



NEWFOUNDLAND AND LABRADOR
BOARD OF COMMISSIONERS OF PUBLIC UTILITIES
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2016-03-18

Mr. Geoff Young
Newfoundland and Labrador Hydro
P.O. Box 12400
St. John's, NL A1B 4K7

Dear Sir:

Re: Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System – Phase Two - Requests for Information PUB-NLH-533 to PUB-NLH-594

Enclosed are Information Requests PUB-NLH-533 to PUB-NLH-594 regarding the above-noted matter. The deadline for Responses to these Requests for Information (RFIs) will be set at a later time.

If you have any questions, please do not hesitate to contact the Board's Legal Counsel, Ms. Jacqui Glynn, by email, jglynn@pub.nl.ca or telephone (709) 726-6781.

Yours truly,


Cheryl Blundon
Board Secretary

/cpj
Encl.

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1 **IN THE MATTER OF**

2 the *Electrical Power Control Act, 1994*,
3 SNL 1994, Chapter E-5.1 (the "*EPCA*")
4 and the *Public Utilities Act*, RSNL 1990,
5 Chapter P-47 (the "*Act*"), as amended; and
6

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

**PUBLIC UTILITIES BOARD
REQUESTS FOR INFORMATION**

PUB-NLH-533 to PUB-NLH-594

Issued: March 18, 2016

- PUB-NLH-533** Does Hydro still consider under frequency load shedding ("UFLS") acceptable for loss of generation in the IIS post Muskrat Falls interconnection? If the answer is yes, will the targets for UFLS for Newfoundland Power and Hydro customers remain less than 4 or 5 per year respectively?
- PUB-NLH-534** Reference PUB-NLH-265: It is stated that the present UFLS has df/dt settings at 0.5Hz/s, 0.6Hz/s and 0.7Hz/s. What will be the range of df/dt when the LIL is in service providing minimum or maximum power to the IIS?
- PUB-NLH-535** Reference PUB-NLH-265: Has Hydro made any progress towards determining an appropriate protection scheme for post LIL? If so, please explain the general principles of the proposed new scheme. If not, when will it be completed?
- PUB-NLH-536** Reference PUB-NLH-265: Does Hydro believe that a wide range of the rate of frequency change would complicate the design of the protection, or make the design of the protection easier? Please explain your answer in detail.
- PUB-NLH-537** Reference PUB-NLH-277: What is the status of the design of the load shedding protection system for post LIL? If complete, provide a copy of the study setting out the proposed load shedding scheme. If not complete, when will it be?
- PUB-NLH-538** Reference PUB-NLH-278: Please state what black start facilities will be available in the IIS.
- PUB-NLH-539** Reference PUB-NLH-279: Please state how the review of Hydro's operations capacity planning requirements for post LIL and Maritime Link is progressing, and provide an indication of the expectation of the outcome.
- PUB-NLH-540** Reference PUB-NLH-279: Please state whether a different LOLH will be used for the planning of the standby generation resources post LIL.
- PUB-NLH-541** Reference PUB-NLH-279: Please explain whether Hydro takes into account (i) the risk of two concurrent HVDC cable failures (not necessarily both at the same time); (ii) the risk of an electrode line failures; and (iii) the risk of an electrode line conductor failure in its planning of standby and reserve generation resources for LIL and Maritime Link.
- PUB-NLH-542** Reference PUB-NLH-279: Please state whether or not Hydro expects to provide sufficient generation capacity within the IIS so that the peak

demand could be met at all times in the absence of the LIL but with support from ML. If the answer is no, please provide an estimate of the additional cost that the provision of this level of generation would incur and estimate the extra annual cost that would have to be recovered from the average domestic consumer. In the response state what would the maximum power and energy delivered via the ML be and how often statistically would import via the ML be required.

PUB-NLH-543

Reference PUB-NLH-279: Please state whether or not Hydro expects to provide sufficient generation capacity within the IIS so that the peak demand could be met at all times in the absence of both the LIL and ML. If the answer is no, please provide an estimate of the additional cost the provision of this level of generation would incur and estimate the extra annual cost that would have to be recovered from the average domestic consumer.

