Aluminum Stranded Conductor (ASC) is used as the pole and jumper conductor. The quantity is based on the linear line length, with an additional 4% included for sag and wastage.
- Three types of OPGW cable we used depending on the loading zone:
  - 14.5 mm, 24 Fibre, 140 kN UTS - for the 50 mm ice load zone,
  - 15.5 mm, 24 Fibre, 177 kN UTS - for the 75 mm ice load zone, and
  - 20.6 mm, 24 Fibre, 277 kN UTS - for the 135 mm ice Alpine load zone.

- Each quantity is based on the linear line length, with an additional 5% extra included for sag, down leads, splices, and wastage.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.
- There is no OHSW on the HVdc line.

5.2.9 Quantities of Conductor Accessories

- The quantity of conductor accessories is based on total structure quantities from the preliminary centerline / layout.
- 100% of the line has been considered for compression type splices, dead-ends and jumper connectors.
- Splices will be installed approximately every 1200 m on conductor.
- One jumper assembly, per pole, per tower type C, D and E is considered.
- Preliminary layout has determined that the ± 350 kV HVdc line will have approximately 20 structures that will require the use of counter weights (25 kg each), four weights per pole.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.
- Three aerial marker cones (1 white and 2 orange) will be included per crossing. They will be installed on the appropriate wire for each respective crossing. There are 71 crossings (20 highways, 18 transmission line crossings, 6 water crossings, and 27 distribution crossings) included.

5.2.10 Quantities of OPGW Accessories

- Two spiral vibration dampers, per structure, will be used on the OPGW as per the tower quantity estimation.

- OPGW splice boxes will be installed approximately every 6000 m and on the first structure outside of each substation.
- OPGW down lead clamps have been assumed to be required every 3 m.
- Bird diverters are not required, and not included in the estimate.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.2.11 Counterpoise

- The counterpoise length is estimated as the linear line length plus an additional 2% for wastage.
- A bonding conductor of 10 m, the same material as the counterpoise, will be included per tower.

5.2.12 Quantities of Miscellaneous Hardware and Material

- The hardware required for tower grounding is included.
- Aerial structure number boards will be installed on every 10th structure.
- One structure number tag will be installed on every structure.
- Two danger signs will be installed on every structure.
- Ten aerial line number boards will be included per line, and will be installed on the first structure outside each substation.

5.2.13 Geotechnical Investigations

- The document "350 kV HVdc Geotechnical Baseline (SLI No. 505573-462B-44ER-0001)" includes:
    - The geotechnical report references from past soil investigations,
    - The assessment of foundation types to be used for each of the new ±350 kV HVdc towers,

- The selection criteria for the design parameters of soil and rock for each of the foundation types (1, 2, 3 and 4), and
- The detail of the additional geotechnical investigations necessary to confirm the selection of the foundation types, including the location, type of investigation, and estimated cost for those additional soil tests.

5.2.14 Electrical Effects / Considerations

- The transmission line ROW for the ± 350 kV HVdc line is 60 m, which is assumed to be within the acceptable limits for:
  - Edge of right of way electric / magnetic field levels,
  - Edge of right of way audible noise levels, and
  - Edge of right of way radio and television interference.

5.2.15 Distribution and Transmission Line Conflicts

- The estimate assumes that dead-end structures are required between and on either side of existing power lines when the HVdc line crosses two or more existing power lines. Based on this, six transmission line conflicts have been identified that require modifications. Details of the engineering assumptions made for the modification to these six transmission lines is in Section 4.5 of this document.

5.3 ELECTRODE LINES ON WOOD POLES

5.3.1 Electrode Line Structures

- The electrode lines will be routed to two facilities for the electrode grounding, one at L'Anse-au-Diable and another at Dowden's Point.
- Tangent and angle structures will be single pole direct embedded, Class H1, wood poles, with a horizontal V-brace configuration.

- Dead-end structures will be Class H1, guyed, two pole H-frame structures.
- H1 wood pole sizing will range from 12.3 m (40 ft) to a maximum of 18.5 m (60 ft) in length.
- No long-span or special crossing structure is included.

5.3.2 Hardware Assemblies

- The Electrode line hardware assemblies used for the wood pole sections will be similar to the hardware specified in section 4.1.2 of this document.

5.3.3 Centerline / Layout

- The centreline for the estimate has been established based on the document "Electrode Lines – Route Selection Criteria (SLI Doc. 505573-462A-4ZEC-0002)".
- The layout was completed based on the document "Electrode Lines on Wood Pole – Design Criteria (SLI Doc. 505573-463C-4ZEC-0001)".
- It is assumed that there is flexibility to modify the centerline and PI location in an effort to optimize the line layout.
- The survey data used for preliminary layout was based on available orthophotography; no LiDAR has been used for the electrode line routes.

5.3.4 Quantities of Poles and Foundations

- The quantity of wood poles is based on preliminary PLS-CADD spotting.
- Wood poles will be direct embedded using standard setting methods.
- The quantities of guy wire and anchors are estimated based on the preliminary design and layout. The guy wire length is assumed to be 30 m per guy, four guys per wood pole dead-end.
- Material extras for spares, un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.3.5 Quantities for Conductor Hardware Assemblies

- The quantity of hardware assemblies is based on total wood pole structure quantities from the preliminary centerline/layout.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.3.6 Quantities of Insulators

- The quantity of insulators is based on total structure quantities, from the preliminary centerline/layout.
- Porcelain or toughened glass insulators are assumed to be acceptable in this estimate. The quantity and strength of insulators per structure is based on the document "Electrode Lines on Wood Pole – Design Criteria (SLI Doc. No. 505573-463C-4ZEC-0001)".
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.3.7 Quantities of Electrode conductor

- Both the Labrador and Island Electrode wood poles lines will use single 1192.5 kcmil, ACSR "Grackle", as the conductor.
- The quantity is based on the linear line length, with an additional 4% included for sag and wastage.

5.3.8 Quantities of Electrode Conductor Accessories

- 100% of the electrode lines have considered compression type splices, dead-ends and jumper connectors.

- Stockbridge dampers will be used, as per the manufacturer's recommendation, for each span along the line.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.
- There is neither OHSW nor OPGW on the electrode lines.

5.3.9 Quantities of Miscellaneous Hardware and Material

- Aerial structure number boards will be installed on every 25th structure of the electrode line.
- One structure number tag will be installed on every structure.
- One danger sign will be installed on every structure.
- Aerial line number boards will be included, and will be installed on the first and last structure.

5.3.10 Geotechnical Investigations

- There will be no geotechnical investigation for the wood pole lines.

5.3.11 Electrical Effects / Considerations

Both electrode lines are considered as distribution lines, therefore, as per Newfoundland Hydro standard D1-11-66-R1, the ROW will be 9 m, which is assumed to be within the acceptable limits for:

  - Edge of right of way electric / magnetic field levels,
  - Edge of right of way audible noise levels, and
  - Edge of right of way radio and television interference.

5.4 25 kV CONSTRUCTION POWER

5.4.1 Structure design

- All construction power structures will be Newfoundland Hydro standard 25 kV wood pole structures.
- Two custom structures will be designed to accommodate a long-span river crossing.
- Standard setting methods will be used for each structure.

5.4.2 Hardware Assemblies

- All construction power hardware assemblies will be Newfoundland Hydro standard 25 kV assemblies.
- Custom hardware will be designed to accommodate the river crossing.

5.4.3 Centerline / Layout

- The construction power centerline has been established to follow the existing north road and the future south access road to the accommodation complex for the majority of the route.
- Part of the 25 kV center line will also follow the existing 315 kV HVac line to minimize the tree clearing required.
- It is assumed that there is flexibility to modify the centerline and PI location in an effort to optimize the line layout.
- The survey data used for preliminary layout was provided by Nalcor and based on 2010 LiDAR survey and orthophotography.

5.4.4 Quantities of Structures

- The quantities of wood pole structures are based on preliminary (40% complete engineering) spotting.

- Material extras for spares, un-foreseen re-routes, structure additions, design changes, etc. are not included.
- The quantities of guy wire and anchors are estimated based on the preliminary design and layout. Guy wire length is assumed to be 20 m per guy, four guys per dead end structure.

5.4.5 Quantities for Conductor and ADSS Hardware Assemblies

- The quantities of conductor and ADSS hardware assemblies are based on the total structure quantities from the preliminary centerline/layout.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.4.6 Quantities of Insulators

- Quantity of insulators is based on total structure quantities, from the preliminary centerline/layout.
- The quantity and strength of insulators per structure will be based on Newfoundland Hydro distribution standards.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.4.7 Quantities of Conductor and OPGW

- A single 477 Aluminum Stranded Conductor (ASC) "Cosmos" will be used as the phase and jumper conductor. The quantity is based on the linear line length, with an additional 4% included for sag and wastage.
- 4/0 Aluminum Alloy Stranded Conductor (AASC) "Oxlip" will be used as the neutral wire. The quantity is based on the linear line length, with an additional 4% included for sag and wastage.

- Two ADSS cables, 48 fibres each, shall be installed and used for telecommunication. The quantity is based on the linear line length, with an additional 5% extra included for sag, down leads, splices, and wastage.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.4.8 Quantities of Conductor Accessories

- 100% of the line has been considered for compression type splices, dead-ends and jumper connectors.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.
- Three aerial marker cones (1 white and 2 orange) will be included for the river crossing.

5.4.9 Quantities of ADSS Accessories

- ADSS splice boxes will be installed approximately every 2000 m and on the first structure outside of the substation, as well as at required tap points.
- ADSS down lead clamps have been assumed to be required every 3 m.
- Bird diverters are not required, and are not included in the estimate.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.4.10 Grounding

- Ground rods will be installed at each guyed structure and/or at an interval of 3 structures per kilometre.

5.4.11 Quantities of Miscellaneous Hardware and Material

- One structure number tag will be installed on every structure.

5.4.12 Electrical Effects / Considerations

- The ROW for the 25 kV construction power line is 7.5 m wide, as per the Newfoundland Hydro Standard.

5.4.13 Distribution and Transmission Line Conflicts

- The proposed 25 kV construction power line will have to cross one existing distribution line.

5.5 MODIFICATIONS TO EXISTING LINES FOR HVdc CROSSINGS

The new ± 350 kV HVdc transmission line will only cross one existing transmission line per span. Six existing transmission lines will need alignment modifications to accommodate the new ± 350 kV HVdc transmission line structures. See Table 1 for the list of lines that will need to be modified:

Table 1: Existing Lines to be modified

Modification Number	Line to be modified	kV level	Structure Type
1	TL251	69 kV	Wood Pole
2	TL232	230 kV	Wood Pole
3	TL204	230 kV	Single Circuit Tower
4	NFP	138 kV	Wood Pole
5	NFP	138 kV	Wood Pole
6	TL201	230 kV	Wood Pole

- Any change to an existing transmission line will utilize like structures and assemblies to maintain consistency.

5.5.1 Structure Design

- The tower weights are estimated based on weights provided in NALCOR Dwg. No. 220–T–222.
- The foundations are assumed to be grillage type foundations for each tower.
- All wood pole structures will be Class 1 poles ranging from 15.4 m (50 ft) to 24.6 m (80 ft) in length.
- Wood poles will be direct embedded with the addition of guying, if required.
- No long-span or special crossing structures are included.

5.5.2 Centerline / Layout

- The center line and layout proposed by SLI was selected to minimize the cost and impact to the existing lines.
- The survey data used for the preliminary layout was provided by Nalcor and based on 2010 LiDAR survey and orthophotography.

5.5.3 Quantities of Structures and Foundation Steel

- The quantity of towers/wood poles estimated includes all standard structures, body extensions, and leg/mast extensions, including nuts, bolts, plates, washers, and attachment vangs, as per the design drawings, specifications and other contract documents.
- The quantities of steel towers/wood poles are based on preliminary (40% complete) design.
- Material extras for spares, un-foreseen re-routes, structure additions, design changes, etc. are not included.
- The quantities for the steel grillage are estimated based on the preliminary design and layout.

5.5.4 Quantities for Conductor Hardware Assemblies

- The quantities of hardware assemblies are based on total structure quantities from the preliminary centerline/layout.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.5.5 Quantities of Insulators

- The quantities of insulators are based on total structure quantities from the preliminary centerline/layout.
- The strength and type of insulator selected for each line is listed in Table 2.
- Porcelain or toughened glass insulators are assumed to be acceptable in the estimate. The quantity and strength of the insulators will match that of the existing line.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

Table 2 : Quantity of Insulators for each line to be modified

Modification No.	Line to be modified	kV level	Insulator Type	Insulator Quantity
1	TL251	69 kV	Tangent (line Post)	6
			DE (6 bells – 111 kN)	72
			Jumper (line Post)	6
2	TL232	230 kV	Tangent (14 bells – 111 kN)	84
			DE (16 bells – 111 kN)	576
			Jumper (14 bells 111 kN)	126
3	TL204	230 kV	DE (16 bells – 111 kN)	192
			Jumper (14 bells 111 kN)	42
4	NFP	138 kV	DE (9 bells – 111 kN)	324
			Jumper (8 bells – 111 kN)	72
5	NFP	138 kV	DE (9 bells – 111 kN)	324
			Jumper (8 bells – 111 kN)	72
6	TL201	230 kV	Tangent (14 bells – 111 kN)	42
			DE (16 bells – 111 kN)	576
			Jumper (14 bells 111 kN)	126

5.5.6 Quantities of Conductor and OHSW

- The quantity of conductor and OHSW is based on the linear line length, with an additional 4% included for sag and wastage.
- Table 3 outlines the existing types of conductor and OHSW required for each line modification.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

Table 3: Existing Conductor and OHSW Type

Modification No.	Line to be modified	kV level	Conductor / OHSW Type
1	TL251	69 kV	Single 266 Partridge ACSR
			No OHSW
2	TL232	230 kV	Single 1192.5 Grackle ACSR
			No OHSW

3	TL204	230 kV	Single 1192.5 Grackle ACSR ½" Steel Grade 220 OHSW
4	NFP	138 kV	Single 397 Ibis ACSR No OHSW
5	NFP	138 kV	Single 397 Ibis ACSR No OHSW
6	TL201	230 kV	1192.5 Grackle ACSR No OHSW

5.5.7 Quantities of Conductor Accessories

- It is assumed that compression type splices, dead-ends and jumper connectors will be used for each line modification.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.5.8 Quantities of Miscellaneous Hardware and Material

- The hardware required for structure grounding is included.
- One structure number tag will be installed on every structure.
- Two danger signs will be installed on every structure.

5.5.9 Geotechnical Investigations

- The cost of soil compaction testing is included.

5.6 230 kV RE-TERMINATIONS AT THE FUTURE SOLDIER'S POND SUBSTATION

There are four existing transmission lines that will need to be reconfigured at the future Soldier's Pond substation site to accommodate the new ± 350 kV HVdc transmission line (See Drawing No. ILK-SW-CD-4500-CV-PL-0001-01). See Table 4 for the list of lines that will need to be reconfigured:

Table 4: Lines to be reconfigured at Soldier's Pond

Line No.	kV level	Structure Types
TL201	230 kV	Wood Poles
TL217	230 kV	Single Circuit Towers
TL218	230 kV	Single Circuit Towers
TL242	230 kV	Wood Poles

- Any change to these existing transmission lines will utilize like structures and assemblies to maintain consistency.

5.6.1 Structure Design

- The estimated tower weights are estimated based on the weights provided in Nalcor Dwg. No. 220-T-222.
- The foundations are assumed to be grillage type foundations for each tower.
- All wood poles will be Class H1 poles ranging from 18.5 m (60 ft) to 24.6 m (80 ft) in length.
- The wood poles will be direct embedded with the addition of guying, if required.
- No long-span or special crossing structures have been considered.

5.6.2 Hardware Assemblies

- The hardware assemblies will be designed to match those of the existing transmission line assemblies in strength and function.

5.6.3 Engineering Studies and Front End Engineering

- Geotechnical investigation is not included.

5.6.4 Centerline / Layout

- The centerline and layout has been established to accommodate the new Soldier's Pond substation while minimizing the cost and impact to the existing transmission lines.
- It is assumed that there is flexibility to modify the centerline and PI location in an effort to optimize the line layout.
- The survey data used for preliminary layout was provided by Nalcor and based on 2010 LiDAR survey and orthophotography.

5.6.5 Quantities of Towers / Wood poles and Foundation Steel

- The quantity of structures estimated includes all standard structures, body extensions, and leg/mast extensions, including nuts, bolts, plates, washers, and attachment vangs, as per the design drawings, specifications and other contract documents.
- The quantities of steel towers are based on preliminary PLS-CADD spotting.
- Material extras for spares, un-foreseen re-routes, structure additions, design changes, etc. are not included.
- The quantities of steel grillage, guy wire and anchors are estimated based on the preliminary design and layout. The guy wire length is assumed to be 40 m per guy, four guys per steel tower.

5.6.6 Quantities for Conductor and OHSW Hardware Assemblies

- The quantity of hardware assemblies is based on total structure quantities from the preliminary centerline/layout.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.6.7 Quantities of insulators

- The quantity of insulators is based on total structure quantities from the preliminary centerline/layout.
- The tangent structure will use single "I" string insulators per phase, per tower.
- The dead-end structure will use double strain insulator sets per phase, per tower.
- Porcelain or toughened glass insulators are assumed to be acceptable. The quantity and strength of insulators will match those of the existing structures along the line to maintain consistency.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.6.8 Quantities of Conductor and OHSW

- A single 804 kcmil, Aluminum Alloy Conductor Steel Reinforced Trapezoidal Wire (AACSR / TW) will be used as the pole and jumper conductor for each circuit. The quantity is based on the linear line length, with an additional 4% included for sag and wastage.
- Two 1/2" Grade 220 OHSW, will be used on each circuit for lightning protection. The quantity is based on the linear line length, with an additional 4% included for sag and wastage.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.6.9 Quantities of Conductor Accessories

- 100% of the line has been considered for compression type splices, dead-ends and jumper connectors.
- Conductor splices will be installed approximately every 1800 m.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.6.10 Quantities of OHSW Accessories

- Dampers are assumed to be Stockbridge type, two per structure.
- Bird diverters will not be required, and are not included in the estimate.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.6.11 Quantities of Miscellaneous Hardware and Material

- The hardware required for structure grounding is included.
- Aerial structure number boards will be installed on the first structure outside of the substation.
- One structure number tag will be installed on every structure.
- Two danger signs will be installed on every structure.
- Aerial line number boards will be included per line, and will be installed on the first structure outside of the substation.

5.6.12 Electrical Effects / Considerations

- The 230 kV re-terminations will maintain a ROW width that will match that of the existing 230 kV line.

