# Nalcor's Final Submission to the Board of Commissioners of Public Utilities with respect to the Reference from the Lieutenant-Governor in Council on the Muskrat Falls Project

**March 2, 2012**

**Note to Reader**

This submission references material filed with the Newfoundland and Labrador Board of Commissioners of Public Utilities (the Board) by Nalcor Energy as well as transcripts and presentations from the public hearing and comments received by the Board from interested parties. Exhibits and responses to requests for information (RFIs) are classified as either public or confidential. Confidential exhibits (CEs) have been deemed so by Nalcor where the information contained within is of a commercially sensitive nature. All public exhibits, including abridged or redacted versions of confidential exhibits, transcripts, presentations and public comments are available at the Board's website at the following links:

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| Exhibits: | http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm |
| Responses to RFIs: | http://www.pub.nf.ca/applications/MuskratFalls2011/rfi.htm |
| Public CE's: | http://www.pub.nl.ca/applications/MuskratFalls2011/abridge.htm |
| Transcripts: | http://www.pub.nl.ca/applications/MuskratFalls2011/transcripts.htm |
| Presentations: | http://www.pub.nl.ca/applications/MuskratFalls2011/presentations.htm |
| Public Comments: | http://www.pub.nl.ca/applications/MuskratFalls2011/comments.htm |

**Note to Reader (continued)**

In the footnotes, the following naming conventions apply:

| **Abbreviation** | **Refers to** |
|---|---|
| MHI Vol 1 | Manitoba Hydro International (MHI), "Report on two Generation Expansion Alternatives for the Island Interconnected Electrical System (Volume 1) |
| MHI Vol 2 | Manitoba Hydro International (MHI), "Report on two Generation Expansion Alternatives for the Island Interconnected Electrical System (Volume 2) |
| Nalcor Vol 1 | Nalcor Energy, "Nalcor's Submission to the Board of Commissioners of Public Utilities with respect to the Reference from the Lieutenant-Governor in Council on the Muskrat Falls Project", Volume 1 |
| Nalcor Vol 2 | Nalcor Energy, "Nalcor's Submission to the Board of Commissioners of Public Utilities with respect to the Reference from the Lieutenant-Governor in Council on the Muskrat Falls Project", Volume 2 |
| Exhibit - # | Exhibits filed with the Board by Nalcor, denoted by the Exhibit number. |
| CE - # | Confidential exhibits filed with the Board by Nalcor, denoted by the Confidential Exhibit number. |
| MHI - # | Responses to RFIs made by MHI, denoted by the RFI number. |
| CA/KPL - # | Responses to RFIs made by the Consumer Advocate, denoted by the RFI number. |
| PUB - # | Responses to RFIs made by the Board, denoted by the RFI number. |
| Transcript - Date | Official transcripts of the public hearings, identified by the date of the hearing. |

## List of Acronyms

| Acronym | Definition |
|---|---|
| AACEI | Association for the Advancement of Cost Engineering International |
| ac | Alternating current |
| AESO | Alberta Electric System Operator |
| BCUC | BC Utilities Commission |
| CCCT | Combined Cycle Combustion Turbine |
| CDM | Conservation Demand Management |
| CEs | Confidential Exhibits |
| CF(L)Co | Churchill Falls (Labrador) Corporation |
| COS | Cost of Service |
| CPW | Cumulative Present Worth |
| CSA | Canadian Standards Association |
| CT | Simple Cycle Combustion Turbine |
| dc | Direct current |
| DG2 | Decision Gate 2 |
| DG3 | Decision Gate 3 |
| EIA | Energy Information Admiration |
| EUB | Energy and Utilities Board |
| FEL | Front-End Loading |
| GHG | Greenhouse Gas |
| GWh | Gigawatt Hour |
| HVdc | High Voltage Direct Current |
| IESO | Independent Electricity System Operator |
| IPA | Independent Project Analysis |
| IRR | Internal Rate of Return |
| kV | Kilovolt |
| LCP | Lower Churchill Project |
| LNG | Liquefied Natural Gas |
| LOLH | Loss of Load Hours |
| LRM | Long Range Mountain |
| MH | Manitoba Hydro |
| MHI | Manitoba Hydro International |
| MRI | Meteorology Research Inc. |
| MRO | Midwest Reliability Organization |
| MW | Megawatt |
| NBSO | New Brunswick System Operator |
| NEB | National Energy Board |
| NERC | North American Electric Reliability Corporation |
| NG | Natural Gas |
| NLH | Newfoundland and Labrador Hydro |
| NOx | Nitrous Oxide |
| NSPI | Nova Scotia Power |
| OEB | Ontario Energy Board |
| PLF | Planning Load Forecast |
| PPA | Power Purchase Agreement |

| Acronym | Definition |
|---|---|
| PUB | Public Utilities Board |
| RFIS | Requests for Information |
| RRM | Revenue Requirement Model |
| UARB | Utility and Review Board |
| WECC | Western Electricity Coordinating Council |

## Table of Contents

# 1.0 Introduction

Nalcor Energy participated in the public review hearings conducted by the Newfoundland and Labrador Board of Commissioners of Public Utilities (the Board) between February 13 and February 23, 2012. This document is Nalcor's final submission to the Board, as requested by the Board in the public hearing process.

This final submission addresses particular areas of inquiry raised by the Board, Consumer Advocate, Manitoba Hydro International Ltd (MHI) and members of the public during the public review process.

In preparing this final submission it was Nalcor's intent to demonstrate to the Board and others, the key reasons behind Nalcor's recommendation of the Interconnected Island as the least-cost solution to meet the island's future power needs within the prescribed reliability criteria. It is also Nalcor's intent with this document to respond to particular areas of inquiry and comment raised by the Board, Consumer Advocate, Manitoba Hydro International Ltd (MHI) and members of the public during the public review process, particularly with regard to:

- Credibility of Nalcor's load forecast and fuel forecast methodology and projections
- Thoroughness of Nalcor's screening and analysis of generation options
- Strength of preference for the Interconnected Island alternative, including CPW analysis and revenue requirement
- Quality of the Decision Gate Process, including cost estimating and risk management
- Reliability of the transmission system and integration with the current system
- Value of the strategic benefits of interconnection

## 1.1 Summary of Nalcor's Recommendation

Newfoundland and Labrador Hydro (NLH) has a responsibility to assess and recommend supply options to meet the province's growing energy needs. In 2010, NLH's System Planning Department determined new generation would be required to meet a capacity shortfall in

2015 and an energy shortfall in 2021. An examination of available alternatives determined that an interconnection to Labrador via an HVdc link bringing power from the Muskrat Falls Generating Station was the least-cost option for electricity consumers. Nalcor's submission to the Board in November 2011 fully outlines details for this recommendation.

Nalcor's Cumulative Present Worth (CPW) analysis, validated by MHI, shows a preference of $2,158 million (2010$) for the Interconnected Island alternative. Under the Isolated Island alternative, the dominance of thermal generation means electricity rates will be subject to fuel price volatility. Fossil fuels account for almost 70 percent of the Isolated Island's CPW for NLH's incremental utility costs across the planning period.

By 2021, with Muskrat Falls in operation, thermal production at the Holyrood plant will cease, practically eliminating the island's dependence on oil.

Sensitivity analyses show the preference for the Interconnected Island alternative over the Isolated Island alterative is robust across almost all sensitivity tests, including load growth and fuel costs. Both Nalcor and MHI concluded oil prices would have to be 44 percent below reference projections for the Isolated Island alternative to be favoured on a CPW basis, and therefore a clear preference for electricity consumers.

To determine the price of Muskrat Falls power, Nalcor chose a supply price model because it provides consumers with manageable rates in the early years of operations.

There are cost escalation risks inherent in both the Isolated Island and the Interconnected Island alternatives. Unlike the Isolated Island, in the Interconnected alternative, risks are primarily internal and therefore can be managed and mitigated through project management practises and the Decision Gate (DG) process.

Muskrat Falls, while an intensive capital project, is well understood and extensively studied. Nalcor has invested in the best project processes, practices and people to manage and mitigate risks to consumers. By Decision Gate 3, the accuracy of the Project's cost estimate will be at the narrow range according to the Association for the Advancement of Cost Engineering International (AACEI) standard.

Among many other strategic benefits, the development of the Muskrat Falls Interconnection positions the province for future energy developments and electricity exports.

Low interest rates, the New Dawn Agreement, the water management agreement, the strength of the provincial economy, and a federal commitment to a loan guarantee make it the right time to develop Muskrat Falls.

## 2.0 Load Forecasting

Load forecasting projects electricity demand and energy requirements through future periods. Preparing a long-term load forecast is the first step in the planning process as it establishes the anticipated electricity requirement for the island's consumers. The forecast is used by NLH's system planners to ensure sufficient generation resources are available to reliably meet consumers' energy requirements.

NLH approaches load forecasting cautiously and considers its load forecast practices and resulting long-term demand and energy requirements for the island's future to be reasonable. The long-term load forecast completed in 2010 and used in the Decision Gate 2 (DG2) analysis was based on a set of conservative underlying assumptions, including the province's economic forecast, which has moderate growth expectations for the province.

While the island's industrial electricity requirements have declined recently due to structural changes within international pulp and paper markets, utility requirements comprised of domestic and commercial loads continue to increase. By 2015, continued growth of the island's utility demand, combined with the electricity requirements for Vale's nickel processing facility, will offset the recent declines experienced in island load.

### 2.1 Capacity and Energy Deficits

Nalcor's 2010 Planning Load Forecast (PLF) for the Isolated Island system identified system capacity deficits commencing in 2015, with firm energy deficits commencing in 2021. Without new supply capacity by 2015, demand will increase to a point where additional generation is required to maintain an appropriate generation reserve for the forecast peak demand. In the absence of additional supply, NLH's reserve capacity will fall below the minimum standard that ensures a continuing reliable supply of electricity to meet the island's demand. As forecasted load continues to grow, the island will also experience an energy deficit by 2021 if additional generation capability is not added. This deficit exists when the island's overall electricity requirements are greater than the combined firm energy capability of NLH's thermal and hydroelectric generation plants.

## 2.2 NLH's Load Forecasting Methods

### 2.2.1 Utility Load Forecasting

The utility load forecasting methodology used by NLH is a well-established approach that has been used within the electric utility industry for many decades. Over the past 30 years, NLH has continually refined this approach in an effort to ensure the preparation of objective and unbiased load forecasts. This statistical-based econometric approach is used to forecast utility energy and peak demand requirements 20 years into the future.