PUB-NLH-544

When Hydro performs generation planning studies using Strategist, is the LIL modelled as a generator and ML as a curtailable load?

PUB-NLH-545

Reference PUB-NLH-440: Please confirm whether the Holyrood Thermal Generating station would ever be in operational service when the LIL is in service.

PUB-NLH-546

Reference PUB-NLH-031: Has Hydro asked the HVDC converter manufacturer to investigate whether HVDC OHL or ice melting operation could be accommodated in the HVDC design? If yes, what would be the impact on the converter station equipment, and what would be the additional cost and other impacts on the converter station and what conclusions did Hydro reach? If no consideration was given to this conclusion from the Manitoba Hydro Report, why not?

PUB-NLH-547

Please provide the minimum Effective Short Circuit Capacity ("ESCC") at Soldiers Pond at which the LIL will be expected to deliver:

- Maximum power
- 50% of maximum power
- Minimum power

In the response state whether the appropriate ESCC will always be available for the required operating conditions.

PUB-NLH-548

What steps have been taken in the design and build of the electrode lines to minimise its outage rate, when it is not run on the HVDC OHL?

PUB-NLH-549

What is the fault rate of lower voltage transmission lines using wood poles, as compared to the 230kV transmission lines and how do the repair times for both compare?

PUB-NLH-550

Reference MHI Report, Review of the Muskrat Falls and Labrador Island HVDC Link and the Isolated Island Option, October 2012, Section 2, section 2.2.2, page 28: MHI mentions that there could be some advantage in providing some overload capability of the LIL when in bipolar mode. Did Hydro investigate the possibility and benefits of providing such overloads? If so, what conclusions were reached? If not, why not?

PUB-NLH-551

Reference MHI Report, Review of the Muskrat Falls and Labrador Island HVDC Link and the Isolated Island Option, October 2012, Section 2, section 2.2.2, page 28: MHI also recommend that a small signal study be performed to confirm the need or otherwise of power system stabilisers. Has Hydro performed or does it plan to perform such studies? If a study has been performed what was the outcome of the study? If not, why not?

PUB-NLH-552

Reference MHI Report, Review of the Muskrat Falls and Labrador Island HVDC Link and the Isolated Island Option, October 2012, Section 2, section 2.2.2, page 28: In section 2.2.5 MHI recommends that Hydro should consider the synchronous condensers when determining the harmonic impedance of the system. Has Hydro performed new studies following the changes to the synchronous condensers? If so, what was the impact of the new studies? If not, why not?

PUB-NLH-553

Reference PUB-NLH-231: Please explain how the equipment at the neutral of the converter station is protected from surge voltages resulting from lightning strikes to the electrode line, particularly at Soldiers Pond. In the response, include:

- The risk of a breakdown across converter station insulation in such event
- The consequence of sustained arcing to ground from the neutral busbars
- How such a breakdown would be detected by the protection system
- The protective action that would be taken
- Whether the HVDC control system has been designed to automatically minimise the current flow in the ground connection if the scheme is operated with the neutral point connected to the ground mat.

PUB-NLH-554

Reference CA-NLH-034 and PUB-NLH-157: Please provide an update on the work needed to minimise the consequences of breaker failures on system outages.

PUB-NLH-555

Reference PUB-NLH-241: What design changes would have to be made to the ac switchyard at Muskrat Falls and the ac switchyard at Soldiers Pond to prevent a stuck breaker resulting in the need for under frequency load shedding? In the response provide an estimate of the cost of such a change at each ac switchyard. Also, please provide a list of breaker

failure events on the IIS during the past 20 years, and a brief description of the impact of each of these events.

PUB-NLH-556

Reference PUB-NLH-268 and PUB-NLH-270: Given the distance between the midpoints of the AC OHL and the HVDC OHL in the two figures provided, there seem to be a risk that in the event of a collapse of the HVDC OHL tower both the HVDC OHL and the AC OHL could collapse. Has Hydro considered this scenario? If so, what would be the impact on the supply of energy to consumers? If not, why not?

PUB-NLH-557

Reference PUB-NLH-518: Operation with one of the stations having a connection to the station ground mat would result in the risk that a temporary or permanent pole fault could become a complete bipolar outage. What precautions would Hydro take before operating in this mode?

