NEWFOUNDLAND POWER
A FORTIS COMPANY

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HAND DELIVERED

September 19, 2014

Board of Commissioners
of Public Utilities
P.O. Box 21040
120 Torbay Road
St. John's, NL A1A 5B2

Attention: G. Cheryl Blundon
Director of Corporate Services
and Board Secretary

Ladies and Gentlemen:

Re: The Board's Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System – Requests for Information

Please find enclosed the original and 12 copies of Newfoundland Power's Requests for Information NP-NLH-1 to NP-NLH-35.

The information requested is required for evaluation by the Company and its expert of Island Interconnected system adequacy and reliability after the interconnection with the Muskrat Falls generating facility.

For convenience, the Requests for Information are provided on three-hole punched paper.

A copy of this letter, together with enclosures, has been forwarded directly to the parties listed below.

If you have any questions regarding the enclosed, please contact the undersigned at your convenience.

Yours very truly,

Peter Alteen, QC
Vice President,
Regulation & Planning

power of life
SUPPORT CANCER CARE. RIGHT HERE.

Enclosures

c. Geoffrey Young
Newfoundland and Labrador Hydro

Paul Coxworthy
Stewart McKelvey

Danny Dumaresque

Thomas Johnson
O'Dea Earle Law Offices

Roberta Frampton Benefiel
Grand Riverkeeper Labrador Inc.

IN THE MATTER OF
the *Electrical Power Control Act, 1994*,
SNL 1994, Chapter E-5.1 (the "*EPCA*")
and the *Public Utilities Act*, RSNL 1990,
Chapter P-47 (the "*Act*"), as amended; and

IN THE MATTER OF the Board's Investigation
and Hearing into Supply Issues and Power Outages
on the Island Interconnected System.

Requests for Information by
Newfoundland Power Inc.

NP-NLH-1 to NP-NLH-35

September 19, 2014

Requests for Information

NP-NLH-001 Reference: Public Utilities Board Muskrat Falls Review, *Manitoba Hydro International: Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System*, January 2012, page 54.

"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."

Please confirm Nalcor/Hydro is not currently NERC compliant and outline what measures would be required for Nalcor/Hydro's generation and transmission system to achieve and maintain NERC compliance following interconnection to the North American grid.

NP-NLH-002 Reference: Public Utilities Board Muskrat Falls Review, *Manitoba Hydro International: Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System*, January 2012, page 54.

"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."

Has Nalcor/Hydro completed the self-assessment referred to by MHI? If so, please provide a copy. If not, please explain why not.

NP-NLH-003 Reference: Public Utilities Board Muskrat Falls Review, *Manitoba Hydro International: Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System*, January 2012, page 54.

"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."

What are the current and future reliability consequences for the Island Interconnected System of Nalcor/Hydro not being NERC compliant?

NP-NLH-004 Reference: Public Utilities Board Muskrat Falls Review, *Manitoba Hydro International: Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System*, January 2012, page 11.

"Design Loading Criteria – Nalcor has selected a 1:50-year reliability return period (basis for design loading criteria) for the HVdc transmission line, which is inconsistent with the recommended 1:500-year reliability return period outlined in the International Standard CEI/IEC 60826:2003 with Canadian deviations in CSA Standard CAN/CSA-C22.3 No. 60826:06, for this class of transmission line without an alternate supply."

Please confirm the return period of climatic loads used in the design of the Labrador – Island HVdc Link and provide all the detailed ice and wind weather cases as well as suspension tower load cases, including the mathematical calculations supporting them.

NP-NLH-005 Reference: Public Utilities Board Muskrat Falls Review, *Manitoba Hydro International: Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System*, January 2012, page 11.

"Design Loading Criteria – Nalcor has selected a 1:50-year reliability return period (basis for design loading criteria) for the HVdc transmission line, which is inconsistent with the recommended 1:500-year reliability return period outlined in the International Standard CEI/IEC 60826:2003 with Canadian deviations in CSA Standard CAN/CSA-C22.3 No. 60826:06, for this class of transmission line without an alternate supply."

Please confirm the return period of climatic loads used in the design of the proposed 230kV transmission line from Bay d'Espoir to Western Avalon and provide all the detailed ice and wind weather cases as well as suspension tower load cases, including the mathematical calculations supporting them.

NP-NLH-006 Reference: Public Utilities Board Muskrat Falls Review, *Manitoba Hydro International: Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System*, January 2012, page 11.

