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 regulations thereunder; and

IN THE MATTER OF Newfoundland and Labrador Hydro's Reliability and Resource Adequacy Study.

Requests for Information by
Newfoundland Power Inc.

NP-NLH-001 to NP-NLH-054

June 30, 2020

Requests for Information

NP-NLH-001 Reference: Hydro's April 30, 2020 letter Re: Reliability and Resource Adequacy Study Review – Assessment of As-Designed Capacity of the Labrador-Island Link.

"Not surprisingly, there are differences between this expert information and previous expert information provided to the Board of Commissioners of Public Utilities ("Board"). Newfoundland and Labrador Hydro ("Hydro") notes the observed discrepancies between the expert reports will be examined carefully considering the individual load case results, as well as the assumptions used by each expert consultant, so that the basis for the discrepancies will be understood and ultimately considered in the line reliability assessment."

Has Hydro completed its examination of the discrepancies between the expert reports? If so, please provide detailed comments on the discrepancies and the implications for the reliability assessment. If not, when does Hydro plan to complete the examination and provide its views?

NP-NLH-002 Reference: Hydro's April 30, 2020 letter Re: Reliability and Resource Adequacy Study Review – Assessment of As-Designed Capacity of the Labrador-Island Link.

"EFLA's report will be used together with the Assessment of LIL Reliability in Consideration of Climatological Loads, currently underway by Haldar & Associates Ltd., to inform Hydro's probabilistic failure analysis in determining overall line reliability."

Please provide a detailed overview of the work being undertaken by Haldar & Associates including: (i) the scope of the work assigned by Hydro; (ii) the methodology being employed; (iii) the use of local weather data; (iv) similar assessments that Haldar & Associates, or its principals, have undertaken in the past; and (v) how Haldar & Associates' methodology compares to industry standards for assessing transmission line reliability.

NP-NLH-003 Reference: Hydro's April 30, 2020 letter Re: Reliability and Resource Adequacy Study Review – Assessment of As-Designed Capacity of the Labrador-Island Link.

"EFLA's report will be used together with the Assessment of LIL Reliability in Consideration of Climatological Loads, currently underway by Haldar & Associates Ltd., to inform Hydro's probabilistic failure analysis in determining overall line reliability."

Please provide a detailed description of the work that Haldar & Associates, or its principals, completed in relation to the LIL prior to the work that is currently underway.

NP-NLH-004 Reference: Hydro's April 30, 2020 letter Re: Reliability and Resource Adequacy Study Review – Assessment of As-Designed Capacity of the Labrador-Island Link.

"EFLA's report will be used together with the Assessment of LIL Reliability in Consideration of Climatological Loads, currently underway by Haldar & Associates Ltd., to inform Hydro's probabilistic failure analysis in determining overall line reliability."

Please explain what information in the EFLA report will be used in Haldar & Associates' assessment of LIL reliability and how that information will be used in the assessment.

NP-NLH-005 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 5.

"The study concludes that overall, the LITL fulfills the CSA-50 loading and is close to fulfilling the CSA-150 loading…"

Section A.1.2.5 – Selection of reliability levels in the CSA Standard CAN/CSA C22.3 No. 60826-10 describes three reliability levels for transmission lines (50, 150, and 500 year return periods). What does EFLA consider to be the appropriate reliability level for the LIL? In the response, please explain EFLA's reasoning.

NP-NLH-006 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, pages 5-6.

"The OPGW conductor has utilization exceedance up to 9% in the load case "Ice and Wind" in zones 3b, 4a, 4b, 6 and 10. The maximum utilization in the study was set at the damage limit of 80% of RTS. The increased utilization may lead to permanent elongation of the OPGW, however it is within the failure limit and should not break or result in a line outage. It may therefore be possible to accept a higher utilization value in few spans provided it is well below the failure limit. The strength capacity corresponds to approximately 90 years return period of loading."

Please provide the tensions limits of the OPGW as specified by Nalcor/Hydro and as provided by the manufacturer of the OPGW.

NP-NLH-007 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, pages 5-6.

