NEWFOUNDLAND POWER
A FORTIS COMPANY

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HAND DELIVERED

June 1, 2015

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-36 to NP-NLH-81.

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.

Newfoundland Power must express its frustration at the lack of timeliness in Hydro's disclosure for Phase II of the Board's investigation. Hydro has not yet provided information required by the Board's recent Order No. P.U. 13(2015). This information was originally requested by Newfoundland Power on September 19, 2014. Given these circumstances, Newfoundland Power will likely require additional opportunity to pursue disclosure on behalf of its customers in Phase II of the Board's investigation.

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

Enciosures

c. Geoffrey Young
Newfoundland and Labrador Hydro

Paul Coxworthy
Stewart McKelvey

Danny Dumaresque

Thomas Johnson, QC
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Roberta Frampton Benefiel
Grand Riverkeeper Labrador Inc.

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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-36 to NP-NLH-81

June 1, 2015

Requests for Information

NP-NLH-036 Please identify and include résumés for Newfoundland and Labrador Hydro's witnesses for responding to questions regarding the reliability of the Labrador Island Link in Phase II of the 2014 Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System.

NP-NLH-037 Reference: Response to Request for Information NP-NLH-004

Were any tower designs performed prior to the adoption of the weather criteria outlined in Table 1 - LITL Climatic Design Criteria from the response to Request for Information NP-NLH-004? If so, please provide the design criteria used for those towers.

NP-NLH-038 Reference: Response to Request for Information NP-NLH-004

Please provide a table that compares the transmission line parameters for the as-designed structures to the parameters used to verify conformance to the CAN/CSA-C22.3 No. 60826-10 standard. The response should include the following parameters:

a) Design overload and strength factors
b) Tower loading cases
c) Wind and weight spans
d) Conductors and OPGW sag and tensions
e) Unbalanced ice loading cases
f) Security loads, including broken conductor loads
g) Clearances under maximum ice and after load

NP-NLH-039 Reference: Response to Request for Information NP-NLH-004

The response to Request for Information NP-NLH-004 states on Page 3 of 57 at lines 8-9:

"No structure was loaded beyond 100% of its as-designed structural capacity in any of these scenarios."

Was the design of any portion of the Labrador Island Link changed to accommodate the evaluation to the CAN/CSA-C22.3 No. 60826-10 1:500 year return period? If so, please explain the design changes in detail.

NP-NLH-040 Reference: Response to Request for Information NP-NLH-004

The response to Request for Information NP-NLH-004 states on Page 3 of 57 at lines 8-9:

"No structure was loaded beyond 100% of its as-designed structural capacity in any of these scenarios."

Please describe in detail, the process used and the assumptions made to verify that the Labrador Island Link towers were not loaded beyond 100% of the as-designed structural capacity. In the response, please provide a table showing tower load cases used for checking each tower.

NP-NLH-041 Reference: Response to Request for Information NP-NLH-004

Table 1 – LITL Climatic Design Criteria in the response to Request for Information NP-NLH-004 indicates that rime ice is the predominant ice in loading zones 2a, 2b, 2c, 5, 7a, 7b, and 7c. Please describe the rime ice density (kg/m^3) that has been used for developing the design criteria for the Labrador Island Link and why that particular rime ice density was used.

NP-NLH-042 Reference: Response to Request for Information NP-NLH-004

The response to Request for Information NP-NLH-004 states on Page 12 of 57, Lines 2-6:

"As will be seen in this section, the as designed LITL structures will be capable of withstanding 150-year CSA return period glaze ice loadings for the portion of the LITL off the Avalon Peninsula and 500-year CSA return period glaze loadings for the portion of the Avalon Peninsula."

Please explain in detail, if the Labrador Island Link structures on the Avalon Peninsula will be capable of withstanding 150-year and 500-year return period glaze ice loadings based on Hydro's own criteria, data, and information provided in the Muskrat Falls Review as Exhibit 85 – Reliability Study of Transmission Lines on the Avalon and Connaigre Peninsulas.

NP-NLH-043 Reference: Response to Request for Information NP-NLH-004

Please confirm that the line labeled *CSA 1:500* in Figure 4 - Climatic Ice Loads from MHI DG3 Report, represents glaze ice in loading zones 1, 3a, 3b, 4b, 4a, 6, 8a, 8b, 9, 10, 11a, 11b.

