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NEWFOUNDLAND POWER
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HAND DELIVERED

June 17, 2016

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 - Phase Two – Requests for Information NP-NLH-105 (Energy Supply Risk Assessment Report) and NP-NLH-106 to NP-NLH-154 (Teshmont Report)

Please find enclosed the original and 12 copies of Newfoundland Power's Requests for Information NP-NLH-105 in relation to the Energy Supply Risk Assessment Report and NP-NLH-106 to NP-NLH-154 in relation to the Teshmont Report regarding the above noted Application.

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,

Gerard Hayes
Senior Counsel

Enclosures

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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-105 to NP-NLH-154

June 17, 2016

Requests for Information

NP-NLH-105 Reference: *Energy Supply Risk Assessment*, *May 2016*, Page 18, Lines 18-22.

"For the purposes of this investigation, it was assumed that the Holyrood thermal units are de-rated in accordance with Table 4. These de-ratings were based on analysis and recommendations from Hydro's Asset Management team."

Table 4 – Assumed De-Rated Capacity for Holyrood Units

Unit	*Nameplate Rating (MW)*	*De-Rated Capacity (MW)*
Holyrood Unit 1	*175*	*150 (160 Emergency)*
Holyrood Unit 2	*175*	*150 (160 Emergency)*
Holyrood Unit 3	*150*	*140 (150 Emergency)*

Please explain whether or not Hydro has finalized the de-rated capacity of Holyrood Units 1, 2 and 3 on a go forward basis until the integration of the Muskrat Falls project?

NP-NLH-106 Please confirm that the probabilistic assessment conducted by Teshmont is intended to compare the anticipated future Island Interconnected System reliability (Post-HVDC systems) with the existing Island Interconnected System reliability (Pre-HVDC systems) which is comprised of legacy generation assets including the existing Holyrood Thermal Generating Station and other assets of various ages and reliability.

NP-NLH-107 Please confirm that the Teshmont Report contains a probabilistic assessment of reliability based upon anticipated average numbers of failures and average repair time.

NP-NLH-108 Please confirm that the Teshmont report does not provide any assessment of the possibility or the probability of extended outages or the extent or duration of any extended outages and the required repair time for such extended outages.

NP-NLH-109 Please indicate the extent, if any, to which Teshmont has reviewed or analyzed Hydro's estimate of a two week repair time for major system failures as indicated in the response to Request for Information PUB-NLH-299.

NP-NLH-110 Is it Teshmont's opinion that the Island Interconnected System must be designed and configured to respond to major system failures of extended duration and not simply to system averages?

NP-NLH-111 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Page 1, Line 26 to Page 2, Line 1.

"Hydro's current deterministic based Transmission Planning Criteria are similar to North American Electric Reliability Corporation (NERC) Transmission Planning standards; however, deviations from the NERC standards have been applied due to the isolated nature of the IIS and the potential cost impact of full compliance on the limited customer base."

Please list and explain the deviations that have been applied by Hydro to the NERC standards.

NP-NLH-112 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Page 1, Line 26 to Page 2, Line 1.

"Hydro's current deterministic based Transmission Planning Criteria are similar to North American Electric Reliability Corporation (NERC) Transmission Planning standards; however, deviations from the NERC standards have been applied due to the isolated nature of the IIS and the potential cost impact of full compliance on the limited customer base."

Please describe any expert opinions Hydro has obtained as to the appropriateness of the deviations from the NERC standards that have been applied.

NP-NLH-113 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Page 2, Footnote 2.

"There is no single universally accepted probabilistic reliability based value, or index, to demonstrate that a transmission network provides an acceptable level of reliability."

The statement seems to imply that there are multiple (as opposed to single) accepted probabilistic values or indices for transmission reliability. Please provide a list of known values or indices used to determine transmission line reliability, and indicate how they were established and how they are used.

NP-NLH-114 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 2 of 56.

"*System security, i.e. the ability of the system to transition between each pre- and post- contingency operating condition and remain stable, was not assessed in this study. That is to say, the analysis does not include transient outages, but focuses on sustained outages only."*

Please explain whether or not Teshmont considered the likelihood that the transient loss of a single pole or bipole on the Labrador Island Link would create a sustained outage.