“The OPGW conductor has utilization exceedance up to 9% in the load case “Ice and Wind” in zones 3b, 4a, 4b, 6 and 10. The maximum utilization in the study was set at the damage limit of 80% of RTS. The increased utilization may lead to permanent elongation of the OPGW, however it is within the failure limit and should not break or result in a line outage. It may therefore be possible to accept a higher utilization value in few spans provided it is well below the failure limit. The strength capacity corresponds to approximately 90 years return period of loading.”

Did EFLA calculate ice loading for the OPGW in accordance with Section 6.3.2 – Ice Data of CSA Standard *CAN/CSA C22.3 No. 60826-10* which recommends to use the same linear unit weight of ice as for the LIL phase conductors? If not, why not?

NP-NLH-008 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, pages 5-6.

“The OPGW conductor has utilization exceedance up to 9% in the load case “Ice and Wind” in zones 3b, 4a, 4b, 6 and 10. The maximum utilization in the study was set at the damage limit of 80% of RTS. The increased utilization may lead to permanent elongation of the OPGW, however it is within the failure limit and should not break or result in a line outage. It may therefore be possible to accept a higher utilization value in few spans provided it is well below the failure limit. The strength capacity corresponds to approximately 90 years return period of loading.”

In EFLA’s view, how should the limitations highlighted regarding the OPGW be considered in determining the overall reliability level of the LIL? In the response please explain how the overall reliability of the LIL may be limited by the reliability of the OPGW.

NP-NLH-009 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 11.

Please define the terms (i) as-designed, (ii) DESIGN; and (iii) as-built and explain how these terms are used in the EFLA report.

NP-NLH-010 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 11.

"Data from these three tasks, once completed, will be used in the development of the final report titled "Reliability Assessment of LITL considering Climatological Loads."

Please confirm that the "final report" referred to is the one now being prepared by Haldar & Associates for submission in this proceeding.

NP-NLH-011 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 11.

"The original design of the LITL here defined as "DESIGN" was based on the design principles of CAN/CSA-C22.3 No 60826-10 (CSA), using operational experience and special studies in the determination of climatic loads."

Was EFLA's assessment based on the original design of the LIL or a modified design that followed changes made to improve its reliability?

NP-NLH-012 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 23.

"Adjustments recommended by EFLA to accommodate CSA 60826-10 loadings were incorporated into the PLS-Cadd design files for the analysis. EFLA independently checked results in few PLS-Cadd and PLS-Tower models and Nalcor reviewed and commented to assumptions."

Please provide details of all recommended adjustments that were made by EFLA including whether those recommendations led to reductions or increases in weather loadings.

NP-NLH-013 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 23.

"PLS-Cadd software was used to calculate forces in all towers and cable sections based on settings from the "as-design" line using the ruling span concept (Level 1) analysis."

Did EFLA conduct any Finite Element analysis of the LIL including the use of the PLS-Cadd Finite Element analysis tool? If so, please provide the results of the analysis. If not, why not?

NP-NLH-014 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 23.

"A review of tower models, tower detailing and tower design was not part of the scope of this study."

Please explain the reasoning for EFLA to make changes to the PLS-CADD and PLS-Tower files, as described on the bottom of page 23 and the top of page 24 of the EFLA report, when a review of tower models, tower detailing and tower design were not part of the scope for the EFLA study.

NP-NLH-015 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, pages 23-24.

"Following modifications were made to the PLS-Cadd and PLS-Tower files for the analysis:

- *Loading was modified into CSA loading, as described in chapter 3.2. The PLS-Cadd option "IEC 60824:2017F" was selected instead of using "Wind on face" as done in the design.*
- *Stiffness of a few elements in seven suspension towers was reduced by a factor 10 to create more realistic force distribution in the tower members.*
- *Improvements were made of the modeling of the earth wire peak in tower 1219(A1) to better represent reality.*

Please provide the utilization factors for the affected towers before and after the noted modifications were made to the PLS-Cadd and PLS-Tower files.

NP-NLH-016 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 25.

"Damage limit 75% of the characteristic strength or rated tensile strength (typical range in 70% to 80%)"

Please explain why EFLA used an 80% utilization tension limit as opposed to the 75% damage limit referenced above, or values as low as 60% as shown in Table 12.

NP-NLH-017 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 26.