An extensive review by the Board's consultant, MHI, of NLH's load forecasting preparation practices confirmed that the load forecast has been performed with due diligence and care using generally accepted practices but noted that end-use modeling techniques for domestic loads are not currently employed.[1] However, MHI stated in its presentation during the Board hearings that even with the adoption of end-use modeling, the accuracy of the forecast may not improve but the quality of the derived knowledge would.[2] Nalcor concurs with MHI's comments and believes that an end-use modeling framework will not provide Nalcor with a more accurate method of forecasting.

To drive the utility electricity forecast, NLH considered the 20-year forecast for the provincial economy prepared by the province's Department of Finance. MHI reviewed the key economic assumptions and concluded those used in the domestic forecast (i.e., residential) are conservative, and those used in the general service (i.e., commercial and institutional) forecast can be expected to produce a good forecast.[3]

### 2.2.2 Industrial Load Forecasting

NLH's forecast for industrial power requirements is based on direct inputs from its three large industrial customers. Given NLH's small industrial customer base, it would not be appropriate for NLH to forecast industrial requirements independent of direct input from the

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[1] MHI, Vol 1, p. 8.
[2] Transcript-February 15, 2012, pp.118, lines 15-25.
[3] MHI, Vol 2, p. 33.

industrial customers. MHI indicated in the Muskrat Falls Review before the Board that the industrial forecast approach used by NLH is consistent with the approach used by MHI.[4]

In its report to the Board, MHI expressed that Nalcor's assumption that Corner Brook Pulp and Paper will continue operation through the entire planning period is optimistic. However, MHI also stated that Nalcor's assumption that there would be no new industrial load over the planning horizon was pessimistic.[5]

Nalcor believes the current industrial load growth assumptions are therefore reasonable. The province's industrial customers supported this view in their letter to the Board in which they said: "The current island customers expect and believe that the Province's citizens would expect that the provincial government will, over the review period, pursue policies that promote the maintenance and expansion of industrial activity on the island as a vital component of the province's economy."[6]

In addition to the possibility of new industrial load developing on the island, there is considerable opportunity for industrial load growth in Labrador associated with expansion within the mining sector. While this opportunity exists and such expansion has been publically discussed in the past, to date there have been no firm commitments or contracts to begin new operations or to significantly expand existing operations. As it is not standard utility practice to make generation planning decisions based on a prospective load, new industrial load growth in Labrador has not been factored into Nalcor's generation planning and subsequent CPW analysis.

## 2.3 Load Forecasting Issues

For the Muskrat Falls and Labrador-Island Transmission Link analysis it was necessary to extend the standard 20-year long-term load forecast for an additional 38 years to coincide with the service life of the transmission link. Given the forecast period involved, NLH conservatively extended the forecast by setting the longer-term annual load increments to

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4 Transcript-February 15, 2012, pp. 220-224.
5 MHI, Vol 1, p. 8.
6 Stewart McKelvey, Letter to the Board dated Feb. 29, 2012.

reflect underlying provincial economic growth after accounting for electric heat market saturation that is expected to be from 75 to 80 percent. The purpose of this long-term trend for load growth is to provide a conservative and prudent provision for the long-term electricity growth prospects for the island under an assumption of a modestly growing economy.

Issues regarding NLH's load forecasts were raised during the Board public presentations. These issues stemmed from the belief that the forecasts are exaggerated and that the province's population will not require the amount of electricity being projected. The load growth in Nalcor's domestic load forecast is primarily associated with an expanded electric heat market share and customer growth that is linked to housing demand and rising income levels. Electricity is expected to remain as the principal fuel source for customers main heating requirements on the island. The housing start forecast which Nalcor uses to predict future customer levels is based on the provincial government's Department of Finance's forecast of the provincial economy. The Department of Finance has extensive forecasting experience of the provincial economy and incorporates the relevant factors involved with preparing macro-economic forecasts. The housing start forecast provided to Nalcor is linked to the long-term population projection as well as other pertinent factors affecting housing demand for the province.

Nalcor recognizes that load forecasts are subject to error and, therefore, evaluated the impacts of material reductions in future load expectations through discrete load sensitivity cases.[7] The load sensitivity analysis undertaken demonstrated that the CPW preference for the Interconnected Island alternative over the Isolated Island alterative is robust across a wide range in future load assumptions.

[7] Nalcor Vol 1, pp. 124-128.

## 3.0 Identification of Alternatives and Screening

The second step in the generation planning process is the identification and screening of supply options. Nalcor has a thorough screening process for evaluating energy supply options and has considered a broad portfolio to meet future energy needs. All supply options are initially considered and screened based on five key screening principles. These include: 1) security of supply and reliability, 2) cost to electricity consumers, 3) environmental considerations, 4) risk and uncertainty and 5) financial viability of non-regulated elements. This screening enables NLH to concentrate its resources towards only those technologies and alternatives that offer the highest economic and technical potential for successful integration into Newfoundland and Labrador's electricity system and offer the best benefit to electricity consumers.

Those generation options that remain following the initial screening are input into Nalcor's generation planning software *Ventyx Strategist®* (*Strategist®*) for further analysis. *Strategist®* evaluates all of the supply options that pass the initial screening together with the load forecast and reliability criteria to determine the optimized, least-cost generation expansion plan. The generation expansion planning process is discussed further in Section 4.

MHI reviewed Nalcor's generation resource planning process and concluded: "Nalcor has an exhaustive process for reviewing generation options that is in keeping with leading North American utilities."[8]

### 3.1 Analysis of Generation Options

Nalcor identified a range of supply options that could be considered to meet future generation expansion requirements for the island and provided a comprehensive analysis of all these options in its November submission to the Board.[9]

During the Board's public hearings there were several presentations challenging Nalcor's analysis of generation options, particularly domestic natural gas, liquefied natural gas (LNG),

[8] MHI Vol. 1, p. 8.
[9] Nalcor Vol. 1, pp. 56-103.

Churchill Falls power in 2041, wind generation, and conservation and demand management. These generation options did not pass initial screening as they were deemed to be not viable to meet the growing demand as summarized in the following sections.

# 4.0 Generation Expansion Plans

The next step in the planning process involves the development of optimized least-cost generation expansions plans in *Strategist®* for the Isolated Island and Interconnected Island supply alternatives. This was done using the supply options that have advanced through Nalcor's screening process (outlined in Section 3), while adhering to generation and transmission planning criteria and resource development constraints.

The two resulting expansion plans (Isolated Island and Interconnected Island) represent the optimal combination of wind, hydro and thermal resources that can collectively meet reliability criteria. The Isolated Island expansion plan continues to rely primarily on thermal generation, including continued operation of the aging Holyrood plant. The Interconnected Island alternative moves the island from dependence on thermal generation to the utilization of hydropower from the Churchill River.

## 4.1 Isolated Island Alternative[10]

The Isolated Island generation expansion plan represents the optimal scenario of all potential supply options available to meet the island's forecasted demand absent a connection between the island system and the North American grid. Each supply option included in the Isolated Island alternative is sufficiently engineered to ensure it can meet Nalcor's reliability, environmental and operational requirements.

The optimal generation plan for the Isolated Island alternative as determined by *Strategist®* is a thermal-based plan with increased use of the Holyrood oil-fired plant as well as development of more wind generation, smaller-sized hydro plants and a series of gas turbines. The island will continue to rely primarily on thermal generation, including continued operation of Holyrood. The dominance of thermal generation means electricity rates for consumers under the Isolated Island alternative will be subject to the volatility and continued projected increases of fuel prices in world markets.

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[10] This section is a brief summary of the Isolated Island alternative generation expansion plan. Additional details on the plan are available in Section 5.0 of Nalcor's Submission to the Board of Commissioners of Public Utilities with respect to the Reference from the Lieutenant-Governor in Council on the Muskrat Falls Project, Volume 1 (November 2011).

New wind generation is limited to the addition of a 25 MW wind farm in 2014 and the replacement of existing wind farms on retirement due to operational limitations on the amount of wind that can be integrated into an isolated grid system. MHI's independent review validated Nalcor's analysis in this regard.[11]

### 4.1.1 Reliance on Holyrood Thermal Generating Plant

The Holyrood plant is over 40-years old and nearing the end of its operating life. The Isolated Island alternative has the continued operation of two of Holyrood's three units until 2033 with the third unit continuing to operate until 2036. However, it is possible that Holyrood will not be able to reliably operate until those dates. In its report, MHI commented on the service life of the Holyrood plant noting, "Operating the Holyrood Thermal Generating Station beyond 50 years, to a maximum of 60 years, with reduced reliability, may not be practical. There may come a point well before 2041 when the plant becomes unreliable to operate."[12] Should the replacement of Holyrood become necessary before the dates contemplated in the Isolated Island alternative, the CPW for the Isolated Island alternative and the subsequent cost to consumers would increase.

Extending the life of the Holyrood plant into the 2030s will require significant capital upgrades included in the Isolated Island's plan and reflected in the CPW. In addition to these upgrades, continued use of the plant requires the installation of new pollution-control equipment to meet the commitments of the Energy Plan.[13] The necessary environmental upgrades consist of the installation of electrostatic precipitators and scrubbers for sulphur emissions, as well as low nitrous oxide (NOx) burners to control NOx emissions.

In addition to the need for pollution abatement measures at the Holyrood plant, federal regulation limiting greenhouse gas emissions (GHGs) appear to be increasingly possible. Nalcor did not factor carbon pricing into future cost projections for the Isolated Island alternative. MHI further concluded that should the GHG emission standard change through

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[11] MHI Vol. 2, pp. 181-184.
[12] MHI Vol. 1, p. 13.
[13] Government of Newfoundland and Labrador, Focusing Our Energy: Newfoundland and Labrador Energy Plan, 2007 - http://www.nr.gov.nl.ca/nr/energy/plan/index.html.

public policy to a lower target, there is a risk that an oil-fired facility such as Holyrood may not be able to operate in the long term.[14]

## 4.2 Interconnected Island Alternative[15]

The Interconnected Island alternative is an optimization of generation alternatives primarily driven by the Muskrat Falls hydroelectric generating facility and the Labrador-Island Transmission Link to the island. As with the Isolated Island generation plan, *Strategist®* was used to enable Nalcor to determine the optimal configuration of available generation options under the interconnected scenario. MHI concluded that the Muskrat Falls studies were conducted in accordance with utility best practices, comprehensively, and with no apparent demonstrated weaknesses. [16]

Along with Muskrat Falls, the plan requires additional generation for both energy and capacity including the Portland Creek hydroelectric development as well as new combustion turbine (CT) and combined cycle combustion turbine (CCCT) units. While the plan is predominantly driven by renewable energy, it does include some new thermal generation post 2033 required to address capacity shortfalls requiring minimal operation and incremental fuel expense. In addition, Churchill Falls power is utilized around 2057 to meet energy requirements in the Interconnected Island alternative.