NP-NLH-115 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 2 of 56.

"The reliability characteristics of the Labrador Island Link and Maritime Link were discussed in detail and compared to industry statistics."

Please explain the degree to which Teshmont reviewed the design of the Labrador Island Link and the Maritime Link with regards to tower design, component selection, wind loading, ice loading, and proximity to other transmission lines.

NP-NLH-116 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 2 of 56.

"The reliability characteristics of the Labrador Island Link and Maritime Link were discussed in detail and compared to industry statistics."

Please explain the degree to which Teshmont compared the criticality of the Labrador Island Link and the Maritime Link with the criticality of the other HVdc lines included in the industry statistics.

NP-NLH-117 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 2 of 56.

"Taking into account the forecasted duration of load levels throughout the year, the exposure to expected unserved energy due to outages of units G1 and G2 would be expected for up to 12% of the year. Meanwhile, the exposure to expected unserved energy due to all Holyrood units combined outage would be up to 18% of the year."

Please explain whether or not Teshmont has conducted any benchmarking analysis using actual Hydro electrical system performance to validate its probabilistic based transmission and generation assessments. If so, please describe how close the assessment reflects actual electrical system performance.

NP-NLH-118 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 4 of 56.

"This report presents the results of a probabilistic based reliability study that assesses the impact of the HVDC Links on the reliability of the IIS."

Please explain the extent to which Teshmont has reviewed responses to Requests for Information relating to Phase II of the Board's Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System since the report was initially drafted in 2014.

NP-NLH-119 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 20 of 56.

Please explain why Hydro used the 2008-2012 data to represent generating unit performance and not a more recent period?

NP-NLH-120 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 20 of 56.

Please explain why Hydro used the 2009-2013 data to represent transmission line performance and not a more recent period?

NP-NLH-121 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 22 of 56.

"Furthermore, some of the Holyrood unit outages were extensive in duration as repairs were not performed immediately in cases when units were scheduled to come offline in the spring. These cases were considered extreme in duration and unrepresentative of the reliability of the generating units."

Please describe the extent to which the cases that were considered extreme in duration were included or excluded in the Teshmont's probabilistic assessment. In the response please indicate how this assumption impacted Teshmont's results.

NP-NLH-122 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 23 of 56.

"…Nalcor advised that the outages for TL201 and TL208 should be excluded from the calculations [25]. It was explained that TL201 had insulator issues that were recently discovered and that have affected its reliability in the past five years, and that TL208 had no customers for a prolonged period of time and failures were repaired at a lower priority."

Please explain why it is appropriate to remove the effects of known insulator issues on TL 201 transmission line outages from the probabilistic analysis.

NP-NLH-123 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 23 of 56.

"…Nalcor advised that the outages for TL201 and TL208 should be excluded from the calculations [25]. It was explained that TL201 had insulator issues that were recently discovered and that have affected its reliability in the past five years, and that TL208 had no customers for a prolonged period of time and failures were repaired at a lower priority."

Has Teshmont considered adjusting its analysis to compensate for the unique climactic conditions and remoteness of the Labrador Island Link in its probabilistic based transmission reliability assessment?

NP-NLH-124 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 23 of 56.

"Based on a total of 59 sustained outages over 23 transmission lines with a total length of 1510 km, an average failure frequency of 0.781 outages per 100 km per year was calculated."

Considering the Labrador Island Link is designed with a single series of transmission line towers over a distance of 1,100km, please comment on why this line will not experience similar outage statistics to what is described above.

NP-NLH-125 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 23 of 56.

"Outages due to ac terminal station equipment such as circuit breaker failures or misoperations are not included in this analysis. It is assumed that such events will be rare given regular maintenance and condition monitoring practices.

Please explain the appropriateness of excluding outages due to ac terminal station equipment from the analysis considering the extent to which such equipment failures contributed to the outages on the Island Interconnected System in January 2014?

NP-NLH-126 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 2 of 56.