"In most standards, the safety factor for the tension hardware is equal or greater than that for the suspension hardware. In the LITL design requirements, the requirement is reversed, i.e. the suspension hardware has a safety factor of 2 and the tension hardware safety factor is 1.44 when the conductor is utilized at 80% of RTS. The safety factor of 2 is considered as rather high when compared with other design standards while 1.44 may be on the lower end for the tension hardware."

Please explain why the LIL was designed with a safety factor of tension hardware that is lower than the safety factor of suspension hardware.

NP-NLH-018 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 26.

"This study considers only load cases that influence the reliability of the LITL, i.e., load cases related to wind, ice, and a combination of wind plus ice. All load cases related to security level and safety level are ignored."

In EFLA's view, is it appropriate to assess the reliability of a transmission line without considering load cases related to security and safety? If not, please explain why EFLA did not consider load cases related to security and safety in its report.

NP-NLH-019 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, pages 26-27.

"Following assumptions/simplifications are made in the study:

- *Assumptions from the design of LITL are followed unless they conflicted with CSA Standard.*
- *Wind direction is assumed transversal, 45^{o}, or longitudinal to spans.*
- *Ice load on tower members is assumed the same as radial ice on a conductor."*
- *Load cases contain only uniform ice formation.*
- *Load cases not relevant to reliability analysis were removed from the analysis.*
- *The unbalance ice load case was removed from the analysis as it was generally not the controlling load case.*
- *Due to the size of the LITL the designers needed to split the PLS-Cadd model into separate models, 37 models were used. The towers on the end of each model is studied in less detail than other towers in this document."*

Please provide a list of LIL design assumptions that EFLA found to conflict with the CSA standard.

NP-NLH-020 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, pages 26-27.

"Following assumptions/simplifications are made in the study:

- *Assumptions from the design of LITL are followed unless they conflicted with CSA Standard.*
- *Wind direction is assumed transversal, 45º, or longitudinal to spans.*
- *Ice load on tower members is assumed the same as radial ice on a conductor."*
- *Load cases contain only uniform ice formation.*
- *Load cases not relevant to reliability analysis were removed from the analysis.*
- *The unbalance ice load case was removed from the analysis as it was generally not the controlling load case.*
- *Due to the size of the LITL the designers needed to split the PLS-Cadd model into separate models, 37 models were used. The towers on the end of each model is studied in less detail than other towers in this document."*

Please explain how EFLA's assumptions of only uniform ice loads on towers are consistent with Section *6.3.6.3 - Non-uniform ice formation on phase conductors and ground wires* of the CSA Standard CAN/CSA C22.3 No. 60826-10.

NP-NLH-021 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, pages 26-27.

"Following assumptions/simplifications are made in the study:

- *Assumptions from the design of LITL are followed unless they conflicted with CSA Standard.*
- *Wind direction is assumed transversal, 45º, or longitudinal to spans.*
- *Ice load on tower members is assumed the same as radial ice on a conductor."*
- *Load cases contain only uniform ice formation.*
- *Load cases not relevant to reliability analysis were removed from the analysis.*
- *The unbalance ice load case was removed from the analysis as it was generally not the controlling load case.*
- *Due to the size of the LITL the designers needed to split the PLS-Cadd model into separate models, 37 models were used. The towers on the end of each model is studied in less detail than other towers in this document."*

Please provide the analysis completed by EFLA to validate its assumption that unbalance ice load was generally not the controlling load case.

NP-NLH-022 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, pages 28-29.

"Further explanation of design loading assumptions:

- *One type of ice was considered in each loading zone based on the dominant icing type. Rime ice was specified in zones 2a-2c, 5 and, 7a-7c. Glaze ice was specified in other zones. Rime icing is the critical icing loading case for 158 km (15%) of the line and the glaze ice for 922 km (85%).*
- *Terrain roughness category for the wind was assessed as category B for areas with rime ice (i.e. zones 2a, 2b, 2c, 5, 7a, 7b and 7c) but category C for all other areas.*
- *Wind speeds were increased in zones 2a-2c, 5, 7a-7c and 9 partly to account for local topographical effects. The wind speeds were increased by a factor of 1.64 in zone 7a, 7b and 7c compared to values specified in CSA/CAN. Topography effects were not considered in other loading zones."*

Please explain why EFLA's assumption regarding terrain roughness is different from Section 6.2.2 Terrain roughness of the CSA Standard CAN/CSA C22.3 No. 60826-10 which states *"Terrain type B is representative of the majority of lines and should lead to acceptable results in all areas except in flat coastal areas, where a terrain type A should be used."*

NP-NLH-023 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 35.