With the displacement of the Holyrood Thermal Generating Station, the Interconnected Island alternative moves the island from thermal generation to an energy future with 98 percent renewable, clean power. The independence from oil will provide relative, long-term stable electricity rates for Newfoundland and Labrador consumers, a benefit currently enjoyed by other hydro dominated jurisdictions such as British Columbia, Manitoba and Quebec. The interconnection of the island with the North American grid will establish a

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[14] MHI Vol.1, p. 17

[15] This section is a brief summary of the Interconnected Island alternative generation expansion plan. Additional details on the plan are available in Section 6.0 of Nalcor's Submission to the Board of Commissioners of Public Utilities with respect to the Reference from the Lieutenant-Governor in Council on the Muskrat Falls Project, Volume 1 (November 2011).

[16] MHI Vol. 1, p. 9

foundation to permit the development of additional wind and other indigenous generation resources, and could pave the way for future renewable electricity exports.

### 4.2.1 Displacement of Holyrood Generation

The Holyrood plant will no longer generate electricity or emissions after 2021. Following the construction and commissioning of Muskrat Falls and the Labrador-Island Transmission Link and successful integration into the Island Interconnected system, thermal production at the Holyrood plant will cease. The generators at the Holyrood plant will then operate only as synchronous condensers to provide reactive power for the high voltage direct current (HVdc) converter station at Soldier's Pond and voltage support on the eastern Avalon Peninsula.

## 4.3 Stable Energy Future for Newfoundland and Labrador

The dependence on fossil fuels in the Isolated Island alternative accounts for almost 70 percent of NLH's total incremental production costs through the study period. This continued reliance on fuel to generate electricity means unstable and rising electricity rates for business, residential and industrial consumers well into the future – a discernible contrast to the stable rates expected under the Interconnected Island alternative.

The Interconnected Island expansion plan practically eliminates the dependence on fuel and, therefore, also eliminates the effects and risks of fuel costs associated with the Isolated Island alternative. Eliminating dependence on fossil fuel results in power purchase costs from Muskrat Falls which are, stable, and known. The exposure to future regulation of GHG and resulting carbon costs is also eliminated.

The Interconnected Island alternative, development of Muskrat Falls and the Labrador Island-Transmission Link, is the lowest-cost solution to meet the long-term electricity needs for consumers and provide power to meet future industrial growth in the province; particularly for the future mining development projects being discussed for Labrador.

## 5.0 Fuel Forecasts

To project the future oil costs associated with both the Isolated Island and Interconnected Island alternative, Nalcor utilized the services of PIRA Energy Group of New York (PIRA), a reputable international supplier of energy market analysis and forecasts, particularly in oil market intelligence. PIRA has over 500 clients worldwide, including the majority of the world's largest oil and gas and petroleum refining companies, the largest US gas and electric utilities, the largest power and gas marketers, and the largest commercial banks. In Newfoundland and Labrador, PIRA has been the source for oil market analysis and pricing in all regulatory matters before the Board since the late 1990s.

While fuel cost is a factor in the CPW of both alternatives, fuel price forecasting is a more significant factor for the Isolated Island alternative as approximately 70 percent of the cost is fuel. Fuel costs account for less than one percent of the costs after Muskrat Falls begins operation in 2017 in the Interconnected Island alternative.

Nalcor submits that the fuel price forecast used in its DG2 analysis was well grounded and realistic. MHI concluded there remains significant uncertainly in fuel price forecasts, and while global disruptions could drive the price of oil well above inflation, new sources of supply may minimize fuel price increases. MHI went on to conclude that if fuel prices drop by 44 percent of those used by Nalcor, there is no difference between the two cumulative present worth analysis, and if they rise more than the reference price, an even greater CPW preference for the Interconnected Island would occur.[17] From the consumers perspective, the price volatility of oil poses a significant risk to consumer electricity rates in the Isolated Island alternative.

### 5.1 Price Forecasts

During this review PIRA's oil price projections have been compared to oil price projections completed by both the National Energy Board (NEB) and the Energy Information

[17] MHI Vol.1, p. 15.

Administration (EIA). This analysis revealed that PIRA's price projections were similar to the both the NEB and EIA's projections.[18]

Notwithstanding the difficulty of global energy market analysis and long-term price forecasting, thermal fuel prices have to enter the production costing analysis of *Strategist®*. Nalcor's use of the independent professional services from PIRA is a reasonable approach. In addition, Nalcor utilizes PIRA's extended services to test the sensitivity of its CPW analysis for alternative energy market futures with both low and high reference oil prices. While Nalcor has notionally projected fuel oil prices to 2067, the underlying prices in real or constant dollar terms have been fixed at the end of the PIRA analysis horizon of 2025, and thereafter escalated at the general inflation rate of two percent annually. In addition, the effect of Nalcor's use of a discounted present value analysis is to place less weight on future values in the longer analysis period due to uncertainty.

During the public presentations before the Board, it was suggested that PIRA did not incorporate the effects of shale oil in its forecast.[19] In its latest forecasts, PIRA recognizes that shale oil liquids will be an important growing source of non-OPEC crude. However, PIRA states that shale oil liquids will primarily offset the decline in other non-OPEC fields and will not result in enough global volume to be a "game changer" for the global crude market.[20]

## 5.2 Risks Associated with Continued Thermal Generation

Under the Isolated Island alternative, fossil fuels account for a significant portion of the CPW for NLH incremental utility costs across the planning period.[21] The exposure to thermal fuel costs is compounded by increasing supply volumes and increasing prices for the Isolated Island. In addition, any future measures by governments to address GHG emissions exposes consumers under the Isolated Island alternative to potential carbon costs associated with

[18] CA/KPL-53 and CE-69. Nalcor notes that in the February 20, 2012 Transcript at page 2, lines 18-22, Mr. Cabot Martin incorrectly imputed a constant dollar crude oil underlying Nalcor's reference fuel oil projections in Exhibit 4. The correct 2008$ constant value for PIRA Energy WTI crude oil would have been $105-$110 per barrel.

[19] Transcript - February 20, p. 16, lines 21 to 23.

[20] CE-60.

[21] Nalcor Vol 1, p. 108

thermal based energy production. Indeed there exists a possibility in the worst case circumstance, there could be a requirement to close thermal plants. [22]

Nalcor recognizes that future oil markets are uncertain. This uncertainty, which has been a cost characteristic of the Isolated Island grid for many years, continues to be the principle driver of electricity prices under the Isolated Island alternative. The probability of a low price future is seen as equally plausible as a high price future. [23] Therefore, the use of a reference forecast from PIRA is reasonable.

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[22] Exhibit 101, pp. 55-57 and 65-66. See also MHI Vol 2, p. 209.
[23] MHI Vol 2, p. 205. See also MHI-130.

# 6.0 Cumulative Present Worth

Cumulative present worth refers to the present value of all incremental utility capital and operating costs incurred to meet a specified load forecast in a manner that complies with a prescribed set of reliability criteria. The CPW analysis completed by Nalcor, and validated by MHI, demonstrated an economic preference of $2,158 million (2010$) for the Interconnected Island alternative over the Isolated Island alternative. Sensitivity analyses completed by MHI, Navigant and Nalcor demonstrated that the CPW preference for the Interconnected Island alternative is robust. MHI's review concluded: "The detailed analysis performed by MHI determined that Nalcor's cumulative present worth analysis was completed using recognized best practices and the cumulative present worth of each option was correct based on the inputs used by Nalcor."[24]

## 6.1 CPW Calculations

Generation expansion planning and analysis provides the incremental production costing for all the operational and capital expenses necessary for NLH to meet the province's power and energy requirements over time. For each year of the extended planning period, *Strategist®* calculates NLH's production expenses given:

- the configuration of thermal and renewable alternative resources at its disposal (in economic order);
- power purchases from third parties;
- annual capital-related expenses as new plants come on line; and
- operating and maintenance costs.

An alternative long-term supply future that has a lower CPW than another supply alternative will be a utility's preferred investment strategy where all other constraints, such as access to capital, are satisfied. The selection of an alternative investment path with a lower CPW is consistent with the objective of providing least-cost power to electricity consumers because it results in an overall lower regulated revenue requirement from customers.

[24] MHI Vol 1, p. 15.

*Strategist®* calculates annual production and capital-related cost estimates in nominal Canadian dollars for each year of the long-term planning period. Consistent with a discounted cash flow analysis, the CPW analysis likewise requires the selection of a discount rate to account for the time value of money. Nalcor sets the discount rate to match NLH's regulated average long run weighted cost of capital, which for the 2010 generation expansion analysis being reported herein, was eight percent.[25]

On February 20, a presenter suggested there is a bias against the Isolated Island alternative with the addition of a considerable number of thermal units post-2041.[26] However, of the 12 thermal units added in the generation expansion plan post-2041 under the Isolated Island alternative, eight units (four base load and four peaking units), are included to replace thermal units at the end of their service lives.[27] By contrast, the island electricity system is not energy constrained under the Interconnected Island alternative by virtue of the island's continual access to power from the Muskrat Falls generation facility. The addition of six peaking units at regular intervals between 2046 and 2066 under the Interconnected Island alternative are solely to maintain NLH's reliability capacity criterion for the island grid.[28] The thermal unit additions factored into the CPW analysis under both the Isolated Island and Interconnected Island alternatives are the correct expansion plans taking into account load, reliability criteria and services lives of equipment.

On February 21, a presenter outlined an incorrect subtraction of future values from a present value.[29] Nalcor's CPW metric for the generation expansion alternatives is, mathematically, a discounted present value measure. CPW is not reported as the cumulative total of the future nominal or current dollars of the day and the CPW metric is not a nominal dollar future "project budget". However, the individual capital costs for thermal plant additions in any given year for both generation expansion alternatives are in future nominal or current dollars of the day before discounting through the CPW analysis. Accordingly, it is

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[25] Nalcor Vol 1, pp. 34-35.
[26] Transcript - February 20, 2012, p. 61, lines 1-11.
[27] Nalcor Vol 1, p. 106.
[28] Nalcor Vol 1, p. 117.
[29] Transcript - February 21, 2012, p. 7, lines 1-3 and page 8, lines 1-7.

mathematically incorrect to subtract a future nominal dollar cost from a cumulative present value and doing so results in incorrect conclusions regarding the economic preference of an Isolated Island alternative over an Interconnected Island alternative.