"The purpose of this study is to assess the adequacy of Newfoundland and Labrador Hydro's Interconnected Island System (IIS) generation and transmission equipment under critical N-1 and N-2 contingencies on a probabilistic basis."

Does Teshmont agree with Hydro's assessment that the loss of the Labrador Island Link bipole be treated as an N-2 contingency? In the response, please address if Teshmont has assessed whether or not the failure of the Labrador Island Link bipole is plausible, likely enough, and critical enough to be treated as a single N-1 contingency (ie. require power flow in all other elements of the power system to be at or below normal rating).

NP-NLH-127 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 25 of 56, Table 10.

Please update Table 10, as set out below, to include the N-2 contingency reliability statistics for a Labrador Island Link bipole outage.

Table 10 – Double (N-2) Contingency Reliability Statistics for Post-HVDC Case

Contingency	***Failure Rate (outages per year)***	***Average Outage Duration (hours)***
TL265-TL268	*8.387E-06*	*2.392*
TL218-TL236	*2.569E-05*	*2.392*
TL242-TL266	*1.639E-05*	*2.392*
TL265-Holyrood CT	*5.366E-03*	*3.885*
LIL Bipole Outage		

NP-NLH-128 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 28 of 56.

"The forced outage rates and availability of the HVDC systems are highly dependent on their design, installation, and location…Therefore, unless details of a specific system are available, an accurate estimate of its forced outage rates and availability cannot be calculated. For the purpose of this study, Teshmont is planning to use the following values which are based on the information that was provided to Teshmont by Nalcor Energy."

Please describe in detail the extent to which Teshmont was able to review the design, installation, and location details of the Muskrat Falls project, Labrador Island Link, and Maritime Link to determine the appropriateness of the values it used in its probabilistic based transmission reliability assessment. In the response, please indicate what limitations, if any, Teshmont had to obtaining the design, installation, and location details associated with the Labrador Island Link?

NP-NLH-129 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 28 of 56.

"The forced outage rates and availability of the HVDC systems are highly dependent on their design, installation, and location…Therefore, unless details of a specific system are available, an accurate estimate of its forced outage rates and availability cannot be calculated. For the purpose of this study, Teshmont is planning to use the following values which are based on the information that was provided to Teshmont by Nalcor Energy."

Given the above statement and the fact that the data used in the analysis was based on a limited number of HVdc systems, what precautions would Teshmont advise in the interpretation of its results?

NP-NLH-130 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 23 of 56 and 28 of 56.

Please complete the following table:

Transmission Failure	**Failure Rate (failures/year/100km)**
Existing 230kV Transmission System *(Section 4.3.3 230kV Transmission Lines)*	
Average Failure Rate Per Pole *(Section 5.2.1.2 HVDC Overhead Lines)*	
Average Common Mode Failure Rate *(Section 5.2.1.2 HVDC Overhead Lines)*	

NP-NLH-131 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 28 of 56.

"Based on the Nalcor study the following are the expected failure rates and repair times for the HVDC overhead lines.

- *Average failure rate per pole (based on 1100km length): 2.101/year*
- *Average repair time: 1.78 hours*
- *Average common mode failure rate: 0.02/year/100km*
- *Average common mode repair time: 24 hours"*

Please explain why 'Average failure rate per pole' is represented in failures/year while 'Average common mode failure rate' is represented in failures/year/km.

NP-NLH-132 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 28 of 56.

"Based on the Nalcor study the following are the expected failure rates and repair times for the HVDC overhead lines.

- *Average failure rate per pole (based on 1100km length): 2.101/year*
- *Average repair time: 1.78 hours*
- *Average common mode failure rate: 0.02/year/100km*
- *Average common mode repair time: 24 hours"*

Please provide the average common mode failure rate in 'failures/year'.

NP-NLH-133 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 28 of 56.

"Based on the Nalcor study the following are the expected failure rates and repair times for the HVDC overhead lines.

- *Average failure rate per pole (based on 1100km length): 2.101/year*
- *Average repair time: 1.78 hours*
- *Average common mode failure rate: 0.02/year/100km*
- *Average common mode repair time: 24 hours"*

Please provide the Labrador Island Link failure rates per pole, and common mode failure rates, due purely to severe weather events. Please present the response in 'failures/year'.