"Following assumptions are made in the study:

- *In this study, a wind speed of $0.6 \cdot V_R$ is used for the load case "Wind and Ice" in case of glaze ice.*
- *All design in the LITL was based on using radial ice in the PLS-Cadd models. It was not possible to define the ice load in "Wind and Ice" as $0.40 \cdot G_R$ without considerable modification. Therefore, a simple approach was made with approximating the loading as 0.58 of the radial ice loading. It overestimates the icing in case of pole conductor and electrode conductor but slight underestimation in case of small OPGW with high ice load.*
- *In this study, a wind speed of $0.4 \cdot V_R$ is used for the load case "Ice and Wind" in case of glaze ice.*
- *The drag coefficient of conductor covered with glaze ice is assumed = 1.0, which is recommended in Table 8 of the CSA 60826-10 standard."*

Please explain why EFLA assumed the bottom of the range of values for wind speed ($0.6 \cdot V_R$ and $0.4 \cdot V_R$) in both the "Wind and Ice" and "Ice and Wind" loading combinations.

NP-NLH-024 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 50.

"All suspension towers have sufficient structural capacity when analyzed with the CSA-50 loading and DESIGN loads. With the CSA-150 loading majority of the suspension towers are below 80% utilization and eight towers have a maximum utilization up to 104% in zone 3a and 11-4 under "Wind + Ice" load case."

Please complete the Wind + Ice load case for the suspension towers with a wind speed of $0.85 \cdot V_R$ as opposed to the $0.6 \cdot V_R$ used by EFLA. In the response please detail the number of towers that are above 80% and 100% utilization for the CSA-50, CSA-150, and CSA-500 loadings and provide a table, similar to Table 20.

NP-NLH-025 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 50.

"All suspension towers have sufficient structural capacity when analyzed with the CSA-50 loading and DESIGN loads. With the CSA-150 loading majority of the suspension towers are below 80% utilization and eight towers have a maximum utilization up to 104% in zone 3a and 11-4 under "Wind + Ice" load case."

Please complete the Wind + Ice load case analysis for the suspension towers with (i) a wind speed of $0.85 \cdot V_R$ as opposed to the $0.6 \cdot V_R$, and (ii) terrain category B in places where Nalcor/Hydro elected to use terrain category C. In the response please detail the number of towers that are above 80% and 100% utilization for the revised CSA-50, CSA-150, and CSA-500 loadings and provide a table, similar to Table 20.

NP-NLH-026 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 50.

"All suspension towers have sufficient structural capacity when analyzed with the CSA-50 loading and DESIGN loads. With the CSA-150 loading majority of the suspension towers are below 80% utilization and eight towers have a maximum utilization up to 104% in zone 3a and 11-4 under "Wind + Ice" load case."

Please complete the Wind + Ice load case analysis for the suspension towers with terrain category B in places where Nalcor/Hydro elected to use terrain category C. In the response please detail the number of towers that are above 80% and 100% utilization for the revised CSA-50, CSA-150, and CSA-500 loadings and provide a table, similar to Table 20.

NP-NLH-027 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 51.

"The "Strain Margin" type test [12] indicate that the optical fibres permanent attenuation in signal was below the limits specified in IEEE Std. 1138-2009 when tested up to the RTS."

Please explain how Hydro would diagnose a failure of the OPGW optical fibres and describe the work and the duration of the work that would be required to make repairs?

NP-NLH-028 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 51.

"The "Strain Margin" type test [12] indicate that the optical fibres permanent attenuation in signal was below the limits specified in IEEE Std. 1138-2009 when tested up to the RTS."

Please provide a detailed technical explanation of how the OPGW optical fibres are able to withstand permanent elongation/attenuation and continue to function appropriately when subjected to ice loads in multiple spans at 109% RTS.

NP-NLH-029 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 51.