PUB-NLH-558

Please provide the maximum power that can be delivered to Soldiers Pond during monopolar operation with metallic return.

PUB-NLH-559

Reference PUB-NLH-505: Please provide an estimate of the cost of a study to evaluate the impact on the HVDC OHL tower of replacing the current electrode line conductors with new conductors capable of meeting the 1.5 pu over current requirement during period of high loads on the LIL, i.e. during winter peaks and also provide the cost of actually replacing the electrode line conductors with larger conductors, if this was decided.

PUB-NLH-560

Reference PUB-NLH-444: Please confirm the number of synchronous condensers in service for the study presented in this response.

PUB-NLH-561

Reference PUB-NLH-488: Please state the status of the reactive power study at Bottom Brook.

PUB-NLH-562

Reference PUB-NLH-488: Please state whether or not there is still a potential issue with high over voltages at Bottom Brook during some operating conditions and faults.

PUB-NLH-563

Reference PUB-NLH-264, Attachment 4 and PUB-NLH-484: Please state whether or not Hydro still consider it acceptable for faults at Bay d'Espoir to result in instability of the IIS, post LIL.

PUB-NLH-564

Reference PUB-NLH-264, Attachment 4 and PUB-NLH-484: Please state whether the occurrence of three phase faults at Bay d'Espoir under peak load conditions could lead to instability both when 2 and 3 high inertia synchronous condensers are in service at Soldiers Pond.

PUB-NLH-565 Reference PUB-NLH-523: Please provide the report on the need for additional reactive power compensation in the Bottom Brooke area.

PUB-NLH-566 Reference PUB-NLH-531: Please provide a copy of the updated preliminary interconnection study.

PUB-NLH-567 Please confirm that the HVDC manufacturer has included the following studies, in addition to the evaluation of fundamental frequency induction during normal operating conditions:

- Corona and Field effects
- Impact on the LIL of transient currents (e.g. from line to ground faults and 3ph faults) in the AC line.
- Impact on the AC line of transient currents (e.g. from line to ground faults and pole to pole faults) in the HVDC OHL.
- The risk of contact between the AC OHL and the HVDC OHL, including collapse of transmission towers.
- The impact of contact between the AC OHL and the HVDC OHL.

If the HVDC manufacturer did not perform these, has the evaluation been performed by someone else? If not, please explain why not.

PUB-NLH-568 None of the studies performed have considered the consequence of a restrike on the HVDC OHL, as may occasionally happen. The scenario would be as follows:

1. Lightning strikes the HVDC OHL line (either just one pole or both poles – both should be studied)
2. The HVDC converter stops the current flow, waits for the preset re-starting time, and then energise the line again.
3. When the voltage reach say 90% the arc restrikes, and step 2 is repeated – normally with an increased de-ionization time.
4. Either the 2nd attempt is successful or a further attempt starting with a lower dc voltage setting (say 80%) will be required.

Please perform such a study both for monopolar and bipolar operation. The purpose of the study should be to identify the impact that these scenarios would have on the performance of the ISS, and if relevant to identify the additional inertia that would be required to protect the IIS.

PUB-NLH-569 Has Hydro identified any LIL failure conditions that could result in a blackout of the IIS? In this response state whether an assessment of such a risk been performed for all conceivable system states prior to a failure of the LIL.

PUB-NLH-570

Have any of Hydro's studies identified any conditions where a curtailment of the ML could be used to prevent under frequency load shedding, but penalties might be payable? If so, please outline these circumstances. In the response please explain how the time limited operation of the ML, i.e. the time that the MF power block is being transmitted to Nova Scotia, is taken into account in Hydro's assessment.

PUB-NLH-571

Please clarify whether curtailment of the ML (to 0MW) will result in the HVDC scheme being instantaneously blocked (and tripped) or in the gradual ramping down of the power to 0MW, with the ML continuing to provide reactive power control even after reaching 0MW.

PUB-NLH-572

Please provide details of the proposed frequency control for the IIS in the ML control design. In the response state whether dead-bands will be used; have payments for this service been agreed and if so, please provide details.