During the public presentations, such calculations were used to produce a perceived cost benefit in waiting until 2041 to construct the Labrador-Island Link to coincide with the return of Churchill Falls power. A correct analysis, completed with Nalcor's assumptions used in MHI Nalcor 3, confirms a continued $1,283 million preference for the Interconnected Island alternative.

## 6.2 CPW Preference for the Interconnected Island Alternative

The CPW for the Isolated Island alternative, at $8,810 million, compared against the CPW for the Interconnected Island alternative, at $6,652 million, yields an economic preference for the Interconnected Island alternative of $2,158 million (2010$). The change in cost structure, from a progressive dependence on internationally controlled thermal fuels to one investing in domestic and indigenous renewable infrastructure, is achieved with the Interconnected Island alternative and at a lower long-run cost for consumers.[30]

## 6.3 Sensitivity Analyses

Nalcor has undertaken sensitivity analyses to stress test the preferred alternative. Under a wide range of sensitivities relating to load, oil prices, CDM and capital costs, the reference CPW results are robust.

For the Interconnected Island alternative not to be preferred to the Isolated Island alternative, oil prices would have to be 44 percent below reference projections on a sustained basis[31] which is slightly less than PIRA's low oil price future.[32] Nalcor used PIRA's

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[30] Nalcor Vol 1, p. 124.
[31] MHI-41 Rev.1
[32] MHI-41 Rev.1. To illustrate the price ranges for these price scenarios, the average price for NLH's 0.7% heavy fuel oil for the period 2010 to 2017, as of January 2010, is $99 /BBL CDN. By contrast, the low price forecast for the same period is $52 /BBL, while the high price forecast is $156 /BBL.

reference price forecast which is "not just one of many plausible scenarios but one that (PIRA) put(s) forward as a most likely basis for decision making."[33]

At DG2, assuming all other inputs remain equal, the CPW analysis for the PIRA high projections would be $5,474 million preference for the Interconnected Island alternative and $120 million preference for the Interconnected Island alternative in the PIRA low scenario.

Even if fuel prices are at PIRA low, there is still a modest CPW preference for the Interconnected Island alternative. However, if the fuel prices are at the highest forecasted levels, the investment preference for the Interconnected Island alternative increases materially by more than $3,316 million to $5,474 million. Nalcor notes that the probability of prices trending to PIRA low and high is the same.[34]

There are also a number of contingencies not included in Nalcor's DG2 analysis, which would further benefit consumers, such as the Federal Loan Guarantee (CPW preference of $2,758 million) and future carbon pricing on fossil fuels (CPW preference of $2,655 million)[35].

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[33] MHI-131
[34] MHI Vol 2, p. 205 and MHI-130.
[35] Nalcor Vol 1, p. 126.

## 7.0 Revenue Requirement

NLH calculates its total revenue requirement in any given year by building up the costs for existing operating expenses and capital assets, combined with the incremental operating expenses and capital charges for a future long-term generation expansion plan. Through the Revenue Requirement Model (RRM), electricity prices are established to match costs. [36]

There are two models available to determine the price of Muskrat Falls power: Cost of Service (COS) and escalating supply price which during the course of this Review has been generally referred to as the Power Purchase Agreement (PPA). Under COS, ratepayers pay higher rates in the early years based on the undepreciated net book value of the plant. Under the PPA approach, rates remain fixed in constant dollars over the life of the project, escalating at a pre-determined rate approximating inflation. Nalcor recommends the PPA approach, with a proposed constant dollar base price of approximately $76 per megawatt hour (MWh) in 2010$ for Muskrat Falls power and escalation at two percent annually as providing the best scenario for electricity consumers.

In addition to providing consumers with manageable rates for Muskrat Fall's power in the early years of operations, this pricing approach avoids intergenerational inequity by ensuring that all existing and future consumers will pay the same price in constant or real 2010$ over the life of the project.

### 7.1 Forecasting Revenue Requirements

To forecast the annual costs for utility operations, and to assess longer-term electricity rate trends, NLH analyzes its costs for each year of the analysis period to determine the annual revenue requirement. This revenue requirement can be summarized as the collection of the following general cost categories:[37]

- Operating and maintenance expenses

[36] Nalcor Vol 1, pp. 138-139.

[37] While the majority of NLH's costs are related to the Island power grid, it also incurs costs for its customers served from the Labrador power grid and from isolated diesel systems. Regulated costs incurred to serve Labrador grid and diesel system customers have been identified and excluded from this revenue requirement analysis.

- Fuel costs
- Purchase power expenses from third or related parties
- Annual capital charges, comprised of:
    - Depreciation
    - Return on Rate Base, comprised of
        - Interest expenses and
        - Return on equity
- All other miscellaneous net cost items.

NLH's total revenue requirement in any given year of the planning period entails building up the costs for existing operating expenses and capital assets, along with the incremental operating expenses and capital charges for a future long-term generation expansion plan. This is accomplished with the RRM. The RRM shows the annual revenue requirement due from customers where prices are established to match costs.[38]

Combining the total annual revenue requirement due from customers, with total wholesale energy to be delivered as per the 2010 load forecast provides a projection of the overall wholesale rate trends for the electricity supply futures under analysis.[39]

## 7.2 Pricing for Muskrat Falls Power

When reviewing the pricing approach for Muskrat Falls power, Nalcor considered the traditional COS model. This model is a regulatory accounting mechanism for the recovery of a firm's fixed costs through depreciation plus a return-on-rate base. The return-on-rate base recovers annual financing charges on unrecovered capital costs by applying a weighted average cost of capital to the net book value of the assets. Under COS, a regulated utility enjoys its largest returns on equity in the earlier years following the in-service for a capital intensive asset. For the Muskrat Falls investment, this period would coincide with a lower utilization of the asset resulting in unfavourably high unit costs in the early years.

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[38] Nalcor Vol 1, pp. 138-139.
[39] Nalcor Vol 1, pp. 141-142.

For the pricing of Muskrat Falls' power, Nalcor is proposing the PPA pricing framework whereby the price (per unit of energy required by island customers) is established at the outset and escalates at a pre-determined rate approximating inflation. The internal rate of return (IRR) financial analysis approach is used to determine the price at which costs are fully recovered and the defined or targeted return on equity is achieved. So long as the IRR is set at an appropriate value in light of prevailing regulated returns on equity, both the investor and the customer will be indifferent in economic terms to the pricing method over the life of the project.

Nalcor has proposed a constant dollar base price of approximately $76/MWh in 2010$ for Muskrat Falls power, which when escalated at two percent annually and applied against the growing on island requirement for Muskrat Falls energy, provides an 8.4 percent IRR to the shareholder. [40] In addition to providing consumers with stable rates for Muskrat Falls power in the early years of operations, this pricing approach avoids intergenerational inequity by ensuring that all existing and future consumers will pay the same price in constant or real 2010$ over the life of the project.

During the public presentations to the Board, inaccurate statements were made regarding the application of subsidies in Nalcor's proposed pricing approach for Muskrat Falls' power.[41] As noted, the PPA approach in the context of an IRR financial analysis framework, recovers all investment and operating costs and provides the shareholder with positive cash flow every year.[42] There is no subsidy in the early years, there is no forgone income and there is no surcharge in later years. Beyond 2067, pricing will be a policy decision for the government at that time.

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[40] CA/KPL-Nalcor-278 Nalcor corrects an error in Philip Raphals table GRK-3 with respect to the purchase price for Muskrat Falls power. See also Transcript-February 23, 2012, page 28 lines 8-12 and lines 18-20 for Philip Raphal's incorrect reference to the power purchase price for Muskrat Falls.

[41] Transcript - February 20, 2012, p 67, lines 21-25, p. 68, lines 1-7, p. 69, lines 4-11.

[42] PUB-60

# 8.0 Decision Gate Process

The decision gate (DG) or staged gate process is an industry-accepted best practice approach for decision-making for major capital projects. Independent reviews, including MHI's, confirmed Nalcor's use of the decision gate process for the Lower Churchill (Muskrat Falls) project as industry best practice and noted that Nalcor's inputs were appropriate.

## 8.1 Process Description

Nalcor uses the decision gate process, which is recognized as a credible and proven process that provides checks and balances decision makers require to demonstrate that an acceptable level of readiness has been achieved to progress the project through a decision gate. Prior to each decision gate, Nalcor engages in a thorough assessment and independent project reviews are completed before a recommendation is made to Nalcor's Board of Directors and Shareholder, the Government of Newfoundland and Labrador, on whether to proceed. There are four gates in the Lower Churchill (Muskrat Falls and Labrador-Island Transmission Link) projects up to, and including first power:

- DG1: Approval to proceed with concept selection
- DG2: Approval of development scenario and to commence detailed design
- DG3: Project sanction
- DG4: Approval to commence first power generation

Nalcor is currently progressing towards DG3 at which time an updated CPW analysis will be completed applying the most current inputs including: oil price forecasts, load forecasts, generation expansion planning data, base capital costs, risks, detailed escalations and contingency, exchange rates and interest rates.

## 8.2 MHI Review of Decision Gate Process

Nalcor's use of the Decision Gate has been independently verified as being an industry best practice by Independent Project Analysis (IPA),[43] the DG2 Independent Project Review team,[44] Navigant Consulting Ltd.[45] and MHI.[46]

MHI conducted a thorough review of the inputs to the DG2 decision regarding the cost estimate, escalation indices and risk analysis processes that Nalcor carried out at DG2. After completing its review, MHI concluded:

- *Cost Estimate Process:* Nalcor has adopted the practices used by the Association of the Advancement of Cost Engineering International (AACEI) Recommended Practice no 17R-97, which is recognized as a leading authority in total cost management.[47]
- *Escalation Indices:* Nalcor's process is very similar to that used by Manitoba Hydro and is a utility best practice.[48]
- *Risk Review*: The available studies have identified technical risks and appropriate risk mitigation strategies.[49]

The MHI review at DG2 validated that Nalcor had applied these processes appropriately to arrive at proper inputs for the CPW analysis.