5.7 735 kV HVac INTERCONNECTION

Two new 0.6 km of 735 kV HVac transmission lines will be required between the existing 735 kV Churchill Falls switchyard and the future 735 kV switchyard extension (See drawing No. MFA-SW-CD-4100-CV-PL-0001-01).

5.7.1 Structure Design

- For estimating purposes, SLI has used the tower types and weights provided in document created by HATCH, titled "AC1020 – Tower Type Selection, 735 kV".
- Tangent towers shall be tower type "NFGA", a guyed V lattice tower.
- Dead-end towers shall be tower type "NFBL", a rigid self supporting tower with four legs.

5.7.2 Hardware Assemblies

- The hardware assemblies will match those of the existing 735 kV transmission lines.
- The tangent towers shall have two double "I" string insulators and one "V" string insulator per tower.
- Dead-end towers shall have four strain insulator strings, per phase, per tower.
- Jumpers shall be "V" string insulators.

5.7.3 Centerline / Layout

- This estimate is based on the most efficient center line connection between the future addition to the existing 735 kV Churchill Falls switchyard and the future 735 kV / 315 kV Churchill Falls Switchyard (SLI Doc. No. 505573-480B-41DD-0001).
- The survey data used for the preliminary layout was provided by Nalcor and based on 2010 LiDAR survey and orthophotography.

5.7.4 Quantities of Towers and Foundation Steel

- The quantity of towers estimated includes all basic/standard towers, body extensions, and leg/mast extensions, including nuts, bolts, plates, washers, and attachment vangs, as per the design drawings, specifications and other contract documents.
- The quantity of towers is based on preliminary PLS-CADD spotting.

- Material extras for spares, un-foreseen re-routes, structure additions, design changes, etc. are not included.
- The quantities of steel grillage, guy wire, and anchors are estimated based on the preliminary design and layout. The guy wire length is assumed to be 60 m per guy, four guys per tangent tower.

5.7.5 Quantities for Conductor, OHSW and OPGW Hardware Assemblies

- The quantity of hardware assemblies is based on total tower quantities from the preliminary centerline/layout.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.7.6 Quantities of Insulators

- The quantities of insulators are based on total tower quantities from the preliminary centerline/layout.
- Porcelain or toughened glass insulators are assumed to be acceptable.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.7.7 Quantities of Conductor and OHSW / OPGW

- Four-bundle 54/19 ACSR, "Plover" will be used as the phase and jumper conductor. The quantity is based on the linear line length, with an additional 4% included for sag and wastage.
- One 9/16" grade 220 steel OHSW will be installed on each of the 735 kV lines. The quantity is based on the linear line length, with an additional 2% included for sag and wastage.

- One OPGW, 24 fibres cable, will be installed on each 735 kV line. The quantity is based on the linear line length with an additional 5% extra included for sag, down leads, splices, and wastage.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.7.8 Quantities of Conductor Accessories

- Spacer dampers for quad bundled conductor are assumed to be installed every 60 m per phase and are assumed to be adequate for the damping requirements of the line.
- 100% of the line has been considered for compression type splices, dead-ends and jumper connectors.
- Rigid spacers will be used on jumper conductors, assuming six spacers per phase, per jumper.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.7.9 Quantities of OPGW Accessories

- OPGW down lead clamps have been assumed to be required every 3 m.
- Two vibration dampers per structure will be used on the OPGW, per the tower quantity estimation.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.7.10 Quantities of OHSW Accessories

- Two vibration dampers per structure will be used on the OHSW, per the tower quantity estimation.
- 100% of the line has been considered for compression type splices.

- Bird diverters are not required, and are not included in the estimate.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.7.11 Quantities of Miscellaneous Hardware and Material

- The hardware required for tower grounding is included.
- One structure number tag will be installed on every structure.
- Two danger signs will be installed on every structure.

5.8 315 kV HVac INTERCONNECTION AT MUSKRAT FALLS SUBSTATION

Four 0.5 km, 315 kV HVac single circuit transmission lines will be required for the interconnection between the powerhouse and the switchyard at the Muskrat Falls Substation (Drawing No.MFA-SN-CD-4300-CV-PL-0001-01).

5.8.1 Tower Design and Testing

- This interconnection will utilize the same 315 kV lattice steel tower family developed specifically for the LCP project. The tower design criteria is based on the document "315 kV HVac Tower Design Criteria (SLI Doc.505573-361B-43EC-0001)".
- The four lines will use the D and E type towers to complete the interconnection for this 50 mm radial ice loading zone.
- All tower weights are estimated based on tower designs completed by SLI.

5.8.2 Hardware Assemblies and Testing

- The interconnection will use the same hardware assemblies designed for the 250 km, 315 kV HVac line from MF to CF.

- All 315 kV assemblies will use reduced-corona hardware.
- The hardware assembly prototype testing is included, along with witness testing by SLI.
- Third party inspection during manufacturing has been included.

5.8.3 Centerline/Layout

- This estimate is based on the center line and layout that was established to facilitate the spans required to connect the new powerhouse to the 315 kV switch yard at the Muskrat Falls Substation.
- It is assumed that there is flexibility to modify the centerline and PI location in an effort to optimize the line layout.
- The survey data used for preliminary layout was provided by Nalcor and based on 2010 LiDAR survey and orthophotography.

5.8.4 Quantities of Towers and Foundation Steel

- The quantity of towers estimated includes all basic/standard towers, body extensions, and leg/mast extensions, including nuts, bolts, plates, washers, and attachment vangs, as per the design drawings, specifications and other contract documents.
- The quantity of towers is based on preliminary PLS-CADD spotting.
- Material extras for spares, un-foreseen re-routes, structure additions, design changes, etc. are not included.
- Steel grillage foundations will be used for these towers.

5.8.5 Quantities for Conductor, OHSW and OHSW Hardware Assemblies

- The quantities of hardware assemblies are based on total tower quantities, from the preliminary centerline/layout.

- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.8.6 Quantities of Insulators

- The quantities of insulators are based on total tower quantities, from the preliminary centerline/layout.
- Porcelain or toughened glass insulators are assumed to be acceptable. The quantity and strength of insulators is based on the document titled: "315 kV HVac Line Design Criteria (SLI Doc.505573-361C-4ZEC-0001)".
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.8.7 Quantities of Conductor and OHSW / OPGW

- Two-bundle 795 kcmil, 26/7 ACSR "Drake", will be used as the phase and jumper conductor. The quantity is based on the linear line length, with an additional 4% included for sag and wastage.
- One OHSW will be installed on each line, using 1/2" grade 220 steel. The quantity is based on the linear line length, with an additional 2% included for sag and wastage.
- One OPGW, 24 fibre cable, will be installed on each line, the quantity is based on the linear line length with an additional 5% extra included for sag, down leads, splices, and wastage.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.8.8 Quantities of Conductor Accessories

- Spacer dampers are assumed to be installed every 60 m, per phase, and are assumed to be adequate for the damping requirements of the line.

- 100% of the line has been considered for compression type splices, dead-ends and jumper connectors.
- Rigid spacers will be used on jumper conductors, assuming six spacers, per phase, per jumper.
- One jumper assembly, per phase, per tower type D and E is included.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.8.9 Quantities of OPGW Accessories

- Two spiral vibration dampers per structure, will be used on the OPGW as per the tower quantity estimation.
- OPGW down lead clamps have been assumed to be required every 3 m.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.8.10 Quantities of OHSW Accessories

- Two spiral vibration dampers, per structure will be used on the OHSW as per the tower quantity estimation.
- The bonding conductor is assumed to be #2 ACSR "Sparrow" and the length is estimated to be 1.5 m for suspension towers and 2.0 m for the dead-end structures.
- 100% of the line has been considered for compression type splices.
- Bird diverters are not required and are not included in the estimate.
- Material extras for un-foreseen re-routes, structure additions, design changes, etc. are not included.

5.8.11 Quantities of Miscellaneous Hardware and Material

- The hardware required for tower grounding is included.
- One structure number tag will be installed on every structure.
- Two danger signs will be installed on every structure.
- Aerial line number boards will be included per line, and will be installed on the first structure outside of the Muskrat Falls Substation.

5.8.12 Geotechnical Investigations

- Geotechnical investigation is not included.

5.8.13 Electrical Effects / Considerations

- Transmission line ROW is 50 m, which is assumed to be within the acceptable limits for:
  - Edge of right of way electric / magnetic field levels,
  - Edge of right of way audible noise levels, and
  - Edge of right of way radio and television interference.

5.8.14 Distribution and Transmission Line Conflicts

- It is assumed that no line crossings will be required for this 315 kV interconnection.

6 PROCUREMENT ASSUMPTIONS

- The prices for lattice steel towers, foundation steel grillages, rock anchor and anchor bolts, conductor, insulators, grounding material, OHSW, OPGW and accessories, guy wires, hardware fittings for conductor, insulator, OHSW, and guy wire and poles are based on budget prices received from potential suppliers.
- Allowances have been made for inspection visits

- Allowances are included for type tests of insulator strings and OPGW. Eight full scale tower tests (two for HVac and six for HVdc) are also included.

6.1 REFERENCES

- List of bulk material – 315kV HVac Engineering Quantity tracking (SLI Doc. No. 500573-4600-33RA-I-0001)
- List of bulk material – 350kV HVdc Engineering Quantity tracking (SLI Doc. No. 500573-4600-33RA-I-0002)

7 CONSTRUCTION ASSUMPTIONS

7.1 OVERVIEW

7.1.1 Component 4 Construction Estimates

The assumptions reviewed in this document refer to the following estimates that are contained in the appendix:

- One estimate for the HVac clearing and line construction,
- Four estimates for the HVdc clearing and line construction,
- Estimate for the two wood pole electrode lines,
- Estimate for required modifications to existing lines that will be crossed by the HVdc line in the Avalon Peninsula package,
- Estimate for re-terminating existing 230 kV lines at the proposed Soldiers Pond station,
- Estimate for a 735 kV connection at Churchill Falls, and
- Estimate for 315 kV interconnections at Muskrat Falls (powerhouse).

7.1.2 Included in the Estimates

- The quantities of construction work involved as provided in the engineering estimates.

- The crew sizes required and the productivity rates associated with completing the construction work. The labour rates are based on information provided by the client with modifications for specialists, such as linemen.
- Material handling and transportation.
- Survey work.
- Geo-technical investigations.
- Management and administration costs including supervision; safety and environmental monitoring; and quality and cost control.
- Accommodation for on-site employees based on installation cost of $50,000, per camp bed, and a daily cost of $150, per person.
- Travel for employees while on site and at the end of the rotation based on a 21/7 schedule.
- Contractor target of 15% profit.
- Contractor Insurance of 1%.
- Contractor bonding of 1%.

7.1.3 Not Included in the Estimates

- Switching and outage costs related to Nalcor and other utility companies.
- Line inspections conducted by Nalcor and other utility companies.
- Salvage costs for TL240 between Happy Valley and Churchill Falls.
- Environmental field visits for obtaining site information, etc. for regulatory compliances including stream crossings, etc.
- SLI EPCM costs including civil material testing lab and services.
- Insurance for Nalcor supplied materials.

7.1.4 Special Items

7.1.4.1 Helicopter Costs

Helicopters will be used extensively on Component 4 of the LCP. SLI and Nalcor will use small helicopters (three to five passengers) for supervision and to assist with medical evacuations and fire suppression. Geo-technical consultants will use small and medium helicopters to transport personnel and equipment for soil investigation. Construction contractors will use all sizes of these machines including heavy lift helicopters for setting towers, transporting men and equipment, and for stringing operations.

The cost for the helicopter usage is included in the construction assumptions that follow, or in the separate EPCM estimates. The rates used in the estimates for helicopters are in the following table:

Table 5: Rates used in the Estimates for Helicopters

Small Machines AStar, 206LR (4 or 5 passengers; light loads of material and tools)	$2,000 / hr
Medium Machines Various helicopters with capacity for 5 to 15 passengers or a lift capacity of 3300 to 9000 lb	$3,500 / hr to $7,000 / hr
Heavy Lift Machines Erickson Air-Crane S64E (20,000 lb lift) Erickson Air-Crane S64F (25,000 lb lift)	 $14,500 / hr $17,000 / hr

7.1.4.2 Material Marshalling

A logistics study is underway that will help to plan the management of the transmission line materials. The construction estimates are currently based on the assumption that there will be main marshalling yards established west of Happy Valley, near Corner Brook, and on the Avalon Peninsula. Based on this model, the line contractors will be responsible for transporting the material from these main yards to the transmission line, using temporary lay-down locations, as necessary.

7.1.4.3 Site Offices and Accommodations

The contractors will be responsible for establishing their own accommodation and office facilities. Exceptions include:

- Using the Accommodation Complex planned for the Muskrat Falls site during the construction of the first few kilometres of the HVdc line.
- Using space at a proposed marshalling yard/office/accommodation complex that would be built west of Happy Valley.
- Using a free-issued camp that could be provided to a contractor for the HVac line.

For all camps established by the contractors, they will be obligated to provide accommodations and office space to SLI and the client. These spaces would be used by managers, engineers, inspectors/lab techs and HS & E staff.

7.1.5 References

- Refer to Part 4 of the Construction Management Plan (SLI Doc. No. 505573-0000-30PL-1-0003) for detailed descriptions of the construction packages, line route conditions and schedule.
- Clearing Estimation Costs - HVac Lines (SLI Doc. No. 500573-4600-40RA-I-0001).
- Clearing Estimation Costs - HVdc Lines (SLI Doc. No. 500573-4600-40RA-I-0002).

7.2 315 KV HVac LINE CONSTRUCTION

7.2.1 Construction Quantities

As identified in section 4.1 - 315 kV HVac Transmission Line, LIDAR survey information and aerial photography has been used to define the corridor for the two 315 kV circuits and to spot the tower types and heights that meet the design criteria. The dimensions of the corridor have been used to estimate the labour costs of clearing the right-of-way. The quantities of the various towers and foundations have been used to estimate the labour costs of constructing the line.

7.2.2 Access

Accessibility to the two HVac lines is fairly well understood.

- The line route crosses the Trans Labrador Highway (TLH) twenty times, providing access to all of the work areas.
- Field investigation has taken place to review points of inflection and other areas of concern.
- A desk-top review of aerial mapping has been used to complete the tower spotting. It is assumed that no significant changes will be required.
- Based on the current assessment of access requirements, all structures can be accessed by a combination of:
    - Existing roads and trails,
    - Minor grading work, removal of small amounts of deadfall, stumps, rocks and other debris,
    - Installation of culverts and temporary bridges, and
    - If required, winter roads or frozen conditions for a small number of locations.

It is assumed that the TLH, including all bridges, etc. will provide unobstructed access for the project.

7.2.3 Survey

- The completed LIDAR survey was not part of the SLI scope of work.
- The costs associated with marking the boundaries of the right-of-way prior to clearing and the staking of the structure centres will be completed by SLI as part of the EPCM agreement.
- The staking of the structure foundations and survey of the as-built locations of the completed foundations will be the responsibility of the line contractor and is included in the estimate.
- A post-construction legal survey of the right-of-way is not included in the estimate.

7.2.4 Clearing and Access Construction

- A clearing and access study has identified tree densities and the locations where culverts and temporary crossings need to be installed. (A copy of the study is attached.) The study also identifies where off-right-of-way access is required.
- Environmental constraints have been identified and accounted for in the execution of clearing and access construction work. Approximately 1% of the clearing and access estimate is earmarked for environmental mitigation.
- Estimated costs of clearing are based on experience from previous projects and are proportional to vegetation density. It is assumed that 89% of the clearing will be completed mechanically (feller-bunchers, mulchers), 7% will be cleared by hand (chain saws) and the remaining 4% will not require tree removal.
- The cost of removing access to the right-of-way following completion of construction has been included in the estimate.

7.2.5 Foundation Construction

- The location and types of foundations have been based on a preliminary study and a report by AMEC engineers. In addition, a desk-top study using a bare earth model was used to determine the likely type of foundation at each tower site.
- Site-specific foundation types will be reviewed and adjusted through a geo-tech survey to be undertaken as tree clearing work in being completed. It is assumed that this survey will not significantly change the quantities of the foundation types that are used for the construction estimate. The cost of the geotechnical survey is included in the estimate.
- It is assumed that the majority of anchors for guyed towers will be drilled to a depth of 10 metres.
- During construction, inspection and testing of the soil conditions encountered during excavations will confirm the foundation type that is being used for each tower. This may result foundation type changes that requires transport of different foundation steel on and off site. A

unit price for these possible changes will be included in the tender packages. For the construction estimate, it is assumed that this will be a rare occurrence.

- It is assumed that all tower sites will be accessible by ground transportation. A small number of locations may require the contractor to take advantage of frozen conditions in the winter.
- Estimated costs associated with the installation of each of the foundation types are determined by previous experience with similar foundation that includes labour, equipment and material such as concrete and backfill.

7.2.6 Tower Assembly and Erection

- It is anticipated that all tower sites will be accessible by ground transportation. This includes hauling tower steel and the movement of cranes that are large enough to set the towers.
- Estimated costs associated with the assembly and erection of each of the tower types are determined by previous experience with similar projects. Tower weights are a determining factor.

7.2.7 Stringing – Conductor, OPGW and OHSW

- It is assumed that all tower sites will be accessible by cranes with man-baskets.
- It is expected that the contractor will use a small helicopter for stringing lead-lines. They will employ tension stringing techniques.
- The cost of installing rider poles at twenty highway crossings and four line crossings is included in the estimate. As well, the planning and precautions associated with safely completing the stringing across these crossings is included.
- It is assumed that no modifications or line outages will be required on TL240. Recloser blocking will be required.
- Reel lengths of about 3000 m will be used for conductor and OHSW. Two-bundle, Drake conductor will be used and spacer dampers will be installed.

- Reel lengths of about 6000 m will be used for the OPGW. Approximately 45 splices will be installed in each line.
- Estimated costs associated with stringing are determined by previous experience on similar projects.

7.2.8 Counterpoise

- It is assumed that the line route will be accessible for the installation of the counterpoise and related grounds and connections.

7.2.9 Continuity of Construction

It is unlikely that the HVac lines can be built consecutively from one end to the other. However, it is assumed that there will not be significant costs due to demobilizations or frequent transfers of men and equipment from one section of line to another.

7.3 ±350 KV HVdc LINE CONSTRUCTION

7.3.1 Construction Quantities

As identified in section 4.2 - ±350 kV HVdc Transmission Line, ten families of towers are being designed to accommodate the conditions that will be met on the proposed transmission line between Muskrat Falls and Soldiers Pond. LIDAR survey information and aerial photography have been used to define the route and to make an initial pass at spotting towers. The initial estimate of quantities of foundations that are required is based on the proportion of foundation types proposed for the HVac lines.

