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Subject: *Confidential: IE Report (October 21) - Email 1 of 2
Date: Tuesday, November 5, 2013 5:23:56 PM
Attachments: _.png
IE Report - all but Section 4 (Draft) (October 21, 2013).PDF

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----- Forwarded by James Meaney/NLHydro on 11/05/2013 05:23 PM -----

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Date: 11/02/2013 02:40 PM

Subject: LCRP - Confidential - IE Report (October 21) - Email 1 of 2 [IWOV-Legal.FID1816602]

Hi Jim,

In light of your comments to the O/S items list, it has come to our attention that you are not in receipt of the latest version of the IE Report dated October 21. In the interest of time, due to the calls and meetings commencing on Monday, we have attached the latest version to this email and ask that you keep it confidential and do not relay this information or confirm to any other parties that you are in receipt of this report. We are in process of finding out why it was not provided to you and obtaining MWH's okay to pass it along (which should not be an issue but again, as noted above, time is of the essence and so we are sending it along now).

I am sending the report in two separate emails. This attachment contains all of the report but for section 4, which will follow in my next email.

Many thanks,

Suhuyini

Suhuyini Abudulai

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IE Report - all but Section 4 (Draft) (October 21, 2013).PDF

INDEPENDENT ENGINEER'S REPORT

LOWER CHURCHILL PROJECT

DRAFT- OCTOBER 21, 2013

Prepared for:

Government of Canada

Prepared by:

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MUSKRAT FALLS GENERATING STATION AND LABRADOR TRANSMISSION ASSETS

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SECTION 1

MUSKRAT FALLS GENERATING STATION AND LABRADOR TRANSMISSION ASSETS

1.1 INTRODUCTION

The Lower Churchill Project (LCP) is a proposed large, important energy generating and transmission facility of regional and national significance to Newfoundland and Labrador, Nova Scotia, and the federal government of Canada (Government). When completed, the LCP will have a capacity to generate and transmit more than 824 megawatts (MW) of electricity at an initial capital cost of approximately $6.2B[1].

The purpose of this report is to provide Independent Engineer's (IE) opinions to support the financing of the LCP using long-term bonds that will be guaranteed by Canada's best-in-the-world credit worthiness, rated AAA. To that end, this report presents professional opinions that the estimated construction and operations costs are reasonable, that the estimated construction schedule is reasonable, and that projected financial results of operations will generate sufficient net revenues to repay the debt, including revenues to meet debt service coverage requirements as well as to properly operate and maintain the LCP facilities.

Nalcor Energy (Nalcor) selected MWH Canada, Inc. (MWH) to prepare this Independent Engineer's Report (IER) and additional services pertaining to construction monitoring and long-term monitoring services after the LCP has been placed in commercial operation. MWH has no financial ties to Nalcor aside from the agreement to prepare this report (Nalcor/MWH Agreement). MWH has no fiduciary relationship with other firms involved with the LCP or interest in the sale of bonds to finance the LCP.

1.2 PROJECT DATA AND COMMUNICATIONS PROTOCOLS

1.2.1 Contacts

The Nalcor/MWH Agreement was signed on August 27, 2012. A kickoff meeting was held on September 13 and 14, 2012 in St. John's, Newfoundland. Nalcor selected Mr. Lance Clarke, Project Commercial Manager, Lower Churchill Project to be MWH's principal contact during the duration of the IE's review and preparation of the IER. Mr. James Meaney, CFA, General Manager Finance, was also designated as another principal contact. Additionally, Mr. Ross Beckwith, Nalcor's Commercial Coordinator, was also designated as a contact for discussions. Mr. Peter Madden has been the day-to-day contact for MWH. For all issues pertaining to the Nalcor/MWH Agreement, Mr. Nicholas Argirov, MWH Vice President, has been the principal

[1] The reader is advised that within this report, all dollars given are Year-2012 and Year-2013 Canadian Dollars, depending on the award date

Nalcor contact. Rey Hokenson is MWH's day-to-day contact and is the project manager (PM) for this assignment.

1.2.2 Documents

On September 7, 2012, MWH transmitted a list of documents to be provided by Nalcor for the IE's review. The request indicated that MWH wished to receive hard copies of all of the documents that Nalcor expected MWH to review, including two copies of each document along with two CDs or DVDs of the data for further copies to be made by MWH for each of its principal offices in Vancouver, BC and Bellevue, WA. Nalcor subsequently requested that MWH use Nalcor's data room to obtain the information. Because of difficulties encountered in downloading information and to print and save documents for future assessments using the data room, MWH requested an additional system be employed to review data. In response to MWH's request, Nalcor gave permission for MWH to use the Aconex on-line project management system. The Aconex system greatly facilitated information gathering.

1.2.3 Project Schedule

The Project Milestone Schedule for the preparation and award of the numerous contracts that will be prepared by Nalcor and the Engineering, Procurement, and Construction Management (EPCM) Consultant is given in Appendix A. The IE's Execution Plan has been tailored to accommodate the Project Milestone Schedule.

Given contractual responsibilities pertaining to reporting, wherein MWH would be reporting directly to the Government's representatives rather than Nalcor's for future phases of work, MWH would expect that new data-handling protocols may be required for MWH to follow. Additionally, new procedures may need to be established to gain access to contracts and other data required for the IE's review.

1.3 PROJECT DESCRIPTION

The history of the LCP dates to the early 20th century when it was envisioned that a series of hydroelectric projects would be developed on the Hamilton River (now the Churchill River). During the mid-1960s an earnest effort was made to plan for the development of this valuable resource when Labrador and Newfoundland were in need of power. At that time electricity demand was growing by more than 10 percent per year. The plan was to construct the first project, Churchill Falls, on the Churchill River upstream of the LCP for supplying power to Newfoundland Island in 1972, and then to construct the LCP following completion of the 5,428 MW Churchill Falls Generating Station. The Churchill Falls Project commissioned its first unit in 1971 to feed power to Newfoundland. The Churchill Falls Project provides about 65% of the power available from the Churchill River, with the remaining 35 percent coming from two proposed power stations, Gull Island and Muskrat Falls. Muskrat Falls has been sized to provide 824 MW, while Gull Island has been sized to provide 2250 MW.

The first phase of the LCP is to construct a new dam and power station in Labrador at Muskrat Falls; a new 350 kV HVdc transmission line between the Muskrat Falls switchyard and Soldiers Pond converter station located West of St. John's, Newfoundland, which includes a subsea crossing of the Strait of Belle Isle (Appendices B Location Map and C Transmission Line Routes). Additionally, the Muskrat Falls switchyard will be connected to the Churchill Falls switchyard through an extension of the Churchill Falls yard. A 345 kV HVac line will be used. The subsections following this general description more fully describe the LCP features.

The Phase I development also provides for the construction by Emera, a large energy and service company based in the northeastern United States and Canada, of a new maritime transmission link between Newfoundland and Nova Scotia employing a 180 kilometer (km)-long subsea cable system that allows LCP power to be used in Nova Scotia. The Emera project is not intended to be included in this review by the IE; it is covered in a separate IER. The second phase of the LCP is construction of Gull Island.

1.3.1 Muskrat Falls Generating Station

The Muskrat Falls Generating Station (MFGS) consists of several primary components: a powerhouse with an integral intake structure; a vertical-gated auxiliary spillway; an overflow service spillway fitted to the north roller compacted concrete (RCC) dam; a south rock-fill embankment dam; a project switchyard; and protective works located in the left abutment (North Spur) to control seepage. The MFGS will be serviced by a new 21 km access road that connects the project to Highway 510, south of the Churchill River bridge crossing and by a road that connects the north abutment area to Highway 500, Trans-Labrador Highway to Churchill Falls. The powerhouse substructure is reinforced concrete with a structural steel superstructure. The reinforced concrete intake structure, integral with the powerhouse, will be fitted with three service gates and three bulkhead gates, located upstream of the service gates, for each of the four intake bays. The installed capacity of the powerhouse will be 824 MW with each of the four generating units rated at 229 megavolt amperes (MVA) with a 0.9 Power Factor at 39 meters net head.

The spillway consists of two components: (1) a reinforced concrete five-bay structure, fitted with 10.5-meter-wide by 22-meter-high vertical lift gates, and (2) a 425-meter-long, ogee-shaped overflow RCC spillway. The spillway sections acting in combination can pass the Probable Maximum Flood (PMF) of 25,060 cubic meters per second (cms) at El. 45.1. The overflow spillway is normally used to pass flows that exceed the powerhouse hydraulic capacity of 2,660 cms.

The protective works located in the left abutment include a slurry wall constructed to bedrock to control seepage from the reservoir and local groundwater, and include shoreline bank protection to prevent erosion from ice heave and abrasion, and wind-induced waves.

The Muskrat Falls powerhouse and switchyard will be connected to the Trans-Labrador Highway by an access road located on the south side of the Churchill River (Appendix D List of Contracts Planned to be Issued by Nalcor Energy).

1.3.2 Labrador Transmission Assets Project

Near the powerhouse, the Muskrat Falls switchyard will be constructed to transmit power via two 315 kV HVac overhead transmission lines to the 350 kV HVdc converter station. Four feeder lines will be used; two feeders will be connected to the converter transformers and two feeders will connect to the filters. These lines are part of the Labrador Transmission Assets Project (LTAP) which is 1,100 km long. Each of these lines is to have a capacity of 900 MW (Appendix E Site Plans, One-Line Diagrams, Powerhouse Control System).

The Muskrat Falls switchyard will also connect to the Churchill Falls switchyard that will be extended to accommodate the interconnection from Muskrat Falls and to Gull Island. Two 315 kV HVac overhead transmission lines will be used for this line. Provisions will be made for Gull Island interconnection which are included for later use. One of the lines will have one overhead ground wire (OHGW) and one optical ground wire (OPGW), and the second line will have two OHGWs.

The Churchill Falls switchyard will extend the existing 735 KV bus with bus coupling circuit breakers. Two 833 MVA, 735-345 kV auto-transformers will be used with tertiary windings rated at 13.8 kV to supply the substation service loads. This extension will be located approximately 500 meters east of the existing Churchill Falls switchyard and will include space for future 735 kV and 345 kV line feeders. This complex will also include two 735 kV transmission lines, each 500 meters in length to join the existing Churchill Falls switchyard to the Churchill Falls switchyard extension.

Twin 350 kV HVdc lines between Muskrat Falls and the Strait of Belle Isle (SOBI) will be used. Again, each line will have the capacity of 900 MW that will allow the Muskrat Fall power station entire plant load to be transmitted on one line. The lines will be carried on lattice steel towers with self-supported angles and dead-ends and with guyed suspension towers. Each of the lines will have overhead lightning protection with one being an OPGW for the operations telecommunication system. Two electrode lines each 380 km long between Muskrat Falls and the electrode station will be employed and will also be mounted on the transmission towers. The Muskrat Falls powerhouse step-up transformers will be connected to the switchyard using overhead lines supported on steel lattice towers.

1.3.3 Labrador Island Link Project

The Labrador Island Link Project (LIL) (by Emera) will consist of a converter station located at Muskrat Falls, a transmission link fr

om Muskrat Falls switchyard to the SOBI, 380 km long, a transition station at the Labrador side of the SOBI from the transmission line to a submarine cable, a submarine cable under the SOBI, a transition station on the Newfoundland side of the SOBI from the submarine cable to an overhead transmission line, a transmission line from the SOBI to Soldiers Pond, and a converter terminal station located at Soldiers Pond, west of St. John's. The transition station (compound) at Shoal Cove will include an enclosed building and provision for the submarine cable termination system and associated switching equipment. Also included will be control, protection, and monitoring and communication equipment within the building (Appendix E Site Plans, One-Line Diagrams, Powerhouse Control System).

The converter stations at Muskrat Falls and Soldiers Pond will be designed as automated, remotely controlled facilities. The direct current (DC) system will be a point-to-point +/- 350 kV Land Cover Classification (LCC) bi-pole from Muskrat Falls to Soldiers Pond. During a converter pole outage, the HVdc system will immediately and automatically reconfigure to operate as a monopole, with a metallic return without interruption to the service using sea electrodes installed at Conception Bay.

This project also includes a 350 kV HVdc, 900 MW submarine cable system that will extend from Forteau Point, Labrador to Shoal Cove, Newfoundland across the SOBI. The offshore component will consist of three submarine HVdc MI cables; one of the cables will be used as a spare. Each of the cables will be installed on the seafloor with approximately 150 meters of separation and all within a 500 meter wide by 34 Km long corridor. Each of the cables will carry 450 MW with a rated capacity of 100 percent overload for 10 minutes and 50 percent overload for continuous operation. The water depth along the subsea transmission corridor varies between 60 meters to 120 meters. The cables will be protected along the length by a rock berm and the route was selected to avoid iceberg contact. The undersea cables will extend through steel pipe encasements in bored holes to protect the cables in the heavy ice and surf zones. The cables will be trenched underground about 2 meters depth to two transition compounds that will be located approximately 1 km from the land entry locations. The transition compounds contain the cable terminations, switch gear and transition to the overhead line transmission system.

A shoreline pond electrode system will be located on the Labrador side of the SOBI. An electrode system pond will be located on the east side of Conception Bay near Soldiers Pond; the electrode line is 10 km long from Soldiers Pond to Conception Bay. The electrode ponds allow the transmission system to operate as a monopole system if one of the conductors is not functioning.

The switchyard at Soldiers Pond will interconnect eight 230 kV HVac transmission lines (four existing transmission lines looped in), and the synchronous condensers and the Soldiers Pond Converter Station. The upgrade at Soldiers Pond will include three new 175 megavolt ampere reactive (MVAR) high-inertia synchronous condensers, 230 kV and 138 kV circuit breaker

replacements, and replacement of conductors and reconstruction of eight transmission lines entering and leaving the switchyard.

Information pertaining to the Maritime Link Transmission Project to be constructed and financed by Emera will be found in a separate report prepared for the Government responsible for its financing.

1.4 REVIEW OF CONSTRUCTION PROGRESS

An initial project site visit was scheduled for September 2012, but because of the lack of construction activities pertaining to contracts that MWH would be reviewing as part of their assignment, the site visit trip was postponed until September 24-26, 2013. This postponement also gave representatives of the Government an opportunity to partake in the viewing of the progress of the work to that date with the IE's principal technical representatives in attendance.

Currently there are only two major construction contracts under way. The contract dealing with the southerly access road is completed. Of about 21 km of access road to be built, MWH understands that it is nearly finished. Additionally, the Bulk Excavation Contract has been initiated, and progress has reached 90 percent. The first scheduled excavation blast occurred during early February 2013. The three Daily Site Reports recording progress in early June 2013 did not contain quantitative information.

Section 2 of this IER contains observations made during the site visit conducted in September 2013. Subsequent discussions between Nalcor's senior representative and the IE indicate that there may be additional site visits due to the Project Schedule and the need and desire to have participation of the Government after financial close.

SECTION 2

SITE VISIT AND OFFICE INTERVIEWS

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SECTION 2

SITE VISIT AND OFFICE INTERVIEWS

2.1 SITE VISIT

As noted in Section 1, MWH did not visit the site because of the late start due to the delay in Project sanctioning, and lack of site work that would be beneficial for the IE to view. MWH had tentatively agreed with Nalcor to schedule a site visit in July or August 2013. We believed that work would in full progress on the bulk excavation and the construction camp would also be available to view. This trip was again postponed and the site visit occurred on September 24-26, 2013. Our Agreement with Nalcor requires only one site visit, but during one of our conversations it was suggested by the IE that a couple of more visits be scheduled since this would provide a better opportunity to gauge progress and allow the Government of Canada's representatives to also view the work-in-progress prior to the financial close. We do not plan to conduct another site visit before financial close unless Government requires another visit to be conducted.

2.2 GENERAL

Two members of MWH, as part of the IE's team, attended a project briefing and participated in a site visit to the Muskrat Falls project during September 24-26, 2013. The project briefing was carried out by project designers and supervisory staff in the SNC-L/Nalcor project offices in St. John's on September 24, 2013. SNC-L has an EPCM Agreement with Nalcor and currently is providing the design services for Muskrat Falls. The date of the EPCM Agreement is February 2011. SNC-L works with Nalcor in an Integrated Project Team to manage this Project. (Refer to Section 4.) The briefing presentations covered the main aspects of the safety programs, geotechnical and civil design, field conditions, and site facilities and construction progress of the powerhouse and spillway excavations and cofferdam construction.

Site visits to the Muskrat Falls project were made on September 25 and 26, 2013. The site visit included tours of the North Spur, cofferdams, spillway, and powerhouse/tailrace channels and the project infrastructure. Most of the project construction work viewed was being completed as part of ongoing work associated with Contract CH-006. These visits were guided by Nalcor and SNC-L. Separate discussions were held about blasting, geology, and rock slope stability with SNC-L of the project geology/geotechnical engineering team.

Principal observations and comments on the active geotechnical construction and design works are presented in the following subsections. Photographs taken during the site visit are included in Appendix F Photographs and Artist Rendering.

2.2.1 North Spur

2.2.1.1 General

The North Spur is a 1000 m long, 500 m wide and 45 to 60 m high ridge that connects the Muskrat Falls rock knoll to the north bank of the river (Photograph 3, Appendix F). When the reservoir is impounded, this feature will form a natural dam and become a major part of the river impoundment system. The feature is composed of unconsolidated mixed sand and marine silt/clay sediments. The depth to bedrock underneath the spur is in the range of 200 to 250 m. It contains a significant amount of glacio-marine silt-clay sediments, including horizons of highly sensitive clay strata, mixed with some sandy layers. The sensitive marine clays, which are similar to those found in Quebec and Norway, are susceptible to rapid strength loss, liquefaction and deep-seated progressive rotational failures when overstressed.

The upstream and downstream slopes of this feature are subject to ongoing river erosion and mass wasting. This has contributed to local slope over-steepening of the slope, which triggers rotational sliding on both the downstream and upstream sides of the spur. Past studies indicate multiple small-to-large slide events have occurred during the recent centuries. A significant landslide took place on downstream slope of the North Spur in 1978 (Photographs 4 and 5, Appendix F). During 1980, it was determined that the natural mass wasting processes could be arrested by controlling the water table with a pumped well system. A line of pumped wells was installed in the center of the spur in 1981, and continues to operate to present times.

2.2.1.2 Site Visit Observations

A brief site visit was made on September 24 to the plateau on top (Photograph 4, Appendix F) and the scarp of the 1978 slide (Photograph 5, Appendix F). The drilled wells were viewed and found to be satisfactory; these are currently in operation. The slide is covered with vegetation indicating no significant activity for at least the past 25 years. As can be seen in photos, fine-to-medium sand is exposed in the crest of the slide scar. Large tilted and eroded blocks of cohesive soil could be seen at the toe (Photograph 6, Appendix F), adjacent to the river shoreline.

2.2.1.3 Technical Issues

After reservoir impoundment, long-term seepage and slope stability characteristics of the spur should be similar to a modern dam. Measures are needed to achieve the following: (a) control piezometric (i.e., water surface) levels; (b) control seepage across the wier; and (c) stabilize the upstream and downstream slopes. During the September 24, 2013 briefing in St. John's, design staff indicated that the following measures are planned.

- Construction of an upstream cut-off wall and blanket to block water seepage from the reservoir. The cut-off wall (plastic cement slurry wall) will be connected to the clay formation that extends beneath the river level. The troublesome layer is mostly above

current river level (sensitive silty clay) and contains many sand layers, which could transmit water across the spur.

- Construction of an extension to the cut-off wall across the north end of the spur to cut off seepage from the high ground north of the river.
- Perform excavation to achieve local top cutting unloading by excavation of the top of the spur and the upper slope to improve sliding slope stability.
- Construct a downstream erosion protection and downstream stabilizing fill on the lower downstream slope.
- Install an impermeable geomembrane on the ground surface to minimize direct infiltration from precipitation.
- Provide toe relief drains and a major drainage trench for further lowering of the water table.
- Provide downstream erosion protection and downstream stabilizing fill in selected areas to improve local toe stability and eliminate potential for retrogressive failures due to presence of sensitive marine clays in the upper clay unit.

Current plans are to discontinue the pumping of the dewatering wells; this pumping will be discontinued when the reservoir is impounded at the end of the stabilization program. However, the pumped wells will be left operational at the end of construction. If the scheduled water table monitoring shows that the groundwater table is not sufficiently controlled by the impervious blanket and cut-off walls, pumping will be resumed. The criteria for this decision have not been made available for this review.

2.2.1.4 Comments and Queries

Based on the IE's current understanding of the technical issues, the following clarifications given in Table 2-1 need to be addressed.

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Table 2-1

North Spur Questions

Item No.	Topic	Questions	Integrated Project Team Response
1.	Slope Stability	a. Are the current designs backed up by new stability analyses? b. Have progressive failure mechanisms and/or other considerations appropriate for sensitive clays been considered? c. Have any finite element analyses been carried out in this regard? d. It would be useful to see if the analyses have quantified the impact of the various remediation measures that have been proposed; can Nalcor furnish the analyses?	a. b. c. d.
2.	Seepage Analyses	a. Can Nalcor provide the new seepage analyses showing the impact of the upstream blanket and plastic cement cutoff wall (i.e., with and without this installation)?	a.
3.	Piezometer Levels after Impoundment	a. Please provide the impact of increased piezometric pressures on the lower clay relative to the current saturation levels. b. Does this increase in piezometric pressure change the properties of clays whose water contents are greater than their liquid limits?	a. b.
4.	Operation of Pumped Wells during Reservoir Operation	a. It is understood that the operation of the pumped wells will be	a.

Item No.	Topic	Questions	Integrated Project Team Response
		discontinued once all of the stability measures have been completed. This decision will be subject to piezometric levels as indicated by monitoring. Has the project group established “trigger” piezometric levels that will indicate that pumping must resume?	
5.	Landslide Generated Wave in Reservoir	a. The reservoir contains at least 15 old and relatively recent landslide scars. Future landslides are likely after impoundment. It is understood that earlier studies have computed that a 4.5 m wave can be generated by the rapid failure of a 50 Mm^3 landslide. Is this the maximum wave for stability calculations and overtopping assessments? b. Has there been an evaluation of the impact of a severe landslide generated wave on the planned slope protection measures on the upstream slope of the spur?	a. b.
6.	Earthquake Criteria	a. Has the 0.09 PGA earthquake ground motion value (damsite, hard rock NEHRP A type site) been increased for seismic analyses of the overburden terrain of the spur (overburden NEHRP D type site)?	a.
7.	Liquefaction Analyses of Sensitive Silt/Clay	a. Have liquefaction analyses for earthquake loadings been carried out for the sensitive silt/clay slopes? b. Have the unique properties of the	a.

Item No.	Topic	Questions	Integrated Project Team Response
		sensitive silt/clays been evaluated and what tests were performed? c. Has a summary report been prepared? Please furnish MWH a copy for our review.	
8.	Planned Monitoring Program	a. Has a long-term monitoring program for recording instrument data and visual observations been produced? It would be useful to see details of this, particularly plans for continuing technical evaluation of the results.	a.

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2.2.2 Cofferdams

2.2.2.1 General

Construction work was in progress on the RCC cofferdam (Photographs 7, 8, and 9, Appendix F) and on fill cofferdams No. 1 and No. 2 (Photographs 10 and 11, Appendix F). At the time of the site visit, the RCC cofferdam was approximately 40 to 50 percent complete and the fill cofferdams were about 20 percent complete. These structures are scheduled for completion by the first week of November, 2013. A discussion of these structures is given in the following sections.

2.2.2.2 RCC Cofferdam

The RCC cofferdam is well advanced, as can be seen on the photographs. As decided by the contractor, this structure is being constructed in three separate sections, which will then be joined together into one continuous structure. Photographs 7 and 8 show the upper levels are being formed in layers with wooden formworks.

The RCC properties are judged to be satisfactory and detailing of the structures is satisfactory. It is understood that the RCC mixture currently being used has a 12-day strength of 12 MPa. The tops of the two higher sections are still a few meters below the planned crest level of El. 21 m for this phase of the work.

Photographs 9a, 9b, and 9c show details of the pre-formed tension joints (contraction joints). These joints are being constructed by inserting plastic sheeting into the RCC in each lift. As can be seen on Photograph 9c, water-stops are being installed at the outer (upstream) end of each joint to reduce leakage, which is typical for this type of construction.

2.2.2.3 Embankment Cofferdams

Fill placement was being placed for Cofferdam No. 2, near the downstream end of the RCC cofferdam and at Cofferdam No. 1 at the upstream end. The impervious core consists of compacted grey, silty-sand till. Pit-run sandy gravel is being placed in the upstream transition zone and blasted rockfill is used in the upstream and downstream shell. The rock fill consists of equal-dimensional, sound gneiss particles. As can be seen in the photographs, the zoning of the dam is well-controlled laterally and vertically. Visually, the fill properties are satisfactory and appropriate compaction methods are being employed in MWH's opinion.

2.2.3 Powerhouse/Tailrace and Spillway Excavations

2.2.3.1 General

Excavation of the power intake/powerhouse/tailrace channel is more than 85 percent complete, according to Nalcor. Blasting of the spillway channel is completed, although the downstream end and has not yet been mucked. These works are generally on schedule and the powerhouse/tailrace channel will be substantially completed by the end of October 2013.

Photographs 2 to 19 show various aspects of the powerhouse/tailrace excavation and some details of the spillway excavation are shown on Photographs 20 to 23. Groundwater inflow into the two major excavations is very low and easily handled by part time pumping.

2.2.3.2 Rock Conditions – General Description

The excavations are in granitic gneiss bedrock. The rock is very strong, competent, and generally fresh and has a gneissic foliation that is inclined towards the south. There is a distinct color layering parallel to the foliation (Photographs 13, 14, and 15, Appendix F). In slightly weathered rock (right abutment) near the ground surface (approximately 3 to 5 m depth below the top of rock), these layers are relatively loose and give the rock a slabby appearance. At depth, the effect of this fabric is less distinct and the rock mass has a more homogeneous, massive character. The gneiss is intruded by a number of very strong, crystalline granite dykes and veins (Photograph 19, Appendix F). A number of thin (10 to 30 cm wide) schistose to homogeneous amphibolite layers can be seen in the south wall of the spillway (Photographs 20 and 21, Appendix F) and in other locations of the excavations. Some of these layers form distinct weakness planes of soft, fissile material that extend for 50 m or more along the excavation walls.

The rock mass is broken by a few sets of discontinuities. Site geologists have identified three prevalent joint sets that are developed throughout both excavations:

Set No.	Dip/Dip Dir. (deg)
S1	32/184
S3	51/077
S4	80/303

Discontinuity set S1 is generally parallel to foliation. Individual S1 joint planes can run for 50 m or more in some cases. Sets S3 and S4 cut across the foliation and persist for lengths of up to 10 or 15 m in many areas. Other secondary joint sets are developed at a number of locations. Joint spacing generally varies from 10 cm to more than 100 cm. Joint surfaces are generally planar to slightly wavy and slightly rough. Some altered surfaces were noted but silt/clay infillings appear to be rare.

2.2.3.3 Powerhouse and Spillway Channels Blasting

Blasting for rock excavations is being carried out in a competent fashion in MWH's opinion. Careful, controlled blasting techniques (no explosives in the control line holes) are used in the concrete structures areas (Photographs 13, 15, and 18a, Appendix F). Presplit blasting is employed to form final walls in the open channels of the tailrace, intake, and spillway (Photographs 13, 16, and 18a, Appendix F). General characteristics are as follows:

- All holes and faces are vertical
- In open channel areas there is a 0.75 m wide bench every 10 m vertical distance

- In the line drilled concrete structures areas there is a 0.75 m bench every 20 m vertical distance
- Powder factor ranges from about 0.8 to about 1.1 kg/m^3
- Vibration monitoring is carried out for all blasts

Blast hole spacing and loading vary depending upon location. However, the site staff personnel indicate these typical patterns apply:

Table 2-2

Typical Blast Patterns (varies from place to place)

Blast Hole Type		Line Drilled Areas (Concrete Structure Areas)	Presplit Blasted Faces (Open Channel Areas)
Control Line Holes		Unloaded 6.5 in. holes, spaced 240 mm co; 20 m deep	Lightly loaded 3.5 in. holes spaced 750 mm cc; 10 m deep
Buffer Holes	First row	Lightly loaded 3.5 in. holes, burden of 0.75 m from presplit line, spacing 1.5 m cc	Lightly loaded 3.5 in. holes, burden of 0.75 to 1.0 m from presplit line, spacing 1.5 m cc
	Second row		Lightly loaded 4.5 in. holes, burden of 1.5 m to 2.5 m from presplit holes, spacing 2.5 m
Production Holes		6.5 in. holes, located 1.5 m from buffer row Blast hole spacing varies from 4.50 x 4.50 m to 4.75 x 4.75 m	6.5 in. holes, spaced 3.00 m burden from buffer row Blast hole spacing varies from 4.50 x 4.50 m to 4.75 to 4.75 m

During the site visit, MWH observed that:

- Most of the line-drilled walls have about 85 percent to 95 percent half-barrel traces and overbreak is minimal (Photographs 15, 16, and 18b, Appendix F).
- The presplit walls are also very good with an estimated 75 percent to 90 percent half-barrel traces (Photographs 16, 17, 18b, and 20, Appendix F). Photograph 16 shows a good comparison between line-drilled and presplit blasted faces at the same location.
- No significant rock mass blast damage (i.e., cracking, block loosening, etc.) could be seen in any of the walls.
- A few areas of localized overbreak were noted in the walls of the spillway and powerhouse/tailrace excavations. For example, a few of the areas of shallow overbreak can be seen in the line-drilled lower north slope of the powerhouse excavation in Photograph 15. Photograph 16 shows detail of an overbreak feature in the presplit wall

on the north side of the tailrace excavation. Photograph 19 shows localized overbreak on an outside corner on the south side of the powerhouse excavation. In almost all cases, the overbreak is triggered by shallow block sliding or toppling along natural discontinuities adjacent the face. None of these features are serious concerns but they serve to show the influence of natural discontinuities on the blasting results.