NP-NLH-044 Reference: Response to Request for Information NP-NLH-004

Please confirm that the bars labeled *Ice Load* in Figure 4 – Climatic Ice Loads from MHI DG3 Report, represent rime ice loading in zones 2a, 2b, 2c, 5, 7a, 7b, and 7c.

NP-NLH-045 Reference: Response to Request for Information NP-NLH-004

What densities (kg/m^3) of rime ice and glaze ice are assumed in Figure 4 – Climatic Ice Loads from MHI DG3 Report?

NP-NLH-046 Reference: Response to Request for Information NP-NLH-004

Please provide a graph, similar to Figure 4 - Climatic Ice Loads from MHI DG3 Report that has a vertical axis showing Radial Ice Loading in kg/m rather than Radial Ice Loading in mm.

NP-NLH-047 Reference: Response to Request for Information NP-NLH-004

Please provide a graph, similar to Figure 4 - Climatic Ice Loads from MHI DG3 Report in the response to Request for Information NP-NLH-004 that shows the CSA 1:500 year reference line based on the 2010 version of the CAN/CSA-C22.3 No. 60826 standard.

NP-NLH-048 Reference: Response to Request for Information NP-NLH-004

The response to Request for Information NP-NLH-004 provides graphs on pages 20, 21, 36, 37, 44, 45, 46, 47, 48, and 49 showing % Utilization for each as-designed structure under various load cases. Please provide the methodology used to determine the %Utilization for each of these graphs.

NP-NLH-049 Reference: Response to Request for Information NP-NLH-004

The response to Request for Information NP-NLH-004 provides graphs on pages 20, 21, 36, 37, 44, 45, 46, 47, 48, and 49 showing %Utilization for each as-designed structure under various load cases. Please provide the data used (numerators and denominators) to calculate the % Utilization for each structure in these graphs.

NP-NLH-050 Reference: Response to Request for Information NP-NLH-004

The response to Request for Information NP-NLH-004 states on Page 33 of 57, Lines 4-8:

"Design calculations consider these effects, and therefore Terrain Category C was selected for all glaze ice zones. As a conservative assumption line designers maintained Terrain Category B in the rime ice zones, even though topography suggests Category C."

Please explain in detail, why Hydro has not used Category B for all geographic areas as recommended in the CAN/CSA-C22.3 No. 60826-10 standard in Section 6.2.2. on page CSA/12.

NP-NLH-051 Reference: Response to Request for Information PUB-NLH-212

The response to Request for Information PUB-NLH-212 states in Attachment A, at page 9 of 34:

"…[CSA/CAN C-22.2 No. 60826:06] Figure CA.2 indicates a radial ice thickness of 40 mm at 10 m which translates into a 1:50 year return period ice thickness of 60 mm (2.4 inches) at the line conductor elevation. The method for calculating increase return period loads indicates a 1:100 year ice thickness of 66 mm, a 1:150 year ice thickness of 69 mm (2.7 inches) and a 1:500 year ice thickness of 78 mm (3.1 inches)."

Page 10 of Attachment 1 to the Request for Information PUB-NLH-212 states:

"Investigations by NLH following the 1994 ice storm revealed that the original design ice loads of 25 mm to 38 mm (1 to 1.5 inches) have a return period of approximately one in ten years (1:10). Based upon the location of the transmission line on the Avalon Peninsula the 1 in 25 year return period (1:25) was determined to be between 48 mm and 66 mm (1.9 and 2.6 inches) of radial ice and the 1 in 50 year return period (1:50) between 60 mm and 75 mm (2.35 and 3 inches) of radial ice. Consequently reinforcement of the 230 kV steel lines on the Avalon Peninsula between 1998 and 2002 utilizing a radial ice thickness of between 66 mm and 75 mm (2.6 and 3.0 inches) resulted in improved reliability of the 230 kV transmission system with a return period between 1:25 and 1:50 years based upon line and location.

Please explain in detail, how a 1:500 year return period for 78mm of ice developed using the CAN/CSA-C22.3 No. 60826:06 standard can be considered appropriate on the Avalon Peninsula when studies and measurements indicate that a 1:50 year return period is only slightly less, between 60mm and 75mm.