7.3.2 Contract Packages

For contract bidding purposes, the HVdc line route has been divided into four packages. An independent estimate for clearing and line construction has been created for each package. The productivity rates for each estimate are based on the travel distances, weather conditions and access requirements within each package.

For each estimate, the dimensions of the corridor and approximate tree densities have been used to estimate the labour costs of clearing the right-of-way. The tower quantities within each package have been used to estimate the labour costs of foundation installation, tower assembly, setting and stringing.

7.3.3 Access

A high-level desk-top study and helicopter surveys of portions of the line route have been used to provide a good estimation of the accessibility to all portion of the HVdc line route. The estimates for access requirements are based on the following observations:

- Most of the line route on the island of Newfoundland is accessible from existing roads that cross the line, dividing it into manageable segments.
- The portion of line through the Long Range Mountains has been estimated for helicopter access for all phases of work.
- The portion of line going north from the south coast of Labrador has been estimated for helicopter access for all phases of work.
- The line route across the interior of Labrador from Muskrat Falls to the Bujeault River is remote but there should be access to the majority of structures. However, there are few access points to this portion of line and it is proposed that approximately 45 km of class 1 road be built to the south-east end of this section. As well, the access road along the right-of-way will have to be built and maintained to accommodate the traffic that will need to travel. One central portion of the line will likely be accessible only with ice bridges during the winter.

The estimates account for all of these identified conditions.

7.3.4 Survey

- The completed LIDAR survey was not part of the SLI scope of work.

- The costs associated with marking the boundaries of the right-of-way prior to clearing and the staking of the structure centres will be completed by SLI as part of the EPCM agreement.
- Staking of the structure foundations and survey of the as-built locations of the completed foundations will be the responsibility of the line contractor and is included in the estimate.
- A post-construction legal survey of the right-of-way is not included in the estimate.

7.3.5 Clearing and Access Construction

- A high level clearing and access study for the proposed HVdc line route has been used to approximate tree densities and to estimate the work required to establish access along the right-of-way. The study also identifies the existing access available and the amount of off-right-of-way access that is required for clearing and line construction.
- It is assumed that the majority of environmental constraints have been identified and accounted for in the estimate of clearing and access construction work. Approximately 1% of the clearing and access estimate is earmarked for environmental mitigation.
- Estimated costs of clearing are based on experience from previous projects and are proportional to vegetation density. It is assumed that 79% of the clearing will be completed mechanically (feller-bunchers, mulchers), 19% will be cleared by hand (chain saws) and the remaining 2% will not require tree removal.
- The cost of removing access to the right-of-way following completion of construction has been included in the estimate.

7.3.6 Foundation Construction

- As indicated, the initial quantities and sizes of HVdc tower foundations have been estimated by using amounts that are proportional to the HVac design. It is assumed that as engineering work progresses, the final foundation designs will not cause a significant change in the construction estimate.

- It is assumed that the majority of anchors for guyed towers will be drilled to a depth of 10 metres.
- During construction, inspection and testing of the soil conditions encountered during excavations will confirm the foundation type that is being used for each tower. This may result foundation type changes that requires transport of different foundation steel on and off site. A unit price for these possible changes will be included in the tender packages. For the construction estimate, it is assumed that this will be a rare occurrence.
- Access to tower sites for foundation installation will vary considerably throughout the HVdc line. The variability is accounted for within each estimate. This includes some areas where men and equipment will have to be transported by helicopter.
- Estimated costs associated with the installation of each of the foundation types are determined by previous experience with similar foundation. The estimates include labour, equipment and material such as concrete and backfill.

7.3.7 Tower Assembly and Erection

- Access to tower sites for tower assembly and erection will vary considerably throughout the HVdc line. The majority of towers will be assembled at the tower sites and set by crane. Some of these locations will require winter access. Two large areas (southern Labrador and the Long Range Mountains in the Northern Peninsula) will require the use of helicopters for setting towers. One or two shorter sections may require helicopter setting as well. The cost of setting towers under these conditions is included in the estimates.
- Estimated costs associated with the assembly and erection of each of the tower types are determined by previous experience with similar projects.

7.3.8 Stringing – Conductor and OPGW

- It is assumed that the majority of tower sites will be accessible by cranes with man-baskets. It is also assumed that the areas where towers are set by helicopter will require crews to work off the towers without man-lifts and be transported by helicopter.

- It is expected that the contractor will use a small helicopter for stringing lead-lines. He will employ tension stringing techniques.
- The cost of installing rider poles at highway crossings and line crossings is included in the estimate. As well, the planning and precautions associated with safely completing the stringing across these crossings is included.
- Modifications to existing circuits will be required is some cases and referenced below.
- Reel lengths of about 1200 m will be used for conductors.
- Reel lengths of about 6000 m will be used for the OPGW.
- Estimated costs associated with stringing are determined by previous experience on similar projects.

7.3.9 Counterpoise

- The installation of counterpoise will require a variety of forms of transportation. This is included in the estimate.

7.3.10 Continuity of Construction

Within each package of the HVdc line, contractors will be challenged to maintain a high level of productivity from their work-forces. It is unlikely that any package can be built consecutively from one end to the other. However, it is assumed that there will not be significant costs due to demobilizations or frequent transfers of men and equipment from one section of line to another.

7.4 MISCELLANEOUS PACKAGES

7.4.1 Additional Work - LCP Transmission System

The following sub-projects are required to complete the proposed transmission system:

- Two electrode lines

- Modifications to existing lines for crossings in the fourth section of the HVdc line
- 230 kV line re-terminations at Soldiers Pond
- 735 kV interconnection at Churchill Falls
- 315 kV interconnection at Muskrat Falls (Powerhouse)

These sub-projects are being developed as separate engineering packages but will be included with the larger bid packages when they are tendered. Not included is the 25 kV Construction Power sub-project.

The cost estimates to construct these packages were developed as follows:

- Based on experience, the crew size and equipment requirements were identified. Labour rates, equipment costs, indirect costs and overhead costs used for the major construction components were applied.
- The estimated number of crew days required to complete each sub-project is based on previous projects of similar scope.
- Access and clearing costs, if any, are based on a review of aerial mapping
- Outages and the extra time required to cross other circuits or roads is included in the estimate of crew days required. It is assumed that no significant delays will be encountered

It is assumed that there will be no major changes to the scope or location of these projects.

Appendix 1

CCE Work Breakdown Structure

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Capital Cost Estimate WBS Cost Breakdown

nalcor energy LOWER CHURCHILL PROJECT

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
5000000							No Physical Component
	5100100						Indirect C-1
		5100101					Overall Project Management
		5100102					Construction Management
		5100103					Engineering Power Plant
		5100104					Engineering Const Support PPlant
		5100105					Engineering Management T.L.
		5100106					Engineering Support T.L.
		5100107					Engineering DC Specialties
		5100108					Procurement
		5100109					Contract Management
		5100199					Other Allowances / Indirects
	5100300						Indirect C-3
		5100301					Churcill Falls - Site management
		5100302					Substation Muskart Ac and DC - Site management
		5100303					Muskrat Falls - Substation Tap 315/138/25kv - Site
		5100304					Forteau Point - Transition compounds - Site manage
		5100305					L'Anse-au-Diable - Electrode - Site management
		5100306					Shoal Cove - Transition compounds - Site mgmt
		5100307					Soldiers Pond DC Converter Station - Site Mgmt
		5100308					Soldiers Pond AC Substation - Site Mgmt
		5100309					Soldiers Pond - Synchronous condensers -Site Mgmt
		5100310					Dowden's Point - Electrode - Site management
		5100311					Trainінig Personnal (Based at St-Johns)
		5100312					Construction Substation-Management - Site St-John
		5100313					ENGINEERING SUPPORT FOR DC SPECIALTIES
		5100399					Other Allowances/Indirects
	5100400						Indirect C-4
		5100401					Engineering Mgmt T. L.
		5100402					Project Management - St-Johns Site
		5100499					Indirect/Others
10000000							Support Facilities - General
	11000000						Access - General
		11100000					Access Roads
			11100100				Access Roads - Construction / Temporary
			11100200				Access Roads - Permanent
			11100300				Access Roads - North Spur
		11500000					Construction Bridge over spillway approach channel
		11600000					Barge / Ferry Access
	13000000						Construction Power General
		13200000					Construction Power - Muskrat Falls
		13300000					Construction Power - Island Link
	14000000						Construction Telecommunications - General
		14200000					Construction Telecommunications - Muskrat Falls
		14300000					Construction Telecommunications - Island Link
	15000000						Accommodation Complex / Temporary Buildings
		15100000					General Site
			15110000				Recreational Areas
			15120000				Other Specialties
		15200000					Buildings - Central Core
		15300000					Buildings - Dormitories
		15400000					Buildings - Administration Buildings and Workshops
		15500000					Buildings - Warehousing
		15600000					Buildings - Other
		15700000					Site Services (Infrastructure)
	16000000						Temporary Staging Areas
		16100000					Overburden Stockpiling area
		16200000					Rock Stockpiling Area
		16300000					Rock Quarry
	17000000						Housing Facilities (HF)
		17100000					Happy Valley - Goose Bay HF (Option)
	18000000						Offsite Logistics Infrastructure & Support - Gener
		18100000					Offsite Marshalling Areas and Warehousing
		18200000					Offsite Port Facilities
		18300000					Offsite Roads and Bridges
	19000000						Other Offices - General
		19100000					Happy Valley - Goose Bay Office (Option)
		19200000					Other Offices
20000000							Reservoir, Diversion, Dam and Spillway - General
	21000000						Reservoir - General
		21100000					Reservoir
			21100100				Access Roads
			21100200				Clearing
			21100300				Fish HADD
		21200000					Water Sampling Stations
		21300000					Trash Management System
		21400000					Reservoir Stabilization
		21500000					Water Management System
	23000000						Dams and Cofferdams - General
			23000010				Riverside RCC Cofferdam
				23000011			Rock Excavation - Dry Conditions
				23000012			Foundation Preparation, Inclusive of Cleaning - Ro
				23000013			Dental Concrete
				23000014			Sluch Grout on Fondation
				23000015			Slush Grout Along Joints Every 900mm, 2/3 of area
				23000016			Roller Compacted Concrete

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Capital Cost Estimate WBS Cost Breakdown

nalcor energy LOWER CHURCHILL PROJECT

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
			23000020				Riverside Cofferdam Rockfill Section
		23000100					Phase 1 Riverside Cofferdam
		23009990					Indirect
			23009991				Indirect 1
			23009992				Indirect 2
		23200000					North RCC Dam
			23210100				Common Excavation
			23210110				Rock Excavation
			23210120				Drill and Pressure Grout
			23210130				Foundation Preparation
			23210140				Drain Holes
			23210150				Dental Concrete
			23210160				Slush Grout Foundation
			23210170				Roller Compacted Concrete
			23210180				Slush Grout Interlayer
			23210190				Concrete - Upstream Face
			23210200				Concrete - Downstream Face
			23210210				Concrete - Cap
			23210220				Formwork - Drainage Gallery
			23210230				Concrete North Aburment
			23210240				Instrumentation
			23220200				Concrete & RCC Operations
				23220270			Concrete North Abutment
					23220280		Concrete North Abutment
					23220285		North Abutment Formwork
					23220290		Steel Reinforcement
					23220295		Overbreak Concrete & Misc.
						23220296	Overbreak Concrete
						23220297	Waterstop
		23300000					South Rockfill Dam
			23300100				Common Excavation
			23300110				Drill and Pressure Grout
			23300120				Foundation Preparation
			23300130				Drain Holes
			23300140				Dental Concrete
			23300150				Slush Grout
			23300160				Compacted Till Z1
			23300170				Compacted Filter Z2
			23300180				Comp Rkfill Z3, 3b&4
			23300190				Concrete - Crest - south dam (road bed only)
			23300200				Concrete - Drainage gallery
			23300210				Concrete - (CVC)
			23300220				Instrumentation
		23400000					Cofferdams
			23410000				Cofferdam - Upstream
				23411000			Spillway U/S Cofferdam
					23411110		Common Excavation
					23411120		Dumped Rockfill 0-900mm
					23411130		Boulders (produced by others) 1000-1200mm
					23411140		Boulders (produced by others) 1200-1500mm
					23411150		Percussions Boreholes
					23411160		Cement Bentonite Wall
					23411170		Jet Grout Column
					23411180		Dumped Granular or Crushed Rock Max 150mm
					23411190		Fine Rockfill Transition Max 300mm
					23411200		Compacted Till - Zone 1
					23411210		Compacted Granular - Zone 2C
					23411220		Compacted Rockfill - Zone 3C
					23411230		Riprap (produced by others) 4 Class 1
					23411240		Dumped Rockfill (access road) 0-900mm
					23411250		Dumped Till
					23411260		Removal Cofferdam
					23411270		Access Road Intake Channel
				23412000			ND U/S Rockfill Cofferdam
					23412110		Common Excavation
					23412120		Dumped Rockfill 0-900mm
					23412130		Boulders (produced by others) 1000-1200mm
					23412140		Boulders (produced by others) 1200-1500mm
					23412150		Percussions Boreholes
					23412160		Cement Bentonite Wall
					23412170		Jet Grout Column
					23412180		Dumped Granular or Crushed Rock Max 150mm
					23412190		Fine Rockfill Transition Max 300mm
					23412200		Compacted Till - Zone 1
					23412210		Compacted Granular - Zone 2C
					23412220		Compacted Rockfill - Zone 3C
					23412230		Riprap (produced by others) 4 Class 1
					23412240		Dumped Rockfill (access road) 0-900mm
					23412250		Dumped Till
					23412260		Removal Cofferdam
					23412270		Access Road Intake Channel
					23412280		Compacted rockfill Zone 3D (0-900 mm)
			23420000				Cofferdam -Downstream
				23421000			North D/S Cofferdam
					23421100		Excavation CGC
					23421110		Compacted Till
					23421120		Compacted Granular
					23421130		Compacted Rockfill

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Capital Cost Estimate WBS Cost Breakdown

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Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
					23421140		Temp Bridge Across Diversion Discharge Channel
					23421150		Cofferdam Removal
				23422000			Powerhouse D/S Cofferdam
					23422100		Excavation CGC
					23422110		Compacted Till
					23422120		Compacted Granular
					23422130		Compacted Rockfill
					23422140		Temp Bridge Across Diversion Discharge Channel
					23422150		Cofferdam Removal
					23422160		Rip Rap PBO
					23422170		Foundation Prep
					23422180		Concrete
					23422190		Access Road to IN Channel
				23423000			Spillway D/S Cofferdam
					23423100		Excavation CGC
					23423110		Compacted Till
					23423120		Compacted Granular
					23423130		Compacted Rockfill
					23423140		Temp Bridge Across Diversion Discharge Channel
					23423150		Cofferdam Removal
					23423160		Rip Rap PBO
			23430000				Cofferdam - Intake Channel
				23431000			Powerhouse U/S Cofferdam
					23430100		Overburden Excavation
					23430110		Compacted Till - Zone 1
					23430120		Compacted Granular - Zone 2C
					23430130		Compacted Rockfill - Zone 3C
					23430140		Riprap (produced by others) 4 Class 1
					23430150		Foundation Preparation
					23430160		Concrete
					23430170		Access Road To and Across Intake Channel Cofferdam
					23430180		Temporary Bridge Across Diversion Channel Bailey B
					23430190		Remove Rockfill Cofferdam
					23430200		Copacted Rockfill - Zone 3D (0-900mm)
					23430900		Powerhouse Concrete Cofferdam
						23430910	Cofferdam Concrete
						23430920	Overbreak Concrete
		23600000					Transition Structures
			23610000				North Transition Structure
				23610100			Excavation
				23610200			Concrete Operation
					23610210		Concrete CVC
					23610280		Drainage Gallery Formwork
					23610290		Reinforcing Steel
					23610295		Overbreak Concrete & Misc.
						23610296	Overbreak Concrete
						23610297	Waterstop
				23610300			Pressure Relief Holes
			23620000				Center Transition Structure
				23620300			Concrete Operations
					23620310		Concrete CVC
						23620320	Mass Concrete Dam Section
						23620330	Buttress Wall
						23620340	Stoplogs Storage Deck
						23620350	Gate Storage Pad
					23620380		Drainage Gallery Formwork
					23620390		Reinforcing Steel
					23620395		Overbreak Concrete & Misc.
						23620396	Overbreak Concrete
						23620397	Waterstop
			23630000				South Transition Structure
		23700000					Dams / Cofferdams Auxiliary Services
		23700050					CGC Cofferdam Excavation
			23700099				CGC North D/S Cofferdam
			23800000				CGC Powerhouse U/S Cofferdam
			23800001				CGC Powerhouse D/S Cofferdam
			23800002				CGC Spillway D/S Cofferdam
			23800003				CGC Spillway U/S Cofferdam
			23800005				CGC Spillway U/S Cofferdam R1
			23800006				CGC North Dam U/S Rockfill Cofferdam
			23800007				CGC Concrete Aggregates Production
			23800008				CGC South Rockfill Dam
			23800009				CGC North RCC Dam
			23800010				CGC Riverside RCC Cofferdam
			23800011				CGC North Spur
	24000000						Spillway - General
		24000100					Phase 1 , Spillway Excavation
		24100000					Spillway Concrete Structure
			24100100				Piers and End Walls
				24100110			Concrete - Piers and End Walls
					24100111		Piers & End Walls - Curved Noses U/S to EL 45.5
					24100112		Piers & End Walls - Straight Face D/S to EL37/19.3
				24100120			Concrete - LLO Headwalls and Deck
					24100121		LLO Lower Curved Structural Slabs @ EL 15.5
					24100122		LLO Walls to EL 45.5
					24100123		LLO Upper Structural Slabs @ EL 42.7
			24100200				Slabs and Rollways
				24100210			Concrete - Slabs