NP-NLH-134 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 29 of 56.

"Bipole failure rate and repair time:

a. Average failure rate: 0.7078/year
b. Average repair time: 13.49 hours"

Has Teshmont considered when in a year Bipole outages are most likely to occur on the Labrador Island Link? If so, please explain.

NP-NLH-135 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 29 of 56.

"Bipole failure rate and repair time:

a. Average failure rate: 0.7078/year
b. Average repair time: 13.49 hours"

Has Teshmont considered how winter conditions such as ice accumulation and accessibility might extend repair times for a Bipole outage? If so, please explain.

NP-NLH-136 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 29 of 56.

"Bipole failure rate and repair time:

a. Average failure rate: 0.7078/year
b. Average repair time: 13.49 hours"

Please provide the source data that yields an average failure rate of 0.7078/year and an average repair time of 13.49 hours?

NP-NLH-137 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 29 of 56.

"Bipole failure rate and repair time:
a. Average failure rate: 0.7078/year
b. Average repair time: 13.49 hours"

To what extent has Teshmont reviewed Hydro's operational plans to restore service following an extended bipole outage on the Labrador Island Link?

NP-NLH-138 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 29 of 56.

"Bipole failure rate and repair time:
a. Average failure rate: 0.7078/year
b. Average repair time: 13.49 hours"

In the event of severe weather, has Teshmont considered that other transmission lines may also fail and contribute to extended customer interruptions on the IIS?

NP-NLH-139 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 29 of 56.

The failure rates and repair times for a bipole failure as provided in Section 5.2.1.5 of the Teshmont Report and in the response to Request for Information GRK-NLH-068 are similar in magnitude to the failure rates and repair times for Hydro's 230 kV lines provided in Table 7 of the Teshmont Report. Has Hydro given any consideration to whether the need or requirement for back-up capacity available in the event of bipole failure is similar to that of a failure of a 230 kV transmission line? In the response, please provide information on any consideration given to having additional back-up generation on the island to provide reliable capacity during peak period in the event of a bipole outage.

NP-NLH-140 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 30 of 56.

"Please note that, as mentioned before, the forced outage rates and availability of the HVDC systems are highly dependent on their design, installation, and location. Therefore, statistics obtained from one system may not be applicable to another system."

Did Teshmont establish any sort of confidence level to the resulting statistics? If so, what confidence level was determined? If not, why not?

NP-NLH-141 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 32 of 56.

"Unfortunately, only a limited amount of historical data is available for the HVDC overhead lines."

Given these limitations, please describe what confidence Teshmont has with the average failure rates and average outage durations derived from the data? In the response, please identify any actions or information that would improve the historical data used in Teshmont's analysis.

NP-NLH-142 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 33 of 56.

"Please note that the Square Butte HVDC system was frequently hit by tornados, which results in significant outage durations for this system. If the Square Butte is removed from the data, the average failure rates and outage durations will be as follows…"

Please explain the level of understanding that Teshmont has relating to the environmental conditions facing the Labrador Island Link that would allow for the above assumption.

NP-NLH-143 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 33 of 56.

"However, at present some of the Voltage Sourced Converter (VSC) technologies do not have the ability to stop dc fault currents; therefore, in case of a temporary dc fault, the converter ac breakers should be opened. This may result in considerable outage durations and may affect the overall system reliability."

Please explain whether or not the Labrador Island Link VSC technology has the ability to stop dc fault currents as described above.

NP-NLH-144 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 34 of 56.

"Considering the voltage levels for LIL and ML the average outage rates and durations for LIL and ML overhead lines are as follows…"

Please explain how transmission line voltage is correlated to reliability rates and whether or not it is appropriate for Teshmont to assume outage rates for the design of the LIL and ML based on voltage.

NP-NLH-145 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 34 of 56.

"…CEA statistics includes repair times for structural damages. If the outages that were caused by structural damages are taken out, the above average repair times significantly decrease."

Please provide the rationale for investigating repair times that do not include structural damages.