Nalcor's CPW analysis and all other inputs were also validated by MHI as follows: "… Nalcor's cumulative present worth analysis was completed using best practices and the cumulative present worth for each option was correct based on the inputs used by Nalcor. These inputs were reviewed in the technical and financial analyses conducted by MHI and were generally found to be appropriate."[50]

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43 Exhibit-20.
44 Exhibit-21 and 22.
45 Exhibit-101.
46 MHI Vol., Section 2.2.
47 CE-51 and MHI Vol 1, Section 2.2.
48 MHI Vol 1, Section 2.2.
49 MHI Vol 2, Section 5.7.
50 MHI Vol 1, Section 7.9

Nalcor is using the same validated best practices and processes for DG3 regarding cost estimation, escalation, contingency and risk analysis. The result of the DG3 CPW analysis will determine the least-cost option to meet the generation expansion plan.

## 8.3 Cost Management

Nalcor agrees that potential cost overruns are a risk associated with any capital project and the primary element of the Interconnected Island alternative is the construction of Muskrat Falls with a transmission link to the island. However, while significant, the risk of potential cost overruns can be controlled through a rigorous risk management process that determines and addresses risks that can negatively impact project costs.[51]

Nalcor has implemented a thorough and recognized best-in-class risk management program built upon the lessons learned from other mega-projects in NL and around the world. As a key component of Nalcor's project governance structure, this risk management program allows Nalcor to work with third-party specialist advisors/consultants to identify and manage all project risks. The program affords decision quality assurance through robust risk-based decision-making tactics that assure the predictability of the project's cost outcome by taking action to mitigate risks that can result in potential cost overruns.

At DG3, project definition will be well advanced and the project cost estimate will include firm contract costs from suppliers and contractors. This, in combination with the advanced engineering and field work, favourable site conditions and a clear understanding and respect of the risks that remain will enable accurate project outturn cost predictability. The degree of project definition at DG3 will place the accuracy of the capital cost estimate within the AACEI Class 3 range, closer to the narrower range of accuracy according to that standard.

Potential cost overruns for the Interconnected Island are being actively managed by applying front-end loading and best practices in risk, estimation and project management. External risks from potential increased costs of raw materials, labour and manufactured items are addressed through escalation allowances built into the estimate. As a result of extensive

[51] Nalcor Vol 2, pp. 64-69 and CE 52.

field work carried out at the Muskrat Falls site, at the Strait of Belle Isle and along the transmission routes, site conditions are well understood.

All of this work provides greater predictability on the outturn cost of the project as it results in project risks being quantified, managed and mitigated.

Cost overruns can also occur in the Isolated Island alternative and as noted by MHI, the level of engineering work to date on those smaller capital projects is at a feasibility level and both cost and schedule were optimistic, "…It is expected that resolution of these uncertainties would result in increases, not decreases in the CPW of the three projects."[52] As a result, there is an increased risk that the capital cost estimates included in the Isolated Island alternative's CPW could be in the upper range of accuracy for an AACEI Class 4 estimate. This possibility was recognized by MHI.[53]

While potential cost overruns are a concern in the Isolated Island alternative, the largest cost component of the Isolated Island alternative is fuel. Unlike capital cost risk, Nalcor has no influence on world oil prices and, as such, must rely on reputable and recognized experts in oil price forecasting to inform its CPW analysis and decision making which it has done with its engagement of PIRA. The volatility of fuel costs places significant external uncontrollable risk on the cost of the Isolated Island alternative and therefore, on Island Interconnected electricity consumers. Nalcor previously discussed the impact fuel prices have on the CPW in Section 6 of this submission to the Board.

## 8.4 Risks Management and Mitigation

The Isolated Island and Interconnected Island alternatives have different risk profiles. The Isolated Island faces risks which are primarily external and impossible to control, whereas the Interconnected Island alternative faces primarily internal risks which the proponent, through its practises and processes, can manage, mitigate or otherwise control.

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[52] MHI Vol 1, p. 71.
[53] Transcript - February 15, 2012, p. 166, lines 7-25 and p. 167, lines 1-17.

### 8.4.1 External Risks – Isolated Island Alternative

The Isolated Island alternative, which has a CPW directly and heavily influenced by long-term price projections for oil, is highly susceptible to external risks. Oil price is outside Nalcor's control as it is influenced by global economic and political conditions. The cost predictability of the Isolated Island alternative is, therefore, much less than that of the Interconnected Island alternative.

### 8.4.2 Internal Risks – Interconnected Island Alternative

The risk profile of the Interconnected Island alternative is primarily comprised of internal risks, specifically in definition and performance/execution. The ability to manage, mitigate and control internal risk is a key driver of cost exposure and hence cost predictability. Given the Muskrat Falls and the Labrador Island Link is a capital intensive project in the first few years, the risk exposure window is short (approximately six years)[54] and has an increased predictive accuracy.

Nalcor has directed considerable effort over the past five years on activities that have a direct influence on capital predictability and ensure the company's cost and schedule expectations are realistic and achievable. An extended focus on front-end loading and defining the project during the planning phase (pre-DG3) is also key to addressing potential risks and avoiding cost overruns. The process provides the critical information needed to make decisions towards project sanction (DG3).

Nalcor's efforts have been validated by IPA, who stated in their August 2010 review for DG2: "Project is better prepared than a typical megaproject at end of Front-End Loading (FEL)," and the "Project has clear objectives and a well-developed project team that has closed the project scope and achieved optimal project definition."[55]

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[54] Transcript - February 15, 2012, p. 213, lines 1-5.
[55] Exhibit-20.

### 8.4.3 Mitigating Risks – Interconnected Island

Internal risks for the Interconnected Island alternative are considered controllable due in part to (a) the favourable construction characteristics Muskrat Falls (i.e., geotechnical conditions, physical layout, and constructability), (b) and the level of engineering planned to be completed by DG3, and (c) the extensive front-end loading efforts during the planning period.

Understanding and considering construction cost risk due to cost escalation is a core component of Nalcor's management of the expected outturn cost for the Project. Nalcor has developed a detailed escalation model specifically for the Project that facilitates the estimation of cost escalation due to both changes in the cost of raw materials and the effects of a supply/demand imbalance.

Detailed market supply and demand information for major cost components are gathered in-house from a variety of sources. This information is then combined with base escalation indices produced by Global Insight and Power Advocate, companies that are recognized industry sources for such information. Using all available data, Nalcor is able to produce a well-grounded, well-researched forecast of cost escalation for use in its investment analysis.[56]

Nalcor's project risk management techniques are leading edge. In 2007, Nalcor engaged Westney Consulting Group to assist with the full implementation of a holistic risk management program for the Project. Westney is well known within the capital project industry for their leading-edge ideologies and approaches to addressing risks as a means of improving the predictability of the investment decision. Nalcor has adopted Westney's Risk Resolution® methodology as the backbone of its risk management process for the Project.[57]

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[56] MHI-50, MHI-70, CE-45
[57] CE-52

## 9.0 System Reliability

Safe and reliable power for its customers is of paramount importance to Nalcor and NLH. Nalcor recognizes its customers; residential, commercial and industrial; depend on electricity to efficiently operate their businesses and homes. And, the expectations of today's electricity consumer, with modern infrastructure and the pace of technological adoption, are increasing.

The system must be planned, designed, and operated to ensure reliable performance under all operating conditions. It must recover predictably after system disturbances, and with the implementation of an interconnection, not adversely affect the operation of neighbouring systems.

Nalcor's activities to ensure reliable operation are focussed on the Interconnected Island alternative, as the Isolated Island scenario is in many respects a continuation of the status quo. Specifically, areas of focus include:

1. Consideration of best practices for the Interconnected Island electricity system,
2. Transmission line design criteria and meteorological loading
3. Reliability Studies
4. Implementation of international reliability standards (North American Electric Reliability Corporation (NERC))
5. System Integration Studies

Each of these areas is discussed further in the following sections.

### 9.1 Industry or Utility Best Practise

The operation of the electrical system on the island of Newfoundland offers many unique challenges. The system is isolated from the rest of the North American system and operates in a harsh environment where the system is consistently exposed to extreme conditions such wind, icing and contamination from salt sea spray. With the experience and expertise of its employees, NLH has safely and reliably operated this system for its customers for over 40 years.

The provision of least-cost reliable service has always been, and will continue to be, the mandate of NLH. It must be recognized, however, that 'best practices' have to be considered in the context of the unique factors of the Island's isolated electricity system.

The notion of 'best practices' cannot be separated from economic and physical considerations, and unrestricted application of 'best practices' used elsewhere could lead to the following:

1) Reconstruction of the entire Island 230 kV transmission grid to a 1 in 150 year return period from the existing levels ranging between 1 in 10 years and 1 in 25 years,

2) Continued operation of large amounts of spinning reserve along with construction of substantial inertia on the Island Interconnected system so as to ride through a forced outage without underfrequency load shedding,

3) Construction of new transmission lines to Burgeo, Port aux Basques, Happy Valley Goose Bay, and St. Anthony, among others, so as to eliminate single transmission lines to these communities.

Instead of spending hundreds of millions of dollars to address these issues directly, appropriate solutions to address the underlying concerns at reasonable cost have been implemented to the overall benefit of electricity consumers. This approach has worked to date for the Isolated system, and Nalcor believes the same prudent approach is appropriate for future planning as well.

Should the island become interconnected to the North American grid, its reliability standards and practices will align more closely with North American standards. However, complete adoption of all practices and standards immediately upon interconnection could be cost prohibitive for electricity consumers and technically challenging. As a result of the potential impact, Nalcor is assessing every reliability option and expenditure separately to ensure it provides value to electricity consumers, complies with existing regulations and does not unduly jeopardize the successful integration of interconnections with the North American grid and the prospect of a more secure energy future for next generations. This work will be an important input to DG3.

## 9.2 Transmission Line Design Criteria and Meteorological Loading

CSA Standard C22.3 (No. 1 Overhead Systems and No. 60826 Design Criteria of Overhead Transmission Lines) is used as a suggested guideline for transmission system engineers to follow in the design of overhead transmission lines. The standard addresses specific design aspects, including the application of meteorological loads. The standard provides guidance for minimum design standards, recommends consideration be given to local conditions and operating history, and reminds designers to consider the relative importance of a transmission line.

Nalcor has approached the application of transmission criteria in a manner consistent with the CSA standard and also with its historic approach for planning the Island system.

Eleven different combinations of wind and ice load cases were identified for the Labrador-Island Transmission Link with different wind loads over the three dominant ice loading zones. There has been much discussion regarding the interpretation of this CSA standard and whether the line should be designed to a 50-year return as proposed by Nalcor or the higher 150-year return as recommended by MHI. Nalcor thought it useful to describe its transmission line design process and provide an understanding of how it relates to the return periods discussed in the CSA standard.