- Observations made during the site visit indicate that the blasting program is well executed and the amount of overbreak is well within the normal standard for this type of work. It is noted that the use of line drilling for the final face control in the concrete structure areas, is very conservative for a rock mass of this quality.

2.2.3.4 Slope Stability and Rock Support

The rock mass contains numerous natural discontinuities that can trigger block sliding and rock falls in the vertical rock faces. These failures are preventable if the hazardous features are identified on a timely basis and supported with appropriate rock support, usually rock bolts.

The SNC-L site geologists have prepared detailed geology maps of all permanent rock faces on a blast-by-blast basis. The mapping is used in out slope stability analyses and as input for rock support design of permanent rock faces. Based on records seen on September 26 in the site office, the site geological and geotechnical work is being performed to a high standard.

The intent of slope and rock support designs is to ensure permanent slope stability in the areas of the concrete structures and the open channels. In the area of the concrete structures, all rock loads are to be taken up by the rock support and none will act on the various concrete structures. Numerous rock bolts have been installed to stabilize the rock faces. It is understood that pattern rock bolts, have been installed throughout the concrete structure areas as well as in some areas of the open cut spillway and tailrace channels. Spot bolting has been installed in other areas to stabilize individual geological features. Rock bolts are fully grouted, tensioned hollow core assemblages. Bolt lengths of 4m, 6m and 9m have been used and pattern rock bolts spacing varies from 2m x 2m to 3m x 3m.

Wire mesh has been draped over all vertical rock faces as a safety measure. This will be removed at the completion of the project. The rock bolts are visible in some areas but the wire mesh makes it difficult see all of the areas which have been rock bolted.

A review of the excavations and the geology indicates the following as given in Table 2-3:

Table 2-3

Geology Summary

Location	Description
North Walls	The North Walls of the Spillway and Powerhouse/Tailrace excavations, which are undercut by the south dipping S1 foliation joints, are susceptible to block sliding (see shallow block sliding along S1 joint planes in Photos 15 and 16). There is potential for relatively deep seated sliding along north wall S1 planes. The project designers and onsite geotechnical staff have evaluated this slope on a blast by blast basis. Rock bolts, both pattern support and spot bolting, have been installed as required and no deep seated or shallow instability was obvious.
South Walls	The jointing in the South Walls is generally favorable for overall South Wall stability. However there have been some very shallow rock fallouts along steeply inclined to vertical joints in this wall (see photos 18b and 19). Despite this, however, there appears to be very potential for deep seated sliding along the south walls. Pattern and spot rock bolts have been installed to stabilize the face in many areas.
East Facing Faces	The S3 joint set, which is is inclined 51 degrees towards the east, undercuts and destabilizes east facing rock faces. To date no permanent east facing slopes have been cut but this joint set is prominently displayed in temporary excavations. There is concern for the upcoming excavation of the bull noses between the generator units. Sliding along J3 joints could cause significant overbreak in this area if it is not controlled. Temporary pre-support, in the form of vertical dowels will be installed before excavation is carried out to preserve the integrity of these features. Permanent support, consisting of tensioned, grouted rock bolts will be installed sub-horizontally once the rock faces have been exposed. This is a sound plan, provided it is combined with very carefully executed blasting.
Foundation Base of Concrete Structures	Foundation conditions for water retaining concrete structures in the powerhouse intake and spillway channel are good. The rock mass is strong and the shear strength of concrete/rock interface will be high. The geological mapping indicates that no systematic sets of sub-horizontal discontinuities are present. This verified by observations made during the September 25/26 site visits. This indicated that there is very little likelihood for the presence of rock mass sliding planes below the foundations of the structures. This should be verified by geological inspections of the final foundations.

The slope control program appears to be satisfactory. However details of rock support design could not be reviewed during the September 25-26 site visit because of limited time. Additionally, the exact extent of rock bolting in the excavation walls was not clear to MWH. The

site staff do not have a single plan showing areas of pattern bolting and spot bolting, nor is there a single document summarizing rock bolt patterns and support loads for various areas, as is normal for a project of this scope. All of this information is available on individual blast faces maps and data sheets, but no compilation has been done. Thus it is not possible to comment on whether sufficient rock support has been installed. In MWH's opinion, this compilation should be performed.

Visual inspections of the rock faces during the September 25-26 site visit were impeded by the ubiquitous wire mesh on the rock faces. This mesh obscures the face and makes it difficult to determine where pattern rock support was installed. It appears that the entire areas of the concrete structures are supported by pattern rock bolts (yellow and red painted bolt heads as seen on Photos 18 and 19). However, MWH was unable to visually determine the extent of rock bolting in much of the tailrace channel. In particular, the extent of pattern bolting in the high north face of the tailrace could not be assessed visually. MWH believes that, because of the J1 sliding planes, the long-term slope stability of this face is critical and should be carefully evaluated and that pattern support is probably needed. This issue should be clarified.

2.2.3.5 Erosion of Unlined Spillway Channel

It is understood that flow velocities in the final Spillway channel will be over 20 m/s. This level of flow can cause serious erosion in the rock mass of an unlined spillway if the rock mass has insufficient resistance to erosion. Erosion hazard is more influenced by the properties of the discontinuities than by the strength of the rock material.

The project designers plan to install a concrete lining in the upstream end of the channel, downstream of the gate structures. Most of the downstream end of the spillway channel has not yet been excavated and rock mass conditions have not yet been determined in this area. To date no decision has been made to line the downstream area pending exposure and evaluation of the rock mass in this area. Geological site staff intend to carry out an engineering geology rock mass evaluation of the excavation once the lower benches have been excavated to allow completion of the geologic mapping. This work will include an assessment of the Annandale Erodibility Index and computations of scour potential. Appropriate concrete lining will be designed and constructed if required. The IE endorses this approach.

2.2.4 River Diversion

Request data for write-up from Nalcor.

2.2.5 Civil Design Aspects

Requested response to email questions sent separately

2.2.6 Infrastructure and Schedule

The following observations pertaining to the project's infrastructure are furnished based on MWH's observations:

- Site camps and infrastructure are adequate to handle the planned construction works.
- The Camp conditions, with only 300 beds, were very tight at the time of the site visit. However new camp facilities are being constructed and there will be accommodations for almost 1,000 persons by November.
- Roads are generally good, and are up the normal standard for a hydroelectric construction site.

The following observations pertaining to the project schedule are as follows:

- Schedule achievements are satisfactory.
- Construction work will continue throughout the winter.
- The major works (CH0007) will be covered by large weatherproof shelters to enable civil works construction during winter conditions.

2.2.7 Summary Observations

The following observations made during the September 2013 site visit by the MWH Team members are summarized below.

- The planned North Spur remediation measures, as presented by design staff in St John's during the site visit, are appropriate to stabilize the slopes, arrest natural mass wasting and to control seepage and piezometric pressures after impoundment of the reservoir. The reviewer has insufficient data to comment on the design analyses at the present time.
- Cofferdam construction is proceeding satisfactorily. Work on the RCC and Fill cofferdams, as viewed during the site visit, show satisfactory work by the contractor and supervisory staff that appears to exceed usual practice.
- The large rock excavations for the Powerhouse/Tailrace and the Spillway channels are more than 90 percent complete. The blasting quality exceeds normal practice, in MWH's opinion. The line drilled and pre-spit permanent faces have very little overbreak and blasting damage is minimal.
- The final rock slopes have been supported by rock bolts in many areas. The design intends that all permanent rock slopes have long term stability against rock falls and

sliding failures. In particular, no rock loads will be carried by concrete structures. In general, pattern rock bolts have been installed in the areas of the concrete structures and in much of the open channels. Unfortunately, this pattern could not be completely verified by visual inspections since the wire mesh obscures the view of the rock faces in many areas. Because they are undercut by S1 joints, stability of the north walls is more susceptible to block sliding than the south walls. It is not clear to MWH if the installed rock support reflects this difference in natural stability, which requires clarification.

- Foundation conditions for water-retaining concrete structures in the Powerhouse, Intake, and Spillway channel are satisfactory. The rock mass is strong and the shear strength of concrete/rock interface is expected to be high, in MWH's opinion. The geological mapping to date indicates that no systematic sets of subhorizontal discontinuities are present.

- Due to high flow velocities that are projected to occur during the operation of the spillway channel, the potential for rock erosion is high and will require mitigation. Nalcor has decided to install a concrete lining in the upstream end of the channel, but the decision for the downstream channel will be decided when the rock, which is presently covered by blasted muck, can be inspected. It is intended to classify the rock with the Annandale erodibility index. This procedure is a useful tool for assisting in the decision to line the channel.

- Site camps and infrastructure are adequate to handle the planned construction works. The camp conditions, with only 300 beds, were very tight at the time of the site visit. However, additional camp facilities are being constructed and there will be accommodations for almost 1,000 persons by November 2013. Roads are generally satisfactory, and are generally up the normal standard for a hydroelectric construction site.

- Schedule achievements are satisfactory. Construction work will continue throughout the winter. The major works will be covered by large weatherproof shelters to enable civil works construction during winter conditions.

SECTION 3

PROJECT DESIGN AND PROJECTED PERFORMANCE

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SECTION 3

PROJECT DESIGN AND PROJECTED PERFORMANCE

3.1 PROJECTED PROJECT PERFORMANCE

In the following paragraphs of this section we have included our comments based on the review of the information furnished to MWH that summarizes our observations to date (October 2013). Additional information has been requested of Nalcor to allow us to complete our review and to allow us to form our final opinions pertaining to each of the subjects included herein. For ease of reference we have highlighted areas still requiring information to be presented.

3.2 PROJECT HYDROLOGY

3.2.1 Spillway Design Flood

For high hazard potential critical structures where loss of life and substantial damage would occur if a dam breach occurred during a flood event or a sunny day event[2], international standards and those of Canada required that the spillway be designed to pass the probable maximum flood (PMF). This flood is derived using stochastic methods that estimate the probable maximum precipitation (PMP) in the watershed and then apply this precipitation to the watershed to derive the runoff associated with the PMF. Consultants involved in this effort found that for the Muskrat Falls Project site, the PMF is 29,750 cms. This flood was used to size the capacity of the gated spillway (16,750 cms) and the RCC dam (13,300 cms). Reservoir flood routing studies using the reservoir volume curve and the hydrograph for the PMF determined the resulting maximum flood elevation of the reservoir during a PMF event to be El. 45.1 mean sea level (msl). From this elevation, the deck elevation of the power station was established, considering freeboard requirements.

3.2.2 Ice Effect on Tailwater Elevation

Ice affects water elevation since water is forced to flow beneath it which results in higher frictional resistance than that generated by an open water surface. A higher water surface elevation for a given flow occurs to overcome the additional resistance. Nalcor performed studies that indicate that ice can expect to form at the site during the months from November to May. The studies indicate, for example, that for a plant discharge of 2,500 cms, the tailwater is 2.0 meters higher when ice cover is present than during the ice free period. This ice-cover condition affects the rated head on the generating units by about 5 percent, and therefore, it must be taken into consideration when computing the power output of the hydroelectric plant. Two tailwater curves were derived for open water and for ice cover which were used in the energy generation model (Vista Decision Support System™(Vista DSS™) where the model

[2] A sunny day event is assumed to be a day when average flow is occurring under the normal reservoir El. 39.0 and normal tailwater with no rainfall.

employs an adjustment factor to shift the curves to accommodate the conditions that are being modeled.

3.2.3 Power Generation

Two models have been used during the derivation studies associated with determining the power generation from the Muskrat Falls (MF) power plant. Both models used a monthly time resolution (time-step). The Vista DSS™ model employs different software and is the preferred model to use for the LCP. It uses a more detailed time resolution and a much more detailed representation of the system. The Water Management Agreement (WMA) for the Churchill River prescribes that the operation of the Churchill Falls project and the LCP must be coordinated as prescribed by the Independent River Operator and includes provisions for banking energy in the seasonal reservoirs at Churchill Falls. The Vista DSS™ is reported to accommodate these requirements since it is able to route the release Churchill Falls flows that arrive at Muskrat Falls about three days later. MWH has not independently verified these results, but other commercially available software, such as the suite of programs available from the U.S. Army Corps of Engineers would allow comparisons to be made if there is a requirement to do so.

The firm energy capability for the Project is defined as “the maximum annual energy that can be supported by Muskrat Falls during the critical (dry) hydrologic sequence, assuming coordinated operations between the Muskrat Falls and the CF(L) Co’s facilities, as specified in the WMA and while meeting all of CF(L)Co’s obligations from prior agreements.” We note that for each system, the definition of firm energy is specifically defined for it. International standards sometimes require an assessment that looks at the energy that is available for 95 percent of the time or 98 percent of the time, for example. In the analysis, the critical period was determined, and for this period detailed chronologic simulation was performed to determine the firm energy capability of Muskrat Falls. The load demand on the Churchill Falls plant was determined based on contractual obligations and by considering the full range of hydrologic variability according to the reports furnished to MWH. Excess sales opportunities were also determined, as according to information furnished us, and both load and excess sales were inputted to the firm energy and Average Annual Energy (AAE) analyses.

The AAE for the Project is defined as

> the increase in the average annual generation that can be expected from the Churchill River with the addition of Muskrat Falls, again reflecting the benefits of coordinated operations with the CF(L)Co facilities. The average annual energy is estimated by simulating operations over long periods (of time, sic) and the range of hydrologic conditions, as defined by the available hydrology.

The AAE was determined by performing a series of long-term analyses, using a range of Muskrat Falls load demands which were higher and lower than the firm energy demands. The simulations used 30-years of record; the simulations were reported to be repeated “54 times with a different hydrological sequence each time”. The period of hydrologic record was from

1957 to 2010 where data was used (a period of 53 years). Normally, we advise that the period of record must be at least 30 to 35 years of record before these studies are meaningful, and normally like to use 50 years of record if it is available in determining AAE.

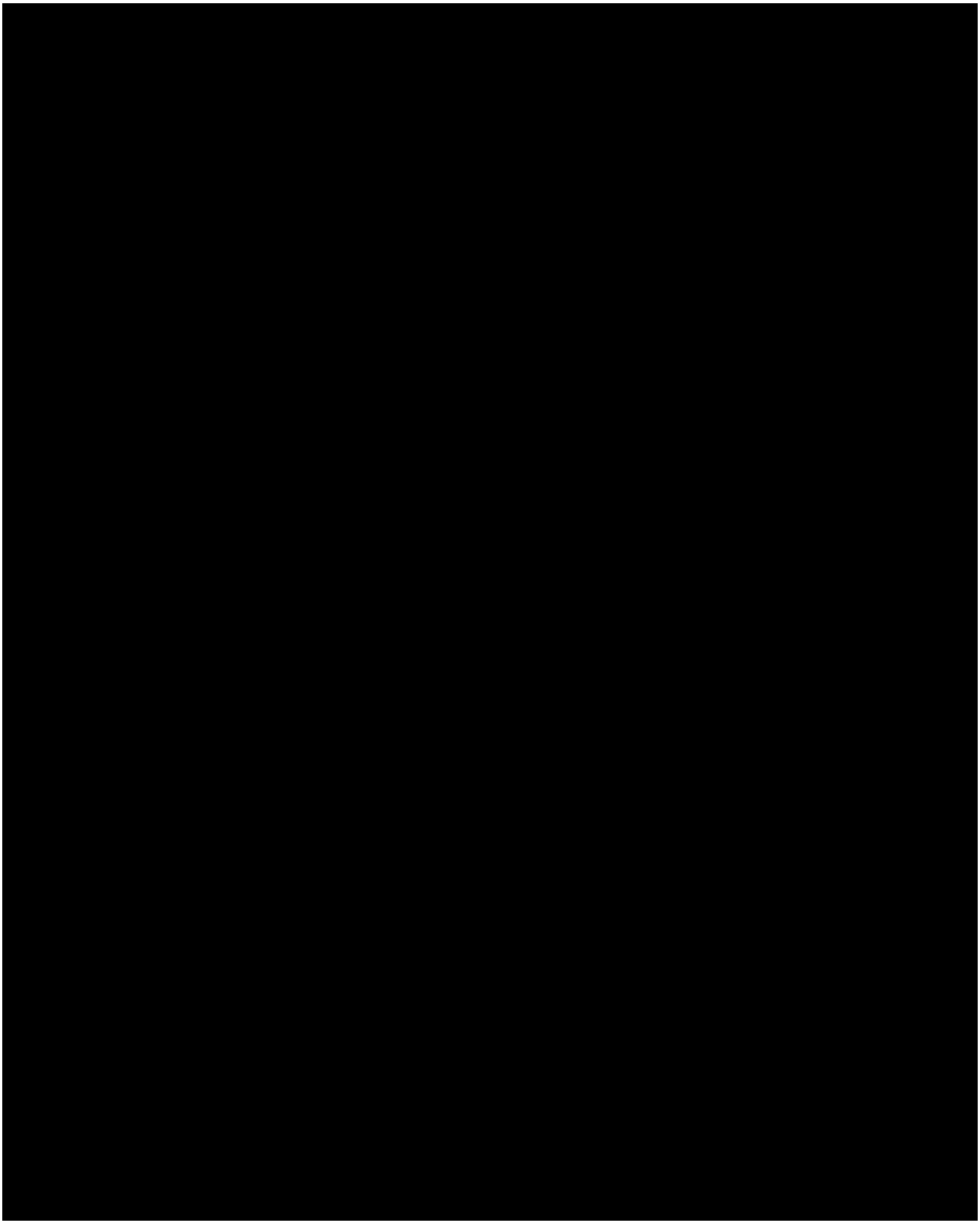
The energy runs also made use of computed headloss equations, relating the losses to the flow squared, and to the guaranteed efficiency of the turbine and generator as it relates to rated head and discharge. This information is presented in one of the documents furnished to the IE that was prepared by Nalcor's consultant, Hatch Energy. Nalcor's support data is also included in the hydraulic design criteria that specifically identifies the equations used to compute the headloss. A loss that is typically omitted, or incorrectly derived, is the loss at the exit of the draft tube; MWH verified that this was included. The IE has not independently confirmed the values used, nor has it separately confirmed the calculated power and energy from the project, however, the procedures followed are typically used in the power generation model.

We were advised that at full head and flow, 0.47 meters of head loss was derived and included in power estimates. An equation was developed for headloss and a coefficient determined based on these parameters for other flows and heads.

Based on the plots that relate the guaranteed efficiency of the turbine and generator, as noted above, these guaranteed values were used in the model to compute the power. We believe that the guarantee value is that value prescribed in the turbine and generator generating equipment Request for Proposal (RFP), and not the actual value that Andritz committed to furnish in the contract as their guarantee value. Nalcor advised the model values are a "little higher" than the guarantee values. Normally, the final energy computations are performed using the equipment manufacturer's guaranteed values to determine the values of power that are used in the financial pro forma.

When the generating units are shut down, Nalcor indicated flow will be released at the gated spillway structure. This release, depending on river flows, may remove water from storage. The reservoir will be maintained between El. 39.0 and El. 38.5 msl.

The results of the power generation runs performed by a consultant (Hatch) are given in Table 3-1, below.



3.2.4 Diversion Flood Assumed for Construction and Ice Affects

To enable cofferdam heights to be determined, Nalcor selected a return period flood of 20-years recurrence interval. Normally for larger projects where excavations are open for about one year while concrete is being placed, a 20-year to 25-year recurrence interval is selected as the minimum value for which the contractor must provide protection. Risks associated with floods with recurrence levels higher than this value are then either assigned to the Owner as their responsibility or to the contractor depending on contract language. For embankment structures, usually a longer period than 20-year return period for important structures is prescribed. For construction that takes longer than one year of cofferdam use, recurrence intervals of longer period are prescribed and costs of increased cofferdam sizes are paid for by the Owner. Determination of the value to use should be based on economics, balancing the cost of higher and larger cofferdams with the loss or damage of the structures being constructed and the cofferdam, cofferdam rebuilding, clean-up costs, environmental mitigation costs and fines, and lengthening of the contract schedule which delays power production, and higher interest during construction payments on construction loans. Once the recurrence interval is selected, the water surface elevation is determined from hydraulic studies associated with the construction flood discharge, and the freeboard (elevation distance between the flood level and cofferdam crest) is determined to establish the crest elevation of the cofferdam.

In the case of Muskrat Falls, another important consideration was required since ice jams are known to occur almost every year downstream of the dam and power station complex site. Historically data is available that allows a determination of water level flood elevation that occurs during an ice jam. Selecting the elevation that corresponds to a recurrence interval of 40-years for an ice jam event was then determined and compared to the elevation established from a 20-year return period flood; in this case, the ice jam elevation controlled the design of the RCC cofferdam (No.3) and establishes its height.

3.3 EXPECTED PERFORMANCE OF MAJOR SYSTEMS

Based on our current understanding of the LCP and Nalcor's contracting philosophy, which we have observed in reviewing the RFPs and the Contracts reviewed to date (October 2013), only tier-one fabricators, suppliers and installers of equipment and systems, along with tier-one contractors are being solicited to propose on the work. Tier one companies are assumed to be top-level and among the largest and most well-known companies of their type and are among the most important members of a supply chain to supply to an original equipment manufacturer. This philosophy in turn generates competitive responses from these firms who supply the utility-grade equipment required of the specifications. This equipment and systems meet, in our opinion, the intent of the contract's quality requirements and the technical conditions. We, therefore, are currently of the opinion, and with our monitoring of the work during Phase II and thereafter, expect that the performance of major systems and sub-systems will be satisfactory.

3.4 MAJOR SYSTEMS COMPATIBILITY AND COMPLETENESS

We currently (October 2013) have only three contracts available to form a preliminary opinion pertaining to the compatibility of major systems and completeness. These contracts are as follows: CH0030, LC-SB-003, and CH0007.

Contract CH0030 involving the turbines, generators, and associated controls for this equipment is being provided by Andritz Hydro, a tier-one company. Andritz has provided numerous equipment packages for major hydro projects like this, and several recent ones that MWH has direct knowledge of, being the Owner's Engineer. Based on what has been reviewed to date, without viewing the fabrication, assembly, installation, and start-up and testing, we expect that the hydro-generating package will perform as designed and expected. Since the responsibility of the system compatibility and completeness lies with Andritz, following the technical provisions of the contract documents, we expect this package will be satisfactory.

Contract LC-SB-003 involving the Engineering, Procurement, and Construction (EPC) form of contract delivery for the submarine cable(s), which is directly managed by Nalcor is being provided by one of the three leading designers, fabricators, and installers of submarine cables, Nexans Cable. Based on information known to MWH about other projects Nexans has completed, which are judged to be more difficult than the SOBI cable crossing, we are of the current opinion that their system will be compatible with the land-based transmission systems and their system, and in itself will perform satisfactorily and will be completed, as specified.

Contract CH0007, involving the construction of Intake and Powerhouse, Spillway and Transition Dams, will be performed by Astaldi Canada Inc., based in Toronto. Astaldi's parent company is based in Italy and they have offices in the United States, Latin America, and the Middle East. MWH has direct working experience with Astaldi's Latin America company as Owner's Engineer on much smaller hydroelectric projects with less severe weather conditions than prevail at Muskrat Falls. This contract will need to be very carefully managed to avoid numerous change orders by the Integrated Project Team, in MWH's opinion.

When additional contracts become available for review, MWH will include remarks about their compatibility with other systems they tie to.

3.5 OPERATING HISTORY OF MAJOR EQUIPMENT

The following Table 3-2 lists major equipment that the IE has reviewed or will review during the Phase I work and comments germane to its operating history.

Table 3-2

OPERATING HISTORY OF MAJOR EQUIPMENT

ITEM NO.	CONTRACT	EQUIPMENT	REMARKS PERTAINING TO HISTORY	COMMENTS
1	CH0030	TURBINES	ANDRITZ WILL MANUFACTURE THE TURBINES; ANDRITZ HAS MANUFACTURED OVER 2000 KAPLAN TURBINES WITH OVER 39 BEING IN THE 8-9.5 METER SIZE RANGE	SATISFACTORY
2	CH0030	GENERATORS	ANDRITZ WILL MANUFACTURE THE GENERATORS USING COMPONENTS FROM THEIR WORLDWIDE FACTORIES. ANDRITZ HAS MANUFACTURED OVER 200 GENERATORS IN THE SAME SIZE RANGE 204 MW.	SATISFACTORY
3	CH0030	GOVERNORS	HEMI CONTROLS WILL MANUFACTURE THE GOVERNOR CONTROL SYSTEM. HEMI HAS NOT MANUFACTURED GOVERNORS FOR HYDRAULIC TURBINES FOR KAPLAN-TYPE TURBINES IN THIS SIZE RANGE.	IN MWH'S OPINION, CAREFULLY MONITORING OF THIS EQUIPMENT WILL BE REQUIRED, INCLUDING THE DESIGN AND WITH TRIAL SHOP TESTING OF THE UNITS BEFORE SHIPMENT AND WHEN INSTALLED IN THE FIELD.

ITEM NO.	CONTRACT	EQUIPMENT	REMARKS PERTAINING TO HISTORY	COMMENTS
4	CH0030	STATIC EXCITATION	ABB WILL MANUFACTURE THE STATIC EXCITATION SYSTEM. ABB HAS MANUFACTURED OVER 25 EXCITATION SYSTEMS FOR HYDRO GENERATORS OF THE SAME SIZE OR LARGER RANGE AS THE LOWER CHURCHILL UNITS	SATISFACTORY
5	LC-SB-003	SUBMARINE CABLE	NEXANS HAS MANUFACTURED 2,500-3,000 KM OF MASS IMPREGNATED INSULATED CABLE FOR HVdc SUBMARINE CABLE. NEXANS HAS EXISTED AS A COMPANY FOR 35-YEARS	SATISFACTORY

Nalcor's representative was sent an email on September 3, 2013 requesting Nalcor's list of additional equipment that is acceptable and remarks pertaining to history of experience. Please confirm that no additional items need to be added to the list since they are not available at this time.

3.6 ELECTRICAL INTERCONNECTIONS BETWEEN PROJECTS

3.6.1 General

MWH reviewed the following studies to ascertain if the electrical interconnections between the project provided security as required by the basis of design and good utility practice: stability studies; load flow and short-circuit studies; and the Churchill Falls-Muskrat Falls transmission link study. In addition, MWH reviewed a set of one-line diagrams to determine that the electrical transmission network is complete.

3.6.2 Load Flow and Short-circuit Studies

The studies were carried out by Nalcor to access the steady-state performance of the Newfoundland and Labrador power system with the HVdc interconnections between Muskrat Falls and Soldiers Pond (Island Link) and between Bottom Brook and the Nova Scotia (Maritime Link) power system. The design provided for a DC voltage level of +/- 350 kV and a nominal bipole rating of 900 MW, and for the Maritime Link a DC voltage level of +/- 200 kV and a nominal bipole rating of 500 MW. In addition to the nominal ratings given, the design requires a 10-minute overload capability of 200 percent and a continuous overload capability of 150 percent, both in the mono-polar mode on the Island Link. This will enable the Island system to sustain a permanent pole outage on the Island Link without having to shed load. The Maritime Link is required to have a 500 MW continuous capability in bipolar mode in both directions.

The studies were designed to provide the following information:

- Quantify the operating modes in both the normal and outage conditions;
- Define the overload requirement for the Island Link;
- Define the limits for the Maritime Link export levels;
- Assess the reactive compensation requirements in the Island system under various load conditions;
- Determine the maximum and minimum short circuit levels that would occur at the converter station AC busses at Muskrat Falls, Soldiers Pond and Bottom Brook; and
- Identify system conditions that will result in overloads or under-voltages that will require mitigating measures on the AC systems in Labrador and the Island.

Based on the review of the studies, the design appears to be satisfactory to achieve the objectives of the study and to define the limits on the particular study goals.