"With CSA-150 loading, the utilization of the electrode and the pole conductor is within limits, but the OPGW exceeds the limits in five loading zones with maximum exceedance of 9.3% (124kN) under "Ice and Wind" load case."

Please complete the Ice and Wind load case analysis for the OPGW with a wind speed of $0.5 \cdot V_R$ as opposed to the $0.4 \cdot V_R$. In the response please detail the number of towers that are above 80% and 100% utilization for the revised CSA-50, CSA-150, and CSA-500 loadings and provide a table, similar to Table 20.

NP-NLH-030 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 51.

"With CSA-150 loading, the utilization of the electrode and the pole conductor is within limits, but the OPGW exceeds the limits in five loading zones with maximum exceedance of 9.3% (124kN) under "Ice and Wind" load case."

Please complete the Ice and Wind load case analysis for the OPGW with (i) a wind speed of $0.5 \cdot V_R$ as opposed to the $0.4 \cdot V_R$, and (ii) terrain category B in places where Nalcor/Hydro elected to use terrain category C. In the response please detail the number of towers that are above 80% and 100% utilization for the revised CSA-50, CSA-150, and CSA-500 loadings and provide a table, similar to Table 20.

NP-NLH-031 Reference: *Structural Capacity Assessment of the Labrador Island Transmission Link (LITL)*, EFLA, April 28, 2020, page 55.

"The following work can be undertaken to improve the understanding of the strength capacity of the line and its critical components

- *Complete an updated rime ice study and strength assessment of the key components*
- *Assess the impact of an OPGW failure on the suspension towers when subjected to heavy ice loads. The effect of impulse loading on the tower must be assessed when the OPGW fails to understand the level of failure that can be expected. Will the failure cause an entire tower failure or simply a failure of the earth peak?*

Has Hydro completed its assessment of the impact of an OPGW failure on the suspension towers when subjected to heavy ice loads? If so, please provide the results. If not, when will the results of the assessment be available?

NP-NLH-032 Reference: Hydro's June 4, 2020 Reliability and Resource Adequacy Technical Conference Presentation, Slide 72.

"For the EFLA assessment, local conditions were not considered. This will be addressed in Activity 2 as part of a sensitivity analysis completed for selected segments by Haldar & Associates."

Please provide details of the sensitivity analysis that is to be undertaken by Haldar & Associates. In the response please explain whether the sensitivity analysis will be based upon modifications to assumptions used in the CSA Standard CAN/CSA C22.3 No. 60826-10 relating to terrain roughness (K_R), reference wind speed (V_R), reference design wind speed (g_R) etc.

NP-NLH-033 Reference: *Reliability and Resource Adequacy Study – 2019 Update*, November 15, 2019, Volume 1: Study Methodology and Planning Criteria, Attachment 1, page 7, Footnote 16.

Please provide a copy of the Northeast Power Coordinating Council ("NPCC") Reliability Assessment for Winter 2019-20.

NP-NLH-034 Reference: *Reliability and Resource Adequacy Study – 2019 Update*, November 15, 2019, Volume 1: Study Methodology and Planning Criteria, Attachment 1, page 7, Footnote 16.

To assess potential resource shortages, the NPCC Reliability Assessments consider: (i) two different system conditions (Base Case and Severe Case); and (ii) an Expected Peak demand forecast and an Extreme Peak demand forecast. Has Hydro considered using the NPCC approach as a part of its Reliability and Resource Adequacy Study? If so, please provide Hydro's views and observations on this approach. If not, why not?

NP-NLH-035 Reference: *Reliability and Resource Adequacy Study – 2019 Update*, November 15, 2019, Volume 1: Study Methodology and Planning Criteria, Attachment 1, page 7, Footnote 16.

Is Hydro aware of the extent to which extreme load conditions are used in other jurisdictions as part of system planning criteria or reliability assessments? If so, please provide information on how extreme load conditions are defined and used by the other jurisdictions.

NP-NLH-036 Reference: *Reliability and Resource Adequacy Study – 2019 Update*, November 15, 2019, Volume III: Long-Term Resource Plan, Section 7.2.6 – Assessment of the LIL Bipole Outage Scenario.