"Design Loading Criteria – Nalcor has selected a 1:50-year reliability return period (basis for design loading criteria) for the HVdc transmission line, which is inconsistent with the recommended 1:500-year reliability

return period outlined in the International Standard CEI/IEC 60826:2003 with Canadian deviations in CSA Standard CAN/CSA-C22.3 No. 60826:06, for this class of transmission line without an alternate supply."

Please describe in detail how the design of the Labrador – Island HVdc Link and the proposed 230kV transmission line from Bay d'Espoir to Western Avalon each correspond to weather data for rime, glaze icing and wind derived from available weather studies. The description should address all climatic zones each transmission line traverses.

NP-NLH-007 Reference: GRK-NLH-038 (Revision 1, July 28-14)

"In its second report prepared in October 2012, Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options, MHI completed a thorough assessment of Nalcor's updated work and made the following observations:

> *"[i]t is MHI's opinion Nalcor undertook appropriate due diligence selecting the weather loads for this transmission line" and "[t]he climatic loadings for each line section are approximately equivalent to the climatic loadings calculated assuming Canadian Standards Association (CSA) 1:500 year return period*."

Please provide mathematical calculations to demonstrate that the climatic glaze ice loadings, say for St. John's and the Long Range Mountains, used for designing the Labrador-Island HVdc Link are approximately equivalent to the climatic loadings calculated assuming the Canadian Standards Association (CSA) 1:500 year return period.

NP-NLH-008 Reference: GRK-NLH-038 (Revision 1, July 28-14)

"In its second report prepared in October 2012, Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options, MHI completed a thorough assessment of Nalcor's updated work and made the following observations:

> *"[i]t is MHI's opinion Nalcor undertook appropriate due diligence selecting the weather loads for this transmission line" and "[t]he climatic loadings for each line section are approximately equivalent to the climatic loadings calculated assuming Canadian Standards Association (CSA) 1:500 year return period*."

CSA standard CAN/CSA-C22.3 No. 60826 does not provide values for rime icing in Newfoundland and Labrador. Nalcor Exhibit, Muskrat Falls Exhibit 97 , Revision 1 states that the icing mechanism considered as limiting design load for Zones 2a, 2b, 2c, 5, 7a, 7b, and 7c is rime icing.

Please provide the return periods of rime icing measurements considered in each of these zones along with the mathematical calculations supporting these load selections and return periods.

NP-NLH-009 Reference: Public Utilities Board Muskrat Falls Review, Nalcor Exhibit 97, *Review of Existing Meteorological Studies Conducted on the Labrador Island Transmission Link - Appendix A (R1) – Ice Loading Region Maps*.

Did Nalcor/Hydro use the weather loading data provided in Appendix A (R1) of Nalcor Exhibit 97 to design the Labrador-Island HVdc Link?

NP-NLH-010 Reference: Public Utilities Board Muskrat Falls Review, Nalcor Exhibit 97, *Review of Existing Meteorological Studies Conducted on the Labrador Island Transmission Link - Appendix A (R1) – Ice Loading Region Maps.*

Please confirm the climatic return period for the weather data given below each figure of Exhibit 97, Appendix A (R1).

NP-NLH-011 Reference: Public Utilities Board Muskrat Falls Review, Nalcor Exhibit 97*, Review of Existing Meteorological Studies Conducted on the Labrador Island Transmission Link - Appendix A (R1) – Ice Loading Region Maps.*

Please provide in tabular format a comparison of (i) the weather data given below each figure of Exhibit 97, Appendix A (R1), and (ii) corresponding 1:500 year return period values calculated using the space and height factor, as well as the incremental factor, for a 1:500 year return period in accordance with CSA standard CAN/CSA- C22.3 No. 60826 for the same data.

NP-NLH-012 Reference: Public Utilities Board Muskrat Falls Review, Nalcor Exhibit 92, *DC1070 Preliminary Meteorological Load Review*, Tables 1 and 2, page vi.

Did Nalcor/Hydro use the weather loading data provided in Nalcor Exhibit 92, Tables 1 and 2 in the design of the Labrador-Island HVdc Link? If the data was used, please provide a detailed description of how it was used. If the data was not used, please provide a detailed explanation of why it was not used.

NP-NLH-013 Reference: Public Utilities Board Muskrat Falls Review, Nalcor Exhibit 92, *DC1070 Preliminary Meteorological Load Review*, page 7-1.