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Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
					24100211		Base Slab @ EL 5.0
				24100220			Concrete - Rollways
					24100221		Rollway Slabs to EL 15.7
			24100300				Bridge
				24100310			Concrete - Bridge Decks
					24100311		Bridge Decks - U/S & D/S @ EL 45.5 & 20.3
				24100320			Structural Steel - Bridge
				24100330			Miscellaneous Steel - Bridge
				24100340			Steel Grating - Bridge Deck
				24100350			Spillway D/S Bridge Ramp
			24100400				Secondary Concrete
				24100410			Secondary Concrete - Guides, Sills and Lintels
					24100411		Secondary Concrete - Gates & Stoplogs
			24100500				Reinforcing Steel
				24100510			Reinforcing Steel - Spillway, incl. Bridge
			24100600				Overbreak Concrete and Misc.
				24100610			Overbreak Concrete
				24100620			Waterstops
				24100630			Miscellaneous Steel - Spillway
				24100650			Concrete Heating
			24100700				Drilling and Grouting and Drain Holes
				24100705			Drilling Grout Holes
				24100710			Connection for Grout Stage
				24100715			Cement used for grouting
				24100720			Drilling Check Holes (Cored NX)
				24100725			Drilling Check Holes Non cored 45 deg inclination
				24100730			Connection Water Pressure Testing
				24100735			Water pressure test (lugeon - 5 stages)
				24100740			Drain Holes
		24200000					Gates, Stoplogs, Guides and Hoist
			24200100				Spillway Gates Embedded Parts
				24200190			Spillway Gates Primary Anchors (Instl)
			24200200				Spillway Gates
			24200300				Spillway Gates Hoisting system
			24200400				Spillway Stoplogs Embedded Parts
				24200490			Spillway Stoplogs Primary Anchors (Instl)
			24200500				Spillway Stoplogs
			24200600				Spillway Stoplogs Hoisting system
		24300000					Spillway Channels
			24301000				Spillway Downstream Channel
			24302000				Spillway Approach Channel
				24302100			Spillway Centre Pier
					24302110		Pier Concrete
					24302120		Reinforcing Steel
		24400000					Spillway Auxiliary Services
		24500000					Spillway Electrical
	28000000						North Spur - General
		28000140					North Spur - Kettle Lake Stabilization
		28100000					North Spur - Upstream Rock Berm
			28100110				Excavation
			28100120				Slurry Cut-Off Wall
			28100130				NW/Slurry Cut-Off Wall
			28100140				Compacted Rockfill - Zone 3B - North Shore
			28100150				Till Blanket - Zone 1 - North Shore
			28100160				Rip Rap Zone 4B North Shore
			28100170				Rip Rap Zone 4B South Shore
			28100180				Zone 5 - Material Crushed Stone Max. 31.5mm (perma
			28100190				Compacted Rockfill - Zone 3B - South Shore Excavat
		28200000					North Spur - Downstream Stabilization
			28200110				Dumped Rockfill - Zone 3 - North Shore
			28200120				Dumped Rockfill - Zone 3 - South Shore
			28200130				Compacted Rockfill - Zone 3A - North Shore
			28200140				Compacted Rockfill - Zone 3A - South Shore
			28200150				Compacted Rockfill - Zone 3B - South Shore
			28200160				Granular Material - Zone 2 - North Shore
			28200170				Geomembrane
			28200180				Geotextile
		28300000					North Spur - Pump wells
			28300110				New Pumpwells
			28300120				Refurbish Existing Pumpwells
			28300130				Header Pipe (d = 600mm)
			28300140				Relief Drain Wells
			28400000				North Spur - Crest Unloading
			28400110				Geomembrane
		28600000					North Spur Electrical
30000000							Power Facilities
	30001000						Site preparation
		30001100					Clearing
			30001110				Clearing of Temporary Works (borrow area, access r
		30001200					Stripping
		30001300					Top soil removal
		30001400					Overburden
		30001500					Temporary Roads
		30001600					Construction of Settlement Ponds
	30002000						Miscellaneous Work
		30002100					Steel Guardrails
	31000000						Powerhouse Channels (Inc.Plugs and/or Cofferdam)

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Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
		31001000					Approach Channel Common excavation
		31002000					Approach Channel Rock Excavation
		31003000					Approach Channel Rock Consolidation
			31003100				Approach Channel Injected Rock Bolts
			31003200				Approach Channel Non-Injected Rock Bolts
			31003300				Approach Channel Wire mesh
		31004000					Approach Channel Cofferdam
		31005000					Approach Channel Rock Plug
		31006000					Tailrace Channel Common excavation
		31007000					Tailrace Channel Rock excavation
			31007100				Tailrace Channel Injected Rock Bolts
			31007200				Tailrace Channel Non-Injected Rock Bolts
			31007300				Tailrace Channel Wire mesh
		31008000					Tailrace Cofferdam
		31009000					Tailrace Rock Plug
	32000000						Intake - General
		32001000					Intake and Powerhouse Common excavation
		32002000					Intake and Powerhouse Rock Excavation
			32002100				Intake Rock Exc
			32002200				Structure Rock Exc
			32002300				Tailrace Rock Exc
		32003000					Intake Concrete Structure
			32003100				Intake Bottom
			32003200				Intake Top
		32004000					Intake and Powerhouse Rock Consolidation
			32004100				Intake and Powerhouse Injected Rock BB
			32004200				Intake and Powerhouse Non-Injected RB
			32004300				Intake and Powerhouse Wire mesh
		32200000					Intake Concrete Structure
			32200100				Concrete
				32200105			Intake Base Slabs to EL -1.7
				32200110			Intake Piers & End Walls - Main
				32200115			Intake Divider Walls
				32200120			Intake Sloping Structural Block from E 7.75 - 26.3
				32200125			Intake Structural Block from E line 26.30 to 45.5
				32200130			Intake Deck @ 45.5 (Gallery Roof @ Gate Hoist Bldg
				32200135			Intake Gate Hoist Building Walls from 45.50
				32200140			Intake Gate Hoist Building Roof (Bldg & Air Plens)
				32200145			Intake Gate Hoist Building Curbs @ 51.50 & 45.50
				32200150			Intake Galleries/Shafts/Pits Exter.- Slabs from E
				32200155			Intake Galleries/Shafts/Pits Exter. - Walls from E
				32200160			Intake Galleries/Shafts/Pits Exter. - Str Slabs
			32200300				Formwork - flat
			32200400				Formwork - curved
			32200500				Secondary Concrete
				32200510			2nd Phase concrete for steel emb. Part
			32200600				Reinforcing Steel
				32200610			Reinforcing Steel
			32200700				Overbreak Concrete & Misc.
				32200710			Overbreak Concrete
				32200720			Waterstops
				32200750			Concrete Heating
				32200760			Tower Crane Setups
				32200770			Temporary Building for Winter Protection
		32400000					Intake Gates, Trashracks, Stoplogs and Hoists
			32400100				Intake Gates Embedded Parts
				32400190			Intake GatesPrimary Anchors (Instll)
			32400200				Intake Gates
			32400300				Intake Gates Hoisting system
			32400400				Intake Trashracks Embedded Parts
				32400490			Intake Trashracks Primary Anchors (Instl)
			32400500				Intake Trashracks
			32400600				Intake Trashracks Mechanical System
			32400700				Intake Stoplogs Embedded Parts
				32400790			Intake Stoplogs Primary Anchors (Instll)
			32400800				Intake Stoplogs
			32400900				Intake Stoplogs Hoisting system
		32500000					Penstocks
		32800000					Penstocks Construction Addit
		32900000					Intake Auxiliary Services
	33000000						Power House
		33100000					Substructure
			33100100				Powerhouse/Intake
			33100200				Intake
			33100300				Powerhouse Area of Units
			33100400				Powerhouse - Service Bay
			33100500				Powerhosue - South Transition
			33100600				Powerhouse - Concrete Deck
			33101000				Substructure - Area of Units
				33101100			Concrete - 1st Stage
					33101105		PH Draft Tube Base Slab -34.1 to -31.1/-26.66
					33101110		PH Intake Side Base Slab - from 17.02 sloping up
					33101115		PH Draft Tube Transitions Encasement -31.1 to -12
					33101120		PH Block Above Dewatering Gallery, D/S -17.8 - -12
					33101125		Draft Walls to Crown: D/S of Trans -31.1--17.8
					33101130		PH Intake Side Walls to Crown
					33101135		PH Piers & A-Line Walls D/S -17.8 to 6.5
					33101140		PH D/S Curtain Walls -0.60 to Turbine Floor 6.50

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Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
					33101145		PH Turbine Floor D/S Craneway Walls 6.5 to 14.15
					33101150		PH Turbine Walls & Pads: Transf/Ballast Walls/Pads
					33101155		PH Turbine Floor Columns 6.50 to Tailrace Deck
					33101160		PH Draft Tube Crown - D/S of Transition
					33101165		PH Intake Side Block to 15.5
					33101170		PH Turbine Floor Slab D/S of A @ 6.5; Craneway Wlk
					33101175		PH Tailrace Slab&Beams: U/S Face LineA Bm D/S 15.5
					33101180		PH External Slabs on Grade - Line A & Line 24
					33101185		PH External Walls - Line A & Line 24
					33101190		PH External Structural Slabs - Line A & Line 24
				33101200			Concrete - 2nd Stage
					33101210		PH Stage 2 Semi-Spiral Cases -12 to 6.5 Turb Flr
					33101220		PH Stage 2 Turbine Floor Walls 6.5 to Gen Flr
					33101230		PH Stage 2 Turbine Floor Columns 6.5 to Gen Flr
					33101240		PH Stage 2 Generator Floor Slabs & Beams @ 15.5
				33101300			Formwork - flat
				33101400			Formwork - curved
				33101500			Secondary Concrete
					33101510		2nd phase concrete for embed. Part
				33101600			Reinforcing Steel
					33101610		Reinforcing Steel
				33101700			Overbreak Concrete & Misc.
					33101710		Overbreak Concrete
					33101720		Waterstops
					33101750		Concrete Heating
					33101760		Temporary Building for 2nd Stage Work
			33102000				Substructure - Service Bay
				33102100			Concrete
					33102110		Service Bay Slabs on Grade D/S of Line E
					33102120		Service Bay Walls D/S of Line E
					33102130		Service Bay Columns D/S of Line E
					33102140		Service Bay Structural Slabs D/S of Line E
					33102150		Galls/Shafts/Pits (Ext): Slabs U/S of E (Int Side)
					33102160		Galls/Shafts/Pits (Ext): Walls U/S of E (Int Side)
				33102300			Formwork - flat
				33102600			Reinforcing Steel
					33102610		Reinforcing Steel
				33102700			Overbreak Concrete & Misc.
					33102710		Overbreak Concrete
					33102720		Waterstops
					33102750		Concrete Heating
			33103000				Mezz. & Parking Area - Slabs on Steel Deck & SOG
				33103100			Concrete
					33103110		PH Intake Side Mezz Slabs @ 25.5 & 34.5 E to C
					33103120		Parking Area Slabs on Grade (Balance)
				33103600			Reinforcing Steel
					33103610		Reinforcing Steel
				33103700			Overbreak Concrete & Misc.
					33103710		Overbreak Concrete
					33103720		Waterstops
		33200000					Superstructure (structure and architecture)
			33200100				Superstructure - Structural Steel
			33200200				Superstructure - Misc. steel (Embed & Non-Embed)
				33200280			Superstructure Steel
				33200290			PH Embedded Misc Parts
			33200300				Superstructure - Architecture
			33200400				Superstructure - Special Doors
		33300000					Draft Tubes Gates, Stoplogs and Hoists
			33300100				Draft Tubes Gates Embedded Parts
			33300200				Draft Tubes Gates
			33300300				Draft Tubes Stoplogs Embedded Parts
				33300390			Draft Tube Stop Logs
			33300400				Draft Tubes Stoplogs
			33300500				Draft Tubes Gates and Stoplogs Hoisting System
		33400000					Building Electrical Services
			33400100				AC Bus Bars and Auxiliary Transformers
			33400200				AC Electrical Distribution 600V and Lower
			33400300				AC Auxiliary Systems c/w Batteries and Chargers
			33400350				Powerhouse Building Electrical Major Equipment
			33400400				Emergency Diesel Generator
			33400500				Lighting and power Outlet System
			33400600				Fire Detection and Alarm System
			33400700				Telephone, Communication and Computer Systems
			33400900				Cable Trays and Conduits
		33500000					Building Mechanical Services
			33500100				Fire Protection System
			33500200				Potable Water System
			33500300				Sanitary drainage System
			33500400				Powerhouse HVAC
		33600000					Powerhouse Crane
			33600100				Overhead Crane
			33600200				Powerhouse Elevators
			33600300				Powerhouse Auxiliary Monorails and Hoists
	34000000						Power Generation
		34009999					Indirect
		34100000					Turbine
			34100100				Governor
			34100200				Turbine Mobile Parts

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
			34100300				Turbine Fixed Parts
			34100400				Spiral Case
			34100500				Embedded Parts
			34100600				Draft Tube Liner
		34200000					Generator
			34200100				Excitation System
			34200200				Rotor, Stator & Rotor Guide Bearings
			34200300				Embedded Parts
			34200400				Genarator Circuit Breaker
			34200500				Isolated Phase Bus
			34200600				High Voltage Equipment (345 kV XLPE Cable, ___)
			34200700				Fire Protection System
			34200800				Acoustic Insulation
			34200900				Brake Jack equipment
		34300000					Electrical Ancillary / Auxiliary Systems
			34300100				DC Power / UPS System
			34300200				MV Systems (601V to 15kV)
			34300300				LV Systems (up to 600V)
			34300400				Unit Service Transformer
			34300500				Station Service Transformers
			34300600				Bus Duct
			34300700				Diesel Generators
			34300800				Fire Protection System
			34300900				Vendor Rep Services
		34400000					Mechanical Ancillary / Auxiliary Systems
			34400100				Service Air System
			34400200				Governor Air System
			34400300				Fire Protection System
			34400400				Pump Drainage System
			34400500				Pump Dewatering System
			34400600				Hydraulic Oil Handling and Filtration System
			34400700				Oily Water Interception System
			34400800				Cooling Water System
			34400900				Service Water System
			34401000				Shaft Seal Water System
			34401100				Piezometer System
			34409999				Indirect
		34500000					Protection, Control and monitoring
			34510000				Protection
			34520000				Control and Monitoring
		34600000					Generator Transformers
			34600100				Suppl & Install Generator Transformers
			34600200				Suppl & Install Spare Transformers
		34700000					Spare Parts and Special Tools
	35000000						Not Used
40000000							Switchyards - General
	40000999						Vendor Representatives services
	41000000						Churchill Falls Extension - General
		41000100					Churchill Falls Switchyard Extension - Civil
			41000110				Civil Works
			41000120				Concrete Works
			41000130				Structural Steel Works
			41000140				Architectural/Buildings
			41000150				Mechanical Services
			41000160				Mechanical Equipment
			41000170				Demolition
		41000200					Churchill Falls Switchyard Extension-Equip & Elec
			41000210				Direct
			41000220				Indirect
			41000999				Indirect
	43000000						Muskrat Falls Switchyard
		43000100					Muskrat Falls 315 KV, AC
			43000110				Muskrat Falls 315 KV, AC Civil works-General
				43000111			Civil Works
				43000112			Concrete Works
				43000113			Structural Steel Works
				43000114			Architectural/Buildings
				43000115			Mechanical Services
				43000116			Mechanical Equipment
				43000117			Demolition
			43000120				Muskrat Falls 315 KV, AC-Equip & Elec
				43000121			Direct
				43000122			Indirect
		43000200					Muskrat Falls Substation TAP, 315/168/25 KV, AC
			43000210				Muskrat Falls Substation TAP, 315/168/25 KV, AC-Ci
				43000211			Civil Works
				43000212			Concrete Works
				43000213			Structural Steel Works
				43000214			Architectural/Buildings
				43000215			Mechanical Services
				43000216			Mechanical Equipment
			43000220				Muskrat Falls Substation TAP, 315/168/25 KV, AC-Eq
				43000221			Direct
				43000222			Indirect
				43000299			Indirect
				43000999			Indirect
	45000000						Soldiers Pond Switchyard

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Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
		45000100					Soldiers Pond Switchyard - Civil
			45000110				Civil Works
			45000120				Concrete Works
			45000130				Structural Steel Works
			45000140				Architectural/Buildings
			45000150				Mechanical Services
			45000180				Mechanical Equipment
		45000200					Soldiers Pond Switchyard - Equipment and Electrica
			45000210				Direct
			45000220				Indirect
		45000300					Protection Panels for 230 KV Line
			45000999				Indirect
60000000							Overland Transmission - General
	61000000						AC Overland Transmission (Towers and foundations)
		61300000					Switchyard to Converter Station
		61400000					Churchill Falls to Muskrat Falls (Gull is not phys
			61401000				Contract 1
				61400010			Survey
				61400020			Geotechnical
				61400030			Access roads and Crossings
				61400040			Clearing and Logging
				61400100			Foundation Works
					61400110		Supply and Install Anchors
					61400120		Supply and Install Grillage
					61400130		Supply and Install Concrete & Rebar
				61400200			Towers
					61400210		Procurement of tower steel (Tower packaged)
					61400220		Procurement of guy wires
					61400230		Transport for construction (handling at yard and t
					61400240		Assembly
					61400250		Erection
				61400300			Insulators and hardware
					61400310		Supply and Install
					61400320		Transport for construction (handling at yard and t
				61400400			Conductors, Reels and Accessories
					61400410		Supply and Install
						61400411	Insulators install
						61400412	Cable puller
						61400413	Cable tensioneur
						61400414	Sag & clamp
						61400415	Anchor Dead End
						61400416	Jumper
						61400417	Brace conductor
						61400418	Move Team Puller-Tensioner
						61400419	Temporary Protection
					61400420		Transport for construction (handling at yard and t
				61400500			Optical Power Ground Wire (OPGW) & Accessories
				61400600			Overhead Shield Wire (OHSW) & Accessories
				61400700			Grounding
				61400800			Remedial Work
				61400900			Auxiliary work (general to one or more sections)
				61400901			Counterweight
					61400905		Material Procurement Logistics
					61400910		Marshalling Yards (Setup and Operation)
					61400915		Construction and EPCM personnel Accommodations
					61400920		Communication
					61400925		Sites Offices and Supervision
					61400930		Laboratory Costs
					61400935		Materials and supply transport
					61400940		EPCM Costs (Site & St-John's)
					61400945		Construction Permitting Costs
					61400950		Other Permitting Costs
					61400955		Construction QA/QC
					61400960		Commissioning and turnover
					61400965		Environmental Monitoring
					61400970		Helicopter costs
					61400975		QA & QC Costs (Nalcor, EPCM & Contractor)
				61401999			Indirects
			61402000				Contract 2
				61402010			Survey
				61402020			Geotechnical
				61402030			Access roads and Crossings
				61402040			Clearing and Logging
				61402100			Foundation Works
					61402110		Supply and Install Anchors
					61402120		Supply and Install Grillage
					61402130		Supply and Install Concrete & Rebar
				61402200			Towers
					61402210		Procurement of tower steel (Tower packaged)
					61402220		Procurement of guy wires
					61402230		Transport for construction (handling at yard and t
					61402240		Assembly
					61402250		Erection
				61402300			Insulators and hardware
					61402310		Supply and Install
					61402320		Transport for construction (handling at yard and t
				61402400			Conductors, Reels and Accessories
					61402410		Supply and Install