3.6.3 Stability Studies

The report reviewed by MWH outlined the results of the stability studies carried out to examine the dynamic performance of the AC and DC systems including the HVdc interconnections between Muskrat Falls and Soldiers Pond (Island Link) and between Bottom Brook and the Nova Scotia power system (Maritime Link). In addition to the voltage levels discussed in 3.6.2, the Island Link will normally be a uni-directional from Labrador to Newfoundland, but the system can operate in the reverse direction. The Maritime Link is required to have a 500 MW continuous capability in the bipolar mode in both directions. The studies were designed to determine the dynamic performance of the AC/DC systems following major faults on either the AC or DC systems.

The objectives of the studies were as follows:

- Verify that the interconnected systems of Newfoundland and Labrador with interconnections into Quebec and Nova Scotia can operate satisfactorily through a wide range of faults resulting in outages on the transmission network;

- Determine the requirements of the control functions that will be required on the Island and Maritime DC links;
- Determine the requirements for additional equipment in the form of static volt amperes reactive (var) compensators and synchronous condensers that would be required at or near the converter stations to ensure satisfactory dynamic performance;
- Verify that load shedding on the Island will not occur for the range of fault cases examined; and
- Determine any operating requirements that must be applied to the Island and Maritime DC links to ensure stable operation.

The criteria selected for the study were taken from the Newfoundland and Labrador Hydro (NLH) Transmission Planning Manual and are given below to demonstrate that the project systems will function satisfactorily within the existing system:

- The system will be able to sustain a single contingency loss of any transmission element without loss of system stability;
- The system is able to sustain a successful single pole reclose for a line to ground fault;
- Multi-phase 230 kV faults will be cleared in a maximum clearing time of six cycles;
- Load shedding should not occur for the loss of the largest generator in Newfoundland;
- Load shedding will not occur for the temporary loss of a pole or bipole of an HVdc link;
- The system response should be stable and well damped;
- Post-fault recovery voltages on the AC system shall be:
  - Transient under-voltages following fault clearing should not drop below 0.7 per unit (pu); and
  - The duration of voltage below 0.8 pu following fault clearance should not exceed 20-cycles;
- Post-fault frequencies should not drop below 59 Hz; and
- Under-frequency load shedding should be minimized.

The report discusses the slight modifications that were necessary to accommodate the models used in the Power System Simulator for Engineering (PSSE) program following International Council on Large Electric Systems (CIGRE) documents and discussions with Nalcor pertaining to load shedding. In general, the studies showed that they satisfactorily achieved the objectives and could be considered to be satisfactory in meeting the design.

3.6.4 Dynamic Performance of the Churchill Falls/Muskrat Falls System Study

MWH reviewed the results of the studies carried out to determine the relative capabilities and performance of the transmission link between Churchill Falls and Muskrat Falls for two considered transmission voltages: 315 kV and 345 kV; this link would replace the existing 138 kV line from Churchill Falls that supplies Happy Valley. The study demonstrated that a cost savings of between $10M to $14M could be expected by using the 315 kV systems without sacrificing dependability and thus it was adopted.

3.6.5 One-Line Diagrams

MWH reviewed the one-line diagrams furnished by Nalcor to assess the general arrangements of the electrical systems associated with the projects and to determine if the entire network would be able to function as required by the design criteria.

The following one-line diagrams were reviewed:

- 230 kV Soldiers Pond Terminal Station (AC Substation)
- Muskrat Falls HVdc Transmission System, Overall Single Line Diagram, 315 kVac and 350 kVdc Transmission System (seven single line diagrams)
- 735-315 CF Switchyard Extension, Single-Line Diagram, 735-315 kV Substation
- 315-138 kV Muskrat Falls Switchyard, single-Line diagram, 315-138 kV Switchyard

These one-line diagrams are included in Appendix B.

Based on our general review, the single line diagrams indicate the electrical configuration and the intended protective elements in a clear fashion, and are believed to be satisfactory to meet the design requirements.

3.7 TECHNICAL CRITERIA CONSISTENCY

Our current review of the limited number of contract documents and the RFPs that we have been furnished by Nalcor provide limited opportunity to opine at this time on the technical criteria consistency. However, in viewing contract CH0030 for the turbines and generators and comparing certain provisions of this contract pertaining to the water conveyance passageways with the finishes required of the concrete surfaces required in CH0007 to cite an example, we find that the criteria are consistent and have been accepted by the equipment supplier as being adequate, assuming that the passageway surfaces will actually be constructed, as required.

We also note that provisions have already been made by Nalcor to ensure that the turbine and generator components will fit within the pit dimensions used in the RFP/bid documents for CH0007 since they obtained early-on, dimensional requirements from each of the three bidders for CH0030 to help them plan the layout of the power station for Muskrat Falls and included in the drawing package in the CH0007 RFP.

We further note that for contract CH0006, Bulk Excavation, the provisions for excavation have been carefully coordinated with the drawings and contract language found within RFP CH0007, in our opinion, to accommodate a smooth transition between the contract work when it is accepted by Nalcor and transferred to the contractor for CH0007.

We also noted in contract CH0006 that dewatering of the excavation would be occurring after the contractor was granted substantial completion. Nalcor was questioned about this matter and they indicated that they would be responsible for this system that would be furnished to the contractor for CH0007 to allow it to construct the substructure of the power station, intakes and

transition structure within its contract. The IE was pleased with Nalcor's response and finds it should allow the smooth transition between contracts to be promulgated.

3.8 EXPERIENCE AND CAPABILITY OF MAJOR PROJECT PARTICIPANTS

Nalcor has advised the IE that for all of the major contracts that are currently under design or that have been awarded, a careful screening process was conducted to allow only tier-one contracting groups and suppliers the opportunity to propose on the work. Of the contracts that we have reviewed wherein we have been apprised of the bidders who proposed on the work, we are of the opinion that careful consideration and due diligence to screen prospective bidders has been conducted and that supports Nalcor's philosophy and statements made to the IE.

Each of the contracts that have been awarded to date by Nalcor, except one, were awarded to very experienced contractors and suppliers involved in the work. As noted in the preceding paragraph, careful monitoring of the Integrated Project Team is advised for CH0007. We will continue to monitor the quality of the selected contractors and suppliers and the procedures that Nalcor uses to select from only the best, most experienced, and most reliable fabricators, suppliers and contractors for the LCP.

Nalcor also selected a Canadian Engineering firm that has not only prepared numerous designs for hydroelectric projects and other projects in Canada, but worldwide. Following Nalcor's philosophy of project development and management, Nalcor shortlisted only tier-one engineering firms to propose on the EPCM services that were awarded to SNC-Lavalin (SNC-L). Work is currently ongoing with SNC-L transferring key hydroelectric specialists to St. John's but also performing work in several of their other offices in Canada.

Nalcor has also engaged very experienced consultants who have been employed on mega projects in Canada and internationally to assist permanent staff, but who work solely on the LCP and hold key positions of management on this project. The guidance the Nalcor team provides to its EPCM contractor, and to the contractors it has engaged, should allow early detection and resolution of any issues that may or will occur during the construction of the LCP. Additionally, however, Nalcor has engaged an Advisory Board of senior engineers (Board) to review project findings and independently opine on their findings directly to Nalcor. The Board meets as often as required by project needs and will be active throughout the construction period. MWH personally knows these individuals and MWH's experience working with the contractor selected for CH0007 on three recently completed, smaller hydroelectric projects in Latin America has not been satisfactory, in our opinion. We note that special monitoring and dedication of additional staff to this contract is advisable by the Integrated Project Team, to ensure that Nalcor's stated goals and methodologies are achieved.

SECTION 5

CAPITAL BUDGET

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SECTION 5

CAPITAL BUDGET

5.1 TOTAL PROJECT COST ESTIMATE

5.1.1 Cost Estimate Methodology

A deterministic and risk-adjusted approach based on both direct and indirect costs was followed by Nalcor to arrive at the project's budget. The cost estimate is comprised of three primary components that follow the Recommended Practice No. 10S-90 of the Association for the Advancement of Cost Engineering International (AACEI). A base cost is established for each of the project's scope items that reflects the most likely current cost known associated with the project's specifications, basis of design, drawings, and execution plan. The base estimate includes allowances for identified, but unquantified items.

To the base cost estimate, a risk-adjusted contingency is derived using analytical methods and accounts for uncertainties or variations associated with time or cost that are likely to occur but cannot be specifically identified at the time the estimate is prepared, but based on experience, will likely occur. The estimated contingency does not cover scope changes outside the parameters established for the project or control points for management of change (project execution plan and basis of design, for example) nor does it include natural disasters, strikes or escalation.

Finally, an escalation allowance is developed that provides for changes in price levels that are driven by economic conditions, including inflation. The escalation allowance is added to the base cost estimate including the estimated scope/risk contingency, and is derived using economic indices associated with similar construction or type of product and system.

Generally, Nalcor' cost estimate methodology is considered consistent with, or surpasses, best industry practices for organizing, communicating and reporting the project's current budget relative to indicated risks and opportunities. The cost estimate methodology can best be described as a "bottoms-up" approach relative to level-of-detail, supporting documentation, and implied level-of-effort. A "bottoms-up" approach is considered to be a more robust means of quantifying costs at the resource level versus reliance on high level parametrics or unadjusted historical costs. Typically, at-risk contractors will price work of this nature by doing similar "bottoms-up" or detailed cost estimates to gain precision and reduce estimating errors. As well, the methodology applied to the risk analysis is considered to meet or exceed industry expectations for quantifying known or suspected project constraint issues using probability theory and statistical analysis.

Nalcor qualifies the cost estimate as an AACEI Class 3 effort. MWH is in agreement with this classification and confirms the implied accuracy range (-20% to +30%). While Nalcor adopted a

P50 contingency based on analytical modeling of the project's budgets, MWH expresses the opinion that the calculated overall 6.7% scope contingency is aggressive relative to our legacy experience with similar remote construction endeavors that typically have a contingency reserve for known, but not specifically quantified risks approaching double that which is currently shown for the LCP. A separate allowance for unknown project risks, known as the management reserve, is provided by Nalcor as additional backstop to mitigate project risks. MWH can confirm the establishment of the management reserve for LCP at a theoretical $500M level, but the actual funding of this allowance is not described. As per AACEI practice, the scope contingency is assumed to be spent during project execution while the management reserve is considered not to be spent in entirety during project execution.

5.1.2 Evaluate Cost Estimate and Fixed Price Estimates

Currently under review. No comments are yet available. MWH and Nalcor agreed to update this section once more large contract bids are received.

5.1.3 PM, Construction Contractors Experience

At the present time, we only have knowledge of the EPCM contractor and three other contracting groups of the contracts the IE is required to review and report on. These entities are included in the following Table 5-1 with our remarks.

Table 5-1

CONTRACTOR'S EXPERIENCE

CONTRACT NO.	CONTRACT DESCRIPTION AND CONTRACTOR	REMARKS	OPINION OF INDEPENDENT ENGINEER
CH0006	BULK EXCAVATION HT O'CONNELL, EBJ, NIELSON, AND KIEWIT	EACH OF THE CONTRACTORS IS WELL-KNOWN IN CANADA AND HAS THE FULL CAPABILITIES TO PERFORM THE ENTIRE CONTRACT BY THEMSELVES. THE CONTRACTORS HAVE WORKED TOGETHER ON OTHER HEAVY CIVIL PROJECTS AND ALL HAVE WORKED ON HYDROELECTRIC PROJECTS	SATISFACTORY

CONTRACT NO.	CONTRACT DESCRIPTION AND CONTRACTOR	REMARKS	OPINION OF INDEPENDENT ENGINEER
CH0030	TURBINES & GENERATORS DESIGN, SUPPLY. AND INSTALL AGREEMENT ANDRITZ HYDRO CANADA INC.	ANDRITZ IS A TIER ONE SUPPLIER OF HYDRAULIC TURBINES AND ASSOCIATED EQUIPMENT. ANDRITZ HAS EXPERIENCE IN LARGE-DIAMETER KAPLAN TURBINES OF SIMILAR SIZE (9 METER SIZE)	SATISFACTORY
LC-SB-003	STRAIT OF BELLE ISLE SUBMARINE CABLE DESIGN, SUPPLY AND INSTALL NEXANS CABLE	NEXANS CABLE IS A TIER ONE DESIGNER, SUPPLIER, AND INSTALLER OF SUBMARINE CABLES WORLDWIDE.	SATISFACTORY
EPCM	ENGINERING, PROCUREMENT, AND CONSTRUCION MANAGEMENT SNC-L.	SNC-L IS A TIER ONE ENGINEERING AND CONSULTING COMPANY WHICH HAS DESIGNED AND MANAGED MANY LARGE HYDROELECTRIC PROJECTS, THERMAL GENERATING STATIONS, AND NUCLEAR POWER PLANTS	SATISFACTORY
CH0007	CONSTRUCTION COST OF INTAKE & POWERHOUSE, SPILLWAY & TRANSITION DAMS	ASTALTI HAS BEEN SELECTED AND GIVEN LIMITED NOTICE TO PROCEED. QUALIFICATIONS AND CONTRACT UNDER REVIEW.	
NOTE			

Note: No additional contracts were available for review prior to Financial Close.

5.1.4 Major Equipment Procurement Costs

We have summarized in the tables below, for each of the three projects, the major equipment costs associated with each of the projects found in the DG3 estimate. At the present time, only equipment costs associated with the Muskrat Falls Plant under CH0030 and with the submarine cable, LC-SB-003, are known (October 2013). The costs shown in Table 5-2 are in three currencies, and are additive. We expect that we will be able to have a more complete summary for each of the projects as we near financial close and the submittal of the final IER.

Table 5-2

MUSKRAT FALLS AND LABRADOR TRANSMISSION ASSETS

MAJOR EQUIPMENT PROCUREMENT COSTS

ITEM NO.	CONTRACT NO.	EQUIPMENT	COST			REMARKS
			CAD$	USD$	Euro €	
1	CH0030	Turbines (4)	15,522,428.00	26,301,204.71	257,805.64	
2	CH0030	Governors (4)	6,109,661.86			
3	CH0030	Generators (4)	24,023,018.20	10,147,521.30	3,946,981.40	
4	CH0030	Excitation System (4)	6,242,187.21			
5	CH0007	Under review				Under review
6	CH0007	Under review				Under review
	See Note					

Note: No additional contracts were available for review prior to Financial Close.

Table 5-3

LABRADOR-ISLAND TRANSMISSION LINK

MAJOR EQUIPMENT PROCUREMENT COSTS

ITEM NO.	CONTRACT NO.	EQUIPMENT	COST	REMARKS
			CAD$	
1	LC-SB-003	Cable Supply	64,616,770.00	Contract amount
2	LC-SB-003	Mobilization	33,510,000.00	Contract amount
3	LC-SB-003	Installation	19,913,000.00	Contract amount
See Note				

Note: No additional contracts were available for review prior to Financial Close.

5.1.5 Interconnection Costs

The interconnection costs will not be available prior to Financial Close. These costs will be included in Contract CD0502 which is scheduled to be awarded in December 2013.

5.1.6 Spare Parts

Table 5-4

MUSKRAT FALLS BASE ESTIMATE

SPARE PARTS

ITEM NO.	ITEM	BASE ESTIMATE COST	REMARKS	CONTRACT COST
A.7	SPARES	$1,500,000		
	GSU Transformer	$3,800,000	Spare transformer	

Table 5-5

LABRADOR TRANSMISSION ASSETS BASE ESTIMATE

SPARE PARTS

ITEM NO.	ITEM	BASE ESTIMATE COST	REMARKS	CONTRACT COST
C.4	SPARES	$2,960,613		

Table 5-6

LABRADOR-ISLAND TRANSMISSION LINK BASE ESTIMATE

SPARE PARTS

ITEM NO.	ITEM	BASE ESTIMATE COST	REMARKS	CONTRACT COST
B.6	SPARES	$6,724,135		
	Spare cable	$3,000,000	3,000 m on carousel	

Note: Tables 5-4, 5-5, and 5-6 contain Nalcor's partial listing of spare parts and costs. More information will be available after contract award.

5.1.7 Start-Up and Commissioning Costs

Table 5-7

MUSKRAT FALLS BASE ESTIMATE

START-UP AND COMMISSIONING COSTS

ITEM NO.	ITEM	BASE ESTIMATE COST	REMARKS
D.2	INTEGRATED COMMISSIONING SERVICES	$1,950,000	**No details were provided.**
D.6	QUALITY SURVEILLANCE & INSPECTION/FREIGHT FORWARDING SERVICES	$4,700,000	**No details were provided.**

Table 5-8

LABRADOR TRANSMISSION ASSETS BASE ESTIMATE

START-UP AND COMMISSIONING COSTS

ITEM NO.	ITEM	BASE ESTIMATE COST	REMARKS
D.2	INTEGRATED COMMISSIONING SERVICES	$9,372,938	**No details were provided.**
D.6	QUALITY SURVEILLANCE & INSPECTION/FREIGHT FORWARDING SERVICES	$1,600,000	**No details were provided.**

Table 5-9

LABRADOR-ISLAND TRANSMISSION LINK BASE ESTIMATE

START-UP AND COMMISSIONING COSTS

ITEM NO.	ITEM	BASE ESTIMATE COST	REMARKS
D.2	INTEGRATED COMMISSIONING SERVICES	$3,053,752	**No details were provided.**
D.6	QUALITY SURVEILLANCE & INSPECTION/FREIGHT FORWARDING SERVICES	$8,100,000	**No details were provided.**

5.1.8 Camp Costs

Table 5-10

MUSKRAT FALLS BASE ESTIMATE

CAMP AND RELATED COSTS

ITEM NO. OR CONTRACT	ITEM	BASE ESTIMATE COST	REMARKS
A.1	ACCOMMODATIONS COMPLEX/ADMIN/UTILITIES ACCESS ROADS/CONSTRUCTION POWER	$166,608,338	
A.6	SITE SERVICES	$248,312,374	
D.3	PROJECT VEHICLES / HELICOPTER SUPPORT	$5,691,750	
PD0533	TELECOM DEVICES	$317,425	For early works
SD0560	TELECOM SERVICES	$307,993	For early works
CD0509	CONSTRUCTION DEVICES	$13,733,898	Post early works
CD0535	TL AND SWITCHYARD TELECOM DEVICES AND SERVICES	$1,030,238	Construction Phase

Table 5-11

LABRADOR TRANSMISSION ASSETS BASE ESTIMATE

CAMP AND RELATED COSTS

ITEM NO. OR CONTRACT	ITEM	BASE ESTIMATE COST	REMARKS
D.3	PROJECT VEHICLES / HELICOPTER SUPPORT	$842,250	
C.3	TELECOMMUNICATIONS	$15,467,507	**WHERE SHOULD THIS BE INCLUDED IN A TABLE?**
CD0509	CONSTRUCTION TELECON DEVICES AND SERVICES	$69,024	Post early works
CD0535	TL AND SWITCHYARD	$3,676,493	Construction phase

Table 5-12

LABRADOR-ISLAND TRANSMISSION LINK BASE ESTIMATE

CAMP AND RELATED COSTS

ITEM NO. OR CONTRACT	ITEM	BASE ESTIMATE COST	REMARKS
D.3	PROJECT VEHICLES / HELICOPTER SUPPORT	$10,311000	
CD0509	CONSTRUCTION TELECON DEVICES AND SERVICES	$69,024	Post early works
CD0535	TL AND SWITCHYARD	$3,676,493	Construction phase

Section 14.3.5 Housing Costs and LOA of the Decision Gate 3 Basis of Estimate states:

The labor and housing strategy for the Project assumes the following:

- 1,500 person accommodations complex at Muskrat Falls which will be home to all temporary construction workers at the Muskrat Falls Site, including AC Switchyard and HVdc converter.

- Estimate 95% of workers will be on rotational travel, with the balance of 5% from the local catchment area living out of the MF accommodations.

- Accommodations provided free-of-charge to MF contractors and EPCM staff.

- 150-person accommodations facility at Churchill Falls for construction of CF Switchyard Extension.

- Transmission and reservoir clearing contractors provide mobile camps.

- No accommodations constructed for Soldier's Pond works, Dowden's Point Electrode, and Shoal Coal Transition Compound in lieu of constructing and operating camps given to proximity to local housing. Workers paid leave of absence (LOA), which is considered conservative considering proximity to St. John's and normal 70 km travel free zone.

The costs for camps provided by the transmission and reservoir clearing contracts are contained within the detailed estimate for each of these work scopes. Further details on the sizing of these camps are contained within the Basis of Estimate.

5.1.9 Ancillary Infrastructure and Services Costs

Table 5-13

MUSKRAT FALLS BASE ESTIMATE

ANCILLARY INFRASTRUCTURE AND SERVICES COSTS

ITEM NO.	ITEM	BASE ESTIMATE COST	REMARKS
D.4	INSURANCE/COMMERCIAL	14,531,242	No remarks will be provided by MWH.
D.5	LAND ACQUISITIONS AND PERMITS	$1,115,004	
D.7	ENVIRONMENTAL & ABORIGINAL AFFAIRS	$16,243,349	

Table 5-14

LABRADOR TRANSMISSION ASSETS BASE ESTIMATE

ANCILLARY INFRASTRUCTURE AND SERVICES COSTS

ITEM NO.	ITEM	BASE ESTIMATE COST	REMARKS
D.4	INSURANCE/COMMERICAL	$2,519,988	No remarks will be provided by MWH.
D.5	LAND ACQUISITIONS AND PERMITS	$1,119,630	

Table 5-15

LABRADOR-ISLAND TRANSMISSION LINK BASE ESTIMATE

ANCILLARY INFRASTRUCTURE AND SERVICES COSTS

ITEM NO.	ITEM	BASE ESTIMATE COST	REMARKS
D.4	INSURANCE/COMMERICAL	$15,674,421	No remarks will be provided by MWH.
D.5	LAND ACQUISITIONS AND PERMITS	$18,472,787	
D.7	ENVIRONMENTAL & ABORIGINAL AFFAIRS	$11,735,229	

5.1.10 Schedule and Equipment Delivery

The IE, in responding to this requirement has assembled tables using the information furnished by Nalcor that is presented herein: Commitment Package Estimate(s) for each of the separate subprojects – see Table 5-16 (see also the Schedule of Delivery Dates for each of the subprojects).

Table 5-16

COMMITMENT PACKAGE COST ESTIMATES AND CONTRACT AWARD COST

	CONTRACT PACKAGE ID AND DESCRIPTION	MUSKRAT FALLS GENERATION FACILITY (MF)		LABRADOR ISLAND LINK (LIL)		LABRADOR TRANSMISSION ASSET (LTA)		TOTAL		REMARKS
		ESTIMATED COST	CONTRACT AWARD COST	ESTIMATED COST	CONTRACT AWARD COST	ESTIMATED COST	CONTRACT AWARD COST	ESTIMATED COST	CONTRACT AWARD COST	
1	CD0501 - Supply and Install Converters and Cable Transition Compounds			$401,654,399				$401,654,399		Under review
2	CD0502 - Construction of AC Substations and Synchronous Condensers Facilities			$80,571,584		$60,484,647		$141,056,231		Under review
3	CD0503 - Construction of Earthworks at Various Power Distribution Sites			$47,820,858		$17,447,657		$65,268,515		
4	CD0508 - Supply and Install of Electrode Sites			$27,317,881				$27,317,881		
5	CD0509 - Construction Telecommunication Services - Phase 2	$13,733,898		$69,024		$69,024		$13,871,946		
6	CD0510 - Supply and Install Permanent Communication Systems	$1,908,996		$15,688,478		$5,352,178		$22,949,652		
7	CD0512 - Construction of Construction Power Facilities	$8,973,000						$8,973,000		
8	CD0534 - Supply and Install Soldiers Pond Synchronous Condensers			$74,995,326				$74,995,326		
9	CD0535 - Construction Telecommunication Services - Phase 2 Remote Camps	$1,030,238		$3,676,493		$2,046,305		$6,753,036		
10	CD0538 - Supply and Install Accommodations Camp (CF)					$17,343,523		$17,343,523		
11	CH0002 - Supply and Install Accommodations Complex Buildings	$65,267,191						$65,267,191		
12	CH0003 - Supply and Install Administrative Buildings	$8,369,000						$8,369,000		
13	CH0004 - Construction of Southside Access Road	$34,585,885						$34,585,885		
14	CH0005 - Supply and Install Accommodations Complex Site Utilities	$18,017,564						$18,017,564		
15	CH0006 - Construction of Bulk Excavation Works and Associated Civil Works	$132,970,112	$112,942,295	$1,269,129		$1,232,708		$135,471,949		Under review
16	CH0007 - Construction of Intake and Powerhouse, Spillway and Transition Dams	$687,994,112						$687,994,112		Under review
17	CH0008 - Construction of North Spur Stabilization Works	$62,709,810						$62,709,810		
18	CH0009 - Construction of North and South Dams	$117,166,506						$117,166,506		
19	CH0023 - Construction of Reservoir Clearing South Bank	$85,033,860						$85,033,860		
20	CH0024 - Construction of Reservoir Clearing North Bank	$54,045,313						$54,045,313		
21	CH0030 - Supply and Install Turbines and Generators	$200,000,000	$166,969,064.98					$200,000,000	$166,969,064.98	Satisfactory
22	CH0031 - Supply and Install Mechanical and Electrical Auxiliaries (MF)	$91,913,298						$91,913,298		
23	CH0032 - Supply and Install Powerhouse Hydro-Mechanical Equipment	$101,525,168						$101,525,168		
24	CH0033 - Supply and Install Powerhouse Cranes	$8,872,175						$8,872,175		
25	CH0034 - Supply and Install Powerhouse Elevator	$755,300						$755,300		
26	CH0039 - Supply and Install McKenzies River Permanent Bridge	$2,635,900						$2,635,900		
27	CH0046 - Supply and Install Spillway Hydro-Mechanical Equipment	$50,794,781						$50,794,781		
28	CH0048 - Construction of Site Clearing Access Road & Ancillary Areas	$3,589,830						$3,589,830		
29	CH0049 - Supply and Install Log Booms	$7,500,000						$7,500,000		
30	CH0052 - Construction of Habitat Compensation Works	$10,100,000						$10,100,000		
31	CT0319 - Construction of 315 kV HVac Transmission Line (MF to CF)	$3,770,591				$184,345,852		$188,116,443		
32	CT0327 - Construction of 350 kV HVdc Transmission Line - Section 1			$358,988,474				$358,988,474		Under review

	CONTRACT PACKAGE ID AND DESCRIPTION	MUSKRAT FALLS GENERATION FACILITY (MF)		LABRADOR ISLAND LINK (LIL)		LABRADOR TRANSMISSION ASSET (LTA)		TOTAL		REMARKS
		ESTIMATED COST	CONTRACT AWARD COST	ESTIMATED COST	CONTRACT AWARD COST	ESTIMATED COST	CONTRACT AWARD COST	ESTIMATED COST	CONTRACT AWARD COST	
33	CT0341 - Clearing of Right of Way for 315 kV HVac Transmission Line (MF to CF)					$29,701,301		$29,701,301		
34	CT0342 - Construction of AC Transmission Lines - Island			$13,010,122				$13,010,122		
35	CT0343 - Clearing of Right of Way for HVdc Transmission Line - Section 1			$91,825,753				$91,825,753		
36	CT0345 - Clearing of Right of Way for HVdc Transmission Line - Section 2			$53,762,352				$53,762,352		
37	CT0346 - Construction of 350 kV HVdc Transmission Line - Section 2			$167,647,168				$167,647,168		Under review
38	PD0505 - Supply of Switchyard Equipment, AC Substations at CF, MF and SP			$23,200,921		$71,964,505		$95,165,426		
39	PD0513 - Supply of 138/25 kV Transformers	$2,098,005						$2,098,005		
40	PD0514 - Supply of 138 kV & 25 kV Circuit Breakers	$205,100						$205,100		
41	PD0515 - Supply of 230 kV, 138 kV & 25 kV Disconnect Switches	$212,480						$212,480		
42	PD0518 - Supply of 138 kV Capacitor Voltage Transformers	$25,540						$25,540		
43	PD0519 - Supply of 25 kV Vacuum Interrupters	$142,600						$142,600		
44	PD0520 - Supply of 25 kV 6 x 3.6 MVAR Capacitor Banks	$207,252						$207,252		
45	PD0522 - Supply of Pre-fabricated Control Room Building	$806,701						$806,701		
46	PD0523 - Supply of Substation Service Transformer	$18,236						$18,236		
47	PD0529 - Supply of 25 kV Reclosers	$62,859						$62,859		
48	PD0530 - Supply of 138 kV & 25 kV Surge Arrestors	$41,325						$41,325		
49	PD0531 - Supply of MV Instrument Transformer	$55,512						$55,512		
50	PD0533 - Supply and Install Early Works Telecom Devices	$317,425						$317,425		
51	PD0537 - Supply of Power Transformers, AC Substations at CF, MF and SP			$6,689,740		$22,814,174		$29,503,914		
52	PD0561 - Supply of D20 RTU and Cabinet (CF) - Construction Power	$50,000						$50,000		
53	PD0562 - Supply of Specific Relays and Test Switches (CF) - Construction Power	$100,000						$100,000		
54	PD0563 - Supply of 138 kV Circuit Switcher (CF), MV Switches/Fuse Cut-outs	$117,000						$117,000		
55	PH0014 - Supply of Generator Step-up Transformer	$19,464,468						$19,464,468		Under review
56	PH0015 - Supply of Isolated Phase Bus	$1,860,952						$1,860,952		
57	PH0016 - Supply of Generator Circuit Breakers	$5,056,000						$5,056,000		Under review
58	PH0036 - Supply of Auxiliary Transformers	$469,281						$469,281		
59	PH0037 - Supply of 25 kV Switchgear	$1,366,952						$1,366,952		
60	PH0038 - Supply of Emergency Diesel Generators	$1,706,125						$1,706,125		
61	PT0300 - Supply of Transmission Line Conductors - 315 kV HVac					$19,896,000		$19,896,000		
62	PT0301 - Supply of HVac Insulators - 315 kV HVac					$4,792,470		$4,792,470		
63	PT0302 - Supply of Steel Towers - 315 kV HVac					$23,879,000		$23,879,000		
64	PT0303 - Supply of Tower Hardware - 315 kV HVac					$12,133,405		$12,133,405		
65	PT0304 - Supply of Optical Ground Wire (OPGW) - 315 kV HVac					$2,322,860		$2,322,860		
66	PT0307 - Supply of Steel Tower Foundations - 315 kV HVac					$5,514,614		$5,514,614		
67	PT0308 - Supply of Steel Tower Foundations - 315 kV HVdc			$23,779,087				$23,779,087		