"Due to a lack of statistical data, the meteorological regional loads contain uncertainty."

Given the uncertainty of predicting ice accretion in areas severely exposed to incloud/rime ice and glaze ice, particularly for high return periods, does Nalcor/Hydro agree that, at best, the predicted icing values represent average expected loads for the selected return period of loads and that the range of icing loads for a 1:500 year return period can easily fall within a range of ± 20% or more for a 90% confidence interval? Please fully explain the response.

NP-NLH-014 Reference: Public Utilities Board Muskrat Falls Review, Nalcor Exhibit 92, *DC1070 Preliminary Meteorological Load Review*, Appendix D, page D-2.

"Topographical effects should be added to the basic meteorological loads taking into account statistical variations within each climatic region, which is individually determined from general climate and geographical features."

Please describe in detail how topographical effects were added to the basic meteorological loads in the design of the various components of the Labrador-Island HVdc Link, including the transmission structures. If such effects were not added, please explain why they were not.

NP-NLH-015 Reference: Public Utilities Board Muskrat Falls Review, Nalcor Exhibit 92, *DC1070 Preliminary Meteorological Load Review*, Appendix D, page D-2.

"Topographical effects should be added to the basic meteorological loads taking into account statistical variations within each climatic region, which is individually determined from general climate and geographical features."

Does Nalcor/Hydro agree that topographical amplification factors to be applied to 1:500 year return period climatic loads would be different than the factors applied to 1:50 year return period climatic loads, in order to have a true 1:500 year return period design?

NP-NLH-016 Reference: (http://www.powerinourhands.ca/pdf/MHI.pdf) *Manitoba Hydro International: Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options*, October 2012, page 44.

"From extensive meteorological research, Nalcor determined that the transmission line would require 11 unique weather zones, with a number of subzones, to adequately model the ice-and-wind loading on line structures."

Was the statistical independence of ice occurrence in the various weather zones of the Labrador-Island HVdc Link considered in establishing the design ice loads? For example, in determining the design return period, did Hydro consider that a weather event in the Long Range Mountains would be independent of a weather event on the Avalon Peninsula? If so, please provide the calculations of return period of loads taking into account the statistical independence of the various weather zones in the design of the Labrador-Island HVdc Link.

NP-NLH-017

Reference: (http://www.powerinourhands.ca/pdf/MHI.pdf) *Manitoba Hydro International: Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options*, October 2012, page 32.

"The report characterized the 1:50 return period being for ice-loading only but Nalcor clarified that this was for both wind and ice-loading."

Did Nalcor/Hydro design the Labrador-Island HVdc Link for the combined ice and wind specified in the CSA standard, i.e., using the 1:50 or 1:500 year ice in combination with the average winds occurring during ice persistence as required in CAN/CSA- C22.3 No. 60826? If so, please provide the supporting calculations for the design. If not, please explain the reliability implications of not complying with the CAN/CSA Standard?

NP-NLH-018

Reference: (http://www.powerinourhands.ca/pdf/MHI.pdf) *Manitoba Hydro International: Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options*, October 2012, page 44.

"MHI Reviewed Nalcor's design specification documents which outlined in detail the approach determining the tower design and geometry, span spacing, load capacity, and other detailed engineering criteria pertinent to the proposed HVdc transmission system."

Please provide a copy of the design specifications of all line components of the Labrador-Island HVdc Link and the proposed 230 kV line from Bay d'Espoir to Western Avalon, including tower loads, conductor sag-tensions and any other supporting documents.

NP-NLH-019

Reference: (http://www.powerinourhands.ca/pdf/MHI.pdf) *Manitoba Hydro International: Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options*, October 2012, page 44.

"MHI reviewed Nalcor's design specification documents which outlined in detail the approach determining the tower design and geometry, span spacing, load capacity, and other detailed engineering criteria pertinent to the proposed HVdc transmission system."

Does the design for the Labrador-Island HVdc Link include consideration of ice accumulation on the transmission tower structures? If so, please describe in detail these design considerations. If not, provide the explanation for not including this consideration in the design.

NP-NLH-020 Reference: (http://www.powerinourhands.ca/pdf/MHI.pdf) *Manitoba Hydro International: Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options*, October 2012, page 47.

"The climatic loadings for each line section were selected based on Nalcor's past research studies and statistical analysis of the climate data. Extreme values based upon historical data and observations on ice accumulation and wind speed were implemented in the line regions through the Long Range Mountains and other regions in Labrador."

