3 Technical Reviews – Supporting Studies

3.1 Load Forecast

MHI reviewed Nalcor's load forecast to determine if it was conducted with due diligence, skill, and care consistent with acceptable utility practices. The load forecast predicts future electrical energy (GWh) and demand (MW) requirements, and is a critical factor in developing and evaluating future generation options. MHI completed a comprehensive analysis of NLH's load forecasting methods, data sources, and data analysis techniques drawing on material provided by Nalcor through on-site meetings and in responses to several RFIs, particularly MHI-Nalcor-55, 56, and 90 to 93.

The load forecast analysis considered the total electrical energy and demand requirements of the island of Newfoundland, excluding Labrador's requirements, focused on the period of 2010 – 2029. For analytical purposes, the 2010 forecast year was replaced with weather-adjusted actual figures so as to be representative of normal weather. To support the CPW analysis, the load forecast was extrapolated over an extended period (2029-2067). Results of the extrapolated forecast are reviewed only in the total island energy requirements and interconnected island system peak. The load forecasting process was evaluated using criteria that examined the reasonableness of the methodologies and assumptions used to prepare the 2010 Planning Load Forecast. Past forecast performance was measured by examining the accuracy of the last 10 forecasts prepared by NLH.

3.1.1 Energy Forecast Accuracy

Forecasting an uncertain future is a difficult task. Variations between actual and predicted results must be expected. Experience within the industry based on the results from Manitoba Hydro and other Canadian utilities indicate that a reasonable measure for forecast accuracy is a forecast deviation of 1 percent per year into the future. This means that a 10-year-old forecast should be within plus or minus 10 percent of the actual energy load observed. Table 1 measures energy forecast accuracy in terms of percentage of deviation from the actual load. In order to measure forecast accuracy, historical forecasts are compared to actual weather adjusted results. The Years of History term represents the number of past years used to compare forecast accuracy, thus it can be observed from Table 1 that the January 2001 domestic load forecast originally prepared in 2000 (with ten years of historical observation) was 10% low. This table shows that the past forecast results for the domestic and line loss sectors were reasonable and that the general service forecast has performed extremely well. Previous load forecasts assumed that the pulp and paper industry would continue operations at normal energy consumption levels, without any mill closures. However, those unforeseen closures of two mills caused a severe effect on the industrial forecast and have adversely impacted the total island energy forecast results.

Table 1: Energy Forecast Accuracy by Service Class (%)

	Energy Forecast Accuracy Measured in Percentage of Deviation from the Actual Load									
Years of History	1	2	3	4	5	6	7	8	9	10
Domestic	-1.3%	-2.2%	-3.3%	-3.8%	-4.0%	-4.7%	-5.8%	-6.9%	-7.9%	-10.0%
General Service	0.1%	0.0%	0.0%	0.1%	0.3%	0.4%	0.4%	1.0%	2.0%	6.0%
Industrial	5%	14%	27%	37%	50%	67%	76%	92%	119%	124%
Line Losses	-2.5%	-3.8%	-4.5%	-6.2%	-6.6%	-6.7%	-5.6%	-4.6%	-3.4%	-4.1%
Island Energy	**0.4%**	**1.9%**	**3.7%**	**5.5%**	**7.9%**	**10.6%**	**11.4%**	**13.3%**	**16.6%**	**17.4%**

In terms of electrical energy (GWh), Table 2 shows that virtually all of the total island energy forecast deviations are associated with the high industrial forecast.

Table 2: Energy Forecast Accuracy Measured in GWh of Deviation from Actual Load

	Energy Forecast Accuracy Measured in GWh of Deviation from Actual Load									
Years of History	1	2	3	4	5	6	7	8	9	10
Domestic	-43	-72	-109	-125	-133	-157	-199	-240	-277	-353
General Service	-1	0	0	3	7	8	8	22	44	134
Industrial	88	238	423	586	775	1,007	1,105	1,266	1,505	1,565
Line Losses	-15	-22	-26	-38	-39	-32	-32	-27	-20	-24
Island Energy	29	144	287	428	611	819	881	1,022	1,252	1,321

3.1.2 Peak Forecast Accuracy

Table 3 measures forecast accuracy in terms of percentage of deviation from the actual peak load observed. It also shows that the Newfoundland Power (NP) peak forecast results are excellent. The "other" peak forecast, which includes the peak demand associated with NLH's rural system, transmission system losses and industrial customers, has not performed well. The interconnected island system peak demand forecast is prepared by summing the two sector forecasts. As a result, the "other" peak demand forecast has adversely affected the overall results for the interconnected island peak due to the high industrial forecast.