NP-NLH-146 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 34 of 56.

"…CEA statistics include repair times for structural damages. If the outages that were caused by structural damages are taken out, the above average repair times significantly decrease."

Please explain whether or not the loss of a single structure on the 1,100km Labrador Island Link would result in a bipole outage?

NP-NLH-147 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 34 of 56.

"In summary, the average failure rate that was used in the previous Nalcor study for the LIL is slightly higher than the figures that were estimated based on the CIGRE and CEA data, while the average repair time in the Nalcor study is considerably lower."

Please explain why the average repair time in the most recent Nalcor study is considerably lower?

NP-NLH-148 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 43 of 56.

"This analysis highlights ML impact on overall system stability under Post-HVDC conditions."

Please describe the assumptions used in the Teshmont analysis relating to the availability of the 300 MW of capacity from the Maritime Link.

NP-NLH-149 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 43 of 56.

"This analysis highlights ML impact on overall system stability under Post-HVDC conditions."

Other than the physical reliability data used in the Teshmont assessment, what factors or circumstances might prevent the 300 MW from ML from being available to Hydro?

NP-NLH-150 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 45 of 56.

"HVDC overhead line data was used to determine an average pole failure rate of 0.14/year/100km with an average pole repair time of 36.4 hours per outage for the Labrador Island Link. In comparison, the values used by Nalcor in previous studies were 0.19 outages/year/100km with a duration of 1.78 hours per outage. The Nalcor outage rate is more pessimistic than the values calculated here. However, the duration is much lower."

Please explain what accounts for Nalcor's average pole repair time being much lower than the HVDC overhead line data.

NP-NLH-151 Reference: *Probabilistic Based Transmission Reliability Summary Report*, Appendix A, Page 46 of 56.

Please provide a Summary of Expected Unserved Energy (MWh/year) and Probability of Unserved Load for a Pre-HVDC case assuming the Pre-HVDC case includes the addition of 230 kV transmission line TL267 between Bay d'Espoir and Western Avalon terminal stations. Please provide the results in the form of Table 21 of the Teshmont Report.

NP-NLH-152 The responses to Requests for Information PUB-NLH-2017 and GRK-NLH-068 describe in general how the system will be designed to respond to a permanent bipole failure. Please provide any design criteria that will be used to design the system to respond to a bipole failure. In the response please provide the following information:

1) Initial design estimates for the time from bipole failure to restoring supply in accordance with the 22 corrective actions outlined in Table 16 of the Teshmont Report.
2) Whether the level of exports will be managed to limit exposure to customers from load shedding for potential bipole failures.
3) Whether there is a limit to the amount of load shed beyond which there is potential for a shut-down of the total island interconnected system.
4) The extent to which the total load requirements on the island will impact the time required to restore supply.
5) The extent to which the duration of the repair to a bipole failure might impact the time required to restore supply.
6) Whether the load shedding scheme will require a greater portion of the load on the Avalon Peninsula to be shed than on the rest of the island interconnected system.
7) Any considerations given to potential cold load pickup issues in designing the system response.

NP-NLH-153 The response to Request for Information CA-NLH-030 indicates that in 2019 there will be 30.6 MW of reserve available to supply load during system peak in the event of a bipole failure. Please provide a capacity outage probability table assuming Maritime Link is a three state generator recognizing the probability of bipole operation, monopole operation and a complete bipole failure. Also, please assume that no generation is out of service for planned maintenance. The information should be provided in the following format.

Capacity out of service	Capacity in Service	Probability
0 MW		
20 MW		
40 MW		
60 MW		
. . .		
300 MW		

If this information is not available in this format please provide comparable information that should be available from the Hydro's Strategist© software.

NP-NLH-154 The Teshmont Report appears to assume the probability of a common mode failure of transmission lines is random. Does Hydro have any reliability information regarding the relationship between transmission line failure and weather? If so, please provide this data. If not, please explain whether or not the likelihood of common mode failures increases during severe weather events.

RESPECTFULLY SUBMITTED at St. John's, Newfoundland and Labrador, this 17th day of June, 2016.

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