	CONTRACT PACKAGE ID AND DESCRIPTION	MUSKRAT FALLS GENERATION FACILITY (MF)		LABRADOR ISLAND LINK (LIL)		LABRADOR TRANSMISSION ASSET (LTA)		TOTAL		REMARKS
		ESTIMATED COST	CONTRACT AWARD COST	ESTIMATED COST	CONTRACT AWARD COST	ESTIMATED COST	CONTRACT AWARD COST	ESTIMATED COST	CONTRACT AWARD COST	
68	PT0326 - Supply of Steel Wires - 315 kV HVac					$2,797,761		$2,797,761		
69	PT0328 - Supply of Transmission Line Conductors - 315 kV HVdc			$82,574,783				$82,574,783		
70	PT0329 - Supply of HVdc Insulators - 350 kV HVdc			$49,928,860				$49,928,860		
71	PT0330 - Supply of Steel Towers - 350 kV HVdc			$61,189,733				$61,189,733		
72	PT0331 - Supply of Tower Hardware - 350 kV HVdc			$6,431,818				$6,431,818		
73	PT0334 - Supply of Steel Wires - 350 kV HVdc			$1,815,840				$1,815,840		
74	PT0335 - Supply of Anchor Materials - 315 kV HVac					$1,920,943		$1,920,943		
75	PT0336 - Supply of 25 kV Distribution Line Hardware	$490,000						$490,000		
76	PT0337 - Supply of 25 kV Distribution Line ADSS Fibre Optic Cable	$460,000						$460,000		
77	PT0338 - Supply of 25 kV Distribution Line Conductors	$345,000						$345,000		
78	PT0339 - Supply of 25 kV Distribution Line Insulators	$65,000						$65,000		
79	PT0340 - Supply of Wood Poles for 138/25 kV Distribution Line	$375,000						$375,000		
80	PT0351 - Supply of Wood Poles			$430,060				$430,060		
81	PT0352 - Supply of Anchor Materials - 350 kV HVdc			$21,216,830				$21,216,830		
82	PT0353 - Supply of Optical Ground Wire (OPGW) - 350 kV HVdc			$3,889,923				$3,889,923		
83	SD0536 - Provision of Integrated Commissioning Support Services	$1,950,000		$3,053,762		$9,372,938		$14,376,700		
84	SD0560 - Provision of Early Works Construction Telecommunication Services (MF)	$307,993						$307,993		
85	SH0018 - Provision of Catering, Housekeeping and Janitorial Services (MF)	$114,800,000						$114,800,000		
86	SH0019 - Provision of Security Services	$21,907,250						$21,907,250		
87	SH0020 - Provision of Medical Services	$19,029,000						$19,029,000		
88	SH0021 - Provision of Road Maintenance and Snow Clearing Services (MF)	$8,150,000						$8,150,000		
89	SH0022 - Provision of Fuel Supply and Dispensing Services (MF)	$750,000						$750,000		
90	SH0040 - Provision of Garbage Removal and Disposal Services (MF)	$2,500,000						$2,500,000		
91	SH0041 - Provision of Ground Transportation Services (HVGB to MF)	$12,685,680						$12,685,680		
92	SH0051 - Provision of Building Maintenance Services (MF)	$24,000,000						$240,000,000		
93	SM0700 - Provision of General Freight Forwarding Services	$2,500,000		$7,000,000		$500,000		$10,000,000		
94	SM0701 - Provision of Third Party Quality Surveillance & Inspection Services	$2,200,000		$1,100,000		$1,100,000		$4,400,000		
95	SM0703 - Provision of Happy Valley-Goose Bay Project Office Space	$480,000						$480,000		
96	SM0704 - Provision of Surveying Services	$13,261,600						$13,261,600		
97	SM0705 - Provision of Laboratory Services	$31,078,844						$31,078,844		
98	SM0706 - Supply and Maintenance of Project Vehicles	$2,303,000		$822,500		$164,500		$3,290,000		
99	SM0707 - Provision of Helicopter Services	$3,388,750		$9,488,500		$677,750		$13,555,000		
100	SM0710 - Supply and Maintenance of various IT Equipment	$2,000,000						$2,000,000		
101	SM0713 - Provision of Geotechnical Investigation Services	$2,000,000						$2,000,000		
102	ST0309 - Provision of Geotechnical Investigation Services - 315 kV HVac					$950,000		$950,000		

	CONTRACT PACKAGE ID AND DESCRIPTION	MUSKRAT FALLS GENERATION FACILITY (MF)		LABRADOR ISLAND LINK (LIL)		LABRADOR TRANSMISSION ASSET (LTA)		TOTAL		REMARKS
		ESTIMATED COST	CONTRACT AWARD COST	ESTIMATED COST	CONTRACT AWARD COST	ESTIMATED COST	CONTRACT AWARD COST	ESTIMATED COST	CONTRACT AWARD COST	
103	ST0310 - Provision of Geotechnical Investigation Services - 350 kV HVdc			$3,800,000				$3,800,000		
104	ZZ0999 - Unallocated SOW	$10,000,000		$4,827,959		$1,460,613		$16,278,572		
105	**GRAND TOTAL**	**$2,084,673,458**		**$1,649,537,357**		**$500,284,728**		**$4,450,485,543**		
106	**LC-SB-003 – Strait of Belle Isle Submarine Cable Design, Supply and Install**				**$125,245,370**					Satisfactory

The IE has included columns in Table 5-16 to reflect the actual contract price for each of these items to allow a direct comparison to be made with the estimated price. Currently, (March 2013) MWH has insufficient information to express any opinions pertaining to underruns or overruns of the estimate, or to fill in the table for the contract price except as shown.

Table 5-17

DELIVERY DATES

MAJOR EQUIPMENT AND SYSTEMS

Muskrat Falls Generation		
	Spillway	
CH0032	Gate Anchors	2014 Jan
CH0032	Gate Guides 1	2015 Mar
CH0032	Gate 1	2015 Jun
CH0032	Stoplog Anchors	2014 Jan
CH0032	Stoplog Guides	2015 Mar
CH0032	Stoplog 1	2015 Oct
CH0033	**Powerhouse Crane**	
	Powerhouse Unit 1	
CH0032	Draft Tube Gate anchors	2014 Mar
CH0032	Draft Tube Gate guide	2015 Sep
CH0032	Draft Tube Gate	2016 May
CH0032	Intake Gate anchors	2014 Apr
CH0032	Intake Gate guide	2016 Mar
CH0032	Intake Gate	2016 Jun
CH0030	T/G anchors (embedded)	2014 Mar
CH0030	Stay Ring (embedded) non-embedded parts not included in this list	2016 May
PH0014	Power Transformer	2015 Jul
PH0015	Isophase System	2017 Jul
Labrador Transmission Asset		
PD0537	**Transformers 735kV – Churchill Falls Switch Yard**	2015 Jun
PD0537	**Transformers 315kV – Muskrat Falls Switch Yard**	2015 Jun
	Labrador Marshalling Yard for Transmission Line	
PD0335	Anchors – 50% to Marshalling yard	2013 Aug
PD0307	Steel Tower Foundations – 40% to Marshalling yard	2013 Sep
PD0302	Steel Towers – 1000 Tons to Marshalling yard	2013 Oct

PD0300	Conductor – 50% to Marshalling yard	2013 Nov
Labrador Island Transmission Link		
	Synchronous Condensers – Soldiers Pond	
CD0534	1st unit at site	2014 Dec
	Converter Station Equipment – Muskrat Falls	
CD501	DC Equipment	2015 Jan
CD501	AC Equipment	2015 Mar
	Converter Station Equipment – Soldiers Pond	
CD501	DC Equipment	2015 Apr
CD501	AC Equipment	2016 Feb
	Labrador Marshalling Yard for Transmission Line	
PT0352	Anchors – 50% to Marshalling yard in Lab	2014 Apr
PT0308	Steel Tower Foundations – 50% to Marshalling yard in Lab	2014 Jun
PT0330	Steel Towers – 50% Tons to Marshalling yard in Lab	2014 Aug
PT0328	Conductor – 50% to Marshalling yard in Lab	2014 May
	Newfoundland Marshalling Yard for Transmission Line	
PT0352	Anchors – 50% to Marshalling yard in Nfld	2014 Apr
PT0308	Steel Tower Foundations – 50% to Marshalling yard in Nfld	2014 Jun
PT0330	Steel Towers – 50% Tons to Marshalling yard in Nfld	2014 Aug
PT0328	Conductor – 50% to Marshalling yard in Nfld	2014 May
SOBI Crossing		
	Subsea Cable fabricated and available for pick-up	2015 Nov

5.1.11 Schedule of Values

The schedule showing the estimated base cost (DG3 Cost) by component for MF, LTA and LIL projects cash expenditure schedule and accumulated cash flow is given in Figure 5-1 at the bottom of the table, which has been enlarged following the figure. This exhibit was copied directly from Decision Gate 3 Capital Cost Estimate, LCP-PT-ED-00000-EP-ES-0002-01, and clearly illustrates what Nalcor predicts is the cash flow for the three different projects comprising their portion of the LCP. In the opinion of the IE, we find this schedule to be reasonable and supported by Nalcor's evaluation and analysis. We have not yet independently reviewed the schedule within the limitations of our Agreement.

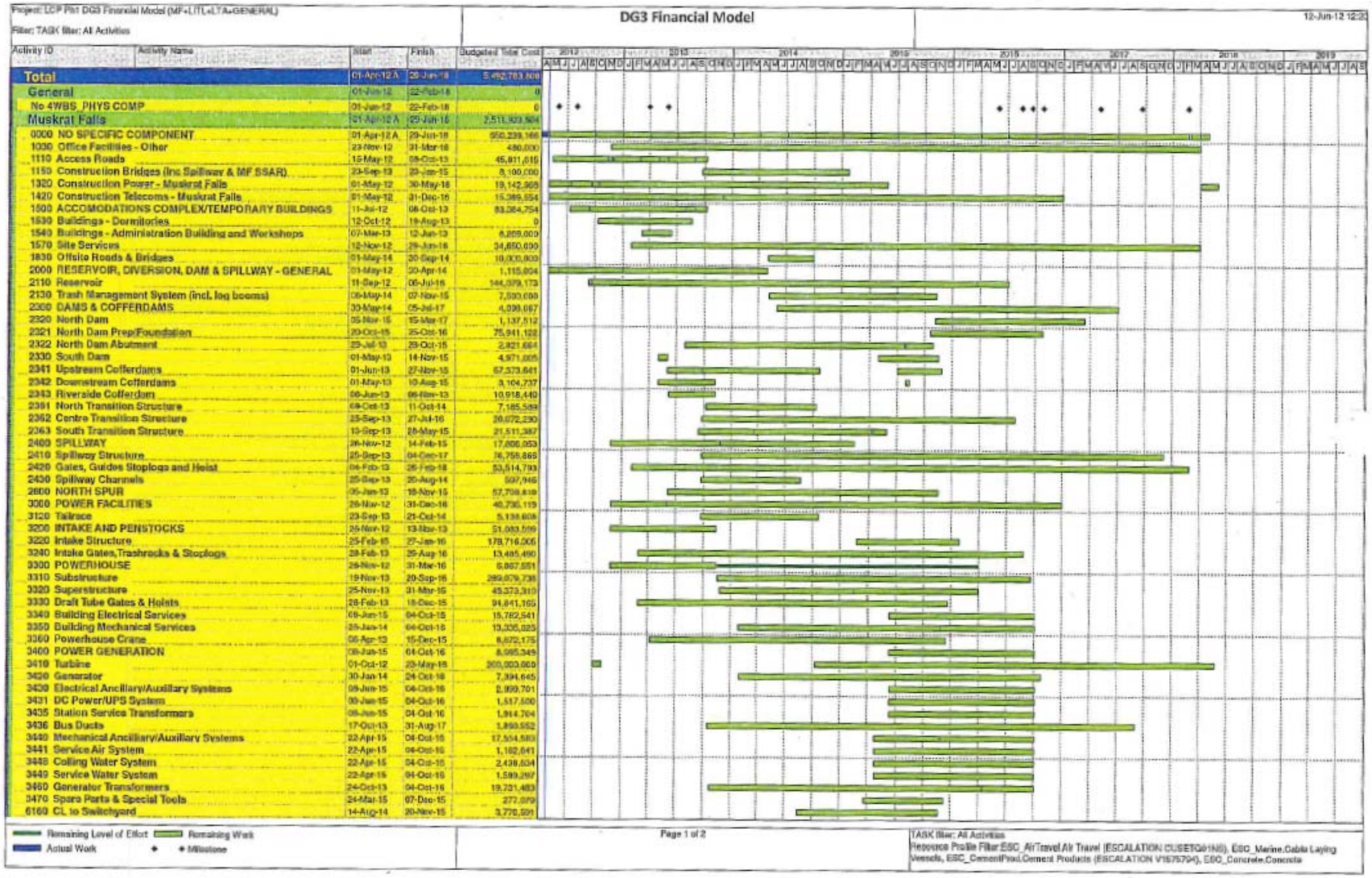


Figure 5-1 Schedule of Expenditures for Major Components of the Projects and Accumulated Cash Flow Projection

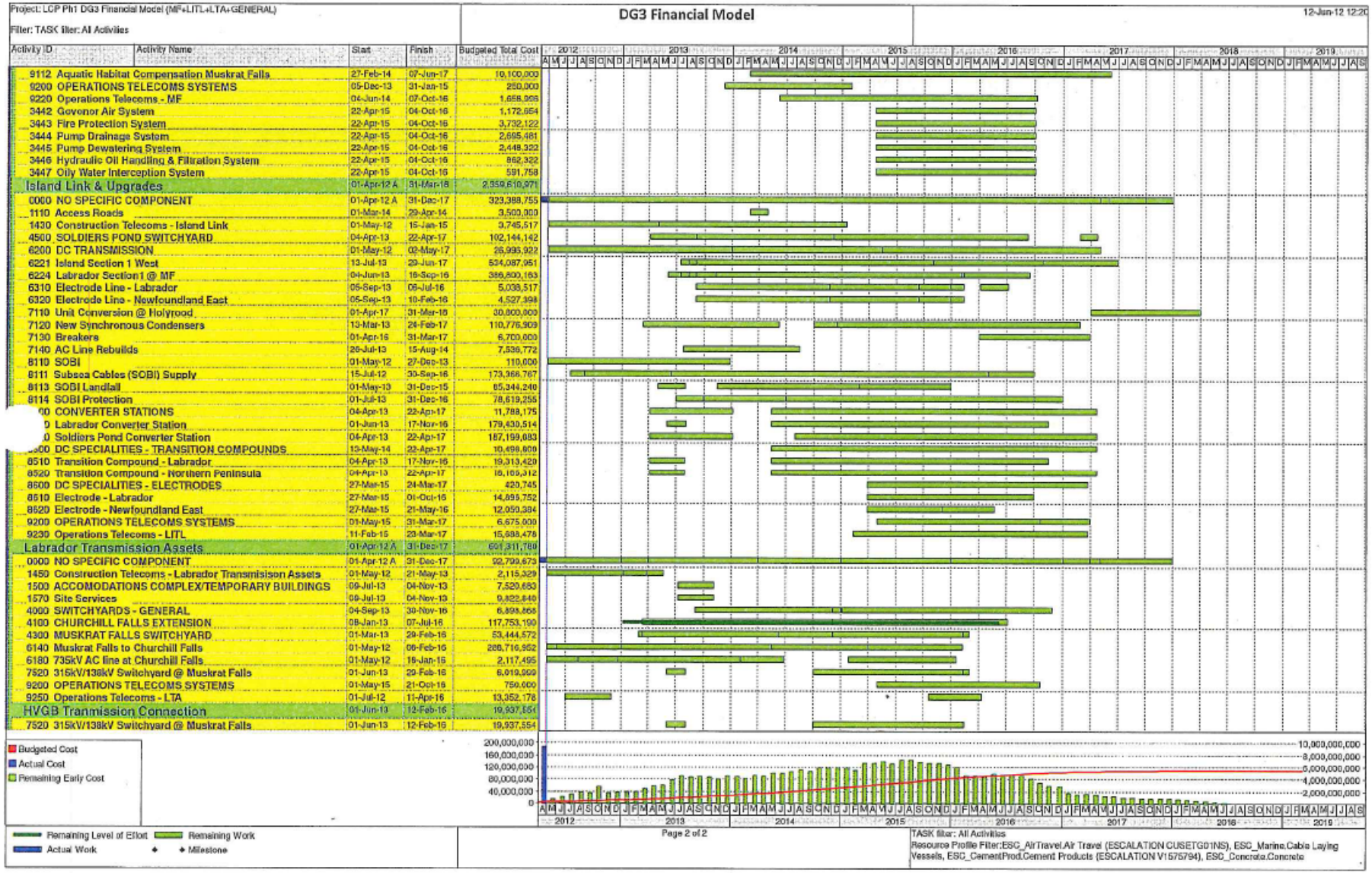
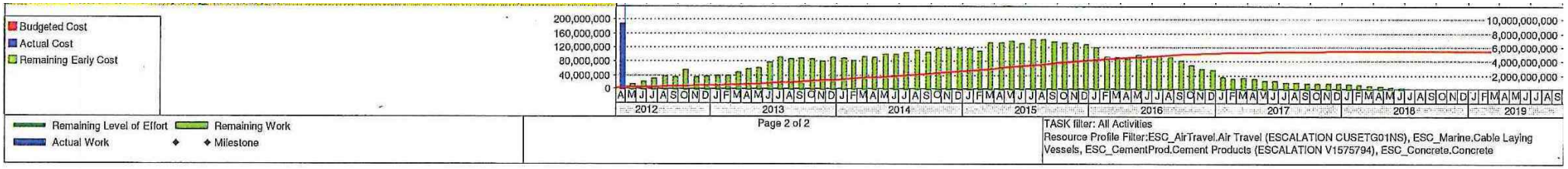


Figure 5-1 Schedule of Expenditures for Major Components of the Projects and Accumulated Cash Flow Projection (continued)

Enlargement of bottom section of Figure 5-1.



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5.1.12 Allowance for Contractor Bonus

Bonuses or performance incentives are only provided under the following contract: CH0007.

For Contract CH0007, the following incentives are offered:

Table 5-18

SUMMARY OF CONTRACTOR BONUS PROVISIONS

ITEM NO	PERFORMANCE GOAL	BONUS	REMARKS
1	**DIVERSION**		
1.1	IF CONTRACTOR ACHIEVES ALL OF THE MILESTONES M4, M5, M6, M7, M8, M9, AND M10 BY THE ASSOCIATED MILESTONE DATES LISTED IN THE MILESTONE SCHEDULE, NALCOR WILL PAY A BONUS OF:	$6,000,000	
1.2	FOR EACH OF THE MILESTONES, M4, M5, M6, M7, M8, AND M9, IF CONTRACTOR ACHIEVES THE MILESTONE EARLIER THAN THE MILESTONE DATE AS LISTED IN THE MILESTONE SCHEDULE, NALCOR WILL PAY A BONUS FOR EACH DAY THAT ACHIEVEMENT IS EARLY, UP TO A MAXIMUM OF 21 DAYS. FOR EACH MILESTONE, THE BONUS SHALL BE $50,000 PER DAY EARLY, TO A MAXIMUM OF $1,050,000.	MAXIMUM BONUS PAYABLE, 6 MILESTONES $6,300,000	
2	**POWERHOUSE INTAKE STRUCTURE**		
2.1	FOR EACH OF THE MILESTONES, M28, M36, M44, AND M52, IF CONTRACTOR	MAXIMUM BONUS PAYABLE, 4 MILESTONES:	

ITEM NO	PERFORMANCE GOAL	BONUS	REMARKS
	ACHIEVES THE MILESTONE EARLIER THAN THE MILESTONE DATE AS LISTED IN THE MILESTONE SCHEDULE, NALCOR WILL PAY A BONUS FOR EACH DAY THAT ACHIEVEMENT IS EARLY, UP TO A MAXIMUM OF 21 DAYS. FOR EACH MILESTONE, THE BONUS SHALL BE $50,000 PER DAY EARLY, TO A MAXIMUM OF $1,050,000	$4,200,000	
	TOTAL POSSIBLE BONUS FOR PERFORMANCE	**$16,500,000**	

Nalcor advised MWH that no other contracts provide for a bonus provision.

5.1.13 Highlight Sensitive and Critical Areas

Nalcor has identified several areas that they believe are the critical risk areas for the projects, namely the following: Performance Risk; Competition for Resources; and Schedule Risk Exposure. A brief discussion of each from Nalcor's perspective follows.

Performance risk is assumed to exist since Nalcor has used historical norms for other hydroelectric projects for estimating purposes. Their estimates were predicated on achieving the envisioned labor strategy and were even assumed to be much better than those associated with a recent and on-going project where restrictive work practices exist. Nalcor is concerned that "…contractor mark-up for unit price agreements could be excessive if there is a perception risk that the labor strategy will not materialize." The experienced front-line supervision which is a key to performance for Lower Churchill Project (and certainly other projects), which has been correctly identified by Nalcor in MWH's opinion, now competes with other projects, world-wide, and could likely place a high demand on CF.

Competition for resources is another concern and because the cost estimate for Muskrat Falls is based upon the labor rates given in the Hebron Agreement and with approximately 18 million person-hours of labor required, which include Nalcor, Project Management Team (PMT) and services, the project demand will compete with Western Canada's other projects for labor. Nalcor advises that in addition, the wages used in the estimates are slightly lower than for Western Canada, but because Newfoundland has larger union premiums, it will result in lower take-home compensation for those employed in LCP assignments. In addition, other large

projects in Western Canada have completion bonuses that are planned and could have an impact on attracting qualified labor resources; Nalcor's LCP does not have the bonus.

Nalcor considers that there is a potential for a time or schedule risk exposure for the MF powerhouse beyond the plan they developed due to weather and the sheer magnitude of the volume of work for the powerhouse. The main concern is with the placement and curing of the 460,000 CM of powerhouse reinforced concrete over several winters which is considered to be a challenge for the contractor for CH0007. Additionally, the Bulk Excavation contractor (CH0006) must keep to schedule to complete its work this fall to enable the contractor for CH0007 to start its work on time.

MWH agrees with Nalcor's assessment that these are certainly risks that must be considered and accounted for in the schedule and estimate. MWH notes that the perceived schedule risk exposure pertaining to the Bulk Excavation contractor completing on time appears to be a non-issue, as viewed during the field trip in late September 2013, assuming that the contractor's performance continues to be satisfactory. Additionally, MWH believes that with Nalcor's acceptance of the contractor's proposal to use an all-weather enclosure for powerhouse construction as proposed by the contractor for CH0007 will certainly mitigate the risk of extensive delays in powerhouse concrete construction during the winter seasons; without having the P6 schedule, MWH is not able to form a concise opinion other than what appears to also be a mitigate, perceived issue of Nalcor's upper management.

With the concern that Nalcor has expressed in the uncertainties surrounding the potential cost increase due to the competition for labor and key personnel, MWH believes that this concern could have been addressed in the cost estimate and reflected in the Project Schedule by including higher contingencies and a lengthened project schedule. A large Owner's contingency could have been assumed as compared to what Nalcor used. In the DG2 and DG3 estimates, MWH generally will follow the AACEI's guidelines for projects with respect to contingencies since AACEI has a broad data base that can statistically support the values used for each level of estimate (decision gate) as is the custom in using AACEI procedures.

5.1.14 Price Risks

Nalcor has discussed in the contracting philosophy their methods to quantity and manage price risks due to changing market conditions, inflation, labor issues, weather and hydrology issues, manufacturing space and equipment availability, delays in meeting milestones, and competition with other projects in Canadian Providences. The risk assessments they conducted following a multi-faceted Project Risk Management Plan using AACEI's recommended practice for price changes for major equipment they will purchase, as well as the construction and installation contracts they and SNC-L will administer, appear to be carefully performed and were taken into consideration in their economic analysis. The CPM schedule was also integrated into the analysis to arrive at appropriate unit cost pricing.

Where appropriate, LDs, LCs and performance protection have also been used to protect Nalcor as well as bonus provisions for at least one contract (CH0007) to help Nalcor achieve their development schedule.

The contingencies for each of the projects are given below in Table 5-19 for reference as follows:

Table 5-19

CONTINGENCIES DERIVED FOR EACH PROJECT

PROJECT	CONTINGENCY AMOUNT (P50)	REMARKS
MUSKRAT FALLS GENERATING STATION	$226,700,000	See Sections 5.1.1 and 9.2.4. MWH advocates for higher basic contingency funding
LABRADOR TRANSMISSION ASSETS PROJECT	$54,800,000	See Sections 5.1.1 and 9.2.4. MWH advocates for higher contingency funding
LABRADOR-ISLAND TRANSMISSION LINK PROJECT	$86,500,000	MWH advocates for high basic contingency funding.
TOTAL	**$368,000,000**	

5.2 DRAWDOWN SCHEDULES

In order to opine on the reasonableness of the drawdown schedules for each of the contracts that MWH is required to review and comment on, we have prepared Table 5-20 wherein we have summarized our findings for each of the contracts. We note that even where we believe we have observed some payments in favor of the contractor or vendor, since the payment schedule was considered among many items in the consideration and award of the contract, other issues may override any unbalance we may observe.

Table 5-20

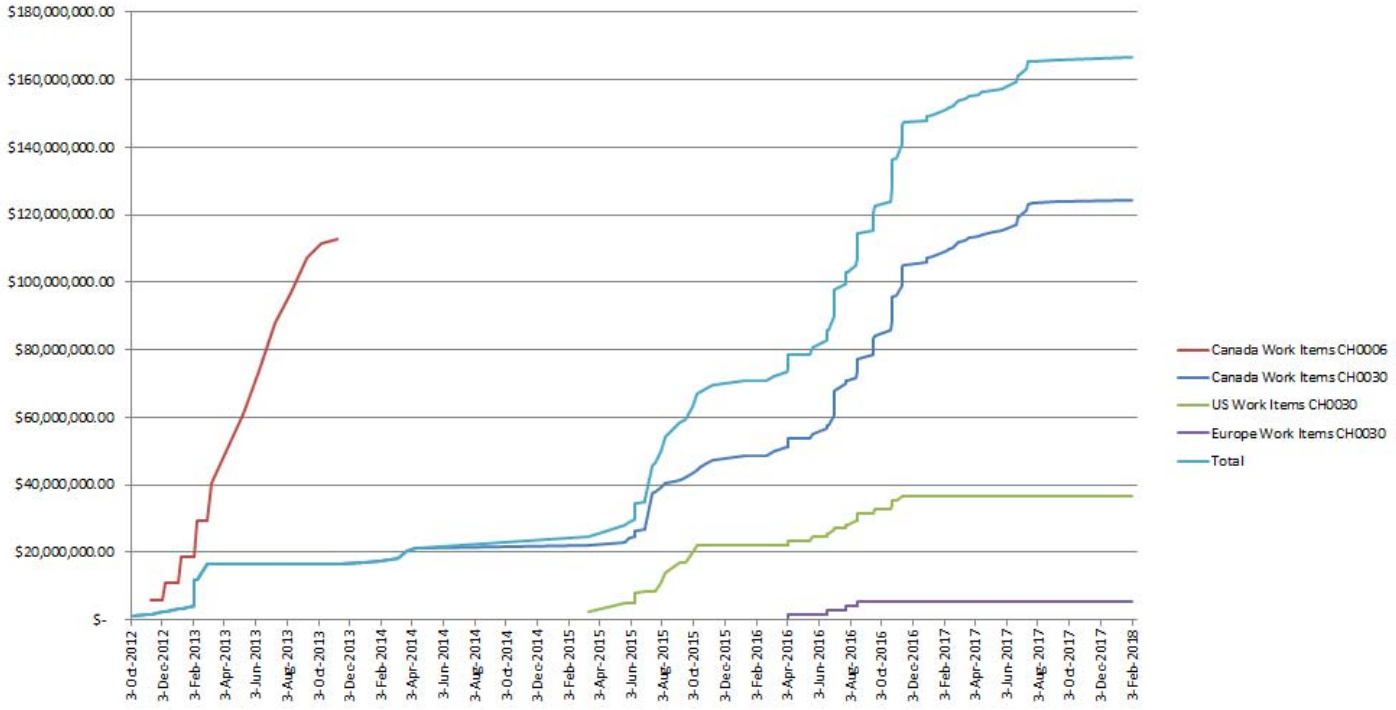
PAYMENT SCHEDULES FOR CONTRACTS REVIEWED

BY THE INDEPENDENT ENGINEER

PROJECT	CONTRACT NUMBER	PAYMENT SCHEDULE		REMARKS/COMMENTS
		NORMAL EXPECTED	UNUSUAL	
MF	CH0030			Under review
	CH0006			Under review
	CH0007			Under review

PROJECT	CONTRACT NUMBER	PAYMENT SCHEDULE		REMARKS/COMMENTS
		NORMAL EXPECTED	UNUSUAL	
SOBI	LC-SB-003			Under review

To allow a more easy comparison to determine if the drawdown payment schedule is normal or unusual, we have plotted each of the schedules we have been asked to review. A composite plot is given in Figure 5-2 below for contract CH0006 and contract CH0030, which has three currencies to consider.