Table 3: Peak Forecast Accuracy (%)

	Peak Forecast Accuracy Measured in Percentage of Deviation from the Actual Load									
Years of History	1	2	3	4	5	6	7	8	9	10
NP Peak	2.1%	0.7%	1.0%	0.6%	1.0%	1.2%	1.3%	0.6%	0.2%	2.5%
Other Peak	1.5%	5.2%	12.3%	19.6%	25.1%	35.3%	37.2%	46.9%	57.7%	96.7%
Island Peak	1.7%	1.6%	3.3%	4.5%	6.0%	8.0%	8.3%	9.4%	10.4%	17.8%

In terms of electrical demand (MW), Table 4 shows that almost all of the interconnected island peak forecast deviation can be associated with the high "other" peak demand forecast.

Table 4: Peak Forecast Accuracy (MW)

	Peak Forecast Accuracy Measured in MW of Deviation from Actual Load									
Years of History	1	2	3	4	5	6	7	8	9	10
NP Peak	22	8	12	7	12	15	15	6	2	30
Other Peak	-15	-4	15	35	52	84	90	116	132	201
Island Peak	7	4	27	42	64	98	105	122	134	231

3.1.3 Load Forecast Summary

The domestic forecast is prepared using a combination of econometric models that predicts the number of customers and average use. The accuracy of the methodology is within acceptable limits, but the forecasting process is biased towards under predicting future consumption. Comparison of forecast versus actual weather-adjusted consumption indicated that the domestic forecast under predicted energy consumption in 53 out of 55 cases examined. The main model, which predicts the average use of a customer in the Newfoundland Power service area, is driven by growth in the number of electric space heating customers. The model does not explain electricity growth from any other domestic end-use. The model has some good points factoring in the effects of marginal electricity prices and technological change, but space heating (although very important) is not the only reason that the average use has increased in the last 40 years.

The general service forecast is prepared using a combination of econometric modeling and linear extrapolation techniques. The main model, which predicts the electricity consumption in the Newfoundland Power service area, is driven by growth in GDP and commercial business investment. The accuracy analysis indicated that this methodology has performed extremely well in the past, producing forecasts that are only 1-2% out, as far as 8 to 9 years into the future. The general service forecast is not biased, under predicting energy consumption 24 times and over predicting energy consumption 31 times out of the 55 cases examined.

The industrial forecast is prepared, on a case by case basis, using direct input from customers on their operational plans. This is a reasonable methodology when considering the small number of industrial customers located on the island. In retrospect, the assumption of continued operation of the pulp and paper plants has been overly optimistic. The industrial forecast has performed poorly in the past because of pulp and paper mill closures that were not accounted for in previous forecasts, even though the industry was facing a reduction in newsprint and paper caused by the internet, a reduction in packaging caused by a shift of manufacturing to China, and increasing low-cost competition from Russia, China, and South America.

In short, the total island energy requirements have been over predicted as a result of one assumption related to the pulp and paper industry that created a high industrial forecast. Otherwise, the total island load forecast has performed extremely well. Table 5 indicates how well the forecast would have performed if the two pulp and paper mill closures, in hindsight, were accounted for in the load forecast.

Table 5: Energy Forecast Accuracy Future Years Island Energy (%)

	Forecast Accuracy Measured in Percentage of Deviation from the Actual Load									
Years of History	1	2	3	4	5	6	7	8	9	10
Island Energy	-1.2%	-1.4%	-0.8%	-0.6%	-0.3%	1.0%	1.0%	1.5%	2.0%	2.9%

The Newfoundland Power peak demand regression equation accounts for 80% of the interconnected island demand and has performed extremely well. However, the interconnected island system peak demand has been over predicting as a result of a high industrial peak demand forecast. If the two pulp and paper mill closures were accounted for in the load forecast, Table 6 shows that the accuracy of the interconnected island system peak demand forecast would be similar to the accuracy of the Newfoundland Power peak demand forecast.