Overall, meteorological loading for the transmission systems for the Labrador Island Link:

- are based on significant historical assessment and current modeling using data and information collected over a 50-year time frame;

- include design maximum ice loads that are realistic for the Newfoundland and Labrador environment; yet significantly exceed the loadings published in the CSA standard, usually equating to CSA 500-year loads or more; and
- include design maximum wind loads that meet CSA 50-year wind speeds, and are higher than historical transmission line design levels even though NLH transmission lines have never failed due to extreme wind.

### 9.2.1 Wind Loading

NLH has historically designed most of its transmission lines to a maximum wind load case of 175 kilometres per hour (kph) gust wind speed which corresponds to a sustained wind speed of approximately 100 kph. To date, NLH has not had a structural failure of a transmission line due to the maximum wind load case. The CSA standard provides a map (refer to Figure 1 on the following page) of reference wind speeds for a 50-year return period. These wind speeds range from 100 kph in central Labrador to 130 kph on the Avalon Peninsula. This covers the range of the LCP transmission infrastructure. Based on NLH's operating experience over the past 50 years, and the fact that there have been no failures on the transmission system related to the maximum wind load, NLH considers the 1:50 year wind loads as per CSA standard to be appropriate, and determined that no amplification of these wind loads is required. Therefore, Nalcor has adopted the 50-year CSA wind loads for the design of the Labrador-Island Transmission Link for all but the Alpine region of the Long Range Mountains (LRM).

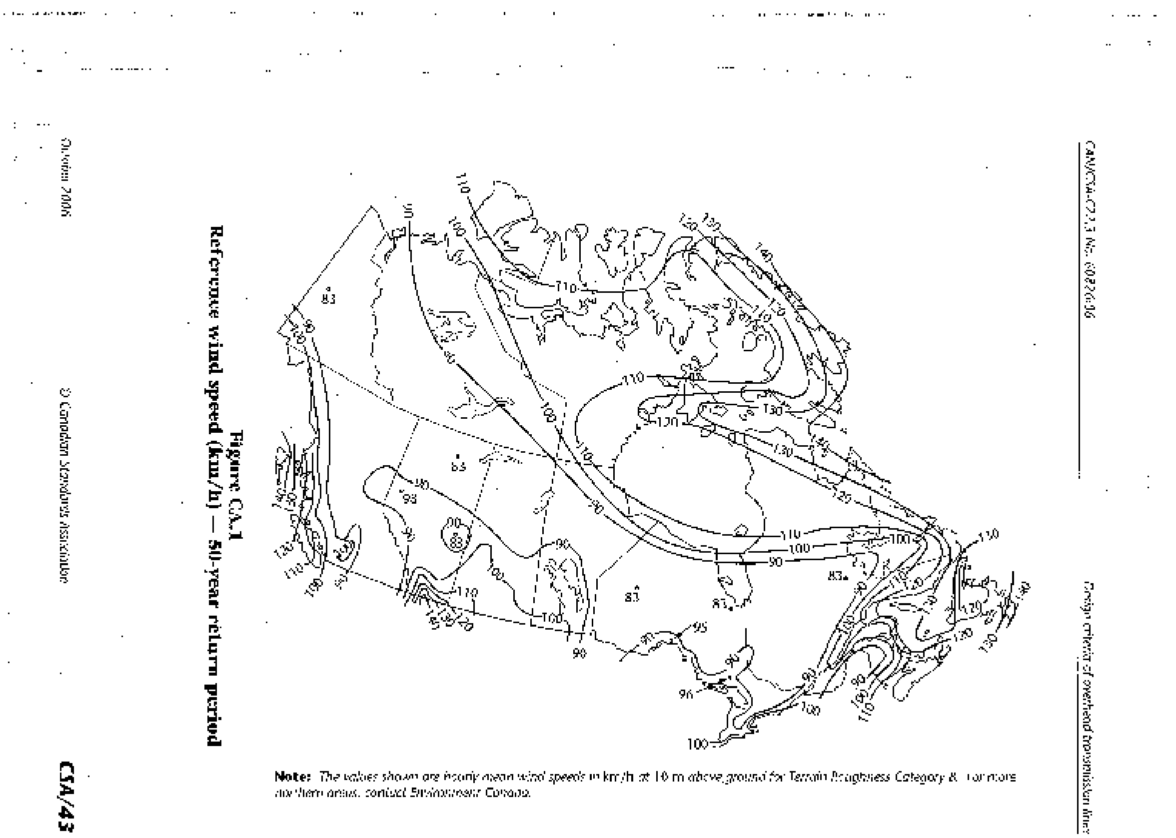


Figure 1 – CSA Reference Wind Speeds

Analysis of wind speeds on the LRM is based on a correlation study between Environment Canada Meteorological Weather Station at Daniel's Harbour on the Northern Peninsula and a wind speed monitor installed in the LRM. This analysis resulted in a reference wind speed of 180 kph, much higher than any wind load in the province but considered realistic for this area. Given the knowledge that topographical features amplify the wind speed profile in the LRM, Nalcor has selected this reference wind speed of 180 kph as the 1:50 year design wind speed as opposed to the 120 kph wind speed specified in the CSA standard. Nalcor also applied the 180 kph reference wind speed to the other Alpine regions (highlands of St. John and Labrador coast) along the transmission line. The selection of this elevated reference wind is considered appropriate for those areas.

### 9.2.2 Ice Loading

Through decades of experience operating transmission infrastructure in harsh environments, NLH has gained considerable knowledge of the necessary design criteria for its electricity infrastructure. NLH has designed transmission lines in recent years to ice loads higher than those published in the CSA Standard.

CSA C22.3 Figure CA.2 (refer to Figure 2 on the following page) provides reference icing amounts for a 50-year return period. These values range from 15 millimetres (mm) of radial glaze ice (ice thickness measured from the conductor surface) in central Labrador up to a maximum of 40 mm on the Avalon Peninsula. CSA recommends a factor of 1.5 times the reference amount to account for the spatial nature of transmission systems, and the elevation correction for conductors which are assumed to be 20 m higher than the reference level of 10 m above ground. This would equate to 50-year design loads from 23 mm to 60 mm across the transmission system. CSA also recommends that spatial factors less than 1.5 may be substantiated by local data and experience.

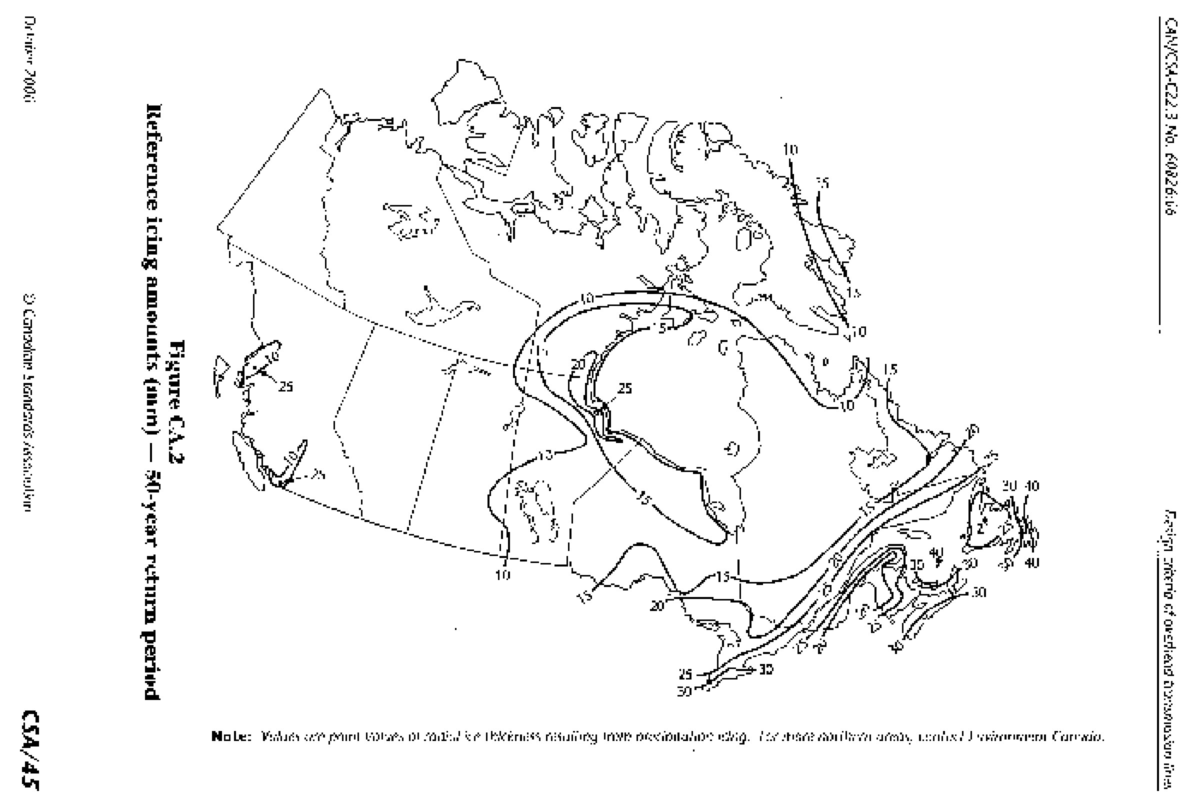


Figure 2 – CSA Reference Ice Amounts

In the case of Newfoundland and Labrador, Nalcor has determined that the design ice loads should be higher than those published in the CSA Standard based on a substantial amount of historical data[58].

Studies completed by Meteorology Research Inc. (MRI), Teshmont and RSW for the complete Labrador-Island Transmission Link produced loads of up to 100 mm of radial glaze ice. These loads are significantly higher than the CSA loads and there is very little evidence of loads coming close to this level in the history of transmission lines in the province. A study

58 Exhibit-71to Exhibit-96.

completed by Kathy Jones for the entire Labrador-Island Transmission Link route, produced loads that were significantly lower than the CSA Standard loads, loads which have been experienced relatively frequently in the province[59].

The discrepancy in findings between the various studies led to a dilemma as to what loads should be used consistently in the design criteria. While the MRI and Teshmont studies produced up to 100 mm of radial glaze ice, recent meteorological load studies in the NLH electricity system have produced load cases of 75 mm of radial glaze ice on the Avalon[60], and 50 mm of radial glaze ice for the Granite Canal line. Both locations are based on an extreme value analysis using 40 years of data and the analyses resulted in what was calculated statistically to be 1:50 year return period load cases.