Note:
Source: Andritz Hydro Milestone Payment Schedule, Exhibit 2, Appendix B.
Payments are reported in Canadian dollars (CAD). Payments originally in US$ and Euros have been converted to CAD based on the exchange rate on December 31, 2012 as reported in OANDA Corporation, Historical Exchange Rates.

Figure 5-2 Composite Plot of Drawdown Payment Schedule –

Contract CH0006 and Contract CH0030

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SECTION 6

COMMERCIAL OPERATION AND MAINTENANCE SERVICES

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SECTION 6

COMMERCIAL OPERATION AND MAINTENANCE SERVICES

6.1 OPERATIONS AND MAINTENANCE PLAN

6.1.1 Commercial Operation Services

Nalcor plans to use outside services to assist it in operating and maintaining the terminal station extension at CF according to Nalcor's Operations and Maintenance (O&M) Philosophy document. The Churchill Falls Labrador Corporation will be responsible for the operation and maintenance of this facility.

Nalcor plans to operate the other components of the LCP they are constructing and financing by themselves, or through subsidiary companies established for taxing and legal reasons.

6.1.2 Adequacy of Start-Up and Long-Term Procedures

No comments will be furnished by MWH prior to Financial Close. The program for the operation services is currently under development and will not be available for review until later next year.

6.1.3 Reasonableness of Annual Operations and Maintenance Budget

Under review.

6.1.4 Reasonableness of Operation and Maintenance Fee

No information is currently available for MWH's review. Nalcor advises that this information will not be available until late 2014.

6.1.5 Proposed Training Budget

No information is yet available for MWH's review. Nalcor advises that this information will not be available until late 2014.

6.2 OPERATIONS AND MAINTENANCE COST ESTIMATE

6.2.1 Completeness

The following table presents the estimated annual O&M costs provided for our review by Nalcor. They are figures that have been developed by the Integrated Project Team, which have been used in Nalcor's financial pro forma.

Table 6-1

ANNUAL OPERATIONS AND MAINTENANCE COSTS

Year:	1	2	3	4	5	10	20	30	40	50
Muskrat Falls Generation	$ 6,345,025	$ 6,345,025	$ 6,345,025	$ 6,345,025	$ 6,345,025	$ 6,345,025	$ 6,345,025	$ 6,345,025	$ 6,345,025	$ 6,345,025
Labrador Transmisson Assets	$ 2,148,360	$ 2,148,360	$ 2,148,360	$ 2,148,360	$ 2,148,360	$ 2,148,360	$ 2,148,360	$ 2,148,360	$ 2,148,360	$ 2,148,360
Labrador - Island Transmisson Link	$15,970,624	$15,970,624	$14,623,124	$15,870,624	$14,623,124	$16,070,624	$14,823,124	$14,823,124	$14,823,124	$14,823,124
Total:	**$24,464,009**	**$24,464,009**	**$23,116,509**	**$24,364,009**	**$23,116,509**	**$24,564,009**	**$23,316,509**	**$23,316,509**	**$23,316,509**	**$23,316,509**

The data shown in Table 6-1 are based on January 2012 costs and include 15 contingency allowances. Each of the first five years, starting from the first date of commercial operation of the project, the tenth year, and then each subsequent tenth year are indicated.

Corporate costs (general and overhead) are allocated among the three projects based on the direct O&M cost estimates. They are:

- MF 23.95 percent;
- LTA 19.28 percent; and
- LIL 56.77 percent.

Energy Control Centre (ECC) costs are allocated among two projects based on expected use. They are:

- LTA 25 percent; and
- LIL 75 percent.

6.2.2 Assumptions

6.2.2.1 Nalcor's O&M strategy is to operate MF, terminal and converter stations at Soldiers Pond and MF, terminal station extension at CF, AC transmission lines in Labrador, DC transmission lines in Labrador and Newfoundland, and the SOBI crossing and transition stations remotely from Nalcor's ECC in St. John's and by local staff as required.

6.2.2.2 Routine maintenance, condition and performance monitoring, inspection, adjustment and minor repairs will be performed by Nalcor staff working at the facilities, or located nearby in other Nalcor facilities.

6.2.2.3 Major maintenance and repair, specialized inspections, tests, and adjustments will be performed by contractors through various arrangements depending on the service to be provided.

6.2.2.4 Support services including technical, environmental, accounting, budgeting, financial reporting, procurement, human resources, legal, etc. will be provided from Nalcor headquarters in St. John's.

6.2.2.5 Staffing requirements are discussed in the tables below, and were provided by Nalcor.

6.2.2.6 Nalcor has advised MWH that, as the design is refined and more specific details are finalized, the staffing requirements will be reviewed and adjusted, if needed.

6.2.3 Reasonableness of Assumptions

The assumptions listed in Table 6.2 are reasonable and many are generally assumed by utilities for large projects like Churchill Falls.

6.2.4 Staffing

Contained within Nalcor's O&M Philosophy document, LCP-PT-0000-PM-00010-01, are summary tables that designate the positions, number of personnel, and classification/expertise that are required for each of its major facilities found in the document for the LCP. For the principal facilities, we have included several of these tables below as reported by Nalcor.

Table 6-2

STAFFING REQUIREMENTS PROPOSED FOR MUSKRAT FALLS FACILITY

POSITION	NO. REQUIRED	CLASSIFICATION/EXPERTISE
PLANT MANAGER	1	ELECTRICAL/MECHANICAL ENGINEER
PLANT ENGINEER, ASSET SEPCIALIST	1	ELECTRICAL/MECHANICAL ENGINEER
TECHNCIAL SUPERVISOR	1	P&C/OPERATIONS/MECHANICAL/ ELECTRICAL TRADES & TECHNOLOGY
TECHNCIAL OPERATOR	4	P&C/COMMUNICATIONS/OPERATIONS/MECHANICAL/ELECTRICAL TRADES & TECHNOLOGY
UTILITY WORKER	2	GENERAL MAINTENANCE
PLANNER	1	MECHANICAL/ELECTRICAL—TRADES & TECHNOLOGY
ENVIRON-MENTAL COORDI-NATOR	1	BIOLOGY, SCIENCE
AREA OFFICE CLERK	1	ADMINISTRATION, ACCOUNTING

POSITION	NO. REQUIRED	CLASSIFICATION/EXPERTISE
CLERK	1	CLERICAL/DOCUMENT CONTROL/STORES/TOOL CRIB
TOTAL STAFF MF	**13**	

Table 6-3

STAFFING REQUIREMENTS PROPOSED

FOR

MUSKRAT FALLS, ISLAND LINK AND MARITIME LINK TRANSMISSION (SIC) FACILITIES

POSITION	NO. REQUIRED	CLASSIFICATION/EXPERTISE
SYSTEM OPERATOR	5	ELECTRICAL TECHNOLOGY
SYSTEM PERFORMANCE	1	ELECTRICAL ENGINEERING
OPERATIONS PLANNING	1	ELECTRICAL ENGINEERING
GENERATION COORDINATOR	1	ELECTRICAL OR HYDROTECHNICAL ENGINEER
TOTAL MF; LIL; ML	**8**	

The IE notes that the staffing includes provisions for the Maritime Link facilities that are believed to be just those that deal with Nalcor assets.

According to Nalcor's O&M Philosophy document, the Churchill Falls Labrador Corporation will be responsible for the operation and maintenance of the terminal station extension at CF.

Table 6-4

STAFFING REQUIREMENTS PROPOSED FOR MAINTENANCE OF TRANSMISSION LINES, ELECTRODE LINE, SHORE LINE POND ELECTRODE, DISTRIBUTION LINES AT MUSKRAT FALLS AND ASSOCIATED FACILITIES IN LABRADOR WILL BE THE RESPONSIBILITY OF TRANSMISSION AND RURAL OPERATIONS (TRO) LABRADOR. THIS INCLUDED THE SWITCHYARD AND CONVERTER STATION AT MUSKRAT FALLS, THE TRANSITION STATION AT FORTEAU BAY

POSITION	NO. REQUIRED	CLASSIFICATIONS/EXPERTISE	REMARKS
LINE WORKER	6	TRADES	
PROTECTION & CONTROL (P&C) TECHNOLOGIST	2	ELECTRICAL TECHNOLOGY	
ELECTRICIAN	4	TRADES	
TERMINAL MAINTENANCE A	2	TRADES	
SUPERVISOR	2	TRADES	
CLERICAL	1	TRADES	
PLANNER	1	TRADES	THE IE QUESTIONS THE EXPERTISE REQUIRED FOR THE PLANNER BELIEVING IT SHOULD BE AN ENGINEER OR TECHNOLOGIST
EQUIPMENT ENGINEER	1	PROFESSIONAL ENGINEER	
MECHANIC	1	TRADES	
TOTAL TRO LABRADOR	**20**		CURRENTLY UNDER REVIEW

Table 6-5

PROPOSED STAFFING LEVELS FOR TRO NORTHERN/CENTRAL INCLUDING MAINTENANCE OF TRANSMISSION LINES AND ASSOCIATED FACILITIES ON NEWFOUNDLAND INCLUDING SWITCHYARD AT SOLDIER'S POND, THE ELECTRODE LINE, SHORELINE POND ELECTRODE AT CONCEPTION BAY, THE SOBI CABLE CROSSING AND TRANSITION STATION NEAR SHOAL COVE

POSITION	NO. REQUIRED	CLASSIFICATION/EXPERTISE	REMARKS
LINE WORKER	8	TRADES	
P&C TECHNOLOGIST[1]	4	ELECTRICAL TECHNOLOGY	
NETWORK SERVICES TECHNICIAN	3	COMMUNICATION TECHNOLOGY	
EQUIPMENT ENGINER	1	ELCTRICAL ENGINEERING	
ELECTRICIAN	6	TRADES	
TERMINAL MAINTENANCE A	2	TRADES	
GENERAL MAINTENANCE B	1	TRADES	
SUPERVISOR	2	TRADES	
VEGETATION INSPECTOR	1	TRADES	
PLANNER[2]	1	TRADES	THE IE QUESTIONS THE EXPERTISE REQUIRED FOR THE PLANNER. IT IS OUR OPINION THAT THIS IS AN ENGINEERING TASK.
MECHANIC	2	TRADES	
TOTAL TRO[3] NORTHERN & CENTRAL	**31**		CURRENTLY UNDER REVIEW

Notes: 1. A P&C Technologist is a person who will installs, tests, and performs maintenance and modifications to protective relaying, metering, instrumentation, and control equipment.

2. A Planner is defined as a person who co-ordinates the development and implementation of a computerized maintenance program, develops schedules, and assists in the implementation of maintenance.

3. Transmission and Rural Operations

Table 6-6

PROPOSED STAFFING LEVELS FOR SOLDIERS POND CONVERTER STATION

POSITION	NO. REQUIRED	CLASSIFICATION/EXPERTISE	REMARKS
TECHNICAL SUPERVISOR	1	TECHNICAL SUPERVISOR P&C/ELECTRICAL TECHNOLOGY/ENGINEERING	
TECHNICAL OPERATOR	4	P&C/ELECTRICAL/MECHANICAL/OPERATIONS-TRADES AND TECHNOLOGY	
UTILITY WORKER	2	GENERAL MAINTENANCE	
ASSET SPECIALIST	1	ELECTRICAL/MECHANICAL ENGINEER TECHNOLOGIST	
TOTAL SOLDIERS POND	**8**		CURRENTLY UNDER REVIEW.

Table 6-7
PROPOSED STAFFING LEVELS FOR ST. JOHN'S CORPORATE HEAD OFFICE
(ADDITIONAL STAFF REQUIRED FOR THE PROJECT)

POSITION	NO. REQUIRED	CLASSIFICATION/EXPERTISE	REMARKS
ENGINEERING	3	**MECHANICAL, P&C, ELECTRICAL**	
FINANCE-BUDGETS	1	ACCOUNTING GRADUATE	
FINANCE—GENERAL ACCOUNTING, FINANCIAL STATEMENT PREPARATION AND REPORTING	2	ACCOUNTING GRADUATE	

POSITION	NO. REQUIRED	CLASSIFICATION/EXPERTISE	REMARKS
FINANCE—TRANSACTIONAL PROCESSING	3	ACCOUNTING GRADUATE	
FINANCE—CASH MANAGEMENT	1.5	ACCOUNTING GRADUATE	
ENVIRONMENTAL SPECIALIST, ECOLOGIST	3	BIOLOGY, SCIENCE	IN THE IE'S OPINION, THERE DO NOT SEEM TO BE SUFFICIENT BIOLOGISTS AND ENVIRONMENTAL ENGINEERS TO MONITOR THE PROJECT AND ITS GREAT GEOGRAPHIC SPREAD, ESPECIALLY IN THE EARLY YEARS WHEN THERE WILL BE NUMEROUS REPORTS TO DEVELOP AND FACILITIES TO MONITOR AND REPORT ON. THERE IS NO MENTION OF ANY CONTRACTORS AND CONSULTANTS PLANNED TO AID THE PROPOSED STAFF AS PRESENTLY PLANNED.[1]
INFRASTRUCTURE SUPPORT & CLIENT SUPPORT SPECIALIST (IS)	3	DEGREE OR DIPLOMA WITH APPROPRIATE TRAINING	
TOTAL CORPORATE HEAD OFFICE	**16.5**		CURRENTLY UNDER REVIEW

[1]Nalcor advised there are other staff to assist, thus a reasonable number of biologists will be available to accommodate project needs.

The total number of personnel that Nalcor proposes to use to operate and maintain the LCP facilities under their domain is 105.5 people.

In addition to those technical personnel and specialists who will be assigned to the LCP, Nalcor plans to engage the following services from others as given in Table 6-8, immediately below.

Table 6-8

CONTRACTORS AND CONSULTANTS

SERVICE	REMARKS
SNOW CLEARING	
ROAD MAINTENANCE	
SUPPLY OF CONSUMABLES	
PEST CONTROL	
VEGETATION MANAGEMENT	
VEHICLE MAINTENANCE	
HELICOPTER SERVICES	
TRUCKING AND OTHER TRANSPORTATION	
DIVING	
ELEVATOR MAINTENANCE	
FIRE ALARM AND SUPPRESSION SYSTEMS MAINTENANCE	
CRANE AND HOIST MAINTENANCE	
PRESSURE VESSEL INSPECTIONS	
HVAC MAINTENANCE	
DAM SAFETY INSPECTIONS	IE SUGGESTS THIS CONSULTANT BE INCLUDED

In addition to the outside services to be provided by others to Nalcor for the LCP, Nalcor has identified specialized technical support for the following equipment and systems as given in Table 6-9.

Table 6-9

TECHNICAL SUPPORT

SERVICE, EQUIPMENT OR SYSTEM	REMARKS
TURBINES	
GOVERNORS	
GENERATORS	
EXCITERS	
CONVERTER STATION EQUIPMENT	
CONTROL SYSTEMS	
SWITCHGEAR	
TRANSFORMERS	
SUBMARINE CABLE	
DYKE BOARD OF CONSULTANTS	IE RECOMMENDS THAT THE BOARD OF CONSULTANTS BE MOVED TO TABLE 6-8.
ENVIRONMENTAL CONSULTANTS	THE IE RECOMMENDS THAT IT BE CONSIDERED THAT ENVIRONMENTAL CONSULTANTS BE ADDED TO THIS LIST.

6.2.5 Maintenance Provisions

What Maintenance Provisions require comment by IE? We realize that descriptive material will not be available until next year.

6.2.6 Administrative Costs

Corporate costs (general and overhead) are allocated among the three projects based on the direct O&M cost estimates. They are:

- MF 23.95 percent;
- LTA 19.28 percent; and
- LIL 56.77 percent.

ECC costs are allocated among two projects based on expected use. They are:

- LTA 25 percent; and
- LIL 75 percent.

6.2.7 Management Fees

No information is currently available for MWH's review. Nalcor advised information will be available next year.

6.2.8 Consumables

No information is currently available for MWH's review. Nalcor advised information will be available next year.

6.3 NALCOR ENERGY'S RELIABILITY STATISTICS

In the review of information furnished to MWH by Nalcor, we found information that is germane to consider for this review in document: LCP-PT-MD-0000-AM-PH-0001-01, REV.B1, Appendix XIV: Reliability Statistics. Nalcor's regulated utility, NLH, has been a member of the Canadian Electricity Association (CEA) for many years, and the 2006 to 2010 reporting period, which is tabulated below for reference, is a good source of data pertaining to the reliability of their projects compared to other utilities in their classification.

Table 6-10

NLH HISTORICAL RELIABILITY STATISTICS

YEARS 2006-2010

PARAMETER	CEA AVERAGE	NLH AVERAGE	NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION *Generating Availability Data System* (2007-2011) AVERAGE VALUE IS:[8]
FOR (FORCED OUTAGE RATE)[1]	2.60%	0.79%	5.79
DAFOR (DERATE ADJUSTED FORCED OUTAGE RATE)[2]	2.74	0.96	5.30
DAUFOP (DERATE ADJUSTED UTILIZATION FORCED OUTAGE PROBABILITY)[3]	2.40	0.84	NO DATA AVAILABLE
ICBF (INCAPABILITY FACTOR)[4]	8.4	8.04	11.92

PARAMETER	CEA AVERAGE	NLH AVERAGE	NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION *Generating Availability Data System* (2007-2011) AVERAGE VALUE IS:[8]
FAIL RATE[5]	2.15	2.79	3.10
MOF (MAINTENANCE OUTAGE FACTOR)[6]	0.85	0.70	1.92
POF(PLANNED OUTAGE FACTOR)[7]	5.41	6.59	8.46

NOTES: 1. A measure of the time a unit is unable to operate because of a problem.

2. A measure of the time a unit is unable to operate, or is able to operate but not at rated capacity, because of a problem.

3. The probability that a unit will not be available, or is available but not at rated capacity, when required.

4. A measure of the total outage time for a unit.

5. The rate at which a unit encounters a forced outage.

6. A measure of the total maintenance outage hours for a unit.

7. A measure of the planned maintenance outage hours for a unit.

8. Values in table were computed by MWH using North American Electric Reliability Corporation's (NAERC) Generating Availability Data System (GADS) data.

Nalcor draws the following conclusion: "The table indicates that the generating equipment operated by Newfoundland and Labrador Hydro performs very well compared to the other Canadian utilities." Based on the numbers presented in Table 6-10, the IE concurs with this observation.

The IE has also added values taken from NAERC's GADS for about the same period of time for comparison purposes. Based on these values, which have a much broader base but include plants in the southern and western portion of the United States, we find Nalcor's overall performance exceeds the NAERC averages for the period compared.

Based on the above data, the IE is of the opinion that the expected performance of Nalcor, and the companies it has established to operate and maintain the LCP assets, is expected to be at least as reliable as the CEA average and is satisfactory.

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SECTION 7

PROJECT AGREEMENTS

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SECTION 7

PROJECT AGREEMENTS

7.1 WATER MANAGEMENT AGREEMENT (WMA)

The WMA, between Nalcor and the Churchill Falls Labrador Corporation Limited was ordered by the Board of Commissioners of Public Utilities, Newfoundland and Labrador, No. P.U. 8(2010) on March 9, 2010. The intent of the WMA is to manage and operate facilities within the Province in the most efficient way for the production, transmission, and distribution of power and energy, and be assessed and allocated and re-allocated in the manner necessary to effect such a policy. As such, the objective of the WMA

> shall be the coordination of the Power generation and Energy production in the aggregate for all Production Facilities on the Churchill River to satisfy the Delivery Requirements for all Suppliers, in a manner that provides for the maximization of the long term Energy-generating potential of the Churchill River, while ensuring that the provisions of any Prior Power Contracts are not adversely affected.

The WMA requires the establishment of a Water Management Committee consisting of four members selected by the parties, and the Committee is required to appoint an Independent Coordinator which may be one or more persons.

The duties of the Independent Coordinator shall

> establish short and long term Production Schedules for all Production Facilities on the Churchill River, through the coordination of production scheduling of the Suppliers based upon the use of the aggregate generating Capability, storage and transmission facilities of any supplier on the Churchill River.

The Independent Coordinator is required to determine the total power to be produced and is required to determine and prepare the production schedules, which shall specify the amount of power to be produced by each supplier's production facilities in accordance with the provisions of the WMA. The Independent Coordinator is required to determine the energy storage and energy losses assignments for each of the suppliers in accordance with the terms of the WMA. The procedure under which this is accomplished and the calculations necessary to do so are described in Annex "A" to the WMA to appropriately assign energy storage amounts and energy losses to each supplier. Energy benefits for each of the suppliers are also described therein.

The term of the WMA is discussed in Article 12 of the agreement and will continue in full force until the earliest of the

(i) the permanent cessation of all operations at either of the CF(L)Co Production Facilities or the Nalcor Production Facilities, and (ii) any earlier date agreed to by the Suppliers, subject to the execution of a new water management agreement agreed to by the Suppliers and approved by the Board pursuant to Subsection 5.4(3)(a) of the Act.

In the opinion of the IE, the WMA is similar to other agreements where compensation must be allocated to generation facilities that share the resources of a river basin and is found to be satisfactory.

7.2 WATER LEASE AGREEMENT (LEASE)

The Water Lease Agreement (Lease) between Nalcor and Newfoundland and Labrador was made March 17, 2009. It gives Nalcor the exclusive use of all of that part of the Churchill River below the 425-foot-contour line and that part of the Churchill River below El. 425, downstream to the intersection of the Churchill River with the meridian of 60 degrees-45 minutes west of Greenwich, and includes all waters that originate within the Churchill River catchment area and all rivers that naturally flow within the catchment area. It also gives Nalcor the right to flood those areas held by the Lease. The period of the Lease is 50 years.

Government has reserved rights of the public to use the Lower Churchill River for the purpose of fishing, shooting, hunting, trapping, logging, and travelling. It places restrictions on the public that would constitute a hazard to Nalcor where it would create an operation concern.

The Lease gives Nalcor the exclusive right to store and regulate so much of the Lower Churchill River as is economic or beneficial for the purpose of developing the Lower Churchill River.

Nalcor may be required to install, operate, and maintain stream flow, water level monitoring stations, and other instrumentation and means to measure and record level of quality at designated locations. Copies of records can be provided, as requested, at least once per year.

Nalcor is required to pay to Government $2.50 per MWhour of power generated each year from their facilities. This rate can be adjusted every year based on the Consumer Price Index (CPI, Canada, All-items) as established under the Statistics Act of Canada.

Records must show the rates and amounts of water used on a daily basis for the generation of hydroelectric power, rates and amounts of water spilled or released downstream, operating water levels, extent of the flooded area, and additional related information requested by Government. Submittals are to be made at the end of March each year to the Water Rights Section of the Department of Environment and Conservation.

7.3 O&M AGREEMENTS

O&M Agreements are currently being discussed and planned by Nalcor and will not be available for review until later next year. The IE, therefore, cannot comment on the following: Term and

Termination Provisions; Budget Review and Control; Owner and Operator Responsibilities; Operations and Maintenance Plans; Environmental Compliance Plans; Reporting Procedures; Compensation and Incentive Bonus; and Consistency.

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SECTION 8

REVIEW PERMITS AND LICENSES

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SECTION 8

REVIEW PERMITS AND LICENSES

8.1 PROJECT-WIDE ENVIRONMENTAL PROTECTION PLAN (P-WEPP)

As part of MWH's review of permits and licenses, we reviewed the Project-Wide Environmental Protection Plan (P-WEPP)-Component 1 and 4b (Plan) provided by Nalcor. Our copy notes a date of January 24, 2013, which is believed to be the most current edition of the Plan. The Plan succinctly provides the basis for all work practices required to mitigate negative environmental effects associated with construction and commissioning of the LCP. These requirements can be found in the following sections of the Plan:

- INTRODUCTION
- PROJECT DESCRIPTION
- ROLES AND RESPONSIBILITIES
- RELEVANT LEGISLATION
- GENERAL ENVIRONMENTAL PROTECTION PROCEDURES
- ENVIRONMENTAL MONITORING AND FOLLOW UP
- CONTINGENCY PLANS
- FORMS
- REFERENCE DOCUMENTS
- REGULATORY CONTACT LIST.

The Plan includes an extensive number of figures and several tables that illustrate typically acceptable or unacceptable practice, and presents examples of recommended mitigation methods. The Plan lists in considerable detail the General Environmental Protection Procedures recommendations that are to be followed for the LCP. The Plan provides to those monitoring the progress of the work the guidelines and information necessary to successfully inform others as to the acceptability of the work being performed in a satisfactory manner in compliance with the Plan. Sample forms are provided in Section 8 of the Plan, as noted above, to track the activities for which environmental monitoring is prescribed. The forms provide a historic record for regulatory review, as may be required in the permits issued to Nalcor, as well as its contractors. In the opinion of the IE, the Plan, itself, is comprehensive and suitable, and is judged to be satisfactory for the LCP.

Legislation that is relevant to the design and construction of the LCP includes numerous regulatory requirements that are under the jurisdiction of federal, provincial and municipal entities. The LCP adopted Nalcor's Corporate Environmental Policy and Guiding Principles and

its Environmental Management System which meets the requirements of ISO 14001:2009. Listed in Table 8-1 are the acts and regulations that apply to the LCP as identified by Nalcor.

Table 8-1

FEDERAL, PROVINCIAL AND MUNICIPAL

ACTS AND REGULATIONS

AUTHORITY	ACTS AND REGULATIONS	COMMENTS
FEDERAL	CANADIAN ENVIRONMENTAL ASSESSMENT ACT (CEAA)	
	CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA)	
	SPECIES AT RISK ACT (SARA)	
	NAVIGABLE WATER PROTECTION ACT (NWPA)	
	TRANSPORTATION OF DANGEROUS GOODS ACT, 1992	
	OCEANS ACT	
	CANADA SHIPPING ACT	
	MIGRATORY BIRD CONVENTION ACT	
	FISHERIES ACT	
PROVINCIAL	DANGEROUS GOODS TRANSPORTATION ACT	
	ENDANGERED SPECIES ACT	
	FORESTRY ACT	
	HISTORIC RESOURCES ACT	
	NEWFOUNDLAND AND LABRADOR LANDS ACT	
	ENVIRONMENTAL PROTECTION ACT (EPA)	
	• AIR POLLUTION CONTROL REGULATIONS, 2004	
	• GASOLINE VOLATILITY CONTROL REGULATIONS, 2003	
	• PESTICIDES CONTROL REGULATIONS, 2003	

AUTHORITY	ACTS AND REGULATIONS	COMMENTS
	• STORAGE AND HANDLING OF GASOLINE AND ASSOCIATED PRODUCTS REGULATIONS, 2003	
	• USED OIL CONTROL REGULATIONS, 2002	
	• WASTE DIVERSIONS REGULATIONS, 2005	
	• WASTE MANAGEMENT REGULATIONS, 2003	
	• WASTE MATERIAL DISPOSAL AREAS, 1996	
	NALCOR ENERGY/LOWER CHURCHILL GENERATION PROJECT UNDERTAKING ORDER, ENVIRONMENTAL PROTECTION ACT	
	WILDLIFE ACT	
	WATER RESOURCES ACT	THE BULK OF THE COSTS ACCRUED FOR PERMITS PERTAINING TO SECTION 48 OF THIS ACT.
	• WELL DRILLING REGULATIONS, 2003	
	• WATER POWER RENTAL REGULATIONS, 2003	
	• ENVIRONMENTAL CONTROL WATER AND SEWAGE REGULATIONS, 2003	
	MOTORIZED SNOW VEHICLES AND ALL-TERRAIN VEHICLES REGULATIONS, 1996	
MUNICIPAL	WHERE CONSTRUCTION TAKES PLACE WITHIN MUNICIPAL BOUNDARIES, LOCAL BYLAWS ARE REQUIRED TO BE COMPLIED WITH AND PERMITS OBTAINED	APPENDIX L CONTAINS A MAP THAT DELINEATES AREAS WHERE THE PROJECT ABUTS OR PASSES THROUGH, OR IS LOCATED WITHIN, A

AUTHORITY	ACTS AND REGULATIONS	COMMENTS
		MUNICIPAL BOUNDARY. IN RESPONSE TO A QUESTION FROM THE IE ABOUT MUNICIPAL APPROVAL, NALCOR ADVISED THAT THERE ARE NO ACTIVITIES CURRENTLY PLANNED THAT REQUIRE MUNICIPAL APPROVAL. THE PROVINCIAL LEGISLATION ALLOWS THE USE OF LAND FOR PROJECT ACTIVITIES WITHIN MUNICIPALITIES. WASTE MANAGEMENT CONSULTATION IS ONGOING AND THE GOVERNMENT OF NEWFOUNDLAND AND LABRADOR IS CURRENTLY IMPLEMENTING A REGIONAL WASTE MANAGEMENT STRATEGY IN MOST JURISDICTIONS.
		THE IE AT THIS TIME CANNOT OPINE ON ANY PERMITS AND LICENSES THAT ARE INVOLVED WITH THE LIL SINCE THEY HAVE NOT BEEN PROVIDED TO MWH. NALCOR ADVISES THAT NO NEW PERMITS HAVE BEEN ISSUED. THE IE HAS BEEN ADVISED BY GOVERNMENT THAT NO OPINION NEEDS

AUTHORITY	ACTS AND REGULATIONS	COMMENTS
		TO BE EXPRESSED BY THE IE ON ADDITIONAL PERMITS AND LICENSES.