Table 6: Energy Forecast Accuracy Future Years NP Peak (%)

	Forecast Accuracy Measured in Percentage of Deviation from the Actual Load									
Years of History	1	2	3	4	5	6	7	8	9	10
NP Peak	2.1%	0.7%	1.0%	0.6%	1.0%	1.3%	1.3%	0.6%	0.2%	2.5%

The main issue with the peak forecasting methodology is that the system peak is being calculated separately from the energy portion of the forecast. The current peak forecasting process predicts a future load factor of 58%. There is a possibility that the load factor could drop below forecasted levels as low load factor electric space heat is continually added to the system and space heating efficiency improvements (e.g. insulation upgrades) become more difficult to achieve in the future.

3.1.4 Load Forecast Key Findings

A detailed analysis of load forecasting practices, methodologies and results has led to the following key findings:

1. The load forecasting process is conducted with due diligence, skill and care and meets acceptable utility practices with the exception that end-use modelling techniques for domestic loads are not currently employed.

2. The load forecasting process has produced reasonable results for the domestic and line loss sectors, excellent results for the general service sector, and very poor results for the industrial sector. The industrial sector has adversely affected the overall energy and peak forecast results. In hindsight, if the pulp and paper mill closures were accurately forecasted, the energy and peak forecasts would have been excellent.

3. The domestic sector forecast consistently under predicts future energy needs at a rate of 1% per future year. Although the magnitude of the forecast error is acceptable, the frequency of under predicting energy consumption is a concern. The domestic forecasting process is inherently biased towards under predicting energy consumption.

4. In the next ten years, the load forecast performance should produce good results, if the remaining pulp and paper mill remains operational. The forecast may slightly under predict electricity requirements because of a relatively conservative domestic forecast and an upward revision of 90 GWh for the Vale expansion (not included in the forecast being reviewed). Conversely, the load forecast will significantly over predict electricity requirements, if the remaining pulp and paper mill closes.

5. In the long term, if the remaining pulp and paper mill stays operational, the load forecast is likely to under predict future requirements because the domestic forecast is relatively conservative and the industrial forecast does not include any new loads for the study period.

3.2 Hydrology Studies

MHI reviewed Nalcor's various hydrology studies to determine if they were conducted with due diligence, skill, and care consistent with acceptable utility practices.

The hydrological/hydraulic and energy production review of the studies carried out was an examination of Muskrat Falls and the three on-island hydroelectric projects for relevance of input source, methodology, accuracy of estimates and/or assumptions, identification of gaps, recommendations and findings, and examination of quality assurance mechanisms.

The evaluation was carried out by reviewing available documentation since the inception of the various projects under consideration.

Volume 2 – Section 2, Hydrology Studies covers all reviews of hydrological/hydraulic and energy production studies related to the various plants. The studies are far more extensive for Muskrat Falls than for the other three hydroelectric plants. Topics covered in the Muskrat Falls studies are:

- Hydraulic Modeling of Churchill River
- Construction Flood Estimate
- Probable Maximum Flood
- Spillway Design
- Hydraulic Modelling of Structures
- Dam Break Analysis
- Ice Studies
- Energy Estimates

The Muskrat Falls studies were comprehensive and detailed, with no apparent weaknesses identified. However, some of the analyses need to be finalized as part of the detailed design:

- Finalization of spillway design in accordance with the latest probable maximum flood results and results of 3-D modeling of structures;
- Routing of probable maximum flood flows to test final spillway design;
- Evaluation of the need to increase the proposed diversion capacity at Muskrat Falls;
- Evaluation of the potential effects of ice breakup on construction activities;
- Possible modification of the design in the form of adding a wing wall between the powerhouse intake and spillway;
- Estimation of the cost of damages caused by probable maximum flood flows to obtain the total cost of damages of a dam break while re-routing the flows.