The alpine regions are areas above 350 m elevation that experience significant levels of rime (in-cloud) ice. Although Rime ice can occur at any level, rime ice load cases exceed the glaze ice load cases in alpine areas. Because of this, rime ice load cases are used for line design in alpine regions. Because the CSA standard does not cover this type of ice, an intense meteorological study including atmospheric modeling and correlation with test spans on the LRM was performed using international experts in rime ice formation on transmission lines. As a result of this study, Nalcor selected a maximum ice load case of up to 135 mm of radial rime ice for design in all alpine zones.

### 9.2.3 CSA Amplification Factors for 150 and 500-year Return Periods

The CSA standard provides modification factors to increase the 1:50 year loads to various load cases, including 1:150 years and 1:500 years. In terms of radial glaze, 50-year loads are increased to 150-year loads by a factor of 1.15, and 50-year loads are increased to 500-year loads by a factor of 1.30.

According to the CSA standard, the Labrador-Island Transmission Link areas corresponding to the "average regions" should have 50-year loads ranging between 23 to 38 mm, and 500-

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[59] Exhibit-96.
[60] Exhibit-85.

year loads ranging between 33 and 49 mm. Notwithstanding the standard, Nalcor has established a design load of 50 mm radial ice loading in average regions.

The CSA standard corresponding to the zone identified as the Labrador-Island Transmission Link Eastern region has suggested loads of 60 mm for 50-year loads to 78 mm for 500-year. Nalcor's analysis has led it to established a design load of 75 mm in the Eastern region.

In summary, the design ice loading for the Labrador-Island Transmission Link approximate or exceed the CSA recommended 500-year maximum ice loads.

Nalcor believes that the selection of these higher ice loads is appropriate based on NLH's operating experience over the last 50 years.

In summary, Nalcor has developed maximum design loads through analysis of extensive operating experience, meteorological data and extreme value analyses that have been carried out over the last 40 years. Given the importance of the line, Nalcor has undertaken extensive studies of conditions in the areas where the line is expected to be exposed to particularly harsh or extreme conditions and the analysis has led to the selection of a balanced load case set that optimizes structural design, and maintains system reliability.

The chosen Labrador-Island Transmission Line design provides an adequate level of reliability and an increase in the design standard will not significantly improve customer reliability. As Nalcor stated during the Board public hearings, should a higher level of customer reliability be deemed necessary by the Board, Nalcor believes that the increased reliability can be best achieved through the addition of combustion turbines on the island as opposed to an increase in line design.

### 9.3 Reliability Studies

The MHI review is intended to assess Nalcor's analysis comparing two supply options for the island of Newfoundland: 1) a continued Isolated Island alternative and 2) an Interconnected Island alternative involving the construction of the 824 MW Muskrat Falls hydroelectric development in Labrador and an 1100 km HVdc interconnection with the island. MHI raised some concerns with certain aspects of the methodology used by Nalcor in assessing the comparable reliability of the two alternatives. These aspects include the treatment of transmission assets.

MHI maintains that while Nalcor has completed a probabilistic analysis to ensure that both generation expansion alternatives meet the reliability criteria, it is not possible to assess the relative overall reliability of the alternatives without completing a similar probabilistic analysis incorporating the transmission system effects. Nalcor's assessment determined that when the transmission systems for the two alternatives are examined, the only difference in the systems is the 1100 km HVdc link between Muskrat Falls and Soldier's Pond. The remaining transmission elements are identical. As all of the remaining transmission elements would be common to both alternatives, Nalcor's opinion is that a probabilistic analysis of those elements is not necessary to compare the overall reliability of the alternatives.

Nalcor's probabilistic generation adequacy analysis does include a probabilistic analysis for the Labrador-Island Transmission Link including the effects of converter equipment, submarine cables and overhead transmission lines. As a result, a comparison of the annual Loss of Load Hours (LOLH) for the Isolated Island and Interconnected Island alternatives is a measure of the relative reliability of the alternatives. Nalcor acknowledges that the model for the transmission link used for DG2 is dated and may not be completely representative of the current scheme. Nalcor will be developing a new model and redoing the analysis prior to DG3.

The deterministic reliability analysis that Nalcor discusses in Exhibit 106 is not intended to take the place of a more detailed probabilistic analysis. Rather, the analysis intended to demonstrate the extent of customer impact should a failure occur at the worst possible time. The probabilistic generation adequacy analysis that includes a model for the Labrador-Island Transmission Link demonstrates that "probabilistically" the Interconnected Island alternative as proposed meets Nalcor's reliability criteria by maintaining an LOLH of less than 2.8 hours.

Nalcor is aware that many jurisdictions do utilize probabilistic reliability assessment methods that include transmission in their decision making process. However, Nalcor has not yet adopted this practice because it has concerns with the appropriateness of the this type of analysis and believes that an analysis could produce misleading results for the isolated alternative that could misinform the decision making process.

A two-week outage over a 50 year period would still result in 99.9 percent availability. Such a high performance level does not adequately communicate the impact of a two week outage if it occurs during a peak period. A deterministic approach is required to assess the consequences during worst-case conditions and structure an appropriate remedy.

Nalcor will continue to assess a probabilistic methodology and its impacts on the current planning criteria but believes the probabilistic analysis incorporating the generation and the HVdc link is appropriate to compare the reliability of the two alternatives and properly inform the decision making process. Should the island system become interconnected to the North American grid these types of studies will become a normal part of the planning process and Nalcor will transition to a transmission planning criteria comparable to that used in other interconnected jurisdictions.

## 9.4 NERC Reliability Standards

Nalcor is in the process of completing a self-assessment to determine the implications of the adoption of NERC standards. As noted by MHI, eight of Canada's 10 provinces have adopted NERC standards. As outlined in the summary of provincial models below, there is flexibility in how jurisdictions implement these standards. In considering the adoption of NERC standards, it is Nalcor's intent to exercise flexibility and maintain a balanced approach that 1) pays due consideration to cost and the impact on customers and 2) takes into consideration the unique characteristics of the Island Interconnected system.

Summary of NERC Reliability Standards in Canada:

| Province | Key Summary Points |
| --- | --- |

| Province | Key Summary Points |
|---|---|
| British Columbia | • 103 of 120 Reliability Standards adopted and are mandatory. These are NERC standards with some parts not adopted (i.e. compliance section)<br>• Utilities Commission (BCUC) has exclusive jurisdiction to determine whether a Reliability Standard should be adopted in BC<br>• Compliance Monitoring and Enforcement being administered by the Western Electricity Coordinating Council (WECC) |
| Alberta | • 69 standards have been evaluated and 41 have been approved and are in effect. Standards can (and have) been amended to reflect Alberta system<br>• NERC reliability standards apply to the extent they are adopted by the Alberta Electric System Operator (AESO) and then approved or rejected by the Alberta Utilities Commission (AUC) as recommended by the AESO<br>• There is a compliance monitoring program. Monitored by WECC |
| Manitoba | • Manitoba Hydro (MH) is currently required to comply with all NERC Reliability Standards through its membership in the Midwest Reliability Organization (MRO) and its membership in NERC, subject to exceptions based on provincial law<br>• NERC Reliability Standards are not binding on MH to the extent suspended, disallowed or remanded by the Lieutenant Governor in Council. Currently, all NERC Reliability Standards apply to MH<br>• An interim Compliance Enforcement and Monitoring agreement is in place in which the PUB (Manitoba) would be responsible for compliance |
| Saskatchewan | • Standards apply to SaskPower. Approach is to utilize the current Power Corporation Act's unambiguous Authorities to set and enforce Reliability Standards for the electric system<br>• Typically, all NERC approved Reliability Standards shall be viewed as being automatically adopted in Saskatchewan<br>• NERC and MRO used in an audit role for compliance monitoring |
| Ontario | • Compliance with the market rules (and thus with NERC Reliability Standards) is a condition of license from the Ontario Energy Board (OEB) for each market participant and the Independent Electricity System Operator (IESO). All NERC Reliability Standards therefore have effect in Ontario under the market rules<br>• The OEB can initiate a review, remand, and revoke the application of NERC Reliability Standards<br>• The IESO is the sole Ontario entity accountable to NERC for compliance |
| Quebec | • Regie (Utilities Board) has clear authority for mandatory Reliability Standards and for their enforcement<br>• HQT must file with the Regie the Reliability Standards that are considered required for their adoption<br>• 95 Standards (NERC) were filed with the Regie for adoption |

| Province | Key Summary Points |
|---|---|
| New Brunswick | • NERC Reliability Standards are currently adopted in the wholesale market rules administered by the New Brunswick System Operator (NBSO)<br>• All NERC Standards are mandatory and enforceable. Standards are filed with the Energy and Utilities Board (EUB) for approval and are not able to be modified<br>• NBSO is the sole New Brunswick entity accountable to NERC for compliance |
| Nova Scotia | • All NERC standards are adopted and are mandatory and enforceable<br>• Nova Scotia Power (NSPI) completes a review of standards and submits to the Utility and Review Board (UARB) for approval<br>• Registered entities are subject to NERC's compliance monitoring and enforcement program |

## 9.5 AC Integration Studies

In the absence of a complete AC integration study MHI maintains that it did not have enough information to determine whether Nalcor's DG2 assumptions regarding AC integration were valid. Nalcor has confidence in its assumptions and determined there was enough data presented to validate the assumptions.

The most significant difference between the DG2 scenario and scenarios studied in 1998, 2008 and 2010 is the Labrador generating source. The previous studies considered the 2250 MW Gull Island development connected to Churchill Falls via 735 kilovolt (kV) transmission lines and to Soldier's Pond on the island of Newfoundland via an 800 MW HVdc link. The current scheme involves the smaller 824 MW Muskrat Falls facility connected to Churchill Falls via two 315 kV transmission lines and to Soldier's Pond on the Island via a 900 MW HVdc link.

Nalcor did a considerable amount of preliminary integration analysis to assess the current project configuration. This analysis addressed the AC Integration of Muskrat Falls into the Labrador system and determined the required transmission voltage and number of transmission lines between Muskrat Falls and Churchill Falls to comply with Nalcor's

Transmission Planning Criteria.[61] Included in this analysis is the operating philosophy of Muskrat Falls and Churchill Falls, the Water Management Agreement and how collectively these support the HVdc line to the island.