Nalcor reports that the total cost of obtaining permits, as reported in DG3 estimate as given in Document #: LCP-PT-ED-0000-EP-ES-0001-01, Rev. B1 is $115,723.24. Table 23-6 of this document lists the cost of the permits and associated fees that were known at that time.

8.2 REVIEW OF PERMITS AND LICENSES AND APPROVALS

Based on our initial review of the documents furnished and those that are available on the Nalcor website for the LCP, we have summarized our findings of representative permits that currently are available for review. This summary is contained in Table 8-2, below. We realize that additional documents will be made available as they are prepared and issued for the LIL that will require further sampling to ascertain the information to form the IE's opinions.

Table 8-2

PRELIMINARY FINDINGS OF REPRESENTATIVE PERMITS

REVIEWED BY THE INDEPENDENT ENGINEER

Document Reviewed			Reviewer's Assessment and Nalcor Comments	
Document No.	Title	Status	Complete / Incomplete	Questions / Comments
SLI-00006	DFO Project Review C7 (5+800) Caroline's Brook	Approved	Complete	Permit should reference Project-Wide Environmental Protection Plan relative to potential equipment oil leaks, operation of equipment in and near water, fueling and overnight storage of equipment, and working within 15 m of a water body. Nalcor comments: 1. The P-WEPP has been referenced in all applications; 2. The requirements P-WEPP requirements are applicable for all construction activities regardless of the approval documentation. 3. Requirements are made aware to all contractors during the procurement process and during

Document Reviewed			Reviewer's Assessment and Nalcor Comments	
Document No.	**Title**	**Status**	**Complete / Incomplete**	**Questions / Comments**
				construction by the LCP Environment Team
SLI-00008	Alter a Body of Water - Temporary Bridge C7 (5+800) Caroline's Brook	Approved	Complete	Permit should reference P-WEPP Plan relative to potential equipment oil leaks, operation of equipment in and near water, fueling and overnight storage of equipment, and working within 15 m of a water body. Nalcor comments: See SLI-00006
SLI-00082	DOEC Blanket Permit - Construction Power- Work within 15m	Approved	Complete	
SLI-00115	DFO Project Review - Water Use - C7 - C22	Approved	Complete	
SLI-00094	DFO Project Review Culvert 1 - Access Road to GD11	To Be Reviewed	Complete	Permit should reference P-WEEP Plan relative to potential equipment oil leaks, operation of equipment in and near water, fueling and overnight storage of equipment, and working within 15 m of a water body. Nalcor Comment: See SLI-0006 Is there a need for water control/pumping contingency if higher stream discharges are encountered? Nalcor Comment: The contingency not required for this temporary structure; design is 1:5 year peak flow; if the flow exceeded, the road will be temporarily closed.
SLI-00079	Navigable Waters Protection Act (Muskrat Falls) p-WC-1e	To Be Reviewed	Complete	

Document Reviewed			Reviewer's Assessment and Nalcor Comments	
Document No.	**Title**	**Status**	**Complete / Incomplete**	**Questions / Comments**
SLI-00158	DOEC Alter a body of water - Dams	To Be Reviewed	Complete	
LCP-AM-CD-0000-EA-RP-0014-01	Fish Habitat Compensation Strategy	DRAFT		pg. 58-60: Would be helpful to have a map showing the various reaches referred to in the Total Phosphorous graphs. Reaches appear to be different from those shown in Figure 3.2. Nalcor Comment: Nalcor advised by DFO to keep additional figures to minimum; the reaches, as MWH notes are slightly different, however, they are known to the regulators. pg. 95: Figure 3.24 shows general cut and fill associated with Delta Compensation Works. Biological function of the delta habitat would likely improve if the placed excavated material elevations paralleled the original ground profile rather than being uniformly horizontal. Nalcor comment: Agree with the comment, however, based on constructability and past experience, they selected least-cost solution recognizing that ice and high flows will modify the sections during post-construction. Fine sediments (i.e., silts and fine sands) would need to comprise <15-18% of the substrate composition if the proposed deltas are to be effective as spawning habitat for most fish (i.e., redd builders and broadcast spawners). It's mentioned that wave action will act to 'clean' the sediments in the new near shore terraces (pg. 96) that will be constructed for

Document Reviewed			Reviewer's Assessment and Nalcor Comments	
Document No.	Title	Status	Complete / Incomplete	Questions / Comments
				habitat compensation. Are all proposed terrace sites subject to sufficient wave action to ensure substrates remain functional for successful fish spawning / incubation? Will the benefits of wave action be outweighed by the effect of waves on shoreline stability/erosion and consequent sediment inputs to those habitats? The Edward's Brook (pg. 100) delta is located in a relatively protected bay. Will tributary discharges be sufficient to scour fine sediments and maintain the spawning function proposed for all the proposed new delta Compensation areas? For example, it appears unlikely that the Metchin River area (pg. 105), Minipi River (pg. 106), Elizabeth River (pg. 107), and West Mechin River (pg. 108) discharges will maintain spawning function within the entire area of the constructed deltas. pg.102: Does the Gull Island Plateau have groundwater upwelling? If it doesn't, then brook trout spawning would be unlikely due to the importance of groundwater upwelling for selection of their spawning locations. Nalcor Comment: This is potential physical habitat construction option and is not included in the Fish Habitat Compensation Plan. It is being considered relevant for ongoing compensation considerations. Nalcor also includes a lengthy additional paragraph regarding this matter that is not included herein, for brevity.

Document Reviewed			Reviewer's Assessment and Nalcor Comments	
Document No.	**Title**	**Status**	**Complete / Incomplete**	**Questions / Comments**
TF8110486-LCD-DRAFT Compensation Plan, Dec 2020, 12 Rev 4[1]	Draft Fish Habitat Compensation Plan, Muskrat Falls Rev 4 Dec 2012	DRAFT		pg. 43: Predicted use of shoals for brook trout spawning will be unlikely due to the importance of groundwater upwelling for selection of their spawning locations. Also, what is the predicted functional life (i.e., number of years) of these shoals as viable spawning / incubation areas given the relatively low velocities and high water depths (see Table 5.5, pg. 40) and the predicted increase in TSS for the initial 10-15 years? pg. 49-50: Predicted use of deltas for brook trout spawning will be unlikely due to the importance of groundwater upwelling for selection of their spawning locations. Nalcor comment: Comment similar to above comment on upwelling RP-0014 pg. 51: Figure 5.14 shows general cut and fill associated with Delta Compensation Works. Biological function of the delta habitat would likely improve if the placed excavated material elevations paralleled the original ground profile rather than being uniformly horizontal. Nalcor Comment: Comment similar to above comment in RP-0014 pg. 53-54: Will high frequency flood discharges in Pinus River be sufficient to scour fine sediments and maintain the spawning function of proposed new delta compensation area? What proportion of the delta is expected to be 'flushed' of fine sediments

Document Reviewed			Reviewer's Assessment and Nalcor Comments	
Document No.	Title	Status	Complete / Incomplete	Questions / Comments
				during a higher frequency event such as 2-yr. event? Nalcor Comment: Yes. Mean annual spring flows are pro-rated at 90 cms. Table 5.8 shows that at a discharge of 55 cms has the potential to flush up to 1 cm diameter material. A 2-yr event would be assumed to be of this magnitude. "...therefore, most of the delta is anticipated to flush, although there will be areas of deposition. Exact extent of substrate redistribution will not be known until monitoring begins after inundation." pg. 58: Have any habitat compensation options for improving / creating spawning and rearing habitat been explored within the cross section of the existing tributaries upstream of the full surface level (FSL)? Nalcor Comment: Yes. As part of the stakeholder consultation process (both Framework and strategy stages) all potential options were presented, and on the table, including compensation outside the entire watershed as well as areas of existing tributaries upstream of the FSL. It was indicated by some stakeholders, similar to other projects in Labrador, that any extension of physical works outside the proposed project area would be an extension of the project footprint. Therefore, compensation options were directed at fish species within the reservoir with physical construction constrained within the reservoir boundary.

Document Reviewed			Reviewer's Assessment and Nalcor Comments	
Document No.	**Title**	**Status**	**Complete / Incomplete**	**Questions / Comments**
				pg. 63: If slope in Tables 5.7 and 5.8 is in percent (as stated), then Incipient Particle Diameters (cm) should be divided by 100. Similarly, potential calculation error in Table 5.09 and 5.10. For the tractive force equation in Newbury and Gaboury (1993), slope is measured as m/m. Nalcor Comment: Correction required. The values of slope are in m/m however the column headings for slope in Tables 5.7 and 5.9l indicate %. The headings have been revised. pg. 83+88: Grain size analysis should also be done at some spawning redd sites to determine percent fines, and therefore, the suitability of the substrate for incubation. Nalcor Comment: As stated on page 87, grain size distributions will be determined for material placed in each delta so that they can be used to determine the degree of substrate shifting and movement. The geotechnical programs have provided data related to existing material as well and will be used for comparisons. Baseline samples of existing instream material can be collected in 2013 and added to the material baseline.
TF1010486_LCHG EEM_Rev3_Dec20 12[1]	Aquatic Environmental Effects Monitoring Program Dec 2012	DRAFT		Generally, the proposed EEM program appears to be quite comprehensive and appropriate in breadth for monitoring effects downstream of Muskrat Falls dam. pg. 27: The frequency and intensity / duration of field sampling events of, for example,

Document Reviewed			Reviewer's Assessment and Nalcor Comments	
Document No.	Title	Status	Complete / Incomplete	Questions / Comments
				turbine entrainment, fish habitat utilization, and fish population assessments, in the mainstem and tributaries should be clearly stated or shown in a table. pg. 43: Why is the trigger for injury/survival rate not provided? Will it be established prior to conducting the monitoring?

Responses to our questions and comments on Permits, Fish Compensation Strategy, Draft Fish Habitat Compensation Plan, and Aquatic Environmental Effects Monitoring Program were provided by Nalcor. We acknowledge that our questions pertaining to these four subjects were satisfactorily answered by Nalcor and, in our opinion, conclude that the adopted approach is satisfactory.

8.3 FUNDING OF ENVIRONMENTAL STUDIES AND ADEQUACY OF BUDGET AMOUNT

8.3.1 Current Studies Funding

Table 8-3 contains the information currently available from Nalcor that lists budget funding for current environmental studies.

Table 8-3

CURRENT ENVIRONMENTAL STUDIES FUNDING MUSKRAT FALLS

AND LABRADOR-ISLAND TRANSMISSION LINK

Control Account Description	Control Account	Budget Items	2013 Budget
Environmental Affairs - General Consultation	5.1.300.0000.0303.02.00	NE-LCP General	$44,787
		Consultation Database	$25,000
		Environmental Affairs - General Consultation	$19,787
	5.1.300.0000.0303.02.00 Total		**$44,787**
Environmental Effects Monitoring	5.1.360.0000.0310.02.00	Both Gull Island and Muskrat Falls Generation	$1,442,500
		Aerial surveys of the river and surrounding locations for waterfowl and analyze temporal use of traditional ashkui sites.	$25,000

Control Account Description	Control Account	Budget Items	2013 Budget
		Ambient air quality monitoring (AAQM) program	$50,000
		Caribou Program	$75,000
		Environmental Effects Monitoring	$900,000
		Mercury levels monitoring program	$100,000
		Nalcor will monitor and assess greenhouse gas fluxes as a result of LCP activities.	$75,000
		Nalcor will monitor ice conditions and issue public advisories on the condition of ice.	$75,000
		Nalcor will monitor methylmercury levels in river otter feces.	$25,000
		Baseline methylmercury exposure program (HHRA)	$105,000
		Regionally uncommon terrestrial vegetation survey	$12,500
		Muskrat Falls – Generation	$255,000
		Comprehensive monitoring and follow-up program upon LCP start-up, employing an adaptive management process	$80,000
		Nalcor will access marten data for post-project trapping for analysis and comparison with pre-project trapping data.	$75,000
		Nalcor will re-deploy GPS/VHF collars on bears in the river valley.	$50,000
		Winter aerial and ground or GPS telemetry surveys of moose	$50,000
		Mud Lake Drinking Water Baseline Study	$0
		Labrador - Island Transmission Link	$435,000
		Access Impacts Monitoring Program	$0
		Environmental Effects Monitoring Program	$210,000
		Furbearer Baseline Study	$75,000
		Harlequin Duck Baseline	$75,000
		Rare Plant Survey & Planning	$75,000
	5.1.360.0000.0310.02.00 Total		**$2,132,500**
Environmental Management Expert Legal Advice	5.1.300.0000.0103.02.10	E&AA Management	$132,782
		Environmental Management Expert Legal Advice	$132,782

Control Account Description	Control Account	Budget Items	2013 Budget
	5.1.300.0000.0103.02.10 Total		**$132,782**
General (Response to Project Modifications)	5.4.330.0000.0000.02.00	Labrador - Island Transmission Link	$29,000
		General (Response to Project Modifications)	$24,000
		Labrador Woodland Caribou Recovery Team	$5,000
	5.4.330.0000.0000.02.00 Total		**$29,000**
LCP Aboriginal Agreements Consultation (Interpretation & Translation)	5.1.420.0000.0000.02.01	Aboriginal Affairs	$75,000
		LCP Aboriginal Agreements Consultation (Interpretation & Translation)	$25,000
		Continually engage Aboriginal groups throughout the construction and operation of the LCP.	$25,000
		Aboriginal Affairs consultation - Linked to Item #1	$25,000
	5.1.420.0000.0000.02.01 Total		**$75,000**
LCP Aboriginal Agreements General Planning & Strategic Support	5.1.420.0000.0000.02.12	IBA	$210,148
		EMC	$55,000
		LCP Aboriginal Agreements General Planning & Strategic Support	$125,148
		IBA Implementation Committee shared costs with Innu Nation	$30,000
	5.1.420.0000.0000.02.12 Total		**$210,148**
LCP Aboriginal Planning Expert Advice	5.1.420.0000.0000.02.11	Aboriginal Affairs	$60,000
		LCP Aboriginal Planning Expert Advice	$60,000
	5.1.420.0000.0000.02.11 Total		**$60,000**
LCP E&AA - Agreements with Other Aboriginal Groups	5.1.430.0000.0403.52.00	Aboriginal Affairs	$168,101
		LCP E&AA - Agreements with Other Aboriginal Groups	$168,101
	5.1.430.0000.0403.52.00 Total		**$168,101**
LCP E&AA - Island Link Environmental Impact Statement (EIS) Response to IR's	5.4.330.0000.0306.02.00	Labrador - Island Transmission Link	$1,880,000
		LCP E&AA - Island Link EIS Response to IR's	$1,880,000

Control Account Description	Control Account	Budget Items	2013 Budget
	5.4.330.0000.0306.02.00 Total		**$1,880,000**
LCP E&AA - OAG Document Production	5.1.430.0000.0403.02.00	Aboriginal Affairs	$9,600
		LCP E&AA - OAG Document Production	$9,600
	5.1.430.0000.0403.02.00 Total		**$9,600**
LCP E&AA - OAG translation	5.1.430.0000.0403.02.01	Aboriginal Affairs	$15,596
		LCP E&AA - OAG translation	$15,596
	5.1.430.0000.0403.02.01 Total		**$15,596**
LCP E&AA - Project Commitments - Island Link Transmission	5.4.330.0000.0350.02.01	Labrador - Island Transmission Link	$250,000
		Caribou Considerations in Design	$0
		Environmental Effects Monitoring Program	$50,000
		LCP E&AA - Project Commitments - Island Link Transmission	$200,000
		Marine Fisheries Compensation Planning/Support	$0
		Rare Plant Mitigation Efforts	$0
		Socioeconomic Effects Monitoring Program	$0
	5.4.330.0000.0350.02.01 Total		**$250,000**
LCP E&AA Aboriginal Agreements Legal Support	5.1.400.0000.0103.02.00	IBA	$228,508
		EMC	$25,000
		LCP E&AA Aboriginal Agreements Legal Support	$203,508
	5.1.400.0000.0103.02.00 Total		**$228,508**
LCP E&AA Generation Project Commitments (WQM, Research, EMS, etc.)	5.2.320.0000.0350.02.00	Both Gull Island and Muskrat Falls Generation	$518,870
		Caribou Program	$100,000
		Compensation program for flooded trap lines	$0
		LCP E&AA Generation Project Commitments (WQM, Research, EMS etc.)	$168,870
		RTWQM	$250,000
		Muskrat Falls – Generation	$80,000
		Nalcor will conduct an amphibian relocation program prior to reservoir filling.	$0

Control Account Description	Control Account	Budget Items	2013 Budget
		Nalcor will re-deploy GPS/VHF collars on bears in the river valley.	$40,000
		Winter aerial and ground or GPS telemetry surveys of moose	$40,000
	5.2.320.0000.0350.02.00 Total		**$598,870**
LCP E&AA Generation Updates and Supplements to Studies	5.2.320.0000.0304.02.10	Both Gull Island and Muskrat Falls Generation	$506,013
		LCP E&AA Generation Updates and Supplements to Studies	$506,013
		Muskrat Falls – Generation	$0
		Update to EcoRisk Assessment - Re-Baseline for Monitoring Program	$0
	5.2.320.0000.0304.02.10 Total		**$506,013**
LCP E&AA Island Transmission Aboriginal & Stakeholder Consultation	5.4.330.0000.0304.02.04	Labrador - Island Transmission Link	$147,801
		LCP E&AA Island Transmission Aboriginal & Stakeholder Consultation	$87,801
		Stakeholder Relations	$60,000
	5.4.330.0000.0304.02.04 Total		**$147,801**
LCP E&AA Management General Consultant Services	5.1.310.0000.0000.02.00	E&AA Management	$6,080
		LCP E&AA Management General Consultant Services	$6,080
	5.1.310.0000.0000.02.00 Total		**$6,080**
LCP E&AA Transmission Island Link DFO Compensation Strategy	5.4.330.0000.0320.02.00	Labrador - Island Transmission Link	$710,000
		LCP E&AA Transmission Island Link DFO Compensation Strategy	$360,000
		Labrador - Island Transmission Link DFO Compensation Strategy	$350,000
	5.4.330.0000.0320.02.00 Total		**$710,000**
LCP E&AA Transmission Island Link Document Production	5.4.330.0000.0305.02.02	Labrador - Island Transmission Link	$154,806
		LCP E&AA Transmission Island Link Document Production	$154,806
	5.4.330.0000.0305.02.02 Total		**$154,806**
LCP E&AA Transmission Island Link Legal Support	5.4.330.0000.0103.02.00	Labrador - Island Transmission Link	$579,661

Control Account Description	Control Account	Budget Items	2013 Budget
		LCP E&AA Transmission Island Link Legal Support	$454,661
		LIL Environmental Management Plans	$50,000
		Marine Fisheries Compensation Planning/Support	$50,000
		Socioeconomic Effects Monitoring Program	$25,000
	5.4.330.0000.0103.02.00 Total		**$579,661**
LCP EA GENERATION - PERMIT fees & Studies	5.2.350.0000.0320.02.00	Both Gull and Muskrat Falls Generation	$850,000
		LCP EA GENERATION - PERMIT fees & studies	$750,000
		Gull Island and MF Stream Surveys	$100,000
	5.2.350.0000.0320.02.00 Total		**$850,000**
LCP EA Generation (Aboriginal and Stakeholder Consultation)	5.2.320.0000.0303.02.00	Both Gull Island and Muskrat Falls Generation	$42,000
		LCP EA Generation (Aboriginal and Stakeholder Consultation)	$42,000
	5.2.320.0000.0303.02.00 Total		**$42,000**
LCP EA Generation DFO Compensation Strategy	5.2.320.0000.0320.02.00	Both Gull Island and Muskrat Falls Generation	$281,099
		LCP EA Generation DFO Compensation Strategy	$281,099
		Muskrat Falls – Generation	$350,000
		FHCP	$350,000
	5.2.320.0000.0320.02.00 Total		**$631,099**
LCP EA Generation Legal Support	5.2.300.0000.0103.02.00	Both Gull Island and Muskrat Falls Generation	$1,427,372
		Compensation program for flooded trap lines	$0
		LCP EA Generation Legal Support	$1,427,372
		Baseline methylmercury exposure program (HHRA)	$0
		Generation EA Court Injunction Legal Support	$0
		Muskrat Falls – Generation	$25,000
		FHCP	$25,000
		Aboriginal Affairs	$100,000
		Continually engage Aboriginal groups throughout the construction and operation of the Project.	$50,000
		Aboriginal Affairs consultation -	$50,000

Control Account Description	Control Account	Budget Items	2013 Budget
		Linked to Item #1	
	5.2.300.0000.0103.02.00 Total		**$1,552,372**
LCP EA Island Link Process Costs (Panel, HADD, etc.)	5.4.330.0000.0310.02.00	Labrador - Island Transmission Link	$600,000
		LCP EA Island Link Process Costs (Panel, HADD, etc.)	$450,000
		LCP EA Island Link Process Costs	$150,000
	5.4.330.0000.0310.02.00 Total		**$600,000**
LCP IBA Third Party Service (Document Preparation IBA, IMA)	5.1.420.0000.0000.02.00	IBA	$20,000
		LCP IBA Third Party Service (Document Preparation IBA, IMA)	$20,000
	5.1.420.0000.0000.02.00 Total		**$20,000**
Regulatory Compliance	5.1.360.0000.0000.00.00	Both Gull Island and Muskrat Falls Generation	$187,500
		Canada Yew relocation program	$0
		Historic and Archaeological Resources Contingency and Response Plan	$25,000
		Historic and Archaeological Resources Recovery	$100,000
		Historic Resources Overview Assessment pre-construction Stage 1	$50,000
		Regionally uncommon aquatic vegetation survey	$12,500
		Muskrat Falls – Generation	$75,000
		Active osprey nest survey and relocation program	$0
		Nalcor will conduct an amphibian relocation program prior to reservoir filling.	$25,000
		Nalcor will conduct surveys of forest avifauna (ruffed grouse and wetland songbird habitat) at key intervals during construction, and operation and maintenance.	$50,000
		Reservoir Beaver survey program	$0
		Fish Recovery/Relocation	$0
		Labrador - Island Transmission Link	$200,000
		Historic Resources Overview Assessment	$200,000

Control Account Description	Control Account	Budget Items	2013 Budget
		Rare Plant Mitigation Efforts	$0
	5.1.360.0000.0000.00.00 Total		**$462,500**
LCP EA LIL - PERMIT fees & studies	5.4.350.0000.0320.02.00	Labrador - Island Transmission Link	$500,000
		Stream Surveys	$500,000
	5.4.350.0000.0320.02.00 Total		**$500,000**
Generation Environmental Policy and Plan Development	5.2.360.0000.0000.00.00	Both Gull Island and Muskrat Falls Generation	$50,000
		Compensation program for flooded trap lines	$25,000
		Nalcor will develop mitigation measures for any species of plant to be in danger of extirpation in Labrador to the LCP.	$25,000
	5.2.360.0000.0000.00.00 Total		**$50,000**
LIL Environmental Policy and Plan Development	5.4.360.0000.0000.00.00	Labrador - Island Transmission Link	$325,000
		Adaptive Management	$0
		Avifauna Considerations in Design	$75,000
		Caribou Considerations during Operations	$0
		Caribou Considerations in Design	$75,000
		LIL Environmental Management Plans	$50,000
		Marine Fisheries Compensation Planning/Support	$50,000
		Marten Baseline Study & Considerations in Design	$50,000
		Socioeconomic Effects Monitoring Program	$25,000
	5.4.360.0000.0000.00.00 Total		**$325,000**
	GRAND TOTAL		**$12,972,224**

MWH has begun to review representative studies and the year-2013 budget amounts with Nalcor representatives and will review with Agency personnel to allow us to better understand the scope of the study and required budget to allow us to give an opinion on the adequacy of the budget.

8.3.2 Studies to be Performed During Construction

Nalcor has prepared a budget for the period 2012 through 2018 to cover the required environmental activities that will be occurring during the construction period and leading up to it. As a basis for the studies, Nalcor considered the following items and commitments:

- Requirements of the Environmental Assessment (EA) for MF and the LTA;
- Commitments and anticipated requirements of the LIL EA;
- Environmental requirements of the Impacts and Benefits Agreement (IBA) with the Innu Nation;
- Mitigation measures designed to maintain compliance with applicable legislation, EA commitments and requirements, and minimize effects; and
- Baseline data needed to inform the environmental effects monitoring programs required post-construction.

Nalcor has advised MWH that they have completed extensive field programs in support of the EA process. The estimates provided herein have been derived with consideration of these costs. Nalcor advised MWH that many of the projected costs should be considered conservative with sampling frequencies at the upper limit of those expected for all programs.

Table 8-4

STUDIES AND SURVEYS TO BE PERFORMED DURING CONSTRUCTION

PROJECT/TOPIC	2012	2013	2014	2015	2016	2017	2018	Total
Muskrat Falls								
Historic Resources--Stage 1		$50,000	$50,000					$100,000
Historic Resources--Stage 3	$800,000	$100,000	$100,000					$1,000,000
Stream Surveys	$35,000	$25,000	$25,000	$25,000	$25,000			$135,000
Avifauna Management (Including Osprey nest relocation)	$70,000	$125,000	$125,000	$75,000				$395,000
Terrestrial Relocation (Beaver/Amphibian)			$100,000		$100,000			$200,000
Fish Recovery and Fish Relocation			$125,000		$125,000			$250,000
Subtotal	$905,000	$300,000	$525,000	$100,000	$250,000			$2,080,000
Labrador TL Asset								
Historic Resources—Stage 1		$12,500	$12,500					$25,000

Historic Resources—Stage 3		$75,000	$75,000					$150,000
Stream Surveys		$10,000	$10,000	$10,000				$30,000
Avifauna Management (Including Osprey nest relocation)		$50,000	$50,000	$50,000				$150,000
Rare Plant Survey (Aquatic)		$5,000	$5,000					$10,000
Subtotal		$152,500	$152,500	$60,000				$365,000
Island Link								
Historic Resources		$200,000	$150,000	$150,000	$75,000			$575,000
Stream Surveys		$50,000	$50,000	$50,000	$50,000			$200,000
Rare Plant Surveys		$50,000	$50,000	$50,000	$50,000			$200,000
Avifauna Management (Including Osprey nest relocation)		$100,000	$100,000	$100,000	$92,500			$392,500
Subtotal		$400,000	$350,000	$350,000	$267,500			$1,367,500
Total	**$90,500**	**$852,500**	**$1,027,500**	**$510,000**	**$517,500**			**$3,812,500**

8.3.3 Studies to be Performed During Project Operation and Environmental Monitoring

Nalcor has furnished budget estimates for funding programs/studies associated with environmental issues that will be conducted during the operating period of the project (current dollars). A summary of this information is contained in Table 8-5.