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Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
						61402411	Insulators install
						61402412	Cable puller
						61402413	Cable tensioneur
						61402414	Sag.& clamp
						61402415	Anchor Dead End
						61402416	Jumper
						61402417	Brace conductor
						61402418	Move Team Puller-Tensioner
						61402419	Temporary Protection
					61402420		Transport for construction (handling at yard and t
				61402500			Optical Power Ground Wire (OPGW) & Accessories
				61402600			Overhead Shield Wire (OHSW) & Accessories
				61402700			Grounding
				61402800			Remedial Work
				61402900			Auxiliary work (general to one or more sections)
				61402901			Counterweight
					61402905		Material Procurement Logistics
					61402910		Marshalling Yards (Setup and Operation)
					61402915		Construction and EPCM personnel Accommodations
					61402920		Communication
					61402925		Sites Offices and Supervision
					61402930		Laboratory Costs
					61402935		Materials and supply transport
					61402940		EPCM Costs (Site & St-John's)
					61402945		Construction Permitting Costs
					61402950		Other Permitting Costs
					61402955		Construction QA/QC
					61402960		Commissioning and turnover
					61402965		Environmental Monitoring
					61402970		Helicopter costs
					61402975		QA & QC Costs (Nalcor, EPCM & Contractor)
				61402999			Indirects
		61600000					Collector Lines Powerhouse to Switchyard
	62000000						HVDC Overland Transmission
		62200000					Island Overland DC Transmission (IODCT)
			62201000				IODCT Section 1 - 250km from SOBI to PK250
				62201010			Anchor drilling DC Segment.2 WA
					62201020		Supply Anchor bar
					62201030		Helico-Anchor
					62201040		Anchor drilling DC Segment.2 WA
					62201050		Anchor Drilling move srt
					62201060		Grout
					62201070		Manufacturing guys
					62201080		Anchor Test
					62201090		INDIRECTS
				62201100			Foundation DC Segment.2 WA
					62201110		Supply Steel found.
					62201120		Helico
					62201130		Type A-1 250kpa
					62201140		Type A-2 100kpa
					62201150		Type A Roc
					62201160		Type B-1 250kpa
					62201170		Type B-2 100kpa
					62201180		Type B Roc
					62201190		Type C-1 250kpa
					62201200		Type C-2 100kpa
					62201210		Type C Roc
					62201220		Type D-1 250kpa
					62201230		Type D-2 100kpa
					62201240		Type D Roc
					62201250		Type E-1 250kpa
					62201260		Type E-2 100kpa
					62201270		Type E Roc
					62201280		Pile driving
					62201290		Deep found Head pile
					62201300		Change 250kpa to Roc
					62201310		Change 100kpa to Deep
					62201320		Exc Mat Disposal
					62201330		Backfill & Compact
					62201340		INDIRECTS
				62201400			Assembly tower DC Segment.2 WA
					62201410		Supply Steel Tower
					62201420		Helicopter
					62201430		Assembly Type A
					62201440		Assembly Type B
					62201450		Assembly Type C
					62201460		Assembly Type D
					62201470		Assembly Type E
					62201480		INDIRECTS
				62201500			Erection tower DC Segment.2 - WA
					62201510		Helicopter
					62201520		Assembly Type A
					62201530		Assembly Type B
					62201540		Assembly Type C
					62201550		Assembly Type D
					62201560		Assembly Type E
					62201570		Inspection Final
					62201580		INDIRECTS

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Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
				62201600			Counterpoise DC Segment.2 - WA
					62201610		Supply Counterpoise
					62201620		Helico
					62201630		Counterpoise
					62201640		INDIRECTS
				62201700			Conductors(4) DC Segment.2 - WA
					62201710		Supply Insulator
					62201720		Suppy conductor
					62201730		Helico-Cond
					62201740		Insulators install
					62201750		Cable puller
					62201760		Cable tensioneur
					62201770		Sag & clamp
					62201780		Anchor Dead End
					62201790		Jumper
					62201800		Brace conductor
					62201810		Move Team Puller-Tensioner
					62201820		Temporary Protection
					62201830		INDIRECTS
				62201840			OHSW&OPGW (1) DC Segment.2 WA
					62201850		Helico
					62201860		Supply OH-OP
					62201670		Cable OHSW
					62201860		Cable OPGW
					62201882		Fusion OPGW
					62201884		Indirects
				62201890			Indirect DC Segment.2 WA
					62201895		MOB & DEMOB
					62201900		SITE OFFICE
					62201905		PERIODIQUE HOMELEAVE
					62201910		MARSHALLING
					62201915		TRANS. PIER TO MARSHALLING
					62201920		Access Road Class 3
					62201925		Campement 1 &2
					62201930		Campement 3
					62201935		TEAM SUPPORT GENERAL
					62201940		DISTRIBUTION TO THE SITE
					62201945		MAINTENANCE ROAD
					62201950		ADMINISTRATION & PROFIT
			62202000				IODCT Section 2 - 260km from PK250 to PK510
				62202010			Anchor drilling DC Segment.3 WA
					62202020		Supply Anchor bar
					62202030		Helico-Anchor
					62202040		Anchor drilling DC Segment.3 WA
					62202050		Anchor Drilling move srt
					62202060		Grout
					62202070		Manufacturing guys
					62202080		Anchor Test
					62202090		INDIRECTS
				62202100			Foundation DC Segment.3 WA
					62202110		Supply Steel found.
					62202120		Helico
					62202130		Type A-1 250kpa
					62202140		Type A-2 100kpa
					62202150		Type A Roc
					62202160		Type B-1 250kpa
					62202170		Type B-2 100kpa
					62202160		Type B Roc
					62202190		Type C-1 250kpa
					62202200		Type C-2 100kpa
					62202210		Type C Roc
					62202220		Type D-1 250kpa
					62202230		Type D-2 100kpa
					62202240		Type D Roc
					62202250		Type E-1 250kpa
					62202260		Type E-2 100kpa
					62202270		Type E Roc
					62202260		Pile driving
					62202290		Deep found Head pile
					62202300		Change 250kpa to Roc
					62202310		Change 100kpa to Deep
					62202320		Exc Mat Disposal
					62202330		Backfill & Compact
					62202340		INDIRECTS
				62202400			Assembly tower DC Segment.3 WA
					62202410		Supply Steel Tower
					62202420		Helicopter
					62202430		Assembly Type A
					62202440		Assembly Type B
					62202450		Assembly Type C
					62202460		Assembly Type D
					62202470		Assembly Type E
					62202480		INDIRECTS
				62202500			Erection tower DC Segment.3 - WA
					62202510		Helicopter
					62202520		Assembly Type A
					62202530		Assembly Type B
					62202540		Assembly Type C

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Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
					62202550		Assembly Type D
					62202560		Assembly Type E
					62202570		Inspection Final
					62202580		INDIRECTS
				62202600			Counterpoise DC Segment.3 - WA
					62202610		Supply Counterpoise
					62202620		Helico
					62202630		Counterpoise
					62202640		INDIRECTS
				62202700			Conductors(4) DC Segment.3 - WA
					62202710		Supply Insulator
					62202720		Suppy conductor
					62202730		Helico-Cond
					62202740		Insulators install
					62202750		Cable puller
					62202760		Cable tensioneur
					62202770		Sag & clamp
					62202780		Anchor Dead End
					62202790		Jumper
					62202800		Brace conductor
					62202810		Move Team Puller-Tensioner
					62202820		Temporary Protection
					62202830		INDIRECTS
				62202840			OHSW&OPGW (1) DC Segment.3 WA
					62202850		Helico
					62202860		Supply OH-OP
					62202870		Cable OHSW
					62202880		Cable OPGW
					62202882		Fusion OPGW
					62202884		Indirects
				62202890			Indirect DC Segment 3 WA
					62202895		MOB & DEMOB
					62202900		SITE OFFICE
					62202905		PERIODIQUE HOMELEAVE
					62202910		MARSHALLING
					62202915		TRANS. PIER TO MARSHALLING
					62202920		Access Road Class 2
					62202925		Campement 1
					62202930		Campement 2
					62202935		TEAM SUPPORT GENERAL
					62202940		DISTRIBUTION TO THE SITE
					62202945		MAINTENANCE ROAD
					62202947		Mitigation
					62202948		Reamenagement Final
					62202950		ADMINISTRATION & PROFIT
			62203000				IODCT Section 3 - 180km from PK510 to Soldiers Pon
				62203005			Anchor Drilling DC Segment.4 WA
					62203010		Supply Anchor bar
					62203020		Helico-Anchor
					62203030		Anchor drilling DC Segment.4 WA
					62203040		Anchor Drilling move srt
					62203050		Grout
					62203060		Manufacturing guys
					62203070		Anchor Test
					62203080		INDIRECTS
				62203100			Foundation DC Segment.4 WA
					62203110		Supply Steel found.
					62203120		Helico
					62203130		Type A-1 250kpa
					62203140		Type A-2 100kpa
					62203150		Type A Roc
					62203160		Type B-1 250kpa
					62203170		Type B-2 100kpa
					62203180		Type B Roc
					62203190		Type C-1 250kpa
					62203200		Type C-2 100kpa
					62203210		Type C Roc
					62203220		Type D-1 250kpa
					62203230		Type D-2 100kpa
					62203240		Type D Roc
					62203250		Type E-1 250kpa
					62203260		Type E-2 100kpa
					62203270		Type E Roc
					62203280		Pile driving
					62203290		Deep found Head pile
					62203300		Change 250kpa to Roc
					62203310		Change 100kpa to Deep
					62203320		Exc Mat Disposal
					62203330		Backfill & Compact
					62203340		INDIRECTS
				62203400			Assembly tower DC Segment.4 WA
					62203410		Supply Steel Tower
					62203420		Helicopter
					62203430		Assembly Type A
					62203440		Assembly Type B
					62203450		Assembly Type C
					62203460		Assembly Type D
					62203470		Assembly Type E

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Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
					62203480		INDIRECTS
				62203500			Erection tower DC Segment.4 - WA
					62203510		Helicopter
					62203520		Assembly Type A
					62203530		Assembly Type B
					62203540		Assembly Type C
					62203550		Assembly Type D
					62203560		Assembly Type E
					62203570		Inspection Final
					62203580		INDIRECTS
				62203600			Counterpoise DC Segment.4 - WA
					62203610		Supply Counterpoise
					62203620		Helico
					62203630		Counterpoise
					62203640		INDIRECTS
				62203700			Conductors(4) DC Segment.4 - WA
					62203710		Supply Insulator
					62203720		Supply conductor
					62203730		Helico-Cond
					62203740		Insulators install
					62203750		Cable puller
					62203760		Cable tensioneur
					62203770		Sag & clamp
					62203780		Anchor Dead End
					62203790		Jumper
					62203800		Brace conductor
					62203810		Move Team Puller-Tensioner
					62203820		Temporary Protection
					62203830		INDIRECTS
				62203840			OHSW&OPGW (1) DC Segment.4 WA
					62203850		Helico
					62203860		Supply OH-OP
					62203870		Cable OHSW
					62203880		Cable OPGW
					62203882		Fusion OPGW
					62203884		Indirects
				62203890			Indirect DC Segment 4 WA
					62203895		MOB & DEMOB
					62203900		SITE OFFICE
					62203905		PERIODIQUE HOMELEAVE
					62203910		MARSHALLING
					62203915		TRANS. PIER TO MARSHALLING
					62203920		Access Road Class 2
					62203925		Campement
					62203930		Campement 1
					62203935		TEAM SUPPORT GENERAL
					62203940		DISTRIBUTION TO THE SITE
					62203945		MAINTENANCE ROAD
					62203947		Mitigation
					62203948		Reamenagement Final
					62203950		ADMINISTRATION & PROFIT
			62204000				IODCT - Auxiliary work
				62204050			Material Procurement Logistics
				62204100			Marshalling Yards (Setup and Operation)
				62204150			Construction and EPCM personnel Accommodations
				62204200			Communication
				62204250			Sites Offices and Supervision
				62204300			Laboratory Costs
				62204350			Materials and supply transport
				62204400			EPCM Costs (Site & St-John's)
				62204450			Construction Permitting Costs
				62204500			Other Permitting Costs
				62204550			Construction QA/QC
				62204600			Commissioning and turnover
				62204650			Environmental Monitoring
				62204700			Helicopter costs
				62204750			QA & QC Costs (Nalcor, EPCM & Contractor)
			62205000				Clear DC line LRM & Estn Segm 6
				62205010			Feller buncher
				62205020			Manual
				62205030			Stockpiling in Box
				62205040			Acces
				62205050			Fascine stacking
				62205060			Fascine implement
				62205070			Temporary bridge
				62205080			Culverts
				62205090			Maintenance access
				62205100			Team Support
				62205110			Supervision
				62205120			Indirects
			62206000				Clear DC line LRM Segm 5
				62206010			Feller buncher
				62206020			Manual
				62206030			Stockpiling in Box
				62206040			Acces
				62206050			Fascine stacking
				62206060			Fascine implement
				62206070			Temporary bridge

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Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
				62206080			Culverts
				62206090			Maintenance access
				62206100			Team Support
				62206110			Supervision
				62206120			Indirects
			62207000				Clear DC line NL Estn Segm 7
				62207010			Feller buncher
				62207020			Manual
				62207030			Stockpiling In Box
				62207040			Acces
				62207050			Fascine stacking
				62207060			Fascine implement
				62207070			Temporary bridge
				62207080			Culverts
				62207090			Maintenance access
				62207100			Team Support
				62207110			Supervision
				62207120			Indirects
			62208000				Clear DC line NL Estn Segm 8
				62208010			Feller buncher
				62208020			Manual
				62208030			Stockpiling In Box
				62208040			Acces
				62208050			Fascine stacking
				62208060			Fascine implement
				62208070			Temporary bridge
				62208080			Culverts
				62208090			Maintenance access
				62208100			Team Support
				62208110			Supervision
				62208120			Indirects
			62209000				Clear DC line LRM Segm 4
				62209010			Feller buncher
				62209020			Manual
				62209030			Stockpiling In Box
				62209040			Acces
				62209050			Fascine stacking
				62209060			Fascine implement
				62209070			Temporary bridge
				62209080			Culverts
				62209090			Maintenance access
				62209100			Team Support
				62209110			Supervision
				62209120			Indirects
		62700000					Labrador Overland DC Transmission (LODCT)
			62701000				LODCT Section 1 - 160km from MF to PK160
				62701110			Survey
				62701120			Geotechnical
				62701130			Access roads and Crossings
				62701140			Clearing and Logging
				62701150			Foundation Works
					62701151		Supply and Install Anchors
						62700150	Supply Anchor Bar
						62700151	Helicopter Anchor
						62700152	Anchor Drilling
						62700153	Anchor Drilling Move srt
						62700154	Grout
						62700155	Manufacturing guys
						62700156	Anchor Test
						62700157	Indirects
					62701152		Supply and Install Grillage
					62701153		Supply and Install Concrete & Rebar
				62701210			Towers
					62701211		Procurement of tower steel (Tower packaged)
					62701212		Procurement of guy wires
					62701213		Transport for construction (handling at yard and t
					62701214		Assembly
					62701215		Erection
				62701310			Insulators and hardware
					62701311		Supply and Install
					62701312		Transport for construction (handling at yard and t
				62701410			Conductors, Reels and Accessories
					62701411		Supply and Install
					62701412		Transport for construction (handling at yard and t
				62701510			Optical Power Ground Wire (OPGW) & Accessories
				62701610			Overhead Shield Wire (OHSW) & Accessories
				62701710			Grounding
				62701810			Remedial Work
				62701910			Counterpoise
				62701999			Indirect
			62702000				LODCT Section 2 - PK160 to SOBI
				62702110			Survey
				62702120			Geotechnical
				62702130			Access roads and Crossings
				62702140			Clearing and Logging
				62702150			Foundation Works
					62702151		Supply and Install Anchors
						62700250	Supply Anchor Bar

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
						62700251	Helicopter Anchor
						62700252	Anchor Drilling
						62700253	Anchor Drilling Move srt
						62700254	Grout
						62700255	Manufacturing guys
						62700256	Anchor Test
						62700257	Indirects
					62702152		Supply and Install Grillage
					62702153		Supply and Install Concrete & Rebar
				62702210			Towers
					62702211		Procurement of tower steel (Tower packaged)
					62702212		Procurement of guy wires
					62702213		Transport for construction (handling at yard and t
					62702214		Assembly
					62702215		Erection
				62702310			Insulators and hardware
					62702311		Supply and Install
					62702312		Transport for construction (handling at yard and t
				62702410			Conductors, Reels and Accessories
					62702411		Supply and Install
					62702412		Transport for construction (handling at yard and t
				62702510			Optical Power Ground Wire (OPGW) & Accessories
				62702610			Overhead Shield Wire (OHSW) & Accessories
				62702710			Grounding
				62702810			Remedial Work
				62702910			Counterpoise
			62703000				LODCT - Auxiliary work
				62703050			Material Procurement Logistics
				62703100			Marshalling Yards (Setup and Operation)
				62703150			Construction and EPCM personnel Accommodations
				62703200			Communication
				62703250			Sites Offices and Supervision
				62703300			Laboratory Costs
				62703350			Materials and supply transport
				62703400			EPCM Costs (Site & St-John's)
				62703450			Construction Permitting Costs
				62703500			Other Permitting Costs
				62703550			Construction QA/QC
				62703600			Commissioning and turnover
				62703650			Environmental Monitoring
				62703700			Helicopter costs
				62703750			QA & QC Costs (Nalcor, EPCM & Contractor)
			62704000				Clear DC Lab Segm 1 & 2
				62704010			Feller buncher
				62704020			Manual
				62704030			Stockpiling in Box
				62704040			Acces
				62704050			Fascine stacking
				62704060			Fascine implement
				62704070			Temporary bridge
				62704080			Culverts
				62704090			Maintenance access
				62704100			Team Support
				62704110			Supervision
				62704120			Indirects
			62705000				Clear DC Lab Sobi Segm 3
				62705010			Feller buncher
				62705020			Manual
				62705030			Stockpiling in Box
				62705040			Acces
				62705050			Fascine stacking
				62705060			Fascine implement
				62705070			Temporary bridge
				62705080			Culverts
				62705090			Maintenance access
				62705100			Team Support
				62705110			Supervision
				62705120			Indirects
	63000000						Electrode Lines
		63100000					Electrode Line - Labrador
			63101000				Framing Wood Pole LAB
				63101010			Supply Wood Pole
				63101020			Susp. 1 Post
				63101030			Dead End. 1 Post
				63101040			Dead End. 2 Post
				63101050			Dead End. 3 Post
				63101060			Indirects
			63102000				Implement Wood Pole LAB
				63102010			Supply Post
				63102020			Str. Earth 1 Post
				63102030			Str. Rock 1 Post
				63102040			Str. Earth D-end 2 Post
				63102050			Str. Rock 2 Post
				63102060			Str. Earth D-end 3 Post
				63102070			Str. Rock 3 Post
				63102080			Backfill & Compact
				63102090			Indirects
			63103600				Counterpoise DC Elect LAB