Both the Round Pond and Island Pond projects are part of the Bay d'Espoir hydraulic system. The relevant hydrological parameters of both projects, in particular the probable maximum flood results and a 37-year flow sequence for energy studies, were estimated in a general Bay d'Espoir regulation study carried out in 1985 by Acres[23].

Because the Round Pond study is more than 25 years old, it should be reviewed in light of new data and the possibility of a change in the operation of the Bay d'Espoir System. Since the probable maximum flood part of the study was carried out before current Canadian Dam Association guidelines took effect, possible implications of the guidelines for the probable maximum flood estimate should be investigated.

For the Island Pond project, should the Round Pond flood hydrology require an update, it may be necessary to reassess the ability of the diversion canal from Island Pond into the Meelpaeg Reservoir to pass an updated probable maximum flood.

A feasibility study of Portland Creek hydropower development was completed in 2006 by SNC-Lavalin. This study is considered adequate to proceed to detailed design. However, the design flood selected as the 1:1000 year flood was estimated from a limited sample of 22 observations. It is possible that a regional flood analysis, such as an Index Flood Method, would provide a more robust estimate.

The results of power and energy studies provide reasonable estimates of the capability of the four hydroelectric developments which are presented in Table 7 below.

Table 7: Hydroelectric Plant Energy and Capacity[24]

	Muskrat Falls	Round Pond	Island Pond	Portland Creek
Installed Capacity (MW)	824	18	36	23
Firm Energy (GWh)	4,540	108	172	99
Average Energy (GWh)	4,910[25]	139	186	142

3.2.1 Hydrology Key Finding

The key finding from the hydrology reviews is as follows:

- The Muskrat Falls studies were conducted in accordance with utility best practices, comprehensively, and with no apparent demonstrated weaknesses. Also, the energy and capacity estimates for Muskrat Falls and the three small hydroelectric facilities on the island, which were prepared by various consultants using industry accepted practices, were reviewed and confirmed to be reasonable for DG2.

[23] Exhibit 54, ACRES, "Bay d'Espoir Flood Analysis and Alternatives Study", December 1985
[24] "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", November 2011.
[25] Without Gull Island

3.3 Power System Reliability Studies

MHI reviewed material available from Nalcor on reliability studies to determine if they were conducted with due diligence, skill, and care consistent with acceptable utility practices. The documentation included:

- Studies and reports on resource planning;
- The Strait of Belle Isle cable crossing;
- The Labrador-Island Link HVdc system overhead line;
- Reliability studies of HVdc schemes; and
- Other related information.

In the design, construction, and operation of electrical power systems one important consideration is whether the system will provide a reliable supply of electricity to meet the needs of the customers. There are many ways to define and characterize reliability and, by any metric used, additions to a power system should not degrade the reliability performance of the system. As the Island of Newfoundland is currently isolated electrically, investigations on reliability are one of the primary concerns.

Reliability evaluation methods can be classified into two categories: deterministic and probabilistic. Deterministic methods are subjective and based on engineering judgement. Industry practitioners largely use deterministic methods as they are simple and intuitive. However, elements of power system behaviour are unpredictable and random in nature. Also, power systems are increasing in complexity. Thus, probabilistic reliability methods applied to modern power systems are an improved and more accurate method for reliability assessment. Deterministic techniques are being augmented by probabilistic methods particularly for significant projects[26] by leading North American electric power entities; Manitoba Hydro, BC Hydro, Hydro Quebec, Hydro One in Ontario and the Northeast Power Coordinating Council, Inc. (NPCC) have all adopted probabilistic methods to establish system reliability metrics. Industry working groups, which provide guidance to reliability practitioners, are now recommending that these methods be adopted as industry wide standards.