NP-NLH-052 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

Please confirm that the 2010 version of CAN/CSA 22.3 No. 60826 was used to validate the design of the Labrador Island Link.

NP-NLH-053 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

The referenced standard CAN/CSA-C22.3 No. 60826-10 states on page CSA/8:

"Requirements have been updated so that the climatic data in the Standard may be augmented by reliable local data."

Please provide the local wind and ice data that has been collected or estimated by Hydro, or from other sources, that exceeds the criteria outlined in Table 1: LITL Climatic Design Criteria in the Response to Request for Information NP-NLH-004.

NP-NLH-054 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

The referenced standard CAN/CSA-C22.3 No. 60826-10 states in Section 7.3.3, on page CSA/15:

"The following default (simplified) values can be used for lattice steel towers in the majority of lines:
(a) suspension towers: $\phi_R = 0.9$ for intact loading cases and $\phi_R = 1.0$ for failure loading cases; and
(b) angle and dead-end towers: intact $\phi_R = 0.8$ and failed system $\phi_R = 0.9$ where $\phi_R = \phi_N\phi_S\phi_Q\phi_C$"

Were strength (reduction) factors applied in the assessment of whether or not the design of the Labrador Island Link met the CAN/CSA-C22.3 No. 60826-10 standard for 1:150 and 1:500 year return periods? If so, please provide the strength (reduction) factors. If not, why not?

NP-NLH-055 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

The referenced standard CAN/CSA-C22.3 No. 60826-10 states in Section 7.2.2, on page CSA/15:

"Despite the prescription of a preferred sequence of failure, the line can fail in a different mode. For example, conductors can break due to overstressing caused by a collapsed tower rather than from overload. Dead-end insulators may also fail due to dynamic loads caused by adjacent tower failures."

Please confirm that all strength (reduction) and load factors specified in CAN/CSA-C22.3 No. 60826-10 were applied to <u>*all*</u> components on the Labrador Island Link to validate conformance to the 1:150 and 1:500 year return periods.

NP-NLH-056 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

The referenced standard CAN/CSA-C22.3 No. 60826-10 states in Section 7.2.2, on page CSA/15:

"Despite the prescription of a preferred sequence of failure, the line can fail in a different mode. For example, conductors can break due to overstressing caused by a collapsed tower rather than from overload. Dead-end insulators may also fail due to dynamic loads caused by adjacent tower failures."

Please confirm that all strength (reduction) and load factors specified in CAN/CSA-C22.3 No. 60826-10 were applied to all components on the planned 3rd 230kV transmission line from Bay D'Espoir to Western Avalon to validate conformance to the 1:150 return period specified for that line.

NP-NLH-057 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

The referenced standard CAN/CSA-C22.3 No. 60826-10 states in Section 6.2.1 on page 43:

"…the effects of acceleration due to funneling between hills or due to sloping grounds are not covered and may require specific studies to assess such influences."

Were amplification factors for topography and wind funneling applied in the assessment of whether or not the design of the Labrador Island Link met the CAN/CSA-C22.3 No. 60826-10 standard for 1:150 and 1:500 year return periods? If so, please provide the amplification factors. If not, why not?

NP-NLH-058 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

The referenced standard CAN/CSA-C22.3 No. 60826-10 states in Section 6.2.5 on page 47:

"τ is the air density correction factor. When limit wind speeds are known to be strongly correlated with an altitude and/or temperature significantly different from the assumptions of 15^{o}C and sea level, the correction factor τ given in Table 5 can be applied…"

Was the air density correction factor 'τ' applied by Hydro in its assessment of whether or not the design of the Labrador Island Link met

the CAN/CSA-C22.3 No. 60826-10 standard for 1:150 and 1:500 year return periods? If so, please provide the air density correction factors. If not, why not?

NP-NLH-059 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

The referenced standard CAN/CSA-C22.3 No. 60826-10 indicates in Table CA.1 Weather Data on page CSA/35 that the Reference Ice Thickness for St. John's is 42mm. Please explain why the source value of 42mm of freezing precipitation was not used for Loading Zone 11-4 of the Labrador Island Link which is located outside the 40mm ice contour.