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Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
				63103610			Supply Counterpoise
				63103620			Helico
				63103630			Counterpoise
				63103640			INDIRECTS
			63103700				Conductors Electrode Line LAB
				63103710			Supply Insulator
				63103720			Suppy conductor
				63103740			Insulators Install
				63103750			Cable puller
				63103760			Cable tensioneur
				63103770			Sag.& clamp
				63103780			Anchor Dead End
				63103790			Jumper
				63103810			Move Team Puller-Tensioner
				63103820			Temporary Protection
				63103830			INDIRECTS
			63103840				OHSW&OPGW Electrode Line LAB
				63103850			Helico
				63103860			Supply OH-OP
				63103870			Cable OHSW
				63103880			Cable OPGW
				63103882			Fusion OPGW
				63103884			Indirects
			63103890				Indirect DC Electrode Line LAB
				63103895			MOB & DEMOB
				63103900			SITE OFFICE
				63103905			PERIODIQUE HOMELEAVE
				63103910			MARSHALLING
				63103915			TRANS. PIER TO MARSHALLING
				63103925			Campement
				63103935			TEAM SUPPORT GENERAL
				63103940			DISTRIBUTION TO THE SITE
				63103945			MAINTENANCE ROAD
				63103950			ADMINISTRATION & PROFIT
		63200000					Electrode Line - Newfoundland East
			63201000				Framing Wood Pole NL
				63201010			Supply Wood Pole
				63201020			Susp. 1 Post
				63201030			Dead End. 1 Post
				63201040			Dead End. 2 Post
				63201050			Dead End. 3 Post
				63201060			Indirects
			63202000				Implement Wood Pole NL
				63202010			Supply Post
				63202020			Str. Earth 1 Post
				63202030			Str. Rock 1 Post
				63202040			Str. Earth D-end 2 Post
				63202050			Str. Rock 2 Post
				63202060			Str. Earth D-end 3 Post
				63202070			Str. Rock 3 Post
				63202080			Backfill & Compact
				63202090			Indirects
			63203700				Conductors Electrode Line NL
				63203710			Supply Insulator
				63203720			Suppy conductor
				63203740			Insulators Install
				63203750			Cable puller
				63203760			Cable tensioneur
				63203770			Sag.& clamp
				63203780			Anchor Dead End
				63203790			Jumper
				63203810			Move Team Puller-Tensioner
				63203820			Temporary Protection
				63203830			INDIRECTS
			63203890				Indirect DC Electrode Line NL
				63203895			MOB & DEMOB
				63203900			SITE OFFICE
				63203905			PERIODIQUE HOMELEAVE
				63203910			MARSHALLING
				63203915			TRANS. PIER TO MARSHALLING
				63203925			Campement
				63203935			TEAM SUPPORT GENERAL
				63203940			DISTRIBUTION TO THE SITE
				63203945			MAINTENANCE ROAD
				63203950			ADMINISTRATION & PROFIT
71200000							New Synchronous Condenser
	71200100						New Synchronous Condenser-Civil
		71200110					Civil Works
		71200120					Concrete Works
		71200130					Structural Steel Works
		71200140					Architectural/Buildings
		71200150					Mechanical Services
		71200160					Mechanical Equipment
		71200170					Indirect
	71200200						New Synchronous Condenser-Equipment
80000000							DC Specialties
	80009000						Testing for Major Electrical Equipment

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
	82000000						DC Specialties - Converter Stations
		82100000					Labrador Converter Station (near MF)
			82100100				labrador Converter Station - Civil
				82100110			Civil Works
				82100120			Concrete Works
				82100130			Structural Steel Works
				82100140			Architectural/Buildings
				82100150			Mechanical Services
				62100160			Mechanical Equipment
			82100200				labrador Converter Station - Equip&Elec
				82100999			Indirects
		82200000					Soldiers Pond Converter Station
			82200100				Soldiers Pond Converter Station - Civil
				82200110			Civil Works
				82200120			Concrete Works
				82200130			Structural Steel Works
				82200140			Architectural/Building
				82200150			Mechanical Services
				82200160			Mechanical Equipment
			82200200				Soldiers Pond Converter Station - Equip&Elec
				82200999			Indirects
	85000000						DC Specialties - Transition Compounds
		85100000					Transition Compound - Labrador
			85100100				Transition Compound - Labrador - Civil
				85100110			Civil Works
				85100120			Concrete Works
				85100130			Structural Steel Works
				65100140			Architectural/Building
				85100150			Mechanical Services
				85100160			Mechanical Equipment
			85100200				Transition Compound - Labrador - Equip&Elec
				85100999			Indirect
		85200000					Transition Compound - Northern Peninsula (NP)
			85200100				Transition Compound - NP - Civil
				85200110			Civil Works
				85200120			Concrete Works
				85200130			Structural Steel Works
				85200140			Architectural/Building
				85200150			Mechanical Services
				85200160			Mechanical Equipment
			85200200				Transition Compound - NP - Equip&Elec
				85200999			Indirect
	86000000						DC Specialties - Electrodes
		86100000					Electrode Labrador
			86101000				Civil Works
				86101100			Direct
				86101200			Indirect
			86102000				Electrical Works
				86102100			Direct
				86102200			Indirect
		86200000					Electrode Newfoundland East
90000000							Other Specialties - General
	92000008						Operations Telecommunications Systems
		92200000					Operations Telecommunication System - Muskrat Fall
			92200100				Muskrat Falls Microwave System
			92200200				Muskrat Falls Fiber Optic Terminal Equipment
			92200300				Operations Telecommunications Systems
		92300000					Operations Telecommunication System - Island Link
			92300100				Island Link Microwave System
			92300200				Island Link Fiber Optic Terminal Equipment
99000000							ESTIMATOR INDIRECTS
	99100000						DAUBERSMITH - Reinforced Concrete Structures
		99123600					Transition Structures Concrete Indirects
			99123610				Mob & Demob
			99123620				Supervision
			99123630				Temporary Buildings
			99123640				Utilities (Air, Water, Power)
			99123650				Support Equipment
			99123660				Administration & Profit
		99124100					Spillway Concrete Structure Indirects
			99124110				Mob & Demob
			99124120				Supervision
			99124130				Temporary Buildings
			99124140				Utilities (Air, Water, Power)
			99124150				Support Equipment
			99124160				Administration & Profit
		99132200					Intake Concrete Structure Indirects
			99132210				Mob & Demob
			99132220				Supervision
			99132230				Temporary Buildings
			99132240				Utilities (Air, Water, Power)
			99132250				Support Equipment
			99132260				Administration & Profit
		99133100					Powerhouse Substructure Concrete Indirects
			99133110				Mob & Demob
			99133120				Supervision
			99133130				Temporary Buildings

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Description
			99133140				Utilities (Air, Water, Power)
			99133150				Support Equipment
			99133160				Administration & Profit

Appendix 2

Nalcor Physical Component coding structure

Lower Churchill Project

Physical Components by Project

For Use in Coding (Dec14 Edit)

Current Valid	LCP Phase 1	MF Island Link	SLI	Physical Component Code	Physical Component Description	1 - LCP General	2 - Gull Island Generation	3 - Muskrat Falls Generation	4 - Labrador Island Transmission Link (LITL)	5 - Maritime Link	6 - Labrador Transmission Assett (LTA)	7 - Export Transmission	8 - Not Used	9 - Reserved
x	x	x	x	**0000**	**No Physical Component**	X	X	X	X	X		X		
x	x	x	x	**1000**	**Support Facilities - General**	X	X	X	X	X		X		
x	x	x		1010	St. John's Office Facilities - Hydro Place	X	X	X	X	X		X		
x	x	x		1020	St. John's Office Facilities - EPCM and Project	X	X	X	X	X		X		
			?	1030	Office Facilities - Other									
x	x	x	x	**1100**	**Access - General**		X	X	X	X		X		
x	x	x	x	1110	Access Roads		X	X	X	X		X		
x	x	x	x	1111	Access Roads - Construction / Temporary		X	X	X	X		X		
x	x	x	x	1112	Access Roads - Permanent		X	X	X	X		X		
x	x	x	x	1150	Construction Bridges (Includes spillway and site access temp bridges)		X	X	X	X				
x	x	x	x	1160	Barge / Ferry Access		X	X	X	X				
x				**1200**	**Other Permanent Facilities**		X							
x				1210	Permanent Accommodation Building		X							
x				1220	Helipad		X							
x	x	x	x	**1300**	**Construction Power General**	X	X	X	X	X				
x	x			1310	Construction Power - Gull Island		X							
	x	x	x	1320	Construction Power - Muskrat Falls			X						
x	x	x	x	1330	Construction Power - Island Link				X					
x	x			1340	Construction Power - Maritime Link					X				
x	x	x	x	**1400**	**Construction Telecommunications - General**	X	X	X	X	X				
x	x			1410	Construction Telecommunications - Gull Island		X							
	x	x	x	1420	Construction Telecommunications - Muskrat Falls			X						
x	x	x	x	1430	Construction Telecommunications - Island Link				X					
x	x			1440	Construction Telecommunications - Maritime Link					X				
x	x	x	x	**1500**	**Accommodation Complex / Temporary Buildings**		X	X	X					
x	x	x	x	1510	General Site		X	X	X					
x	x	x	x	1511	Recreational Areas		X	X	X					
x	x	x	x	1512	Other Specialties		X	X	X					
x	x	x	x	1520	Buildings - Central Core		X	X	X					
x	x	x	x	1530	Buildings - Dormitories		X	X	X					
x	x	x	x	1540	Buildings - Administration Buildings and Workshops		X	X	X					
x	x	x	x	1550	Buildings - Warehousing		X	X	X					
x	x	x	x	1560	Buildings - Other		X	X	X					
x	x	x	x	1570	Site Services		X	X	X					
x	x	x	x	**1700**	**Housing Facilities**		X	X	X			X		
x	x	x	x	1710	Happy Valley - Goose Bay Housing Facilities		X	X	X			X		
x	x	x	x	**1800**	**Offsite Logistics Infrastructure and Support - General**		X	X	X	X		X		
x	x	x	x	1810	Offsite Marshaling Areas and Warehousing		X	X	X	X		X		
x	x	x	x	1820	Offsite Port Facilities		X	X	X	X		X		
x	x	x	x	1830	Offsite Roads and Bridges		X	X	X	X		X		
x	x	x	x	**2000**	**Reservoir, Diversion, Dam and Spillway - General**		X	X						
x	x	x	x	**2100**	**Reservoir - General**		X	X						
x	x	x	x	2110	Reservoir		X	X						
x	x	x	x	2120	Water Sampling Stations		X	X						
x	x	x	x	2130	Trash Management System (Including Log Booms)		X	X						
x	x	x	x	2140	Reservoir Stabilization		X	X						
x	x	x	x	2150	Water Management System		X	X						
x				**2200**	**Diversion Tunnels - General**		X							
x				2210	Diversion Tunnels		X							
x				2290	Diversion Tunnels - Flow Compensation Facility.		X							
x	x	x	x	**2300**	**Dams and Cofferdams - General**		X	X						
x				2310	Gull Island Main Dam - General		X							
x				2312	Foundations / Diaphragm Wall		X							
x				2313	Dam Embankment		X							
x				2314	Face Slab & Plinth - General		X							
	x	x	x	2320	North Dam			X						
	x	x	x	2330	South Dam			X						
x	x	x	x	2340	Cofferdams		X	X						
x	x	x	x	2341	Upstream Cofferdam		X	X						
	x	x	x	2342	Downstream Cofferdam			X						
x	x	x	x	2343	Riverside Cofferdam		X	X						
x	x	x	x	2360	Transition Structures		X	X						
	x	x	x	2361	North Transition Structure			X						
	x	x	x	2362	Center Transition Structure			X						
	x	x	x	2363	South Transition Structure			X						
x	x	x	x	2370	Dams / Cofferdam Auxiliary Services		X	X						
x	x	x	x	**2400**	**Spillway - General**		X	X						
x	x	x	x	2410	Spillway Structure		X	X						
x	x	x	x	2420	Gates, Guides Stoplogs and Hoist		X	X						
x	x	x	x	2430	Spillway Channels		X	X						

Lower Churchill Project

Physical Components by Project

For Use in Coding (Dec14 Edit)

Current Valid	LCP Phase 1	MF Island Link	SLI	Physical Component Code	Physical Component Description	Major Project Designation: 1 - LCP General	2 - Gull Island Generation	3 - Muskrat Falls Generation	4 - Labrador sland Transmission Link (LITL)	5 - Maritime Link	6 - Labrador Transmission Assett (LTA)	7 - Export Transmission	8 - Not Used	9 - Reserved
x	x	x	x	2440	Spillway Auxiliary Services		X	X						
	x	x	x	2800	North Spur - General			X						
	x	x	x	2810	North Spur - Upstream Berm			X						
	x	x	x	2820	North Spur - Downstream Stabilization			X						
	x	x	x	2830	North Spur - Pump Wells			X						
	x	x	x	2840	North Spur - Crest Unloading			X						
	x	x	x	2850	North Spur - Kettle Lake Stabilization			X						
x	x	x	x	3000	**Power Facilities**		X	X						
x	x	x	x	3100	Power House Channels (Includes Plugs and/or Cofferdams)		X	X						
x	x	x	x	3110	Approach Channel		X	X						
x	x	x	x	3120	Tailrace		X	X						
x	x	x	x	3200	Intake and Penstocks - General		X	X						
x	x	x	x	3220	Intake Structure		X	X						
x	x	x	x	3240	Intake Gates Trash racks Stoplogs & Hoists		X	X						
x	x		x	3250	Penstocks		X							
x	x			3280	Penstocks Construction Adit		X							
x	x	x	x	3290	Intake Auxiliary Services		X	X						
x	x	x	x	3300	Power House		X	X						
x	x	x	x	3310	Substructure		X	X						
x	x	x	x	3320	Superstructure		X	X						
x	x	x	x	3330	Gates Trashracks Stoplogs and Hoists		X	X						
x	x	x	x	3340	Building Electrical Services		X	X						
x	x	x	x	3350	Building Mechanical Services		X	X						
x	x	x	x	3360	Powerhouse Crane		X	X						
x	x	x	x	3400	Power Generation		X	X						
x	x	x	x	3410	Turbine		X	X						
x	x	x	x	3411	Governor		X	X						
x	x	x	x	3420	Generator		X	X						
x	x	x	x	3421	Excitation System		X	X						
x	x	x	x	3430	Electrical Ancillary / Auxiliary Systems		X	X						
x	x	x	x	3431	DC Power / UPS System			X						
x	x	x	x	3432	MV Systems (601V - 15Kv)			X						
x	x	x	x	3433	LV Systems (up to 600V)			X						
x	x	x	x	3434	Unit Service Transformers			X						
x	x	x	x	3435	Station Service Transformers			X						
x	x	x	x	3436	Bus Duct			X						
x	x	x	x	3437	Diesel Generators			X						
x	x	x	x	3440	Mechanical Ancillary / Auxiliary Systems		X	X						
x	x	x	x	3441	Service Air System			X						
x	x	x	x	3442	Governor Air System			X						
x	x	x	x	3443	Fire Protection System			X						
x	x	x	x	3444	Pump Drainage System			X						
x	x	x	x	3445	Pump Dewatering System			X						
x	x	x	x	3446	Hydraulic Oil Handling and Filtration System			X						
x	x	x	x	3447	Oily Water interception System			X						
x	x	x	x	3448	Cooling Water System			X						
x	x	x	x	3449	Service Water System			X						
x	x	x	x	3450	Protection, Control and Monitoring		X	X						
x	x	x	x	3451	Protection			X						
x	x	x	x	3452	Control and Monitoring			X						
x	x	x	x	3460	Generator Transformers		X	X						
x	x	x	x	3470	Spare Parts and Special Tools		X	X						
x		x		3500	Not used		X	X						
x	x	x	x	4000	**Switchyards - General**		X	X	X	X	X	X		
x	x	x	x	4100	Churchill Falls Extension		X				X			
x				4200	Gull Island Switchyard		X					X		
x	x	x	x	4300	Muskrat Falls Switchyard			X						
x	x		x	4400	Taylors Brook Switchyard					X				
x	x	x	x	4500	Soldiers Pond Switchyard				X					
x	x			4600	Maritime Switchyard					X				
x	x			4700	Bottom Brook Switchyard					X				
x	x			4800	Granite Canal Switchyard					X				
x	x	x	x	6000	**Overland Transmission - General**		X	X	X	X	X	X		
x	x	x	x	6100	HVac Overland Transmission		X	X	X	X		X		
x				6110	Gull to Churchill Falls		X							
x				6120	Gull Island to PQ Border							X		
x	x	x	x	6130	Switchyard to Converter Station				X					
x	x	x	x	6140	Muskrat Falls to Churchill Falls			X			X			
x				6150	Maritimes AC Transmission					X				
x	x	x	x	6160	Collector Lines Powerhouse to Switchyard		X	X						
x				6170	Bottom Brook to Granite Canal					X				
x	x	x	x	6180	735 kV AC line at Churchill Falls						X			
x	x	x	x	6200	HVdc Overland Transmission				X	X				

Lower Churchill Project

Physical Components by Project

For Use in Coding (Dec14 Edit)