Hydro provides three visuals (Figures 4, 5, and 6) that show the exposure for unserved energy if the outage were to occur on the peak day in the test year, for three weeks at the period of highest annual demand requirements, and the load duration curve for the same period, respectively. Please provide the data used to produce these figures in Microsoft Excel format.

NP-NLH-037 Reference: *Reliability and Resource Adequacy Study – 2019 Update*, November 15, 2019, Volume III: Long-Term Resource Plan, Section 7.2.6 – Assessment of the LIL Bipole Outage Scenario.

Please provide the load required to be served on the Avalon Peninsula during the same date-time intervals as provided in the response to NP-NLH-036. Please provide the data in Microsoft Excel format.

NP-NLH-038 Reference: *Engineering Support Services for: Avalon Capacity Study*, TransGrid Solutions, May 23, 2019, Section 1.1 – Conclusions.

Please provide (i) the capacity limit of the 230 kV transmission corridor between Bay d'Espoir and Soldiers Pond under normal operation of Hydro's transmission planning criteria, and (ii) the equivalent amount of load served by the 230 kV transmission corridor between Bay d'Espoir and Soldiers Pond at this capacity limit.

NP-NLH-039 Reference: *Engineering Support Services for: Avalon Capacity Study*, TransGrid Solutions, May 23, 2019, page 3, Footnote 8.

"With the LIL out of service, transmission losses will increase as a function of dispatch and the location of incremental generation added to meet the capacity shortfall. Under peak load conditions, Island demand can exceed 1900 MW with the LIL out of service."

Please provide the peak load forecast scenario in which Island demand exceeds 1900 MW with the LIL out of service. In what year is this peak load observed?

NP-NLH-040 Reference: *Engineering Support Services for: Avalon Capacity Study*, TransGrid Solutions, May 23, 2019, page 8, Table 2-2.

Please provide the equivalent customer load (demand *minus* station service and transmission losses) on the Island Interconnected System at the Island Demand levels shown in Table 2-2.

NP-NLH-041 Reference: *Engineering Support Services for: Avalon Capacity Study*, TransGrid Solutions, May 23, 2019, page 8, Table 2-2.

Please provide the customer load (demand *minus* station service and transmission losses) capable of being supplied by the 230 kV transmission corridor between Bay d'Espoir and Soldiers Pond at the Island Demand levels shown in Table 2-2.

NP-NLH-042 Reference: *TP-TN-068 – Application of Emergency Transmission Planning Criteria for a Labrador Island Link Bipole Outage*, July 30, 2019, Section 4 – Base Case Analysis.

Please list all contingencies analyzed for both base cases (Base Case 1 and Base Case 2).

NP-NLH-043 Reference: *TP-TN-068 – Application of Emergency Transmission Planning Criteria for a Labrador Island Link Bipole Outage*, July 30, 2019, Section 4 – Base Case Analysis.

Please complete the following table for each contingency for both base cases. (Customer Load means aggregate demand *minus* station service and transmission losses.)

Contingency	**Power Transfer Limit Eastward out of BDE (MW)**	**Customer Load Eastward out of BDE (MW)**

NP-NLH-044 Reference: *TP-TN-068 – Application of Emergency Transmission Planning Criteria for a Labrador Island Link Bipole Outage*, July 30, 2019.

Please provide the peak load served on the Island Interconnected System and the load served through the 230 kV transmission corridor east of Bay D'Espoir for both the Avalon Capacity Study and the TP-TN-068 – Transmission Planning Technical Note. In the response please state the forecast year and whether the forecasts are P50 or P90.

NP-NLH-045 Reference: *Engineering Support Services for: Stage 4D LIL Bipole: Transition to High Power Operation*, TransGrid Solutions, April 7, 2020, Section 3.2.3.

What will be the implications of restricting the pre-contingency power flow on supply requirements on the Avalon if customer impacts are to be avoided prior to the decommissioning of production from Holyrood Thermal Generating Station and the Hardwoods Gas Turbine?

NP-NLH-046 Reference: *Engineering Support Services for: Stage 4D LIL Bipole: Transition to High Power Operation*, TransGrid Solutions, April 7, 2020, Section 3.2.3.