NP-NLH-060 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

The referenced standard CAN/CSA-C22.3 No. 60826-10 which states in Section 6.4.4.4 on page 75:

"Basic meteorological and terrain information should be used to evaluate the probability of severe in-cloud icing along the line route, and the corresponding data should be introduced in the calculations. Otherwise, the values given for freezing rain may be used."

Please provide details of the rime ice *actually experienced* in each geographic zone along the Labrador Island Link route. In the response, please include the maximum amounts experienced, measured, or observed for each zone and provide a reference source for the data.

NP-NLH-061 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

The referenced standard CAN/CSA-C22.3 No. 60826-10 states in Section 6.3.6.3.1A on page CSA/14.

"Non-uniform ice loading examples where the structure is subjected to 70% of the design ice weight on the left or right spans while the other spans are loaded with 28% (40% of 70%) of the same design ice weight are illustrated in Figure 12 and Table 6."

Was the requirement for consideration of unequal ice accumulations in the CAN/CSA-C22.3 No. 60826-10 standard applied in the design of the Labrador Island Link and the planned 3rd 230kV transmission line from Bay D'Espoir to Western Avalon? If so please describe in detail. If not, why not?

NP-NLH-062 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

The referenced standard CAN/CSA-C22.3 No. 60826-10 states in Section 6.4.4.1 on page 73:

"Wind velocities associated with icing episodes can be calculated from data, if available or, when there is little or no data, from the following assumptions. In the latter case, the reference wind speed is multiplied by a reduction factor B_i [0.4-0.5]…"

The response to Request for Information NP-NLH-004 indicates that a reduction factor of 0.4 was used to determine ice loading for the combined wind and ice loading criteria for the Labrador Island Link. Why has the minimum of the range (0.4 to 0.5) been selected? In your response, please indicate how Hydro incorporated Exhibit 95 - *Evaluation of in-cloud icing in the Long Range Mountain Ridge* from the Muskrat Falls Review which implies on page 50 of 96 that a factor of 0.5 is more appropriate.

NP-NLH-063 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

The referenced standard CAN/CSA-C22.3 No. 60826-10 states in Section 6.4.4.1 on page 73:

"Wind velocities associated with icing episodes can be calculated from data, if available or, when there is little or no data, from the following assumptions. In the latter case, the reference wind speed is multiplied by a reduction factor B_i…"

Was data concerning wind velocities associated with actual icing episodes available in the development of the design criteria for the Labrador Island Link? If so, please provide details on how this weather data was used to develop the combined wind and ice loading criteria.

NP-NLH-064 Reference: CAN/CSA-C22.3 No. 60826-10, Design Criteria of Overhead Transmission Lines

The referenced standard CAN/CSA-C22.3 No. 60826-10 states in Section 6.4.5 on page 75:

"Wherever possible, drag coefficients for ice covered conductors should be based on actual measured values. In the absence of this data, the effective drag coefficients and ice densities are given in Table 8."

Please indicate the drag coefficients used in each geographic zone for the Labrador Island Link and the planned 3rd 230kV transmission line from Bay D'Espoir to Western Avalon. If drag coefficients equal to 1.0 were used, please explain why.

NP-NLH-065 Reference: Muskrat Falls Review: Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System, Manitoba Hydro International, January 2012

Page 11 of the Manitoba Hydro International Report on Two Generation Expansion Alternatives for the Island Interconnected System states:

"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 provide the design loading criteria for the Labrador Island Link that was provided to Manitoba Hydro International in its review of the two generation expansion alternatives.

NP-NLH-066 Reference: Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options, October 2012 (http://powerinourhands.ca/pdf/MHI.pdf)

The Manitoba Hydro International Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options states at Page 47:

"The 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 describe in detail, any changes to the ***design loading criteria*** of the Labrador Island Link made between Manitoba Hydro International's Report on Two Generation Expansion Alternatives for the Island Interconnected System in January 2012 and Manitoba Hydro International's Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options in October 2012.