Current Valid	LCP Phase 1	MF Island Link	SLI	Physical Component Code	Physical Component Description	1 - LCP General	2 - Gull Island Generation	3 - Muskrat Falls Generation	4 - Labrador Island Transmission Link (LITL)	5 - Maritime Link	6 - Labrador Transmission Assett (LTA)	7 - Export Transmission	8 - Not Used	9 - Reserved
						Major Project Designation								
x	x	x	x	6220	Island Overland DC Transmission				X					
x	x	x	x	6221	Section 1 Nfld west				X					
x	x	x	x	6222	Section 2 Nfld central				X					
x	x	x	x	6223	Section 3 Nfld East				X					
x	x			6240	Taylors Brook - Cape Ray					X				
x	x			6250	Maritimes DC Transmission					X				
x	x			6260	Cape Ray to Bottom Brook					X				
x	x	x	x	6270	Labrador Overland DC Transmission				X					
	x	x	x	6271	Labrador Section 1 at MF				X					
	x	x	x	6272	Labrador Section 2 at SOBI				X					
x	x	x	x	6300	Electrode Lines				X	X				
x	x	x	x	6310	Electrode Line - Labrador				X					
x	x	x	x	6320	Electrode Line - Newfoundland East				X					
x	x			6330	Electrode Line - Maritimes					X				
x	x			6340	Electrode Line - Newfoundland West					X				
x	x	x		7000	System Upgrades - General				X	X		X		
x	x	x	x	7100	Island System Upgrades East				X					
x	x	x		7110	Unit Conversion at Holyrood to Synchronous Condensers				X					
x	x	x	x	7120	New Synchronous Condensers				X					
x	x	x	?	7130	Breakers				X					
x	x	x	x	7140	AC Line Rebuilds				X					
x	x	x		7150	Holyrood Plant Modifications				X					
x	x			7200	Island System Upgrades West					X				
x	x			7300	Maritimes System Upgrades					X				
x				7400	Quebec System Upgrades							X		
				7500	Labrador HVGB Upgrades									
x	x	x	x	7510	138 kV (TL240) Rebuild			x						
				7520	315 kV / 138 kV Switchyard at Muskrat Falls			x						
x	x	x	x	8000	HVdc Specialties				X	X				
x	x	x		8100	dc Specialties - Marine Crossings				X	X				
x	x	x		8110	dc Specialties - Marine Crossings - SOBI - General				X					
x	x	x		8111	SOBI Cables Supply				X					
x	x	x		8113	SOBI Landfall				X					
x	x	x		8114	SOBI Protection				X					
x	x			8120	dc Specialties - Marine Crossings - Cabot Strait - General					X				
x	x			8121	Cabot Strait Cable Supply					X				
x	x			8123	Cabot Strait Landfall					X				
x	x			8124	Cabot Strait Protection					X				
x	x	x	x	8200	dc Specialties - Converter Stations				X	X				
x	x	x	x	8210	Labrador Converter Station				X					
x	x	x	x	8220	Soldiers Pond Converter Station				X					
x	x			8230	Maritime Converter Station					X				
x	x			8240	Newfoundland West Converter Station					X				
x	x	x	x	8500	dc Specialties - Transition Compounds				X	X				
x	x	x	x	8510	Transition Compound - Labrador				X					
x	x	x	x	8520	Transition Compound - Northern Peninsula				X					
x	x			8530	Transition Compound - Newfoundland West					X				
x	x			8540	Transition Compound - Maritimes					X				
x	x	x	x	8600	dc Specialties - Electrodes				X	X				
x	x	x	x	8610	Electrode Labrador				X					
x	x	x	x	8620	Electrode Newfoundland East				X					
x	x			8630	Electrode Maritime					X				
x	x			8640	Electrode Newfoundland West					X				
x	x	x	x	9000	Other Specialties - General	X	X	X	X	X				
x	x	x	x	9100	Other Specialties - Habitat Compensation	X	X	X	X	X				
x	x	x	x	9110	Fish Habitat Compensation - General	X								
x	x			9111	Fish Habitat Compensation Gull Island		X							
x	x	x	x	9112	Fish Habitat Compensation Muskrat Falls			X						
x	x	x	?	9113	Fish Habitat Compensation SOBI				X					
x	x			9114	Fish Habitat Compensation Cabot Strait					X				
x	x	x	x	9115	Fish Habitat Compensation Electrode Labrador				X					
x	x	x	x	9116	Fish Habitat Compensation Electrode Newfoundland East				X					
x	x			9117	Fish Habitat Compensation Electrode Maritime					X				
x	x			9118	Fish Habitat Compensation Electrode Newfoundland West					X				
x	x		x	9120	Terrestrial Habitat Compensation - General	X								
x	x			9121	Terrestrial Habitat Compensation Gull Island		X							
x	x	x	x	9122	Terrestrial Habitat Compensation Muskrat Falls			X						
x	x	x	x	9200	Operations Telecommunications Systems	X	X	X	X	X				
x				9210	Operations Telecommunication System - Gull Island		X							
x	x	x	x	9220	Operations Telecommunication System - Muskrat Falls			X						
x	x	x	x	9230	Operations Telecommunication System - Island Link				X					
	x			9240	Operations Telecommunication System - Maritime Link					X				

Appendix 3

CCE Labour Rates

SNC-Lavalin Inc. 2011-12-08
505573 LOWER CHURCHILL MUSKRAT FALLS - FINAL
***

Labor Code	Labor Description	Base Rate	Unit	Tax %	Fringes	Overtime Rule	Per Diem	Total
DR01	Driller	62.71	MH	0.00	0.000		0.00	**62.71**
DR02	Driller Foreman	65.00	MH	0.00	0.000		0.00	**65.00**
DR03	Drill Sharpener	62.26	MH	0.00	0.000		0.00	**62.26**
GFB00	Bricklayer	67.11	MH	0.00	0.000		0.00	**67.11**
GFBM1	Boilmaker	70.33	MH	0.00	0.000		0.00	**70.33**
GFBM2	Boilmaker Apprentice - 4	70.33	MH	0.00	0.000		0.00	**70.33**
GFC00	Carpenter	63.80	MH	0.00	0.000		0.00	**63.80**
GFC01	Carpenter Form Setter	63.80	MH	0.00	0.000		0.00	**63.80**
GFC03	Cement Finisher	63.80	MH	0.00	0.000		0.00	**63.80**
GFCF0	Carpenter Foreman	67.36	MH	0.00	0.000		0.00	**67.36**
GFE00	Electrician	69.61	MH	0.00	0.000		0.00	**69.61**
GFE01	Electrician Apprentice -	69.61	MH	0.00	0.000		0.00	**69.61**
GFEF0	Electrician General fore	77.96	MH	0.00	0.000		0.00	**77.96**
GFEF1	Electrician foreman	75.87	MH	0.00	0.000		0.00	**75.87**
GFI00	Insulator	66.84	MH	0.00	0.000		0.00	**66.84**
GFI01	Insulator Apprentice - 4	66.84	MH	0.00	0.000		0.00	**66.84**
GFIF0	Insulator Foreman	69.60	MH	0.00	0.000		0.00	**69.60**
GFIG0	Insulator General Forema	73.59	MH	0.00	0.000		0.00	**73.59**
GFIGF	Iron Woker General Forem	78.98	MH	0.00	0.000		0.00	**78.98**
GFIW0	Iron Worker Journey Man	68.03	MH	0.00	0.000		0.00	**68.03**
GFIW1	Iron Worker Journey 4th	68.03	MH	0.00	0.000		0.00	**68.03**
GFIWF	Iron Woker Foreman (Reba	78.98	MH	0.00	0.000		0.00	**78.98**
GFIWR	Rigger	63.80	MH	0.00	0.000		0.00	**63.80**
GFL01	Labour Class 1	61.82	MH	0.00	0.000		0.00	**61.82**
GFL06	Labour Class 6	62.26	MH	0.00	0.000		0.00	**62.26**
GFL11	Labour Class 11	63.88	MH	0.00	0.000		0.00	**63.88**
GFLF0	Clearing Foreman	67.38	MH	0.00	0.000		0.00	**67.38**
GFLFOCL	Labour Foreman	67.38	MH	0.00	0.000		0.00	**67.38**
GFM00	Millwrights JP rate	68.95	MH	0.00	0.000		0.00	**68.95**
GFM01	Millwright Apprentice -	68.95	MH	0.00	0.000		0.00	**68.95**
GFMF0	Millwrights Blended fore	72.08	MH	0.00	0.000		0.00	**72.08**
GFMG0	Millwrights General Fore	73.22	MH	0.00	0.000		0.00	**73.22**
GFOF0	Operating Foreman	69.31	MH	0.00	0.000		0.00	**69.31**
GFOF1	Operating Group 1	65.57	MH	0.00	0.000		0.00	**65.57**
GFOF2	Operating Group 2	65.57	MH	0.00	0.000		0.00	**65.57**
GFOF3	Operating Group 3	64.96	MH	0.00	0.000		0.00	**64.96**
GFOF4	Operating Group 4	63.20	MH	0.00	0.000		0.00	**63.20**
GFOF5	Operating Group 5	61.88	MH	0.00	0.000		0.00	**61.88**

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Labor Code	Labor Description	Base Rate	Unit	Tax %	Fringes	Overtime Rule	Per Diem	Total
GFOFB	Blaster/Operator CGC	65.00	MH	0.00	0.000		0.00	**65.00**
GFOFBF	Blaster Foreman CGC	67.00	MH	0.00	0.000		0.00	**67.00**
GFOFH	Blaster Helper	62.26	MH	0.00	0.000		0.00	**62.26**
GFP00	Piperfitters Journey Man	72.27	MH	0.00	0.000		0.00	**72.27**
GFP01	Piperfitters Apprentice	72.27	MH	0.00	0.000		0.00	**72.27**
GFPA0	Painter Foreman	78.09	MH	0.00	0.000		0.00	**78.09**
GFPA1	Painter	59.31	MH	0.00	0.000		0.00	**59.31**
GFPA2	Painter Apprentice - 4th	59.31	MH	0.00	0.000		0.00	**59.31**
GFPF0	Pipefitters Forman	81.00	MH	0.00	0.000		0.00	**81.00**
GFPG0	Painter General Foreman	81.00	MH	0.00	0.000		0.00	**81.00**
GFPGF	Plumbers and pipefitters	81.00	MH	0.00	0.000		0.00	**81.00**
GFRI	Rigger for CGC	70.00	MH	0.00	0.000		0.00	**70.00**
GFSM0	Sheet Metal Foreman	71.32	MH	0.00	0.000		0.00	**71.32**
GFSM1	Sheet Metal Worker	69.10	MH	0.00	0.000		0.00	**69.10**
GFSMG	Sheet Metal General Form	72.83	MH	0.00	0.000		0.00	**72.83**
GFT01	Teamster Group 1	62.51	MH	0.00	0.000		0.00	**62.51**
GFT02	Teamster Group 2	62.89	MH	0.00	0.000		0.00	**62.89**
GFT03	Teamster Group 3	63.28	MH	0.00	0.000		0.00	**63.28**
GFWL	Welder for CGC	65.67	MH	0.00	0.000		0.00	**65.67**
RCOF0	Operating Foreman	68.31	MH	0.00	0.000		0.00	**68.31**
RCOF1	Operating Group 1	64.57	MH	0.00	0.000		0.00	**64.57**
RCOF2	Operating Group 2	64.57	MH	0.00	0.000		0.00	**64.57**
RCOF3	Operating Group 3	63.96	MH	0.00	0.000		0.00	**63.96**
RCT01	Teamster Group 1	61.51	MH	0.00	0.000		0.00	**61.51**
RCT02	Teamster Group 2	61.89	MH	0.00	0.000		0.00	**61.89**
RCT03	Teamster Group 3	62.28	MH	0.00	0.000		0.00	**62.28**
TLC00	Carpenter	64.80	MH	0.00	0.000		0.00	**64.80**
TLDR03	Driller Sharpner	63.26	MH	0.00	0.000		0.00	**63.26**
TLEF0	Electrician General fore	78.96	MH	0.00	0.000		0.00	**78.96**
TLELF	Electrical line Workers	68.21	MH	0.00	0.000		0.00	**68.21**
TLIW0	Iron Worker Journey Man	69.03	MH	0.00	0.000		0.00	**69.03**
TLIWF	Iron Woker Foreman (Reba	79.98	MH	0.00	0.000		0.00	**79.98**
TLL01	Labour Class 1	62.82	MH	0.00	0.000		0.00	**62.82**
TLL11	Labour Class 11	64.88	MH	0.00	0.000		0.00	**64.88**
TLLF0	Labour Foreman	68.38	MH	0.00	0.000		0.00	**68.38**
TLLW	Welder	63.88	MH	0.00	0.000		0.00	**63.88**
TLM00	Millwrights JP rate	69.95	MH	0.00	0.000		0.00	**69.95**
TLOF0	Operating Foreman	70.31	MH	0.00	0.000		0.00	**70.31**

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Labor Code	Labor Description	Base Rate	Unit	Tax %	Fringes	Overtime Rule	Per Diem	Total
TLOF1	Operating Group 1	66.57	MH	0.00	0.000		0.00	**66.57**
TLOF2	Operating Group 2	66.57	MH	0.00	0.000		0.00	**66.57**
TLOF4	Operating Group 4	64.20	MH	0.00	0.000		0.00	**64.20**
TLOF5	Operating Group 5	62.88	MH	0.00	0.000		0.00	**62.88**
TLOFH	Blaster Helper	63.26	MH	0.00	0.000		0.00	**63.26**
TLT01	Teamster Group 1	63.51	MH	0.00	0.000		0.00	**63.51**
TLT02	Teamster Group 2	63.89	MH	0.00	0.000		0.00	**63.89**
TLT03	Teamster Group 3	64.28	MH	0.00	0.000		0.00	**64.28**
TLT04	Teamster Group 4	66.43	MH	0.00	0.000		0.00	**66.43**
TZLF	Lineman Foreman	80.98	MH	0.00	0.000		0.00	**80.98**
TZLM	Lineman	69.03	MH	0.00	0.000		0.00	**69.03**
U	*Labor*	*0.00*		*0.00*	*0.000*		*0.00*	**0.00**

* The total per hour is the base rate + taxes + fringes. It DOES NOT include the workers comp component of burden. If you are using the HCSS automatic worker's comp computation, that component will be added to burden only when the labor cost resource is entered into the estimate.

Labor with a unit other than 'MH' is in italics.

Appendix 4

CCE Equipment Rates

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STANDARD EQUIPMENT LIST

Equip Code	Description	Unit	Type	Rent Rate	EOE	Total	Updated
8AIRCRANE	Helicopter-Air Crane	HR	I	14,500.000	0.000	14,500.000	2011-11-30
8ATJH60	Jackhammer 60#	HR	I	2.000	0.003	2.003	2011-11-11
8ATRB30	Rivet Buster 30#	HR	I	2.000	0.003	2.003	2011-11-11
8BC	Bomag Compactor	HR	I	75.000	0.003	75.003	2011-11-11
8BCT1	Cable Breaker Timberland	HR	I	35.000	0.003	35.003	2011-11-11
8BH225B	Backhoe C/W cat 225B	HR	I	92.000	0.003	92.003	2011-11-11
8BH315	Backhoe 315	HR	I	79.230	0.003	79.233	2011-11-11
8BH320	Backhoe 320	HR	I	94.000	0.003	94.003	2011-11-11
8BH325B	BACKHOE C/W CAT 325B	HR	I	112.900	0.003	112.903	2011-09-29
8BH345B	BACKHOE C/W CAT 345B	HR	I	176.700	0.007	176.707	2011-09-29
8BH365B	BACKHOE CAT 365B	HR	I	240.310	0.000	240.310	2011-09-29
8CABPL45B	CabletteTimberland Pl45b	HR	I	35.000	0.003	35.003	2011-11-11
8CCCCP	CGC Conc Pump	HR	I	300.000	0.003	300.003	2011-11-11
8CCCONCT10	TRUCK CONCRETE 8M3	HR	I	115.290	0.001	115.291	2011-09-29
8CCONCCT36	Concrete Trowel 36"	HR	I	3.000	0.003	3.003	2011-11-11
8CCONCGM16	Grout Mixer 16cf	HR	I	7.000	0.003	7.003	2011-11-11
8CCONCHCGEN	Concrete Hi-Cycle Generator	HR	I	5.000	0.003	5.003	2011-11-11
8CCONCHCVIB	Concrete Hi-Cycle Vibrator	HR	I	2.000	0.003	2.003	2011-11-11
8CCONCP2	TRUCK CONCRETE PUMP R	HR	I	115.290	0.003	115.293	2011-11-11
8CCONCP52	Concrete Pump Boom 52m	HR	I	240.000	0.003	240.003	2011-11-11
8CCONCPTC	Concrete Pump Truck Chassi	HR	I	80.000	0.003	80.003	2011-11-11
8CCONCRS	Concrete Roller Screed	HR	I	50.000	0.003	50.003	2011-11-11
8CCONCVIB	Concrete Vibrator	HR	I	5.000	0.003	5.003	2011-11-11
8CCV	Concrete Vibrator SE	HR	I	10.000	0.003	10.003	2011-11-11
8CH22	Chipper 22 inch	HR	I	214.000	0.003	214.003	2011-11-29
8CMPD0150	Compressor NM 150	HR	I	10.000	0.000	10.000	2011-12-03
8CMPD0185	Compressor Diesel 185 C.F.M	HR	I	20.000	0.003	20.003	2011-11-11
8CMPD0650	Compressor NM 650	HR	I	45.000	0.000	45.000	2011-12-03
8CMPD075	COMPRESSOR DIESEL 750	HR	I	55.970	0.003	55.973	2011-09-29
8CMPD150	Compressor 150 pcm	HR	I	10.000	0.003	10.003	2011-11-11
8CMPD650	Compressor 650 C.F.M	HR	I	45.000	0.003	45.003	2011-11-11
8COB	Compactor Cat 563	HR	I	66.230	0.003	66.233	2011-11-11
8COB850T	VIBRATOR SINGLE DRUM B	HR	I	9.740	0.003	9.743	2011-11-11
8CPT1.8	Cable Puller Timberland P20	HR	I	24.000	0.003	24.003	2011-11-11
8CRANE20	Crane 20 ton RT-58D	HR	I	75.000	0.003	75.003	2011-11-11
8CRHYDC50	CRANE HYDRAULIC 50 TON	HR	I	148.310	0.002	148.312	2011-09-29
8CRMOB100	CRANE MOBILE 100 TON	HR	I	201.980	0.002	201.982	2011-09-29