Available documentation on the reliability aspects of the two alternatives prepared by Nalcor and its consultants has been reviewed. These documents include studies and reports on resource planning, the Strait of Belle Isle cable crossing[27], the Labrador-Island Link HVdc system overhead line[28], Power Technologies Inc. (PTI) probabilistic reliability studies on different HVdc schemes[29] and other related information. The forced outage rates assumed for various types of generating units are based on reliable data sources and reasonable assumptions. The procedures and methodologies proposed by PTI in the early 1980's for the development of the HVdc system reliability model are still valid and

---

[26] R. Billinton, J. Satish, "Adequacy Evaluation in Generation, Transmission, and Distribution Systems of an Electric Power System", 1993, IEEE 0-7803-1319-4/93
[27] Exhibit 35, C-CORE, "Iceberg Risk to Subsea Cables in Strait of Belle Isle", June 2011
[28] Exhibit 106, Nalcor, "Technical Note: Labrador — Island HVdc Link and Island Interconnected System Reliability", October 2011
[29] Exhibit 48, PTI, "Newfoundland and Labrador HVdc Project HVdc Link Reliability Studies", June 1981

could have been used for modeling the proposed Labrador-Island Link HVdc system with appropriate modifications.

A probabilistic adequacy study that includes transmission considerations for comparison of the reliability of the two options has not been performed by Nalcor. This is a gap in Nalcor's planning practices. The Labrador-Island Link HVdc forced outage rate of 0.89% per pole assumed for some of the analysis should be replaced by a more advanced and comprehensive reliability model incorporating all components of the Labrador-Island Link HVdc system, and taking into account all risk factors experienced in operations of the system. Probabilistic reliability methods utilize standard terms and indices such as Loss of Load Expectation (LOLE), or Expected Unserved Energy (EUE), and make the risk analysis results plainly understandable in terms of dollars, or loss of load.

A probabilistic adequacy study would include data on the HVdc converter equipment together with the overhead transmission line and submarine cable. The entire HVdc system could experience pole or bipole outages, in some cases for extended periods of time. These risks and contingencies can be mitigated through appropriate design and specification of the HVdc system components.

The first task of a power system reliability study would be to determine component outage models. Following the development of appropriate component reliability models, the next step is to incorporate the models into a system reliability evaluation study. These system studies use various indices to measure the risk inherent in a particular power system configuration.

3.3.1 Component and Sub-system Reliability Modeling

The components and/or subsystems that should be modeled in a probabilistic reliability assessment usually consist of generating units and major transmission facilities. The average performance data from the 2004 Canadian Electricity Association's Annual Report on Generation Equipment Status is used to develop forced outage rates (FOR) for various types of generating units. Although no detailed information is available for review on the reliability of the Labrador-Island Link HVdc system converter stations, reliability data from manufacturers or collected from similar systems may be used to model converter station components[30]. Developing the probabilistic model would involve:

1. A review of the operating history of similar installations around the world;
2. An estimate of specific risks, such as: icebergs, fishing dredges, and ocean currents for the Strait of Belle Isle cable crossing; and rime ice and salt contamination for the overhead HVdc line;
3. An evaluation of the reliability of the proposed cable, overhead line, and converter stations; and

[30] M. G. Bennett, N. S. Dhaliwal and A. Leirbukt, "A survey of the Reliability of HVdc Systems Throughout the World 2007-2008", 43rd CIGRE Session, Aug 22-Aug 27, 2010, Paris, France.

4. Merging the component reliability models to form an overall Labrador-Island Link HVdc system reliability model.

3.3.2 Reliability Comparison of the Two Options

The proposed Labrador-Island Link HVdc system is a vital component of the Infeed Option. The impacts of the HVdc link on overall system reliability should, therefore, be quantitatively evaluated to provide required inputs to the decision-making process. The impact of the proposed Labrador-Island Link HVdc system can be quantified in terms of the commonly used reliability indices of load carrying capability, loss of load expectation, or expected unserved energy. However, no such probabilistic study results were available for review and MHI recommends that these studies be carried out as part of the planning process.

3.3.3 Summary

The forced outage rates assumed in the documentation for various types of generating units are reasonable. The source documents for the development of probabilistic reliability models for the proposed Labrador-Island Link HVdc system are available. The procedures and methodologies proposed by PTI for the development of the HVdc system reliability model are still valid and can, with appropriate modifications, be used for modeling the proposed Labrador-Island Link HVdc system.