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Table 8-5

ENVIRONMENTAL PROGRAMS/STUDIES AND MONITORING COSTS

OPERATIONS PERIOD

Program	Year 1-5	Year 6-10	Year 11-15	Year 16-20	Year 21-25	Component	Comments
Bank Recession Rates downstream	$375,000	$375,000				MF	$75,000 per year up to year 10 and then assumed no longer required. Could be modified based on monitoring results
Bank Erosion with the Reservoir	$625,000	$625,000				MF	$125,000 per year up to year 10 and then assumed no longer required. Could be modified based on monitoring results
Sediment Transport	$375,000	$375,000				MF	$75,000 per year up to year 10 and then assumed no longer required. Could be modified based on monitoring results
Ice Formation - Reservoirs, downstream including Mud Lake	$100,000	$50,000				MF	2x year first 5 years (10,000 per trip including helicopters). Frequency after TBD based on results of monitoring. Assume 1 x per year for year 5 through 10 and then no further monitoring required.

Program	Year 1-5	Year 6-10	Year 11-15	Year 16-20	Year 21-25	Component	Comments
Water Quality Monitoring	$1,250,000	$625,000	$200,000	$200,000	$200,000	MF	For first 5 years use current then scale back based on monitoring results to gradually phase out system. Some level of monitoring to at least 25 years (nutrient levels predicted to return to background)
Green House Gas Flux	$30,000					MF	Cost of equipment - $20,000. High degree of confidence in prediction. Can be measured via plant staff so limited additional cost after installation.
Fish Habitat utilization upstream and Downstream	$750,000	$300,000				MF	Seven years required for Granite Canal authorization. Depends of monitoring results. Based on baseline monitoring
Nutrient Levels upstream and downstream	$500,000	$200,000				MF	Seven years required for Granite Canal authorization. Depends of monitoring results. Based on baseline monitoring

Program	Year 1-5	Year 6-10	Year 11-15	Year 16-20	Year 21-25	Component	Comments
Fish Growth, condition, fecundity, trophic feedings and age structure upstream and downstream	$750,000	$300,000				MF	Seven years required for Granite Canal authorization. Depends of monitoring results. Based on baseline monitoring
Entrainment	$75,000					MF	One time study. Assume results are acceptable.
Compensation Works for substrate placement, habitat stability	$500,000	$200,000				MF	Seven years required for Granite Canal authorization. Depends of monitoring results. Based on baseline monitoring
Benthic macro-invertebrates, primary and secondary productivity, and fish health and habitat utilization in reservoir	$500,000	$200,000				MF	Seven years required for Granite Canal authorization. Depends of monitoring results. Based on baseline monitoring. Based on 3 trips per year.
Monitoring Wetland habitat creation and development success	$500,000	$500,000				MF	Assume similar requirements as FHCP. 10 year monitoring program.
Methylmercury levels in river otter	$125,000					MF	Based on baseline monitoring costs. Not predicted to be an effect so monitoring will only be required for first 5 years to

Program	Year 1-5	Year 6-10	Year 11-15	Year 16-20	Year 21-25	Component	Comments
							confirm predictions. May be revised based on monitoring results.
Monitoring of osprey methylmercury levels through feather collection	$125,000					MF	Based on baseline monitoring costs. Not predicted to be an effect so monitoring will only be required for first 5 years to confirm predictions. May be revised based on monitoring results.
Telemetry monitoring of black bears (included relocated bears)	$100,000					MF	Based on baseline monitoring costs. Not predicted to be an effect so monitoring will only be required for first few years to confirm predictions. May be revised based on monitoring results.
Aerial surveys to monitor the effectiveness of the beaver relocation program	$100,000					MF	Based on baseline monitoring costs. Not predicted to be an effect so monitoring will only be required for first few years to confirm predictions. May be revised based on monitoring results.

Program	Year 1-5	Year 6-10	Year 11-15	Year 16-20	Year 21-25	Component	Comments
Monitor relocated osprey nests	$100,000					MF	Based on baseline monitoring cost. Should determine success within first 2-3 years. High degree of confidence that no significant effect. Extensive experience with technique.
Winter and summer ground surveys of wildlife habitat association transects established as part of baseline to examine changes to distribution and abundance, will be conducted for furbearers and other wildlife	$200,000	$200,000				MF	Based on baseline monitoring costs. Not predicted to be an effect but may be longer term in terms of seeing effects. Monitoring may be required for first 10 years to confirm predictions. May be revised based on monitoring results.
Forest avifauna will be monitored for changes in distribution and abundance by resurveying along transects established in 2006 and 2007	$200,000	$100,000				MF	Based on baseline monitoring costs. Not predicted to be an effect but may be longer term in terms of seeing effects. Monitoring may be required for first 10 years to confirm predictions. May be revised based on monitoring results.

Program	Year 1-5	Year 6-10	Year 11-15	Year 16-20	Year 21-25	Component	Comments
Moose will be monitored using winter aerial surveys and/or GPS telemetry of moose in key wintering areas and areas where habitat is altered	$200,000					MF	Based on baseline monitoring costs. Not predicted to be an effect so monitoring will only be required for first 5 years to confirm predictions. May be revised based on monitoring results.
Assessment of trapping data post project will be conducted	$50,000					MF	Desk top review to confirm effects prediction. $10,000/year for first 5 years.
Methylmercury levels in the reservoirs will be monitored. Monitoring will include fish in the lower Churchill River, Goose Bay, and Lake Melville. Monitoring will also include seals downstream of Muskrat Falls.	$400,000	$400,000	$400,000	$400,000	$400,000	MF	$75,000/year based on baseline program costs (upstream and downstream). Maybe scaled backed based on results but predicted to take 25 years to return to baseline levels.
Total MF	$7,930,000	$4,450,000	$600,000	$600,000	$600,000		
Monitor the effects on listed plants or induced effects resulting from improved access.	$50,000					LIL	Limited area to be monitored

Program	Year 1-5	Year 6-10	Year 11-15	Year 16-20	Year 21-25	Component	Comments
Monitoring of any compensation works as a result of Harmful Alteration, Disruption or Destruction (HADD) of marine fish habitat will be conducted according to a protocol acceptable to DFO. Initial monitoring (as-built monitoring) will be conducted to provide information on the structure of the compensation works, and subsequent effectiveness monitoring will also include a biological component to provide some measure of productivity occurring at the compensation works.	$600,000	$200,000				SOBI	Monitoring of the rock berms will be done using a remotely operated method such as ROV. $200 000 for data collection, data analysis and report preparation x 4 years (Year 2, 3, 5, &7) = $800,000

Assumptions

- Based on review of Generation EIS limited monitoring for Labrador Transmission Assets

- Based on review of LIL EIS there are limited commitments for the overland transmission. Subject to conditions of EA release (i.e. assume no freshwater habitat monitoring for DFO)

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8.3.4 Mitigation During Construction

Nalcor furnished to MWH a list of studies and mitigation measures that they intend to conduct during construction of the LCP. As noted previously, the mitigation measures were designed to maintain compliance with the applicable legislation, EA commitments and requirements, and to minimize effects on the habitat. We have repeated the items that contain mitigation measures in Table 8-6 that were taken from Table 8-4 without knowledge of any study work that was included with the mitigation since there was no breakout of the mitigation costs from study costs. The IE has confirmed with Nalcor that the bulk of the cost is for mitigation of the items listed in Table 8-6. Nalcor has informed MWH that if additional funds are necessary for mitigation, Nalcor will provide the funds to ensure that habitat is fully protected.

Table 8-6

MITIGATION COSTS DURING CONSTRUCTION

PROJECT/TOPIC	2012	2013	2014	2015	2016	2017	2018	TOTAL
Muskrat Falls								
Historic Resources—Stage 3	$800,000	$100,000	$100,000					$1,000,000
Avifauna Management (Including Osprey nest relocation)	$70,000	$125,000	$125,000	$75,000				$395,000
Terrestrial Relocation (Beaver/Amphibian)			$100,000		$100,000			$200,000
Fish Recovery and Fish Relocation			$125,000		$125,000			$250,000
SUBTOTAL	$870,000	$225,000	$450,000	$75,000	$225,000			$1,845,000
Labrador TL Asset								
Historic Resources—Stage 3		$75,000	$75,000					$150,000
Avifauna Management (including Osprey nest relocation)		$50,000	$50,000	$50,000				$150,000
SUBTOTAL		$125,000	$125,000	$50,000				$300,000
Island Link								
Historic Resources		$200,000	$150,000	$150,000	$75,000			$575,000
Avifauna Management (including Osprey nest relocation)		$100,000	$100,000	$100,000	$92,500			$392,500
SUBTOTAL		$300,000	$250,000	$250,000	$167,500			$967,500
TOTAL	**$870,000**	**$650,000**	**$825,000**	**$375,000**	**$392,500**			**$3,112,500**

8.4 ENVIRONMENTAL FLOW

To maintain and provide environmental habitat downstream of the LCP, studies were performed to establish the minimum flow release required from the Muskrat Falls facilities when the power station was shut down. Usually these studies employ instream flow incremental methodology (IFIM) techniques requiring habitat assessment at numerous cross sections along the river and for different depths of water that relate to flow releases. These assessments in turn are related to the requirements of different fish species to arrive at the most desired range of depth, associated with the amount of habitat in which the fish can be sustained. Information provided to MWH indicates that the minimum release flow established for the LCP (the environmental flow) is 552 cms for impoundment of the MF reservoir. No environmental flow condition during operations exists in the DFO Section 35 Fisheries Authorization or the Authorization to Alter a Body of Water provided by the Government of Newfoundland and Labrador. Churchill Falls' minimum flow is 475 cms and Nalcor advises that for practically all times, to maintain the reservoir at 39.0 FSL, flow and of the plant will be at least 475 cms. We have not independently reviewed the data to support this determination of no minimum flow being prescribed.

During the period while the reservoir is filling, estimated to be about 10 to 12 days, releases will be made that amount to 30 percent of the normal flow for the period. Once the reservoir is filled to FSL, El 39.0 flows will be released equal to the inflow. The reservoir will be maintained between El 38.5 and 39.0 msl.

8.5 TECHNICAL REQUIREMENTS AND CONSTRAINTS

From an environmental perspective, Nalcor identified a number of constraints during the planning process that were considered in the design and execution of the LCP. Constraints and methods and means of mitigation to address the issues are summarized in Table 8-7.

Table 8-7

CONSTRAINTS AND PROVIDED MITIGATION

Constraint	Mitigation
Harmful Alteration, Disruption or Destruction of Fish and Fish Habitat, including fish mortality	- Obtain authorization from Dept. of Fisheries and Oceans based on a comprehensive habitat compensation program, environmental effects monitoring program and an approved environmental protection plan. - Used a unique approach to leverage the incidental habitat gained with the reservoir to obtain habitat units. - Committed to compensation flow during impoundment to reduce fish mortality caused by dewatering.
Stream Crossings	Addressed through a blanket approval process

Constraint	Mitigation
	with the Dept. of Environment and Conservation and standard mitigation approach accepted by DFO. Navigable water crossings identified and approval provided for navigable waters.
Historic Resources	Historic Resources potential mapping created and an investigation approach agreed with the provincial archeology office. Recovery plan approved for known sites and a contingency plan in place for inadvertent discoveries.
Wetlands	- Environmental protection plan approved which includes mitigation measures for wetlands. - A wetland compensation strategy has been proposed and a plan will be developed to address wetland losses within the reservoir. - Potential partnerships with wetland conservation agencies are to be explored.
Downstream Effects (including mercury)	Extensive analysis and modeling as part of the environmental assessment process indicates no significant downstream effects beyond Goose Bay. An environmental effects monitoring program has been developed to confirm effects predictions and an adaptive management approach will be employed.
Avifauna and Migratory Birds Convention Act	An avifauna management plan based on comprehensive surveys has been developed to allow project activities to continue during the migratory bird nesting season and to avoid raptor nesting.
Red Wine Mountain Caribou and Endangered Species (including rare plants)	The approved environmental protection plan includes measures to protect caribou and other endangered species. An environmental effects management plan has also been developed for caribou and species at risk.
Transmission Line Routing	Constraint mapping developed for all transmission lines and environmental constraints considered in conjunction with technical and economic constraints to optimize routing.
Reservoir Clearing	Reservoir clearing methodology selected to optimize technical and economic constraints as well as ensure wildlife access, navigation and aesthetics during operations.

The IE has reviewed the EA requirements and Fisheries Act Authorization and is of the opinion that the prescribed conditions will not restrict the LCP given the design will accommodate the prescribed conditions to mitigate the issues. Nalcor has advised MWH that during the LCP's

execution, if issues that are being mitigated are not as effective as proposed, they will modify the mitigation methods and means to achieve the intended results.

8.6 ESTABLISH CONTACT WITH GOVERNMENT

The IE is currently working with Government and its representatives to address outstanding issues. Modifications to the MWH scope of work and report are ongoing to satisfy Government's needs and requirements.

8.7 TECHNICAL AND COMMERCIAL ISSUES

Nalcor advised MWH that only a very limited number of issues were identified during the study and design phase of the project that were of technical and commercial importance. Table 8-8 lists the two potential commercial issues related to constraints to the LCP and includes the adopted mitigation for resolution of the issue.

Table 8-8

TECHNICAL AND COMMERCIAL ISSUES AND PROVIDED MITIGATION

Issue	Mitigation
Requirement for a letter of credit for the fisheries authorization.	This requirement was waived by the Department of Fisheries and Oceans based on the public ownership of the LCP.
Requirement for the provision of minimum downstream flow during impoundment and operations.	Flow values required align with available inflows and the WMA with the Upper Churchill plant.

Based on information made available to MWH and correspondence with Nalcor, there are no known issues with respect to technical or commercial aspects of the project or with permits or licenses. Because the majority of the LCP is on Crown Land, with the exception of small lengths of HVdc transmission line, land acquisition or expropriation will mitigate any perceived issues.

8.8 REVIEW ENVIRONMENTAL SITE ASSESSMENT REPORT

We have included in Section 8.2 our review of only those typical permits prepared for the Muskrat Falls project since there are currently over 300 permits that are current which do not include those being prepared for the LIL project. We have also reviewed the EIS, Executive Summary, for the LIL project during the early phase of our studies. The Executive Summary presents a comprehensive review of the topics that were studied and included in Table 16-3, starting on page 85 of this document, the *Cumulative Environmental Effects Summary: Socio-economic Environment* for the findings to date. Table 8-9 is a simplified version of the EIS Summary and is presented below to be a readily available resource for further assessment by the IE.

Table 8-9

ABBREVIATED SUMMARY OF ENVIRONMENTAL EFFECTS FINDINGS OF EIS

SOCIOECONOMIC ENVIRONMENT

LABRADOR-ISLAND TRANSMISSION LINK

TOPIC	FINDING	FINDING
VALUED ENVIRONMENTAL COMPONENT (VEC)	LIKELY CUMULATIVE ENVIRONMENTAL EFFECTS OF OTHER FUTURE PROJECTS AND ACTIVITIES	CUMULATIVE ENVIRONMENTAL EFFECTS SUMMARY
HISTORIC AND HERITAGE RESOURCES	GROUND DISTURBANCE LCH; GENERAL INFRASTRUCTURE; INCREASED OHV ACCESS WITH FORESTRY ROADS; COULD CONTRIBUTE TO CUMULATIVE EFFECTS NEAR COMMUNITIES	NOT SIGNIFICANT
COMMUNITIES	MAY BE DEMAND ON HEALTH-RELATED INFRASTRUCTURE DURING CONSTRUCTION; HEALTH CONCERNS WITH PROJECT OPERATION; UNIQUE TO THIS TYPE OF PROJECT	NOT SIGNIFICANT
ECONOMY, EMPLOYMENT AND BUSINESS	MAY HAVE EFFECTS THAT OVERLAP WITH PROJECT EFFECTS; MAY RESULT IN LABOR SHORTAGES AND HIGH LABOR COSTS; CAPACITY OF PROVINCIAL COMPANIES TO SUPPLY MATERIALS AND SERVICES TO THE LCP AND OTHER PROJECTS MAY BE COMPROMISED; PROVINCIAL REVENUE BENEFIT FROM the LCP AND OTHER PROJECTS	NOT SIGNIFICANT
LAND AND RESOURCE USE	LIMITED PROPOSED DEVELOPMENT ACTIVITY OR LIKELY CHANGES IN NATURE AND INTENSITY OF EXISTING ACTIVITIES	NOT SIGNIFICANT
MARINE FISHERIES	NO KNOWN OR LIKELY CHANGES TO THE NATURE AND INTENSITY OF VESSEL TRAFFIC, OR ANY OTHER	NOT SIGNIFICANT

TOPIC	FINDING	FINDING
	PROPOSED DEVELOPMENT PROJECTS IN THE AREA	
TOURISM	INSUFFICIENT SUPPLY OF SHORT-TERM ACCOMMODATIONS AND INCREASED DEMAND FOR RESTAURANTS AND RETAIL SERVICES; INCREASED TRAFFIC ON ROUTE 510 AND ROUTE 430; INCREASED NUMBER OF WORKERS AS RESULT OF GENERAL ECONOMIC DEVELOPMENT COULD AFFECT THE ABILITY OF TOURISTS TO FIND AVAILABLE ACCOMMODATION DURING THE PEAK TOURISM SEASON	NOT SIGNIFICANT
VISUAL AESTHETICS	ALTERATIONS TO THE EXISTING VIEWSCAPES DUE TO VEGETATION CLEARING TO ACCOMMODATE ACTIVITIES, OR INFRASTRUCTURE CONSTRUCTION RELATED TO OTHER PROJECTS	NOT SIGNIFICANT

8.9 Aquatic Environmental Effects Monitoring Program

MWH has also reviewed the DRAFT of *Aquatic Environmental Effects Monitoring Program, Muskrat Falls, December 2012*, to gain insight into this program, but will not comment on this program since it no longer is required by Government to do so.

8.10 SALT WATER INTRUSION

In an early study performed by Hatch for Nalcor, a salt water intrusion 3D Model Study was performed to determine the effects of the reservoirs and new schedule of releases that would be necessary for the Muskrat Falls generating complex and the effects in the Churchill River and the estuary from Goose Bay. Salinity and temperature modeling was conducted using a software program DHI MIKE 3 using data from bathymetric surveys of the Churchill River and Canadian Hydrographic Service nautical chart data, and temperature and salinity measurements taken during the 1998-1999 oceanography field program.

The salinity program concluded that there is a stable and slightly brackish surface layer of 2-4 practical salinity units (PSU) in Goose Bay and Lake Melville. There is also a stable saline bottom layer (15-25 PSU) that extends throughout Goose Bay and Lake Melville. Lower

Churchill River salinity was between 2-3 PSU with no variation in depth or location between Muskrat Falls and the river mouth.

With the Muskrat Falls plant in operation and the compensation flow being followed, the salt water penetrations would be pushed back to almost their original location at the river mouth as was modeled when Gull Island was modeled (Muskrat Falls was not solely modeled at this time and we believe that it was not modeled alone). The report concludes that saline intrusion is limited to the ”last few kilometers of the river nearest the mouth” and “that the progress of the intrusion would be halted at this maximum extent even without the release of any compensation flow.” Based on this early study, in the IE’s opinion, there should be no issues with saline penetrations with the LCH in operation.

8.11 RESERVOIR FILLING AND MANAGEMENT STRATEGIES

The IE reviewed the Information Request, IR#JPR.28 (Information Request-Joint Review Panel) associated with the proposed reservoir filling and management strategies under which both Gull Island and the Muskrat Falls projects were reviewed. The criteria that was adopted for flow release was 30 percent of the Mean Annual Flow (MAF) which equates to about 500 cms for the minimum fixed flow during reservoir impounding. The actual minimum flow release is 534 cms. The current normal minimum flow release is 350 cms. The 500 cms has been found to be a flow that ”both the fish populations within the river and the habitat would have experienced previously.” Nalcor has advised the IE that once the spillway is constructed, the compensation flow (minimum flow of 350 cms) will be modified, if necessary based on monitoring results. This will allow flexibility to allow proper adjustments in the flow based on what the monitoring results reveal. It is uncertain whether the permits provide for this adjustment and it must be verified that they do allow for revisions to the prescribed and agreed to value by the regulatory agencies and concerned parties. The report determines the filling time for Muskrat Falls and the environmental effects for fish and fish habitat. The report does not lead directly to a recommendation, but lists the findings of the study, both pro and con. Based on the data presented, Alternative 4: Fall appears to be the desirable choice with a filling time of 15-19 days. Elsewhere in the documents that MWH reviewed, we found a citing of filling time of 9-11 days which equates to the spring alternative, Alternative 2, which lists 9-11 days; this alternative was apparently selected. This alternative notes that it has the least amount of adult mortality, but the young-of-year would be lost in de-watered habitat perimeters. Table 8, page 11, where this information is found does not mention the adults issues under the fish issues. We note there was apparently a trade-off made in which more data was presented to support this decision. We requested support backup data but it was never furnished. Since MWH was apprised by CBB that Government no longer needs the IE’s opinion pertaining to environmental issues, no further comments are necessary by MWH.

8.12 DOCUMENTATION AND SUPPORT CONCLUSIONS

As noted in Section 8.2, the IE has reviewed a sample of the permits that have been prepared to date and requested additional information as well as providing comments on what has been performed. This information was received from Nalcor and noted in Table 8-2.

Based on the exchange of comments to date, in the opinion of the IE, the documentation presented supports the conclusions. No further information has yet been presented on permits and studies performed for the LIL project; no opinion by the IE is necessary since Government has advised MWH that it is no longer a part of their scope of work.

For other studies (e.g., the saline study as discussed in Section 8.10), the documentation presented by Nalcor supports the conclusion that there will be no adverse effect from LCP operations.

8.13 UNUSUAL CIRCUMSTANCES

Unusual circumstances identified by Nalcor that are related to the Muskrat Falls/LTA and LIL include the following items summarized in Table 8-10:

Table 8-10

UNUSUAL CIRCUMSTANCES AND PROVIDED MITIGATION

Circumstance	Mitigation
Cultural significance of the rock knoll at Muskrat Falls.	This effect was mitigated through consultation with the Innu Nation and project design which avoided diversion tunnels through the rock knoll and minimized the disturbance in this area.
Presence of culturally significant sites such as the last shaking tent ceremony.	This effect was mitigated through consultation with the Innu Nation and funding of an Innu Elder Site visit and documentation of this event.
Presence of cultural significant plant in the river valley (Canada Yew).	This was mitigated by commitment to relocate the plants prior to impoundment.

The IE is not aware of any other significant unusual circumstances that should be identified and discussed herein.

8.14 STATUS AND COST OF REMEDIAL ACTIVITIES

Information provided by Nalcor pertaining to costs associated with the environmental surveys, studies, monitoring, and mitigation that are currently ongoing and will be performed during and after construction is summarized in Table 8-11. Detailed information on costs can be found in

the tables referenced in the "IER Table No." column. Current status of the funds spent has not been provided and is unknown to MWH.

Table 8-11

SUMMARY AND STATUS OF REMEDIAL ACTIVITIES ASSOCIATED WITH ENVIRONMENTAL WORK

IER Table No.	Title	Cost to Date	Status	Remarks
8--3	Current Studies Funding MF and LIL	Unknown	Unknown	No information pertaining to the ML is included in this Table or IER
8--4	Studies and Surveys to be Performed During Construction	Unknown	Unknown	
8--5	Environmental Programs/Studied and Monitoring Costs, Operating Period	Period has not started	Not Applicable	
8--6	Mitigation Costs During Construction	Unknown	Unknown	These costs are only for mitigation and do not include studies which are included in Table No. 8--4

8.15 CURRENT STATUS OF PERMITS

Table 8-12 presents a general summary of the permit process to date and the status of the permits, including the authorizing entities responsible for issuing the permits. Table 8-13 lists a breakout of permits for each of the principal contracts furnished to MWH, the agency responsible for review, and the current status. As can be noted in this table, there are still 63 pending permits yet to be approved by Government (as of October 2, 2013). We note that Nalcor advises that the approved permits by Government are all current. MWH has not independently checked to verify that this represents the current conditions and has not directly talked to Government Agencies about any of the permits, relying solely on the input we receive from Nalcor.

Table 8-12

PERMIT STATUS

Description	Permit For	Date Issued	Status
EA Release Federal and Provincial	MF and LTA	March 2012	Issued
EA Release Provincial	LIL	June 2013	Issued; Federal Release imminent
Authorizations	DFO (Generation) DFO (Transmission)		Issued Habitat Quantification Accepted. Determining Compensation requirements.
Authorizations	Transport Canada Dam and Reservoir		Minor Works approved Authorization in progress
Provincial Permits	Crown Lands Dam and Powerhouse Reservoir and Transmission Line Clearing Quarries (blanket), stream crossings (blanket), and buildings		Approved for Generation Site and Labrador Transmission Assets Permit issued Permit issued Numerous permits (See representative permits in Table 8-2.)

Table 8-13

PERMIT STATUS BY CONSTRUCTION PACKAGE

Construction Package	Permits Required	Permits Developed	Submitted to Nalcor	Reviewed by EMC	Submitted to Government	Approved	Pending
South Side Access Road – CH0004	51	51	51	51	51	51	0
Bypass Road – SSAR	8	8	8	8	8	3	5
Clearing – CH0048	54	54	54	54	54	54	0
Site Utilities – CH0005 (temp camp)	22	22	22	22	22	22	0
Construction Power – CD0512	34	34	34	34	34	34	0
Reservoir Clearing	11	11	11	11	11	8	3
Bulk Excavation – CH0006	42	40	40	40	40	35	7
Construction of Intake and Powerhouse, Spillway and Transition Dams – CH0007	2	2	2	2	2	1	1
North Spur Stabilization Works – CH0008	20	12	12	12	12	11	9
HVac Line Clearing – CT0341	15	15	15	15	15	10	5
HVac Line Construction – CT0319	23	23	23	23	23	15	8
Geotechnical SM0713	4	4	4	4	4	3	1
Churchill Falls Camp – CD0538	8	8	8	8	8	7	1
Electrode Geotechnical – SD0565	3	3	3	0	0	0	3
Component 3 Earth Works – CD0503	17	5	5	5	5	0	17
SOBI Civil Works – LC-SB-021	3	1	1	1	1	0	3
TOTAL	**317**	**293**	**293**	**290**	**290**	**254**	**63**

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SECTION 9

NALCOR ENERGY'S PROJECT FINANCIAL PRO FORMA

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SECTION 9

NALCOR ENERGY'S PROJECT FINANCIAL PRO FORMA

The purpose of this section is to review Nalcor's[3] financial planning for the LCP as represented in Nalcor financial models/pro forma and other resources, and to review projected results of operations as represented in Nalcor financial models.

9.1 INTRODUCTION

This section includes the following topics:

- Capital costs
- Financial planning
- Annual costs
- Revenue requirements and projections
- Implementation issues

Reviews of Nalcor's financial planning and projected results of operations are preliminary, conditioned by development of the LCP. The LCP is progressing rapidly, but at this juncture the financial information includes a number of unknown features, including the accuracy and degree of precision of estimated costs and cost contingencies.

The review of overall LCP economics has been narrowed by this constraint, and focus is placed on technical content and analysis of the Nalcor financial models.

The scope of the review covers three projects being developed by Nalcor, namely the Muskrat Falls Generation Facility (MF), Labrador Transmission Assets (LTA), and Labrador Island Link (LIL), collectively comprising the LCP. The review does not include the Maritime Link (ML) project being developed by Emera.

9.2 CAPITAL COSTS

A principal feature of the development of the LCP is preparation of estimates of construction and ancillary costs, collectively known as Capital Costs. Section 5 of this IER addresses in detail the LCP construction cost estimate and also the schedule estimate.

[3] Nalcor is a body corporate existing pursuant to the Energy Corporation Act being Chapter E-11.01 of the *Statutes of Newfoundland and Labrador*, 2007.

9.2.1 Cost Estimating Methodology

Construction cost estimates were prepared by Nalcor and its cost estimating consultants. The IE provided a cursory review of the cost estimating process and results. The review included communications with Nalcor representatives about the methods used to estimate allowances for contingencies at the various stages of design and cost estimate development. Industry-standard methods published by AACEI, the Project Management Institute (PMI) and proprietary methodologies were referenced.

The estimate basis was previously published in Nalcor's *Technical Report for Rating Agency Review* dated October 12, 2012, (Rec No. 200-160341-00009).

The methodology adopted by Nalcor to estimate costs is similar to methods the IE is familiar with in other projects of similar nature and size. Costs of major equipment secured through requests for proposals from manufacturers, all-inclusive lists of materials, adoption of best available technologies and market data, labor costs and productivity factors are factored into the construction cost estimates. The estimates are as reliable as can be expected at this development stage.

By taking into account multiple aspects influencing the costs, from schedule to labor, from construction plans and equipment to logistics, Nalcor developed a solid base for its estimates. The estimates are, in our opinion, comprehensive to the extent that they include escalation, prior costs, financing fees, allowance for funds used during construction (AFUDC, also called interest during construction, or IDC) and debt service reserve accounts.