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STANDARD EQUIPMENT LIST

Equip Code	Description	Unit	Type	Rent Rate	EOE	Total	Updated
8CRTC050	CRANE ROUGH TERRAIN 5	HR	I	124.380	0.003	124.383	2011-09-29
8CRTC100	Crane Rough Terrain 100 Ton	HR	I	200.000	0.003	200.003	2011-11-11
8CRTOW20		HR	I	0.000	0.002	0.002	
8CRW150	CRANE CRAWLER 150 TON	HR	I	233.800	0.003	233.803	2011-09-29
8CRW200	Crane Crawler 200 Ton	HR	I	300.000	0.003	300.003	2011-11-11
8CRW250	CRANE CRAWLER 250 TON	HR	I	331.640	0.004	331.644	2011-09-29
8CRW300	Crane Crawler 300 Ton	HR	I	430.000	0.003	430.003	2011-11-11
8CRWN17	Nodwell 17 ton Crane	HR	I	67.010	0.003	67.013	2011-11-11
8CRWTC	Tower Crane	HR	I	250.000	0.003	250.003	2011-11-11
8CSB16	Chainsaw 16" blade	HR	I	2.800	0.003	2.803	2011-11-11
8CT18T BOOM	BOOM TRUCK 18 TON	HR	I	90.800	0.001	90.801	2011-09-29
8CUTTO	Cutting Torch	HR	I	2.000	0.003	2.003	2011-11-11
8CXLT0106	Lokotrack LT 106 Primary	HR	I	290.000	0.003	290.003	2011-11-11
8CXLT0200	Lokotrack LT 200 Tertiary	HR	I	270.000	0.003	270.003	2011-11-11
8CXLT1100	Lokotrack LT 1100 Secondary	HR	I	304.000	0.003	304.003	2011-11-11
8CXLTSP	Lokotrack Screening Plant	HR	I	170.000	0.003	170.003	2011-11-11
8DD03	Dozer D-3	HR	I	52.100	0.003	52.103	2011-11-11
8DD05	Dozer D-5	HR	I	58.910	0.003	58.913	2011-11-11
8DD05W	Dozer D-5 With Winch	HR	I	77.000	0.003	77.003	2011-11-11
8DD08N	DOZER C/W U-BLADE CAT	HR	I	150.220	0.004	150.224	2011-09-29
8DD09R	DOZER C/W U-BLADE CAT	HR	I	199.190	0.005	199.195	2011-09-29
8DNDM	Drill Manual	HR	I	5.000	0.000	5.000	2011-12-05
8DNM601	Drill NM 601	HR	I	45.000	0.000	45.000	2011-12-03
8DRCHYD7	HYDRAULIC DRILL ROC D7	HR	I	146.280	0.003	146.283	2011-11-11
8DRCHYDR47	HYDRAULIC CRAWLER DRI	HR	I	266.000	0.003	266.003	2011-11-11
8DRM	Drill Manuel	HR	I	5.000	0.003	5.003	2011-11-11
8DRRO601	Drill Rock 601	HR	I	45.000	0.003	45.003	2011-11-11
8EQPFS	Equipment for fuison	HR	I	50.000	0.003	50.003	2011-11-11
8GEN020	GENERATOR DIESEL 20 KW	HR	I	13.870	0.001	13.871	2011-09-29
8GEN05	Generator 5 kw	HR	I	5.000	0.003	5.003	2011-11-11
8GEN060	Generator Diesel 60 KW	HR	I	30.000	0.003	30.003	2011-11-11
8GEN150	GENERATOR DIESEL 150 K	HR	I	62.840	0.004	62.844	2011-09-29
8GR14H	GRADER 14H CAT	HR	I	115.800	0.003	115.803	2011-09-29
8GR14M	Grader 14M	HR	I	144.000	0.003	144.003	2011-11-11
8GR16H	GRADER 16H CAT	HR	I	154.430	0.003	154.433	2011-09-29
8GROUT	Grout Plant	HR	I	20.000	0.003	20.003	2011-11-11
8HELI	Helicopter	HR	I	2,000.000	0.000	2,000.000	2011-11-30

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STANDARD EQUIPMENT LIST

Equip Code	Description	Unit	Type	Rent Rate	EOE	Total	Updated
8HFWFORK05	FORKLIFT 5 TON	HR	I	44.130	0.001	44.131	2011-09-29
8HFWML30	Manlift 30m	HR	I	90.000	0.003	90.003	2011-11-11
8HFWSCISS	SCISSORLIFT RUBBER TIR	HR	I	4.390	0.003	4.393	2011-11-11
8HFWWINCH06	WINCH ELECTRIC 60 TON	HR	I	31.110	0.003	31.113	2011-11-11
8JACKHR	Jackhammer	HR	I	5.000	0.003	5.003	2011-11-11
8JACKLEG	JACK LEG	HR	I	15.000	0.003	15.003	2011-11-11
8LIGHT4	LIGHT TOWER 4 LIGHTS	HR	I	10.200	0.003	10.203	2011-11-11
8LIGHT6	LIGHT TOWER 6 LIGHTS	HR	I	15.690	0.003	15.693	2011-11-11
8LO966F	LOADER CAT 966 3.3 M3	HR	I	76.440	0.003	76.443	2011-09-29
8LO988F	LOADER CAT 966 5.4 M3	HR	I	150.770	0.005	150.775	2011-09-29
8LO992K	Loader Cat 992k 7.0 BCM	HR	I	434.900	0.003	434.903	2011-11-11
8LOLBOBCAT	BOB CAT LIGHT	HR	I	27.660	0.001	27.661	2011-09-29
8LOTCIT38	Tool Carrier IT38 35,000#	HR	I	80.000	0.003	80.003	2011-11-11
8MISCSE	Misc Tools Spillway	HR	I	10.000	0.003	10.003	2011-11-11
8PDHR	Pile Driving Hammer	HR	I	15.000	0.003	15.003	2011-11-11
8PILE10	PILE HAMMER DELMAG DIE	HR	I	70.440	0.001	70.441	2011-09-29
8POHT	Propane Heater	HR	I	2.000	0.003	2.003	2011-11-11
8PUMP03	Water pump 3"	HR	I	3.500	0.003	3.503	2011-11-11
8PUMP04	PUMP SUBMERSIBLE 4"-6"	HR	I	6.910	0.003	6.913	2011-11-11
8PUMP06	PUMP SUBMERSIBLE 6"-8"	HR	I	8.720	0.003	8.723	2011-11-11
8PUMP100	100 Ton Pressure pump	HR	I	10.000	0.003	10.003	2011-11-11
8PW050	Pressure Washer 5000psi	HR	I	15.000	0.003	15.003	2011-11-11
8SHOTCR12	SHOTCRETE EQUIP 0.6 M3	HR	I	30.280	0.003	30.283	2011-11-11
8SK535	Skidder 535	HR	I	136.000	0.003	136.003	2011-11-11
8SOSA	Soldering Station	HR	I	13.000	0.003	13.003	2011-11-11
8SVBUS44	BUS 44 SEATER	HR	I	40.000	0.003	40.003	2011-11-11
8TB	Test Bench	HR	I	25.000	0.003	25.003	2011-11-11
8TD300	Cat 300 Art Dump	HR	I	102.290	0.003	102.293	2011-11-11
8TD725D	TRUCK DUMP CAT 725D 25	HR	I	118.250	0.003	118.253	2011-11-11
8TD769D	TRUCK DUMP CAT 769D 36	HR	I	153.390	0.004	153.394	2011-09-29
8TD773D	TRUCK DUMP CAT 773D 52	HR	I	177.430	0.005	177.435	2011-09-29
8TDT10W	Dump Truck 10 Wheel	HR	I	63.290	0.003	63.293	2011-11-11
8TDYN	Truck Dynamite	HR	I	50.000	0.003	50.003	2011-11-11
8THVTT350	VTT Honda 350cc	HR	I	8.000	0.003	8.003	2011-11-11
8TINJ	TRUCK FOR INJECTION INC	HR	I	80.000	0.003	80.003	2011-11-11
8TPUP001	TRUCK PICK UP 3/4 TON	HR	I	28.440	0.002	28.442	2011-09-29
8TPUP002	TRUCK PICK UP 3/4 TON 4X	HR	I	19.820	0.001	19.821	2011-09-29

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STANDARD EQUIPMENT LIST

Equip Code	Description	Unit	Type	Rent Rate	EOE	Total	Updated
8TR01	Tractor	HR	I	70.000	0.003	70.003	2011-11-11
8TRLTRL18	Trailer Flat Deck 20 Ton	HR	I	6.000	0.003	6.003	2011-11-11
8TRLTRL35	TRAILER LOWBOY 35 TON	HR	I	15.760	0.003	15.763	2011-11-11
8TSP	Truck Snow Plow	HR	I	62.050	0.003	62.053	2011-11-11
8TTRUCK05	TRUCK FLAT BED 5 TON	HR	I	38.910	0.003	38.913	2011-09-29
8TTRUCK12	TRUCK FLAT BED 12 TON	HR	I	50.680	0.003	50.683	2011-09-29
8TW400	CGC Truck w/ Welder 400A	HR	I	100.000	0.003	100.003	2011-11-11
8TWAT4	TRUCK WATER 4000 GAL	HR	I	62.050	0.002	62.052	2011-09-29
8VACUUM	TRUCK VACCUM	HR	I	200.000	0.003	200.003	2011-11-11
8VTT44	VTT 4x4	HR	I	12.000	0.003	12.003	2011-11-11
8W400A	CGC Welder for truck	HR	I	65.670	0.003	65.673	2011-11-11
8WCBUS14	Bus 14 Passenger	HR	I	40.000	0.003	40.003	2011-11-11
8WCCD	Caravan-Diner	HR	I	1.000	0.003	1.003	2011-11-11
8WCCS	Chain Saw	HR	I	1.630	0.003	1.633	2011-11-11
8WCCT	cutting torch	HR	I	2.000	0.000	2.000	2011-12-03
8WCDL322	Delimber 322D FM for RC	HR	I	145.000	0.003	145.003	2011-11-11
8WCFB	Feller Buncher	HR	I	158.000	0.003	158.003	2011-11-29
8WCFB2	Feller Buncher for RC	HR	I	233.000	0.003	233.003	2011-11-11
8WCFE	Fusion Equipment	HR	I	50.000	0.000	50.000	2011-12-04
8WCFT	Fuel Tanker Truck	HR	I	62.050	0.003	62.053	2011-11-11
8WCGN	5kw generator	HR	I	5.000	0.000	5.000	2011-12-03
8WCL320D-1	Loader 320D FM for RC	HR	I	129.310	0.003	129.313	2011-11-11
8WCMK	Muskeg	HR	I	15.000	0.003	15.003	2011-11-11
8WCMKOR	Muskeg Off Road	HR	I	52.000	0.003	52.003	2011-11-11
8WCML	Mulcher	HR	I	150.000	0.003	150.003	2011-11-11
8WCNW	Nodwell	HR	I	67.000	0.003	67.003	2011-11-11
8WCSH2000	Shear 2000	HR	I	32.000	0.003	32.003	2011-11-11
8WCSK	Skidder 610c	HR	I	109.000	0.003	109.003	2011-11-29
8WCSS	Soldering station	HR	I	13.000	0.000	13.000	2011-12-03
8WCTB	Test Bench	HR	I	25.000	0.000	25.000	2011-12-02
8WCTT50	50TN Truck Tractor	HR	I	71.000	0.003	71.003	2011-11-11
8WCTTT	Truck Tractor Trailer for RC	HR	I	135.000	0.003	135.003	2011-11-11
8WCVB	vib a beton	HR	I	5.000	0.000	5.000	2011-12-03
8WCWT	Walki Talki	HR	I	2.000	0.003	2.003	2011-11-11
8WELDD50	Welder Diesel 500 Amp	HR	I	12.000	0.003	12.003	2011-11-11
8WELDE40	WELDER ELECTRIC 400 AM	HR	I	5.960	0.001	5.961	2011-09-29
8WPH	Propane Heater	HR	I	2.000	0.000	2.000	2011-12-04

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STANDARD EQUIPMENT LIST

Equip Code	Description	Unit	Type	Rent Rate	EOE	Total	Updated
8WT1	Wild T-1 & Tripod	HR	I	3.000	0.003	3.003	2011-11-11
8ZBT100	Boom Trk 100' boom	HR	I	200.000	0.003	200.003	2011-11-11
8ZCABL	Cablette de Tirage Timber	HR	I	33.000	0.003	33.003	2011-11-11
8ZCC	Cableway carriage	HR	I	11.000	0.003	11.003	2011-11-11
8ZCHEV	Chevalet Deroulage Timberla	HR	I	3.000	0.003	3.003	2011-11-11
8ZCPBC	Break Cable T25-15	HR	I	35.000	0.000	35.000	2011-12-04
8ZCPTP20	Cable Puller Timb P20	HR	I	24.000	0.000	24.000	2011-12-04
8ZNLT	Norm Lost Time Eq Cost	HR	I	0.000	0.003	0.003	2011-11-11
8ZNTR	Norm Travel Eq Cost	HR	I	0.000	0.003	0.003	2011-11-11
8ZP100	Press 100T	HR	I	10.000	0.003	10.003	2011-11-11
8ZPD	Poulie Deroulage 1 Cable	HR	I	0.850	0.003	0.853	2011-11-11
8ZPTL300	Puller Timberland P-300	HR	I	35.000	0.003	35.003	2011-11-11
8ZRC580	Retro Chrgr 580 Case	HR	I	33.000	0.003	33.003	2011-11-11
8ZRPR	Remorque pour rebobineuse	HR	I	4.570	0.003	4.573	2011-11-11
8ZRT6811	Reenrouleur TL 6811	HR	I	5.360	0.003	5.363	2011-11-11
8ZT1	T1 Wild & Tripod	HR	I	3.000	0.003	3.003	2011-11-11
8ZTENS	Tensioneur Timberland	HR	I	47.500	0.003	47.503	2011-11-11
8ZZFUEL	*Fuel*	*LTR*	*I*	*1.090*	*0.003*	*1.093*	*2011-11-11*
8ZZMISCT	Misc Tools	HR	I	10.000	0.003	10.003	2011-11-11
8ZZOPC	Operating Cost	HR	I	1.000	0.003	1.003	2011-11-11

All costs are per hour.
I/O indicates whether the rent is inside (company) or outside.
Equipment with a unit other than 'HR' is in italics.

Appendix 5

Estimate Ground Rules

Lemay, Paul

To: Lemay, Paul
Subject: Estimate ground rules

Gentlemen,

In order to have a reliable estimate as much as possible and avoid inaccurate pricing, here are the setting rules for all of us:

Most of you will prepare your estimate on an EXCEL format, with the exception of Jim Daubersmith who has the HCSS license, and it is important we follow the same pattern, so it will be easy to transfer the data into HCSS, after.

Each package has a sequence number that relate to a proper physical element and must be carried out for each activity of your estimate items. I am including the general list with an example to follow.

ESTIMATE DETAILS INSTRUCTIONS:

DIRECTS COSTS:

- CONSTRUCTION EQUIPMENT, HOURLY RATE:

  We will use the 2011, first half of the year, of the Equipment Watch, BLUE BOOK edition, and more specifically, **their FHWA**, rates. I will email you the starter list I have prepared, and you can add other pieces of equipment as required, but always from the BLUE BOOK edition. If you do not have this edition, please send me your list of equipment and I will forward you the rates.

  Note for Jim Daubersmith: I put an hourly plug price to start with, for the "Concrete Batch Plant" and the "Crusher", but it must be re-adjust depending of the size we will be using and the production we will need to face. (See details at, OTHERS).

- LABOR RATES:

  We will use the NALCOR Trade Labor Rates that was provided to us and I am forwarding it to all of you. In general we will use a sole rate, including all the fringes and benefit normally carried out here in NL.
  The workings hours will be 10 hrs/day, two shifts and 7 days per week long, on a 21-7 rotation cycle.

- PERMANENT MATERIALS & STS:

  I have prepared a general list of plugs for permanents materials, STS and Subs, you can add some more if you need to.
  The concrete plug price indicated in the PM's list, will be use in the estimate for the small quantities that some of you may have, I am talking less than 200 m3. Same thing for the crushed stone of small diameter for various purpose and again, less than 500 TM (or 300 m3)

- OTHERS:

  A separate price prepared by Jim Daubersmith must be developed and re-imported into the proper item of the estimate under a # item like (# CONCR for the concrete).

For the filtered zone material of the cofferdams and the RCC materials, CGC will prepare a price for the crusher (# CRUSH) and the stockpile zone, and Daubersmith will take is aggregates from these stockpile, since the Concrete Batch plant and the Crusher will be in the same laydown area.

For over break concrete, consider 500 mm horizontal and 300 mm vertically.

INDIRECTS COSTS:

For the indirect costs, I suggest that after you have done it, you enter the total indirect cost on one a line entry on your Direct cost "EXCEL" Summary Sheet, or HCSS entry:
I have include an example (see Appendix I)

- Instructions to follow while making your price:

Mobilization & Demobilization: Assume that "THE CONTRACTOR" will come from a maximum of 2000 km " radius" for travelling purpose of the staff and crew, and for the fleet equipment mobilization, a flat rate of $ 7,500 / trip (ground travel, low boy or highboy)
For air travel, use a $ 700 / trip / person on a 21-7 rotation cycle.
Note: A 1,500 man-camp facilities, will be located at approximately 10 km from the site. Arrange Shuttle bus, for transportation of all craft personal.
Also, an area will be assigned at the camp site for his offices if he desire it, but all the warehouses, mechanical shop, garage will be at the lay down area approximately 2 km from the construction site.

Supervision: We will use a unique all inclusive rate per week / per person (covering fringes, overtime (70-hrs), remoteness premium, bonus, etc). I have included a list of the main position and the *all inclusive rate* to use as follow:

Project Manager: $ 6,000
General superintendant: $ 5,500
Field engineer: $ 4,000
Intermediate engineer: $ 4,000
Secretary: $ 2,000
Administrator/ accountant: $ 3,500
Inspector: $ 3,500
Quality engineer: $ 3,000
Planner: $ 3,000
Draftsman: $ 2,800
Cost engineer: $ 3,000
Surveyors: $ 3,500

Temporary buildings set-up & dismantle: No particular comment, but don't forget to include provision for winter protection if applicable!

Utility supply (air, water and power):

Air: Use diesel or electric compressor at 0.08 / kw-hr and $ 1,50 / liter for the piece of equipment not mention in the main Equipment list.
Water: Industrial water can be obtained direct from the river for the construction needs and potable water will be available at the camp site.
Electricity: A supply of 2,0 MVA will be available at the lay down area located at approximately 2 km from the site, mainly for the concrete batch plant and the crusher equipments. However, at the site itself, the power available should be around 0,5 MVA.

For the peak needs, use propane gas (ex: winter shelter heating)

Job cars & pick-up and support equipment:

Use shuttle to transport workers at site. Pick-up for superintendant, quality control & survey are recommended, but not all staff of the contractor.

Job office expenses: I suggest you use a dollar figur, for each craft hour of the job.

Administration fees: (head office expense, overhead & profit)

Contingency: Do not include anything at this item.

Paul Lemay, p.eng
Lead Estimator.

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