The following system reliability studies and documentation were not performed and must be completed: quantification of the impact of the Labrador-Island Link HVdc system on overall system reliability; a comparison of the two options in terms of reliability considering the Labrador-Island Link HVdc system performance; and the reliability cost implications.

3.3.4 Power System Reliability Key Findings

The following key findings are noted:

1. The forced outage rates (FOR) assumed for various types of generating units are based on reliable sources and considered to be reasonable. The information documenting the derivation of the Labrador-Island Link HVdc system FOR of 0.89% on a per pole basis was not available for MHI's review. MHI has compared the Labrador-Island Link HVdc system pole FOR of 0.89% with published information and that of Manitoba Hydro's HVdc system and finds it within the normally accepted range. However, this FOR should be replaced by a more advanced and comprehensive reliability model incorporating all components of the Labrador-Island Link HVdc system.

2. Probabilistic adequacy studies including transmission considerations, have not been performed for comparison of the reliability between the two options. This is a gap in Nalcor's practices as several Canadian utilities, NERC regions and members have adopted these probabilistic methods for reliability studies particularly for major projects. Probabilistic reliability methods utilize standard terms and indices such as Loss of Load Expectation, or Expected Unserved Energy, and make the risk analysis results plainly understandable in terms of dollars and/or loss of load.

   Deterministic assessments, such as those performed by Nalcor, cannot quantify the true risks associated with a power system and are unable to provide some of the important inputs for making sound engineering and business decisions. Factors such as risk and associated costs including the potential large societal costs related to outages were not evaluated. Probabilistic assessment is a valuable means to assess system risk, reliability and associated costs/benefits for various system improvement options particularly for major projects proposed by Nalcor. MHI has determined that choosing between the two options under review without such an assessment is a gap in Nalcor's work to date. Typically, these studies are completed at DG2. MHI recommends that these probabilistic reliability assessment studies be completed as soon as possible for both options under review. Such studies should become part of Nalcor's planning processes that would allow them to do a comparison of the relative reliability for future facilities.

3.4 Transmission Planning Criteria, AC Integration Studies, and NERC Standards

Nalcor's work in the areas of transmission planning criteria, ac integration studies, and NERC standards as they relate to good utility practice, were reviewed by MHI. The results of this review are summarized in the following sections.

3.4.1 Transmission Planning Criteria

The transmission planning criteria is a critical document that clearly identifies the parameters that trigger when new transmission facilities are required, or existing facilities need to be upgraded. Nalcor provided a document that describes the NLH and Nalcor power system planning criteria[31]. The criterion is applied to the entire power system and is at a very high level. Nalcor also provided a self-assessment on compliance to its transmission planning criteria in Exhibit 42 "Newfoundland and Labrador Hydro 2009 Planning Criteria Review"[32].

Ideally, planning criteria should be set out in a high level document that points the reader to supporting documentation which identifies how the criteria will be met. The format used by Nalcor could be improved by making references to its external and internal standards, guidelines, and policies. Otherwise, the transmission planning criteria in use at Nalcor follow utility best practices.

3.4.2 AC Integration Studies

The ac system integration studies made available by Nalcor to MHI for review were conducted for the Gull Island Generating Station and 1600 MW 3-terminal HVdc interconnector, with one termination at Soldiers Pond and another at Salisbury, New Brunswick. The project definition changed in November 2010 following completion of Nalcor's project alternatives screening study (DG2). Nalcor decided to proceed with generation at Muskrat Falls using a point-to-point HVdc transmission system (Labrador-Island Link) with the inverter at Soldiers Pond. The response to RFI MHI-Nalcor-44 indicated that the ac integration studies for the current configuration would be completed by November 2011, which has now been delayed to the end of March 2012[33]. MHI considers this a significant gap in Nalcor's work to date. This information for a large hydroelectric project would normally be available prior to DG2. These ac integration studies must be completed prior to DG3.