Has Hydro experienced buildup of ice on overhead lines as a result of successive storms or icing events? If so, how was this experience considered in designing the Labrador-Island HVdc Link or any other transmission line?

NP-NLH-021 Reference: (http://www.powerinourhands.ca/pdf/MHI.pdf) *Manitoba Hydro International: Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options*, October 2012, page 37.

"Development of a good emergency response plan is recommended by MHI as part of the operational stage of the project post Decision Gate 3. Nalcor has committed to have this emergency response plan developed prior to in-service."

Following the 1998 ice storm in Quebec, some lines required periods of up to 12 weeks to repair and restore to service.

Please indicate the reliability impact to customers of the Island Interconnected System of the unavailability of the Labrador-Island HVdc Link for 12 weeks due to a widespread extreme icing event in excessive design loads.

NP-NLH-022 Reference: Public Utilities Board Muskrat Falls Review, *Manitoba Hydro International: Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System*, January 2012, page 61.

"The appropriate design criteria for the proposed Labrador-Island Link HVdc transmission line is the "Design Criteria of Overhead transmission Lines" code (International Standard CEI/IEC 60826:2003) with Canadian deviations in CSA Standard CAN/CSA-C22.3 No. 60826:06."

In the CSA standard referenced above, clause No. 6.3.2 states that "The experience of some Canadian utilities is that in some locations the ground wire (GW) accretes as much radial ice weight as the larger-diameter conductors. This is partly due to the higher elevation of the GW, the higher temperature of the phase conductor, and possibly the comparative torsional stiffnesses. In such locations, it is recommended to design the GW for the same linear unit weight of ice as for the phase conductor."

Please describe how this recommendation was followed in the design of the ground wire (GW) or optical power ground wire (OPGW) of the Labrador-Island HVdc Link. If the recommendation was not followed, please explain why it was not.

NP-NLH-023 Reference: Public Utilities Board Muskrat Falls Review, Nalcor Exhibit 92: *DC1070 Preliminary Meteorological Load Review*, Nalcor Exhibit 94: *HVdc Lab-NL Trans Link Ice Loading on HVdc Line Crossing Long Range Mountains,* and Nalcor Exhibit 95: *Evaluation of in-cloud icing in the Long Range Mountain Ridge.*

In Nalcor Exhibits 92, 94 and 95, the importance of wet snow accretion has been indicated to be not large enough to be the limiting design value. It is noted that none of the above reports has provided any details about the calculated amount of wet snow icing.

Please indicate whether wet snow accretion calculations were performed to support the decision to not consider wet snow accretion in the design of the Labrador-Island HVdc Link? If it was considered, please provide the associated mathematical calculations and estimates for 1:50 and 1:500 year return period events.

NP-NLH-024 Please indicate whether wet snow accretion calculations were performed as part of the design process for the proposed 230 kV transmission line from Bay d'Espoir to Western Avalon. If such calculations were performed, please provide the associated mathematical calculations and estimates for 1:50 and 1:500 year return period events.

NP-NLH-025 Reference: Public Utilities Board Muskrat Falls Review, *Manitoba Hydro International: Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System*, January 2012, page 61.

"The appropriate design criteria for the proposed Labrador-Island Link HVdc transmission line is the "Design Criteria of Overhead Transmission Lines" code (International Standard CEI/IEC 60826:2003) with Canadian deviations in CSA Standard CAN/CSA-C22.3 No. 60826:06."

Confirm and provide the mathematical calculations that demonstrate the conversion from wind speed to wind pressure on structures and conductors used for the design of the Labrador-Island HVdc Link is compliant with the CSA standard CAN/CSA-C22.3 No 60826.

NP-NLH-026 Reference: Public Utilities Board Muskrat Falls Review, *Manitoba Hydro International: Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System*, January 2012, page 61.
"The appropriate design criteria for the proposed Labrador-Island Link HVdc transmission line is the "Design Criteria of Overhead transmission Lines" code (International Standard CEI/IEC 60826:2003) with Canadian deviations in CSA Standard CAN/CSA-C22.3 No. 60826:06."

For ambient temperatures below 15°C, CSA standard CAN/CSA-C22.3 No 60826 requires an air density correction factor to be used in order to account for the higher density of cold air. Was such a factor applied in the design of the Labrador-Island HVdc Link?