If tuning the power systems stabilizers does not eliminate the eletromechanical oscillations, what will be the implication of restricting the pre-contingency power flow on supply requirements on the Avalon if customer impacts are to be avoided after decommissioning of production from the Holyrood Thermal Generating Station and the Hardwoods Gas Turbine?

NP-NLH-047 Reference: Response to Request for Information P2-CA-NLH-146.

Please provide the most recent version of NERC Transmission Planning Standard TPL-001-4.

NP-NLH-048 Reference: Response to Request for Information P2-CA-NLH-146.

Requirement R3, Part 3.2 of TPL-001-4, provides for assessment of the impact of extreme events. Further, Hydro's response to Request for Information P2-CA-NLH-146 indicates that severe contingencies have not been listed by Hydro as its transmission criteria is focused on N-1 contingences.

Would Hydro consider including a Bi-Pole outage to its near-term and long-term planning assessment list requiring ongoing assessment? If not please explain why.

NP-NLH-049 Reference: Response to Request for Information P2-CA-NLH-146

Please provide the basis or definition used in other jurisdictions to determine what is an extreme event in accordance with TPL-001-4 that requires ongoing assessment.

NP-NLH-050 Reference: Response to Request for Information P2-CA-NLH-146

Please provide a list of events on the Island Interconnected System that Hydro would consider to be an extreme event in accordance with TPL-001-4.

NP-NLH-051 Reference: Elias Ghannoum, Reliability Assessment of the Labrador Island Link, October 14, 2016, Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System - Phase Two, page 25.

The referenced evidence of Elias Ghannoum observes that the LIL is approximately 1,100 km long and will traverse at least four different climatic zones where the occurrence of maximum icing and wind appears to be uncorrelated. For that reason, Mr. Ghannoum's evidence states, the overall reliability level for the complete LIL will be lower than indicated by the return period of the lowest individual segment.

Does Hydro plan to consider the potential impact of the relative correlation of maximum icing and wind of different climatic zones in assessing the reliability of the LIL? If so, please indicate when Hydro's assessment of that issue will be available. If not, why not?

NP-NLH-052 Reference: *Reliability and Resource Adequacy Study – 2018,* November 16, 2018, Volume I: Study Methodology and Proposed Planning Criteria, Section 4.2.5 1– Transmission Modelling: LIL Reliability, Page 40, lines 16 through 17; Attachment 7, page 20, Table 13.

The report, at page 40, indicates the forced outage rate ("FOR") for the LIL is 0.56% per pole and 0.01% for the bi-pole (full link). Table 13 in Attachment 7 reflects similar numbers, assuming rounding, for the reliability of the LIL converters only. If the FOR used in the planning criteria only reflects converter outages, please provide the FOR for a complete HVDC reliability model, and comment on how this may impact the results of the near-term and long-term reliability assessments.

NP-NLH-053 Reference: *Reliability and Resource Adequacy Study – 2018,* November 16, 2018, Volume I: Study Methodology and Proposed Planning Criteria, Attachment 7, pages 21-23, Tables 15 - 18.

Tables 15 through 18 indicate a failure rate of 0.7656 f/yr. Please confirm that this indicates a bipole outage once every 1.3 years (1/0.7656). If not, please explain.

NP-NLH-054 Reference: Summary of Emergency Restoration Planning, Labrador-Island Link - Overland Transmission, Nalcor Energy, November 29, 2019, pages 19-20, provided as Attachment 1 to a letter to the Board from Hydro dated December 12, 2019.

"Table 5: Estimated Restoration Time by Tower Failure was created and refined by Nalcor Energy from the collective experience of the engineering and operations divisions post construction. It provides an estimated timeline for the restoration of power following a transmission line failure. A strategic analysis will commence in 2020 to evaluate the estimated number of towers that could fail in heavier loaded sections. Due to the design capacity of LITL, it is less probable that large segments of towers will fail. A proper engineering analysis of failure scenarios per region will identify the estimated number of tower failures, which can then be utilized to refine response time."

In Table 5, estimated times of up to 7 weeks are given for possible restoration times resulting from a failure of the LITL. Please advise on the status of the engineering analysis of failure scenarios per region that will identify the estimated number of tower failures and the estimated response times for such failures.

RESPECTFULLY SUBMITTED at St. John's, Newfoundland and Labrador, this 30th day of June, 2020.

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