Nalcor filed the following documents to describe the transmission assets required to support the interconnections to Labrador and the Maritimes:

- Exhibit 23: Historical Summary of the Labrador-Island HVdc System Configuration for the Lower Churchill Project (1974-Present) – July 2011

---

[31] Exhibit 105, Nalcor, System Planning Department, "Transmission Planning Manual", Revision 2, September 2009
[32] Exhibit 42, Nalcor, System Planning Department, "Newfoundland and Labrador Hydro 2009 Planning Criteria Review", Dec 2009
[33] Response to RFI PUB-Nalcor-143

- Exhibit CE31 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

With the redefined project definition, these studies do not adequately describe the facilities required to successfully operate the transmission system under the new configuration. As such, there may be unidentified risks in proceeding with this project at this time. For example, the studies could identify the requirement for additional back-up generation, new transmission, enhanced protection schemes, or other system additions.

Nalcor did supply a study plan which described the scope of activities to be undertaken in the various ac integration studies and contains, modes of operation, criteria, and a number of contingencies to test the performance of the integrated system[34]. For example, a three-phase fault or slow clearing single-phase-to-ground fault close to the converter station could cause a temporary block of the Labrador-Island Link, which would impact the Newfoundland power system.

The response to RFI PUB-Nalcor-144 indicates that the final integration studies for the Infeed Option are being completed in two stages: first the Infeed Option is being studied without the Maritime Link, and then, as a second stage, the Maritime Link will be included.

3.4.3 AC Integration Studies Key Finding

The key finding from the ac integration studies review is as follows:

- System integration studies completed as part of the project alternatives screening process, and provided to MHI by Nalcor were for a Gull Island development with a 1600 MW three terminal HVdc system to Newfoundland and New Brunswick. Significant changes were made to the overall project definition with the proposed Muskrat Falls Generating Station development, and the deletion of the New Brunswick link. Integration studies that would support the changes have not been completed and Nalcor now advises that the studies will not be available until March 2012[35]. As the full requirements for integration of the Labrador-Island Link HVdc system are not known, there may be additional risk factors that may impact the cumulative present worth of the Infeed Option. For example, installation of backup supplies to cover operational limitations in the Labrador-Island Link HVdc system may be required, and additional transmission lines may be needed to maintain acceptable system performance. Spare equipment requirements also need to be taken into consideration. Good utility practice requires that these integration studies be completed as part of the project screening process (DG2). MHI considers this a major gap in Nalcor's work to date. These integrations studies must be completed prior to project sanction (DG3).

---

[34] Response to RFI MHI-Nalcor-39
[35] Response to RFI PUB-Nalcor-143

3.4.4 NERC Standards

"Good utility practice" is a policy that most utilities recognize, either voluntarily or by regulation. The principle behind good utility practice is that electric utilities will adopt the practices and methods of a significant portion of utilities within a geographic boundary.

In Canada, eight of the ten jurisdictions have accepted NERC standards as their reliability standards. With near unanimous acceptance of mandatory standards within Canada aimed at increasing the reliability of the provincial networks, NERC standards are now a practice, method or act followed by a significant portion of the electric utility industry. Therefore any utility that is assessing their adherence to good utility practice whether or not it interconnects to the marketplace, must consider their adherence to NERC Standards.

Nalcor currently does not comply with NERC standards[36,37]. However, should the Maritime Link proceed, and Nalcor participates in the electricity marketplace, NERC standards will ultimately apply. MHI recommends that Nalcor complete a self-assessment and prepare for compliance to NERC standards with or without the Maritime Link.

3.4.5 NERC Standards Key Finding

The key finding from the NERC Standards review is as follows:

- MHI finds that Nalcor currently does not comply with North American Electric Reliability Corporation (NERC) standards. A majority of utilities in Canada have adopted the definition of "good utility practice" that incorporates adherence to NERC standards. Also, should the Maritime Link proceed, and Nalcor participates in the electricity marketplace, NERC standards will ultimately apply. MHI recommends that Nalcor complete a self-assessment and prepare for compliance to NERC standards with or without the Maritime Link.

[36] Exhibit 106, Nalcor, "Technical Note Labrador –Island HVdc Link and Island Interconnected System Reliability", page 33
[37] Response to RFI PUB-Nalcor-164