NP-NLH-067 Reference: Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options, October 2012 (http://powerinourhands.ca/pdf/MHI.pdf)

The Manitoba Hydro International Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options states at Page 47:

"The 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 describe in detail, any changes to the ***design*** of the Labrador Island Link made between Manitoba Hydro International's Report on Two Generation Expansion Alternatives for the Island Interconnected System in January 2012 and Manitoba Hydro International's Review of the Muskrat Falls and Labrador Island HVdc Link and the Isolated Island Options in October 2012.

NP-NLH-068 Reference: Muskrat Falls Review: Exhibit 30 – Lower Churchill Project Design Progression, Sections 6: Basis of Design

Section 6.1 of Exhibit 30 – Lower Churchill Project Design Progression indicates that the Basis of Design for the Lower Churchill Project as *"A compilation of the fundamental criteria, principles and/or assumptions upon which Design Philosophies and Engineering Design Briefs will be developed."*

Exhibit 30, which is dated July 10, 2011, further indicates that the HVAC and HVDC transmission lines as well as the electrode lines for the Lower Churchill Project are designed to a "50 year reliability level return period of loads".

Please explain in detail, if and how Hydro has adopted a new 'Basis of Design' since July 10, 2011 to ensure the design of the Labrador Island Link meets the CAN/CSA-C22.3 No. 60826-10 1:500-year return period on the Avalon Peninsula and a 1:150 year return period on all other sections of the line.

NP-NLH-069 Reference: Muskrat Falls Review: Exhibit 85 – Reliability Study of Transmission Lines on the Avalon and Connaigre Peninsulas

Please explain in detail, the extent to which Exhibit 85 - Reliability Study of Transmission Lines on the Avalon and Connaigre Peninsulas conducted by Asim Haldar, Ph.D., P.Eng in April 1996 was considered in developing the design criteria for the Labrador Island Link.

NP-NLH-070 Reference: Muskrat Falls Review: Exhibit 85 – Reliability Study of Transmission Lines on the Avalon and Connaigre Peninsulas

Exhibit 85 – Reliability Study of Transmission Lines on the Avalon and Connaigre Peninsulas, states on page 4 of 212:

"It is shown clearly that these load values far exceed the original design loads and even a 5-year return period ice load exceeds the ultimate capacities of many of these lines on the Avalon Peninsula. This indicates that the reliability of the line is very low and does not meet the commonly accepted target design loading of 50-year return period which is estimated to be 3.0 inches (75mm) radial of glaze ice."

Given that Hydro's own data and experience indicates that the 1:50 year ice load on the Avalon Peninsula is 75mm, please explain in detail, why Hydro chose instead to use the 1:50 year reference ice load of 40mm from Figure CA.10 of CAN/CSA-C22.3 No. 60826-10 to calculate the 1:500 year return period load?

NP-NLH-071 Reference: Muskrat Falls Review: Exhibit 92: The Lower Churchill Project, DC1070 – Preliminary Meteorological Load Review

Were *any* of the findings, recommendations, or data provided in Exhibit 92 – The Lower Churchill Project, DC1070 – Preliminary Meteorological Load Review used in the development of the design criteria for the Labrador Island Link? If so, please explain in detail. If not, why not?

NP-NLH-072 Reference: Muskrat Falls Review: Exhibit 92: The Lower Churchill Project, DC1070 – Preliminary Meteorological Load Review

Please complete the following table based on data provided in Exhibit 92 - The Lower Churchill Project, DC1070 – Preliminary Meteorological Load Review:

Table 1: LITL Climatic Design Criteria
Based on Muskrat Falls Review: Exhibit 92

Loading	Ice (mm)	Type	Wind (km/hr)	Combined		
				Ice (mm)	Type	Wind (km/Hr)
C1						
C2						
C3						
C4						
C5						
C6						

NP-NLH-073 Reference: Muskrat Falls Review: Exhibit 92: The Lower Churchill Project, DC1070 – Preliminary Meteorological Load Review

What were the complete tower loading cases used for designing towers based on Exhibit 92 - The Lower Churchill Project, DC1070 – Preliminary Meteorological Load Review?

NP-NLH-074 Reference: Muskrat Falls Review: Exhibit 92: The Lower Churchill Project, DC1070 – Preliminary Meteorological Load Review

Please provide a comprehensive list of tower loading cases used for designing and evaluating all tower types based on the data provided in Hydro's response to Request for Information NP-NLH-004.