NP-NLH-027 Reference: (http://www.powerinourhands.ca/pdf/MHI.pdf) *Manitoba Hydro International: Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options*, October 2012, page 46.

"Nalcor has selected a large 3650 MCM 91-Strand all-aluminum conductor (AAC) family for the entire transmission line, and is currently investigating the use of high-strength aluminum alloy conductors of identical size for use in the extreme ice regions required to maintain reliability."

Provide copies of all reports regarding the selection of the 3650 MCM 91-Strand all-aluminum conductor (AAC) and any current carrying conductor on the Labrador-Island HVdc Link.

NP-NLH-028 Reference: (http://www.powerinourhands.ca/pdf/MHI.pdf) *Manitoba Hydro International: Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options*, October 2012, page 46.

"Nalcor has selected a large 3650 MCM 91-Strand all-aluminum conductor (AAC) family for the entire transmission line, and is currently investigating the use of high-strength aluminum alloy conductors of identical size for use in the extreme ice regions required to maintain reliability."

Please describe in detail how the maximum elongation at failure of the AAC conductor chosen for the Labrador-Island HVdc Link, and the conductor's relative softness, have been taken into account in assessing the extent of conductor damage in the event of a transverse failure of a

transmission line tower that could stretch the conductor beyond its elongation limit.

NP-NLH-029 Reference: (http://www.powerinourhands.ca/pdf/MHI.pdf) *Manitoba Hydro International: Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options*, October 2012, page 46.

"Nalcor has selected a large 3650 MCM 91-Strand all-aluminum conductor (AAC) family for the entire transmission line, and is currently investigating the use of high-strength aluminum alloy conductors of identical size for use in the extreme ice regions required to maintain reliability."

Please provide a detailed assessment of the suitability of the conductor selected for the Labrador-Island HVdc Link in light of corona activity, audible noise, and other such electrical and magnetic effects.

NP-NLH-030 Reference: (http://www.powerinourhands.ca/pdf/MHI.pdf) *Manitoba Hydro International: Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options*, October 2012, page 46.

"Nalcor has selected a large 3650 MCM 91-Strand all-aluminum conductor (AAC) family for the entire transmission line, and is currently investigating the use of high-strength aluminum alloy conductors of identical size for use in the extreme ice regions required to maintain reliability."

Please advise whether Nalcor/Hydro has completed its investigation of the use of high-strength aluminum alloy conductors of identical size for use in the extreme ice regions required to maintain reliability. If so, what were the results of that investigation?

NP-NLH-031 Reference: Public Utilities Board Muskrat Falls Review, Nalcor Exhibit 92: *DC1070 Preliminary Meteorological Load Review*, page 7-1.

"Due to a lack of statistical data, the meteorological regional loads contain uncertainty."

In light of the uncertainty in predicting ice loads and the extreme severity of glaze ice and incloud/rime ice accretion in this project, has there been any assessment of de-icing methods that can be used on the Labrador-Island HVdc Link? If so, please provide copies of any assessment reports.

NP-NLH-032 In the case of an electrode failure can the Optical Power Ground Wire (OPGW) described in the response to Request for Information

CA-NLH-051 be used as a return conductor? If so, are there any requirements to insulate the OPGW for a low voltage such as 50kV in order to be able to use it for such purpose?

NP-NLH-033 Reference: CA-NLH-030, Page 3 of 8, Table 2

Please provide a revised table that shows the Island Interconnected System contingency loss of one pole of the Labrador-Island HVdc Link with the additional contingency of the loss of Hydro's largest generator on the Island Interconnected System.

NP-NLH-034 Reference: CA-NLH-030, Page 3 of 8, Lines 4-6

"For loss of the entire Labrador-Island Link, Hydro will import up to 300MW of power from the Maritime Provinces over the Maritime Link to the Island."

Please provide copies of any reports or assessments undertaken to review the availability of 300 MW of import power from the Maritime Provinces over the Maritime Link to the Island?

NP-NLH-035 Reference: PUB-NLH-214, Page 1 of 2, Lines 13-16.

"The loss of power transfer capacity during a single pole outage will discontinue exports of power on the Maritime Link as necessary to ensure system stability and to prevent loss of load on the Island Interconnected System."

Please provide a detailed explanation as to whether exports of power on the Maritime Link will be discontinued in the event of *any* supply shortage on the Island Interconnected System.

RESPECTFULLY SUBMITTED at St. John's, Newfoundland and Labrador, this 19th day of September, 2014.

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