The preliminary integration work shows that Muskrat Falls will be an integral part of the Labrador system and that Churchill Falls with the redundant 315 KV transmission interconnection and the flexibility of the Water Management Agreement will provide support and backup for Muskrat Falls and HVdc interconnection to the island. It is because of the dominance of Churchill Falls that Nalcor is confident that the Labrador system's performance with Muskrat Falls (including the HVdc link) will be very similar to the system performance assessed for the for the Gull Island scenario and new system integration studies will not identify any material changes to the interconnection requirements for Labrador as recommended at DG2.

MHI's opinion is that the current HVdc interconnection to the island is significantly different than previous arrangements and this could result in a requirement for additional island upgrades. The system upgrades included in the DG2 basis of design are those identified in Exhibit CE10: Lower Churchill Project DC1210 HVdc Sensitivity Studies – July 2010. Nalcor's opinion is that the system upgrades used at DG2 are very representative of what will be required. This opinion is supported by the documentation reviewed by MHI.[62]

Exhibits CE03/CE04 of the Lower Churchill Project DC1020 HVdc System Integration Study Volumes 1 and 2 are the most recent full system integration studies. These studies, which were completed in 2008 were based on a three terminal arrangement with 1600 MW leaving Labrador and 800 MW going to a converter in Soldier's Pond and a second 800 MW to a converter in Salisbury, New Brunswick. The island system configuration was also considerably different as there had been an assumed new oil refinery in the Come by Chance area with a 175 MW capacity requirement. The island upgrades identified in Exhibits

[61] Exhibit 59 "Preliminary Transmission System Analysis Muskrat Falls to Churchill Falls Transmission Voltage"
[62] Exhibit 23
Exhibit CE-31 Rev 1: Gull Island to Soldiers Pond HVdc Interconnection dc System Studies –December 1998
Exhibit CE03/CE04: Lower Churchill Project DC1020 HVdc System Integration Study Volumes 1 and 2 – May 2008
Exhibit CE10: Lower Churchill Project DC1210 HVdc Sensitivity Studies – July 2010

CE03/CE04 were substantial. Shortly after the completion of the 2008 studies it became apparent that the new oil refinery load at Come by Chance would not be materializing. At the same time, Nalcor was also reconsidering the merits of mitigating the impacts of the low probability three-phase fault at Bay d'Espoir. Nalcor completed a preliminary analysis based on the new assumptions a summary of which is included in an interoffice memorandum included in Attachment 2 of Undertaking # 9. [63] The analysis revisited all contingencies from the previous study and the results identified a significant reduction in the extent of required upgrades. Subsequent to this, Hatch was commissioned to complete further integration studies[64] to investigate the new assumptions and refine the required upgrades to what is currently being carried in the DG2 design.

The question still remains whether the scheme studied in Exhibits CE03, CE04 and CE 10 is representative of DG2 because of the difference in the multi-terminal and larger sending end arrangement. Nalcor maintains that the island integration requirements are insensitive to the sending end differences and this can be supported by reviewing the results of Exhibits CE10 and CE31. Exhibit CE 31 is based on the 1998 studies of an 800 MW point-to-point HVdc system from Gull Island to Soldier's Pond a configuration very similar to the current arrangement with the exception of generation source, (Gull Island versus Muskrat Falls) the impact of which has been addressed above. The Island systems studied in CE10 and CE31 are very similar and the resulting island upgrades identified in the two studies are very similar. This consistency between required upgrades supports Nalcor's view that the island upgrades are more reliant on the island system arrangements and are relatively insensitive to the sending end system configuration.

Based on the above analysis, Nalcor believes that its decisions and assumptions regarding System Integration at DG2 were reasonable and is confident the new system integration studies currently being completed will validate those decisions and assumptions.

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[63] Undertaking U-9, Attachment 2
[64] Lower Churchill Project DC1210 HVdc Sensitivity Studies – July 2010 Exhibit CE10

In summary, regarding system reliability, Nalcor has focused on ensuring that system reliability is maintained at no less than the level customers receive today and has incorporated detailed design standards in its analysis and planning. The company also recognizes the interconnection via the Maritime Link will provide additional reliability benefits to consumers. Nalcor is also intent that consumers will not be penalized with additional costs for reliability measures which may not be required and may not provide additional benefit to electricity consumers. Nalcor has been both prudent and thorough in its approach to system reliability, however, the company will continue to test and evolve its practises as required to inform its decision making.

## 10 Strategic Benefits of Interconnection and the Muskrat Falls Development

NLH has the responsibility to assess and recommend supply options to meet the province's growing energy needs. This is a function the company has been performing since its inception in the 1970s and its predecessors before it. In 2010, NLH determined new generation would be required to meet a capacity shortfall in 2015 and an energy shortfall in 2021.

The company examined a broad selection of alternatives and determined an interconnection to Labrador via an HVdc link bringing power from the Muskrat Falls Generating Station was the least-cost option for electricity consumers. This alternative was compared against an optimized Isolated Island scenario, which represented the least-cost alternative to provide power to the island without an interconnection. There is a significant cost benefit to consumers through the life of this project and indeed, a benefit to all citizens of this province from this investment. Based on the analysis at DG2, continuing with the Isolated Island alternative represents lost value to electricity consumers of $2.2 billion in 2010 dollars, or 32 percent greater costs than the Interconnected Island alternative. A full analysis must be conducted with the benefits as well as the risks and Nalcor's approach to the development has been fulsome and thorough with a prudent view to risk mitigation and management in both scenarios.

The question, when reduced to its fundamentals, is whether to continue with a thermal or oil-based generation future with no interconnection to Labrador and North America, or to switch to a stable, reliable hydro generation with an interconnection. The Interconnected Island alternative with Muskrat Falls means Nalcor invests capital up front but consumers pay less over the long-term than the Isolated Island alternative and have predictable, lower-cost rates into perpetuity.

Muskrat Falls, while an intensive capital project, is well known and extensively studied. Nalcor has invested in the best processes, practices and people to manage and mitigate risks to consumers. What the company cannot manage, however, is the risk of volatile and rising oil and gas prices. From 2000 to 2011, the price of oil has risen by almost 200 percent, from

$31 per barrel to $92 per barrel. Projections estimate that in 2033, as the Holyrood plant reaches the end of its life in the Isolated Island alternative, the price of oil will be $157 per barrel, a 70 percent increase from 2011. At that time, island consumers will be using about 3.8 million barrels of oil at an annual cost of approximately $600 million.

### 10.1 Long-term Benefits of Hydroelectric Projects

The Muskrat Falls Project and Labrador-Island Transmission Link will be developed and operated in an economically viable and socially responsible manner. The Project represents a strong sustainable development for this province. Hydro projects have a long-term viability with low operating and maintenance costs that will benefit consumers across many generations. A practical example of this from Newfoundland and Labrador's history is the development of the 640 MW Bay d'Espoir project in the 1960s. The investment in those generation facilities resulted in a strong hydro generation fleet that anchored the province's electricity rates to the fourth lowest in the country generally, behind British Columbia (95 percent hydro supplied), Manitoba (98 percent hydro supplied) and Quebec (98 percent hydro supplied). With Muskrat Falls, electricity generation in Newfoundland and Labrador will be 98 percent renewable. Electricity consumers will benefit from the rate stability and predictability that hydropower has brought to these other Canadian provinces.

Unlike thermal generation, domestic hydropower is a secure source of electricity using water flowing from provincial rivers and is not subject to the control of foreign interests and external oil companies, leading to energy independence and security. With Muskrat Falls, Nalcor will be investing in a stable source of energy and also providing a revenue stream from surplus energy and facilitating the development of additional renewable and clean developments.

### 10.2 Right Time for Muskrat Falls Development

At this time, leading up to DG3, Nalcor continues to support and recommend the development of Muskrat Falls with a link to the Island as the preferred and least-cost alternative for electricity consumers. Many conditions have emerged to make this the "right time" and Nalcor is focused on making the right decision at DG3 for both electricity consumers and citizens:

- Oil prices continue to trend at an all-time high and are forecasted to climb.
- Interest rates are low, making financing attractive.
- Through commitment to a federal loan guarantee for the Interconnected Island alternative, the federal government is supporting the development of clean, renewable energy that serves both regional and national interests.
- The Innu Nation has ratified the New Dawn Agreement.
- A Water Management Agreement has been finalized between CF(L)Co and Nalcor, facilitating the operation and management of both facilities.
- The Government of Newfoundland and Labrador, Nalcor's Shareholder, is in a strong fiscal position. Over the past five years three additional oil developments have commenced bringing an incremental $38 billion in nominal value to the province over the next 29 years. The government committed in its Energy Plan to invest non-renewable revenues into renewable investments such as the lower Churchill developments.

There will be significant economic benefit from the Muskrat Falls development in labour, business income and taxation during construction. This was not considered in the economic analysis used to determine the least-cost energy option but is a benefit to the Newfoundland and Labrador economy, its businesses and citizens.

The benefits of interconnection to the Maritimes are also significant. Interconnection will provide markets for surplus energy from Muskrat Falls and other renewable developments across the province, providing benefits to labour, business, government and all citizens. Interconnection will also provide a high degree of reliability with the current configuration and also open up two access routes for export sales. The two access routes provide Nalcor with access to a diverse set of markets, including Nova Scotia, New Brunswick, New England, Quebec, Ontario and New York.

Nalcor notes that while monetization of surplus energy from Muskrat Falls is beyond the Terms of Reference for this proceeding, access to multiple markets with sales opportunities across those markets is an undeniable advantage of the Interconnected Island alternative.

The public dialogue and discussion, both inside and outside the regulatory process, is valuable to Nalcor, to its Shareholder, the Government of Newfoundland and Labrador and to consumers and citizens. Since 2007, Nalcor has conducted over 50 open houses and community sessions across the province. The company had fielded thousands of questions via regulatory processes, from interested parties by email, phone and in-person, and through various media outlets in Newfoundland and Labrador and across Canada. Nalcor appreciates and respects the complexity of the project and values the discussion and dialogue as people seek to understand the benefits of the development of Muskrat Falls.

In summary, Nalcor is a performance-driven company created to support the development of Newfoundland and Labrador's energy resources for the benefit of its people. The company has a robust planning and performance focused culture from the Board of Directors to the front lines and has brought together a team of world-class professionals to execute this project in the best manner possible and subject it to the high level of rigour for any investment of this magnitude. Nalcor maintains confidence in its decision to recommend the Interconnected Island alternative to its Shareholder at DG2, as the lowest-cost alternative for electricity consumers in this province.