NP-NLH-075 Reference: Muskrat Falls Review: Exhibit 92: The Lower Churchill Project, DC1070 – Preliminary Meteorological Load Review

Were the costs associated with constructing the Labrador Island Link using the information provided in Exhibit 92 – The Lower Churchill Project, DC1070 – Preliminary Meteorological Load Review analyzed? If so, please provide any reports or data relating to the analysis.

NP-NLH-076 Reference: Muskrat Falls Review: Exhibit 92: The Lower Churchill Project, DC1070 – Preliminary Meteorological Load Review

Was the decision not to use recommendations of Exhibit 92 - The Lower Churchill Project, DC1070 – Preliminary Meteorological Load Review related in any way to the total costing of the Muskrat Falls project?

NP-NLH-077 Reference: Muskrat Falls Review: Exhibit 95: Evaluation of in-cloud icing in the Long Range Mountain Ridge

Please provide any studies, besides Exhibit 95 – Evaluation of in-cloud icing in the Long Range Mountain Ridge, that were relied upon for in-cloud or rime icing data in the design of the Labrador Island Link.

NP-NLH-078 Reference: Muskrat Falls Review: Exhibit 95: Evaluation of in-cloud icing in the Long Range Mountain Ridge

Exhibit 95 – Evaluation of in-cloud icing in the Long Range Mountain Ridge states at page 34 of 96:

"The WObs [Weather Observation]icing model was used with weather observation data from Daniel's Harbour to evaluate the capacity of the model to capture the measured icing in test span 2009-1."

Please describe whether or not the terrain type, surrounding topography, and elevation above sea level for Daniel's Harbour and the 2009-1 test site are similar enough to evaluate the capacity of the model to capture the measured icing in test span 2009-1?

NP-NLH-079 Reference: Muskrat Falls Review: Exhibit 96: Evaluate extreme ice loads from freezing rain for Newfoundland and Labrador Hydro

Table 5 on page 59 of 109 of Exhibit 96 - Evaluate extreme ice loads from freezing rain for Newfoundland and Labrador Hydro indicates that the 200 year return period for ice on the Avalon Peninsula is 87mm.

Table 1 on page 10 of 57 of the response to Request for Information NP-NLH-004 indicates that the ice loading criteria for the Labrador Island Link along the Avalon Peninsula, which meets a CSA 1:500 year return period is 75mm.

Please explain how the 75mm ice loading criteria for the Avalon Peninsula can be considered sufficient when the information provided in Exhibit 96, which is relied on by Hydro, indicates that 75mm would not even meet a 200-year return period.

NP-NLH-080 Reference: *Extreme Weather Studies by Using Modern Meteorology* (B2-202 CIGRE 2012) prepared by Fikke et al

Is Hydro familiar with the following remarks on page 7 of the article, *Extreme Weather Studies by Using Modern Meteorology* (B2-202 CIGRE 2012) prepared by Fikke et al. which states:

"It has been shown in this paper that up-to-date meteorological weather forecasting models can be applied for detailed studies of atmospheric icing in remote areas where no adequate data for such icing is available. The content of liquid water and droplet sizes within clouds are calculated from physical methods. Although local field measurements always will be valuable to check and to complete model results, no such data are in principle necessary. In order to establish design loads with certain return periods of occurrence such model studies should be linked with long time series of regular meteorological data whenever possible.

Potential events of wet snow are relatively easy to obtain from regular weather data. Rime icing cases are less obvious to detect from the similar data and therefore great care should be taken for this selection."

Please explain in detail, if Hydro agrees that data for any long time series of meteorological data should be used in the design of transmission lines that would experience icing in remote areas and whether or not any such

data was used to design the Labrador Island Link. If no long time series data has been used, please explain why not.

NP-NLH-081 Reference: Cost Action 727 WG1 – Review of Results, IWAIS XIII, Andermatt, September 8-11, 2009, Lasse Makkonen

Is Hydro familiar with the report Cost Action 727 WG1 – Review of Results? If so, please comment on the modeling difficulties referenced in the document and describe in detail how these difficulties were considered and addressed in the development of the design criteria for the Labrador Island Link.

RESPECTFULLY SUBMITTED at St. John's, Newfoundland and Labrador, this 1st day of June, 2015.

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