Significant emphasis was placed in securing competitive proposals from manufacturers for major equipment. However, the IE has not reviewed all of the major contracts required to be reviewed by the Agreement between Nalcor and the IE. Thus, the IE is not in a position to offer an opinion as to whether all appropriate costs have been included in the capital costs assumed in the financial models. Further, without the benefit of reviewing all of the contracts, and confirming certain commercial obligations, such as performance guarantees and liquidated damage provisions, an unqualified opinion cannot yet be formed on the reasonableness and magnitude of increases in the total capital cost under certain commercial scenarios. Regarding the contracts (and one RFP) that have been reviewed by the IE, comments pertaining to warranties, guarantees and liquidated damages are noted in the tables in Section 4 of this report. Another potential impact that cannot be verified without the contract review is how potential change orders will be managed.

9.2.2 Capital Cost Estimates

The principal component of LCP is the funding of capital costs.

A deterministic and risk-adjusted approach, based both on direct and indirect costs, is stated to be the methodology followed to derive the cost estimate. The capital cost estimates used as

input into the Nalcor financial models, already in AACEI Class 3 category, differ (see Table 9-1) from those shown in DG3 ("Project Sanction" granted, milestone preceding Project Execution and EPC phase) Capital Cost and Schedule Estimate Summary Report (DG3). The differences are shown in Table 9-1.

Table 9-1

DG3 COST ESTIMATES AND FINANCIAL MODEL DATA

Line	Description		MF	LTA	LIL	Total
1	DG3 Base Estimate	(1)	$2,511,923,504	$601,311,778	$2,359,610,970	$5,472,846,252
2	DG3 Growth Allowance	(1)(2)	389,234,769	90,270,587	250,137,947	729,643,303
3	Total DG3 Capital Cost Estimate	(1)	$2,901,158,273	$691,582,365	$2,609,748,917	$6,202,489,555
4	Additional Capitalized Costs	(3)	351,231,727	$ 80,237,635	$587,118,083	$1,018,587,445
5	Total Costs to be Funded		$3,252,390,000	$771,820,000	$3,196,867,000	$7,221,077,000
6	Nalcor financial models total capex		$2,901,158,288	$691,582,485	$2,609,748,917	$6,202,489,690
7	Variance Nalcor model data vs. DG3	(4)	$ (15)	$ (120)	$ 0	$ (135)
8	Growth allowance components					
9	P50 contingency		$ 226,700,000	$ 54,800,000	$ 86,500,000	$ 368,000,000
10	Escalation		162,545,000	35,441,000	163,658,000	361,643,000
11	Total		$ 389,245,000	$ 90,241,000	$ 250,158,000	$ 729,643,000
12	Variance of growth allowances	(5)	$ 10,231	$ (29,587)	$ 20,053	$ (303)

Notes:
(1) Source: "DG3 Capital Cost and Schedule Estimate Summary Report" Table 3, p. 15
(2) DG3 Growth Allowance = Estimate Contingency + Escalation Allowance
(3) Includes financing fees, IDC, DSRA and LRA (terms are explained in narrative)
(4) Total DG3 Capital Cost Estimate (line 3) – Nalcor financial models capex (line 6)
(5) DG3 Growth Allowance (line 2) – Total (line 11)

As of the date of the DG3 Report, the DG3 estimate is based on a fixed and firm design and on a level of engineering of over 50 percent (P50), making it an AACEI Class 3 estimate, with a level of accuracy within a -20 to +30 percent range.

Table 9-1 shows that the total DG3 estimates for the three projects consist of DG3 Base Estimates plus DG3 Growth Allowances. Growth allowances include P50 Estimate Contingencies plus an Escalation Allowance, as indicated in Note (2).

The table also includes the total capital cost data included in the Nalcor financial models. The overall "Difference between Nalcor (financial model) data and DG3" row (base plus allowances)

indicates minimal variation between DG3 and Nalcor data for the MF and LTA projects and no variation for the LIL project estimates.

It is important to note the context for the DG3 estimate, which was prepared to verify Decision Gate 2, but also to support the Project Budget determination and provide the input to the financial pro forma models. The opinion of the IE is that the estimates for MF, LTA, and LIL are generally comprehensive to the extent that they include contractors' indirect costs, particularly important in the MF case, where the value of accommodations and site support services represent a measurable percentage of the total estimate.

As indicated in Note (3), additional costs are added to the capex figures to determine the total amounts to be financed. The additional capitalized costs include financing fees, interest during construction, debt service reserve account and a liquidity reserve account.

Differences between the DG3 Growth Allowances and the Nalcor financial models total growth allowances are all less than $30k (bottom line of table), which is *de minimis*.

The DG3 total cost of the three projects as shown in Table 9-1 is about $6.202B. Given the indication earlier that the estimate figure is representative of a range of actual outcomes ranging from -20 to +30 percent of the cost estimate, expected outcomes may be in the range of $5.0B to $8.0B.

9.2.3 Cost Escalation

Estimated capital costs included in DG3 are costs based on 2012 values. These values were escalated in the Nalcor financial models to reflect expected cost bases in the years of construction.

The long duration of the development, construction, and operation phases of the LCP subject project costs to escalation either caused by inflation and various other factors, including changes in market conditions, labor rates, productivity, etc.

As shown in Table 9-1, above, the DG3 capital cost estimates have been adjusted to reflect cost escalation and contingency allowances. The Nalcor financial models also incorporate cost escalation and contingencies as separate line items, as indicated in Table 9-1. The capital costs projected and input into the financial models also incorporate escalation in addition to contingency, which addresses separately risks of a different nature. With the assistance of external experts, Nalcor has projected cost escalation that takes into account how each sector of the economy, e.g. commodity, labor market or global economic factors, is impacted differently. In our opinion, the strategy adopted by Nalcor permits a realistic estimate of escalation. Escalation assumptions input into the MF, LTA, and LIL spreadsheets in the financial models reflect the detailed estimates prepared, and appear consistent with the trends projected for the region. Table 9-2 summarizes the annual escalation through 2018.

Table 9-2

ANNUAL COST ESCALATION

ESCALATION	2012	2013	2014	2015	2016	2017	2018
MUSKRAT FALLS							
CUMMULATIVE	1.1%	2.8%	5.8%	8.3%	10.1%	10.6%	10.2%
ANNUAL	1.1%	17%	2.9%	2.3%	1.7%	0.5%	-0.3%
LABRADOR TRANSMISSION ASSETS							
CUMMULATIVE	0.6%	2.5%	5.4%	10.3%	13.0%	14.8%	
ANNUAL	0.6%	1.9%	2.8%	4.7%	2.5%	1.5%	
LABRADOR ISLAND TRANSMISSION LINK							
CUMMULATIVE	0.2%	2.5%	5.0%	7.8%	9.5%	14.2%	21%
ANNUAL	0.2%	2.3%	2.4%	2.7%	1.6%	4.4%	5.9%
TOTAL PROJECT ESCALATION							
CUMMULATIVE	0.9%	2.7%	5.3%	8.2%	9.8%	12.0%	11.9%
ANNUAL	0.9%	1.8%	2.6%	2.7%	1.5%	1.9%	

9.2.4 Contingency

Capital costs used in the Nalcor financial models include contingency as well as escalation, as shown in Table 9-1.

The level of accuracy supported by the amount of engineering performed at this stage of project development should provide an adequate margin to mitigate the risk of uncertainty still present in the absence of the larger contracts being awarded. At this point in our review, the IE is of the opinion that allowances for contingencies should be greater than the figures provided by the Nalcor cost estimating consultants and summarized in Table 9-1. See Section 6.1.1.

By arriving at the contingency levels used as input to the pro forma following a multi-faceted Project Risk Management Plan, and using AACEI's recommended practice, Nalcor has adopted a reasonable approach in the interim period. However, they have arrived at some figures that do not compare well to those used in other similar projects we have reviewed. The IE typically sees contingency allowances in the range of 12 percent to 18 percent at this state of project development.

The contingency allowance figures for the three projects are identified in Table 9-1, above. Table 9-3 shows the same capex and P50 contingency as Table 9-1 and includes the ratio of

those two parameters. Total aggregate contingency percentage is about 6 percent. These contingency values appear low for this stage of project development, in our opinion.

Table 9-3

CONTINGENCY ALLOWANCE

	MF	LTA	LIL	Total
Total DG3 Capital Cost Estimate	$2,901,158,273	$691,582,365	$2,609,748,917	$6,202,489,555
Growth allowance components				
P50 contingency	$ 226,700,000	$ 54,800,000	$ 86,500,000	$ 368,000,000
P50 contingency $ of Nalcor total capex	7.81%	7.92%	3.31%	5.93%

9.2.5 Indirect Costs

An important component capitalized into the LCP funding mechanisms is the cost of financing. This cost category includes bond counsel, financial advisory, underwriter discount, official statement printing and distribution, and other costs. Because of the very high credit worthiness of the financing securities, we are advised that there will be no cost of bond insurance premiums or surety costs.

Financing costs for the three projects included in the models total more than $123.11M, as follows:

MF .....$ 52.85M

LTA.....$ 12.54M

LIL .....$ 57.72M

Sum $123.11M

Other indirect costs included in DG3 include:

- project management;
- integrated commissioning;
- project vehicles / helicopter support;
- insurance / commercial;
- land acquisition and permits;

- quality surveillance and inspection;
- freight forwarding services; and
- environmental and aboriginal affairs.

In our opinion, the approach and the comprehensiveness of the technical estimates is consistent, and even better than those normally seen in projects of this type.

Financing fees, namely those for arrangement and commitment (LIL at 1.8 percent of amount financed, for example), are in the range typically seen in other similar projects.

The input to the financial models will be revised as the projects move closer to funding.

9.2.6 Historical Capital Outlay

Capital costs that have occurred or shall have occurred prior to project financing are included in the DG3 estimate. Some utilities capitalize such costs in their main financing packages where some form of short-term "bridge financing" may have been used to pay for the initial construction activities. Such bridge financing securities are refinanced into the main financing structures. Other utilities fund the initial construction outlay using equity funds on-hand and do not re-capitalize those expenditures into the main financing vehicles.

Nalcor's DG3 cost estimate and financial planning models include more than $186M in pre-operating construction costs. Pre-operating construction costs are associated with the following items:

Table 9-4 summarizes these costs by project.

Table 9-4

HISTORICAL COSTS (see Notes 1 and 2)

PROJECT	HISTORICAL COST (note 1)
Muskrat Falls	$97,303,164
Labrador Transmission Assets	4,196,093
Labrador Island Transmission Link	85,307,165
Total	**$186,806,422**

Notes:

Note 1: Cost data in Table 9-4 are reported at original cost.

Note 2: Awaiting response for listing of historical costs.

9.2.7 Interest During Construction

The DG3 construction cost estimate does not include costs of IDC, also called AFUDC. However, IDC is an important feature to capitalize in the financings and it is included in the Nalcor financial models. Table 9-5 summarizes the IDC values included for the three projects.

Table 9-5

FINANCING COST AND INTEREST DURING CONSTRUCTION COST

PROJECT	IDC
MF	$403,270,000
LTA	$95,700,000
LIL	$462,976,000
TOTALS	**$961,946,000**

9.2.8 Renewals and Replacements

Nalcor advised the IE that the financial planning for the projects does did not specifically include costs for renewals and replacements in the capital or annual cost estimates. Their opinion is that with proper design and installation and with regular and prudent maintenance following manufacturers' recommended scheduled maintenance there should be no need to replace the equipment since its useful life will exceed the bond repayment period.

The IE is of the opinion, based on experience that funds should be provided for major replacements in the 25-30 year period with minor replacement after 10-15 years of service.

If major repairs/replacements become necessary, Nalcor will have access to Provincial equity funding to be repaid subsequently. This program is consistent with the manner of utilities that use the "Cash Needs" method of revenue requirements. The three step solution: (1) problem happens or will happen; (2) problem solution is funded; and (3) the funding is repaid, is optimized if the utility has a capital reserve or other liquidity feature to minimize the time taken in the funding step.

Although Renewals and Replacements are not included in either DG3 or the Nalcor financial models, Nalcor has included in its Asset Management Philosophy report the R/R data included here in Table 9-6.

Table 9-6

MAJOR MAINTENANCE ACTIVITIES PLANNING

Hydro Power Plant Major Maintenance Activity	Interval (years)	Activity Duration	Activity Cost
Replace bearings	Turbine 25-35 Generator 40-50 Thrust 40-50	4 days	$75,000/bearing
Replace wicket gate bushing	25-50	1 month	$400,000
Replace shaft seal	15-30	2 days	$40,000
Clean rotor and stator	50-75	1 month	$350,000
Repair cavitation	25-50	2 weeks	$60,000
Replace generator cooler	35-50	1 week	$90,000/cooler
Rewind generator	60-80	1.5 months	$9,000,000
Replace exciter	15-20	5 weeks	$1,300,000
Replace governor	15-20	5 weeks	$650,000
Replace voltage regulator	15-20	5 weeks	$300,000

9.2.9 Summary of Capital Costs

While the Capital Cost estimate is reviewed in Section 5 of this IER, it is relevant to note here that the figures used as input to the pro forma appear to be a reasonable representation of the Total Cost, as can best be assumed and projected based on the information available at this time.

Refinement will be required, and will take place, as the level of engineering progresses, design drawings reach a higher level of completion and the construction packages become better defined, and contracts are awarded. Such refinement must take place prior to financial closing.

Table 9-7

CAPITAL COST ESTIMATE SUMMARY

DECISION GATE 3 (DG3)

(not including Growth Allowances)

MUSKRAT FALLS	
Accommodation Complex / Admin / Utilities / Access Roads/ Construction Power	$166,608,338
Bulk Excavation & Main Civil Works for Intake & Powerhouse, Spillway & Transition dams	$823,064,224
North Spur/North and South Dams/Reservoir Clearing/Habitat Compensation works	$336,605,489
T&G's/Powerhouse Mechanical and Electrical Auxiliaries/Hydro Mechanical Equipment/GSUs/Collector Lines	$484,012,733
Telecommunications	$17,298,550
Site Services	$248,312,374
Spares	$1,500,000
Sub-Total	**$2,077,401,708**
Project Management	$292,987,287
Integrated Commissioning Services	$1,950,000
Project Vehicles / Helicopter Support	$5,691,750
Insurance / Commercial	$14,531,242
Land Acquisition and Permits	$1,115,004
Quality Surveillance & Inspection / Freight Forwarding Services	$4,700,000
Environmental & Aboriginal Affairs	$16,243,349
Sub-Total	**$337,218,632**
Historical Cost	**$97,303,164**
TOTAL, MF	**$2,511,923,504**
LABRADOR TRANSMISSION ASSETS	
OL Transmission CF-MF	$288,254,205
Switchyards	$192,087,214
Telecommunications	$15,467,507
Spares	$2,960,613
Sub-Total	**$498,769,539**
Project Management	$82,891,340
Integrated Commissioning Services	$9,372,938
Project Vehicles / Helicopter Support	$842,250
Insurance / Commercial	$2,519,988
Land Acquisition and Permits	$1,119,630

Quality Surveillance & Inspection / Freight Forwarding Services	$1,600,000
Sub-Total	**$98,346,146**
Historical Cost	**$4,196,093**
TOTAL, LTA	**$601,311,778**
LABRADOR-ISLAND TRANSMISSION LINK	
Converters / Transition Compounds/Synch Condensers/SP Switchyard	$639,805,781
Electrode Sites / Island Upgrades	$77,613,063
OL Transmission MF-SP	$929,045,619
SOBI Marine Crossing	$337,440,262
Telecommunications	$21,433,995
Spares	$6,724,135
Sub-Total	**$2,012,062,855**
Project Management	$194,893,751
Integrated Commissioning Services	$3,053,762
Project Vehicles / Helicopter Support	$10,311,000
Insurance / Commercial	$15,674,421
Land Acquisition and Permits	$18,472,787
Quality Surveillance & Inspection / Freight Forwarding Services	$8,100,000
Environmental & Aboriginal Affairs	$11,735,229
Sub-Total	**$262,240,951**
Historical Cost	**$85,307,165**
TOTAL, LIL	**$2,359,610,970**
GRAND TOTAL (not including Growth Allowances)	**$5,472,846,252**
GRAND TOTAL (including Growth Allowances)	**$6,202,489,555**

9.3 FINANCIAL PLANNING

The Nalcor financial planning/pro forma models are comprehensive and evaluate nearly every variable of project cost, financing and debt repayment. The models address the three basic project elements, MF, LTA and LIL, each in two separate Excel workbooks. Nalcor has modeled the effects of providing a single financing for each element as well as a series of tranched issues to reduce reinvestment earning management and to engage, perhaps, more local Canadian investment banks in the underwriting of the large $6.2B capital formation for construction of the three LCP projects mentioned above. The MF workbook identifies an option of melding of the MF and LTA project capital requirements into single financing packages, consistent with the terms of the Federal Loan Guarantee (FLG).

9.3.1 Sources and Uses of Capital Funds

Tables 9-8 and 9-9 show the sources and uses of funds for the MF and LTA projects, as configured in the Nalcor financial models. The MF and LTA projects have combined debt amounts about $2.6B ($2.114B + $502M). The total amounts to be debt and equity funded are shown at the bottom of the Uses columns of the two tables: $3.576B for MF and $0.836B for LTA.

From the total Uses, the value of the LRA (liquidity reserve) is deducted as well the revenues and interest figures, leaving $3.252B to be financed. Sixty-five percent of that amount is $2.114B to be debt financed. This is the figure shown in the Sources column as “Bond1.”

Table 9-8

MF SOURCES AND USES OF CAPITAL FUNDS

MF Sources & Uses of Funds During Funding Period					
Sources	**$ Million**	**%**	**Uses**	**$ Million**	**%**
Equity	1,213.38	33.9	Capex	2,901.16	81.1
Bond1	2,114.01	59.1	IDC	403.27	11.3
Revenues	212.89	6.0	Financing Upfront Fees	52.85	1.5
Interest on BHA	5.00	0.1	Opex	5.52	0.2
Interest on Opt BHA	30.92	0.9	Water Rental	7.90	0.2
			LTA Tariff	39.41	1.1
			DSRA Pre-Funding (Value)	59.46	1.7
			LRA Funding	75.00	2.1
			Innu Implementation Pmts	27.40	0.8
			Innu Annual Pmts	2.76	0.1
			Working Capital	1.48	0.0
Total	**3,576.20**	**100.0**	**Total**	**3,576.20**	**100.0**

Table 9-9

LTA SOURCES AND USES OF CAPITAL FUNDS

LTA Sources & Uses of Funds During Funding Period					
Sources	**$ Million**	**%**	**Uses**	**$ Million**	**%**
Equity	290.11	34.7	Capex	691.58	82.7
Bond1	501.71	60.0	IDC	95.70	11.4
Revenues	39.41	4.7	Financing Upfront Fees	12.54	1.5
Interest on BHA	1.10	0.1	Opex	1.87	0.2
Interest on Opt BHA	4.02	0.5	DSRA Pre-Funding (Value)	14.11	1.7
			LRA Funding	20.00	2.4
			Working Capital	0.53	0.1
Total	**836.34**	**100.0**	**Total**	**836.34**	**100.0**

Analysis of the LTA information, paralleling the above discussion for the MF project confirms the “Bond1” labeled debt financing amount of $0.502B for the LTA project.

The LIL models do not include Sources and Uses of Capital Funds tables, per se. An unpublished worksheet was provided by Nalcor that follows similar format and analytics. [Requires further communication with Nalcor before including comments herein.]

Financial planning must be revisited by Nalcor once the capital cost estimates, O&M cost estimates, and forms of long-term financings are better defined.

9.4 ANNUAL COSTS

Annual costs may seem immaterially small in comparison with the capital costs of the LCP, but it will be important to forecast annual costs for the purposes of bond documents. Operations and maintenance, debt service, depreciation expense, and pay-as-you-go annual capital requirements will be the largest annual costs.

9.4.1 Annual O&M Expenses

Annual O&M cost data have been estimated by Nalcor. The costs for each of the three projects include the following cost categories:

- Staff
- Vehicles
- Service contracts
- Miscellaneous costs.

The LIL cost estimate also includes O&M costs associated with Submarine Cable and Sea Electrodes.

Nalcor has provided projected annual O&M expenses from the time of commissioning, Year 2018, out fifty years.

9.4.2 Debt service

The financial models compute annual debt service, debt service coverage requirements, and debt service reserve account, as discussed above under financial planning. Annual debt service becomes an expense that must be paid by Nalcor using revenues generated by the sale of electricity. To comply with the terms of the FLG, Nalcor will use the “Cash Needs” approach[4] to revenue requirements determination for the MF/LTA and LIL projects. It will plan that rate revenue will be sufficient to meet (with the Liquidity Reserves) the DSCR stipulated in the FLG.

[4] This approach is defined and discussed in subsequent paragraphs.

9.4.3 Capital Revenue Requirements Methods

Revenue requirements for utility service providers are typically computed using either of two computational approaches to establish rates and charges. One approach is called the "Utility Method"; the other is called the "Cash Needs Method." Both methods assume that full direct costs of O&M are to be paid from annual revenues produced by the sale of product (typically quantities x rates).

The methods differ in computation of revenue required to pay for capital projects, including debt service on borrowed funds. Under the **Utility Method**, the utility entity may include depreciation expense and a return on asset value as revenue requirements to be recovered in rate revenue. The return is computed by multiplying the weighted average cost of capital (debt and equity) – sometimes called "discount rate" – times "rate base." Rate base is the sum of depreciated original costs of buying/installing assets that are used and useful in the utility business. In addition to these two main components of revenue requirements (depreciation plus return), the utility may charge for other cost items including AFUDC (IDC), working capital reserve, value of construction work in progress (CWIP) (assumed to become used and useful assets), materials and supplies acquisitions and certain other capital related costs. Interest expense on debt is allowed but the principal payments on debt are not allowed.

Under the **Cash Needs Method**, capital related revenue requirements include pay-as-you-go capital outlay, debt service (principal and interest), funding of capital reserves, and all other capital related costs. In essence the "cash needs" include all direct and indirect annual costs that occur and are not offset by other (non-operating) revenues.

Because Nalcor will be using the "Cash Needs" method, the ordinary protocol of estimating depreciation expense, rate base asset value, working capital reserve requirements, AFUCD, annual CWIP and other data that are necessary for estimating revenue production under the "Utility" method, are not necessary for estimating revenue production with the "Cash Needs" approach. Instead, the focus is on estimating annual costs that require revenue for business reasons and for meeting the DSCR requirement.

9.5 REVENUE PROJECTIONS

Nalcor provided projections of revenue based on the assumed terms of the PPA and the average annual power forecast of 4.93 TWH in their model. Plant usage and internal usage of the other project facilities may or may not be included in the computations. Confirmation of these power deductions has not been independently made by the IE.

9.6 IMPLEMENTATION ISSUES

9.6.1 Dispatch Constraints

The dispatch of the project's power is controlled by the WMA under which the Water Management Committee selects the Independent Coordinator whose responsibility is to:

"…determine the total power to be produced and is required to determine and prepare the production schedules which shall specify the amount of power to be produced by each supplier's production facilities in accordance with the provisions of the Agreement. Nalcor and Churchill Falls (Labrador) Corporation Limited are the "Suppliers of power."

MWH has been advised that the Province of Quebec has introduced a legal challenge to the LCP. MWH are not lawyers, and therefore, are not qualified to opine on the merits or legal issues to be raised in the Quebec challenge or to estimate the probabilities of potential outcomes. MWH recognizes the Quebec challenge as a project risk, but without further information MWH cannot form professional opinions pertaining to technical issues associated with loss of power that would be associated with the Quebec lawsuit should Quebec prevail. Such information is currently being developed by Nalcor at the request of Government and may be available before financial close.

MWH currently does not see where a dispatch constraint could occur, in our opinion, with the WMA in place and dutifully promulgated, and with the information the IE has been provided.

We requested further information from Nalcor pertaining to any dispatch constraints and where and why they may occur, since this issue was studied and risk assessments conducted. Nalcor reports that no constraints were identified.

9.6.2 Project Performance and Reliability

Based on the number of contracts and the RFP for CH0007 that we have been able to review to date, it is still too early to forecast directly from actual results of LCP testing and commissioning of systems, and how each of the turbine-generating units and the systems actually will perform over time. However, based on other projects of similar complexity and size and their performance and reliability history which we are aware of, we have no reason to question at this time that the LCP, as presently configured and provided with the proposed adequate O&M and renewals and replacement budgets, will produce satisfactory performance and will be a reliable and dependable resource.

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SECTION 10

CONCLUSION AND INDEPENDENT ENGINEER'S OPINIONS

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SECTION 10

CONCLUSIONS AND INDEPENDENT ENGINEER'S OPINIONS

The following section lists our principal conclusions and recommendations as of October 1, 2013, which are based on a site visit conducted during the week of September 23, 2013 and data, RFPs, and contracts furnished by Nalcor, the borrower for the following three of the four projects of the LCP: MFGS; LTAP; and LIL.

10.1 PRINCIPAL CONCLUSIONS

10.1.1 In our opinion, and based on past experience, the Integrated Project Team consisting of SNC-L (the borrower's Engineer) and Nalcor (the borrower) are qualified to design, contract, manage, commission, operate and maintain the three projects currently under design and construction for the LCP. Furthermore, in our opinion, an amendment to the SNC-L Agreement with Nalcor should be issued to commemorate the understandings under which the Integrated Project Team is working and to clarify, where necessary, understandings with respect to responsibilities and duties.

10.1.2 The Muskrat Falls Generating site is a relatively easy site to develop from a technical and logistical point of view. The terrain is relatively flat with nearby access to a principal road in Labrador. For both the temporary structures and the permanent facilities, sufficient space is available for the project development.

10.1.3 The North Spur area has been geologically explored and studied in the past by several engineering organizations as well as during the most recent studies conducted by the Integrated Project Team to develop a satisfactory solution to reduce seepage and provide stabilization remediation procedures that should provide a useful life beyond the design life of 50-years, in our opinion. With the existing monitoring program currently being updated of seepage conditions, this update will provide a means to continue to monitor the performance of the area before, during and after pool raise.

10.1.4 Hydrological risk in terms of generation capability is well understood as documented in the studies conducted for the project. With average annual energy established by using long-term flow records of 4.93 TWH/year, the power purchase agreement with Emera allowed Emera to claim 20 percent of the power for 35-years with the commitment to build the transmission system to Nova Scotia, and Nalcor and their special purpose companies using the rest of the power in the Labrador and Newfoundland system. Long-term generation is assured by the Water Agreement that provides storage at Churchill Falls and a means of operating the Churchill River to near-optimize the power production.

10.1.5 Hydrological risk in terms of construction diversion flows at Muskrat Falls have been satisfactorily studied and cofferdam heights and means of diversion have been designed to

account for ice jams as well as flood flows with a return period of 20-years; 40-years for the ice jam events. Mitigation of flooding event risks beyond these normally assumed return-period events will be the responsibility of Nalcor Energy.

10.1.6 Construction safety requires contractors to supply their Health, Safety and Security Plans as part of their required submittals. They must follow the generally-high standards established by Nalcor Energy which follows a 'safety first' philosophy.

10.1.7 The risk of problems associated with transportation are mitigated to some extent by Nalcor providing storage facilities at two locations as well as providing transportation to the sites of the projects. Risk associated with transportation of materials, equipment, and supplies to these facilities is the responsibility of the contractors. Risk still exists using overseas suppliers, however, these shipments will be closely monitored as required by Nalcor's overarching transportation plan.

10.1.8 RFPs and Contracts reviewed to date are generally satisfactorily written and similar with respect to terms and conditions imposed on the suppliers and contractors. The contracts convey to the parties the clear responsibilities of the contractor as well as Nalcor, with no ambiguities detectable by the Independent Engineer in the documents we have reviewed to date. Nalcor has established a system wherein they weigh the bid amount with the security provided (performance bond amount, letters of credit, and parent-company guarantees) to arrive at a satisfactory level of risk and to keep the price as low as practical. We normally do not see this level of balancing all factors considering risk to reduce cost on other projects we are aware of, but find the methodology employed by Nalcor to be satisfactory for the projects.

10.1.9 Based on the limited number of large contracts we have reviewed, it is our opinion that the DG3 cost estimate was robustly prepared, following the general procedures outlined in the AACEI for a Class 3 estimate. We differ from Nalcor's opinion as to the level of accuracy of the estimate in that we strictly follow the recommendations of AACEI for this level of estimate wherein they allow a -20% to a + 30% allowance for estimating accuracy.

10.1.10 Construction to date pertaining to the contracts that MWH is required to review is limited to the Bulk Excavation contract, CH0006, that currently is on schedule and at budget levels. We are not aware of any change orders to this contract that Nalcor has apprised MWH of that would increase the cost above the contract amount. We have reviewed the Integrated Project Schedule prepared by Nalcor and find that it is generally complete as far as listing contracts, but it is just a simplistic Gantt chart without activity linking, critical path(s), float time, ETC, and is not suitable to the level of detail we require and had expected to view to allow us to form opinions. Until we view more large contracts under construction and obtain the P6 classic CPM view of the project schedule, we cannot express an opinion as to the likelihood of the contracts being completed as scheduled.

10.1.11 Work in progress.

10.2 PRINCIPAL RECOMMENDATIONS

Work in progress.