PUB-NLH-573

Reference PUB-NLH-252: Please state whether or not the HVDC manufacturer has included in his guarantee for bipolar outages the failure of the second pole, whilst the first pole is out for maintenance or repair.

PUB-NLH-574

Reference PUB-NLH-513: In this response Hydro predicts the frequency of a pole outage, followed by a second pole outage during the winter months at once every 3 years. Please confirm that this would be in addition to the bipole outage rate as stated in PUB-NLH-212 Attachment 2. If yes, please explain why this has not been reflected in the table provided in GRK-NLH-060. If the scenario described is not in addition to the bipole outage rate as stated in PUB-NLH-212 Attachment 2, please explain where this scenario is reflected in the tables provided in PUB-NLH-212 Attachment 2 and in the tables provided in GRK-NLH-060.

PUB-NLH-575

Reference PUB-NLH-513: Please provide the most up to date predicted overall outage rate and availability for the LIL, including bipolar and monopolar outages, providing information both for scheduled and forced outages and update the information in GRK-NLH-060 or confirm that information.

PUB-NLH-576

Reference GRK-NLH-060, Bipole Outage Rate: Please provide justification for Hydro's reduction of the Bipole outage rate of the HVDC converter stations of 0.1 in the table provided in GRK-NLH-060, rather than the value of 0.4 provided in the report by SNC Lavalin, Reliability & Availability of the HVDC Island Link, 10 Apr-2012 filed as Attachment 2 with PUB-NLH-212.

PUB-NLH-577

Reference GRK-NLH-060, Reduced Power Operation: Please explain why the 3-day outage per pole for converter maintenance has not been

included in the table provided in GRK-NLH-060, when this outage was included in the report by SNC Lavalin, Reliability & Availability of the HVDC Island Link, 10 Apr-2012. Please explain why the outage rate for the converter poles in the table has been taken as the original value of 3.28 in the report by SNC Lavalin, Reliability & Availability of the HVDC Island Link, 10 Apr-2012, filed as Attachment 2 with PUB-NLH-212, rather than the higher value guaranteed by the manufacturer.

PUB-NLH-578

Please provide a copy of the probabilistic reliability study for the converters, considering all major components and systems of the LIL converter stations completed by the manufacturer of the HVDC converter stations. Please provide the main results of the study and explain the study methodology.

PUB-NLH-579

Please explain why Hydro has not performed an overall probabilistic reliability evaluation, as was recommended by MHI in their 2012 report "Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System, Volume 2: Studies".

PUB-NLH-580

Reference DD-NLH-051: The C-Core report recommends that additional observations should be performed to confirm the iceberg rolling frequency, indicating that some uncertainty exists relative to the prediction of the frequency of potential iceberg strikes to the HVDC cables. Have such further observations been performed? If so, do the results change the conclusions of the report, e.g. the probability of iceberg strikes to the HVDC cables? If not, please explain why such further observation has not been performed.

PUB-NLH-581

It is noted that the review undertaken by Manitoba Hydro International in 2012 "Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System, Volume 1: Summary of Reviews" commented in section 4.4.3 on the scour data in the area, which surprisingly had shown scouring at depth of 70 to 75m. It is stated that these marks may be from earlier glacial periods, but this cannot be positively confirmed. Therefore, a risk of iceberg damage may still exist even with the deeper exit points of the HDD. Please comment on this potential risk, and provide additional data if available.

PUB-NLH-582

Please state the intended minimum separation distance between the 3 HVDC cables.

PUB-NLH-583

Please state the actual minimum depth at which the HDD delivers the HVDC cables to the sea bed and the minimum cable depth during the crossing from Forteau Point to Mistaken Cove. If the minimum depth is less than 80 m, please explain why the risk of iceberg damage would not

- 1 be unacceptable. Please submit any studies performed that support
2 Hydro's conclusion to accept the risk of water depths of less than 70m.
3
- 4 **PUB-NLH-584** Please explain how Hydro will ensure that the drag free zone is respected
5 by all fishing vessels.
6
- 7 **PUB-NLH-585** Reference PUB-NLH-504: Please provide an estimate of the return
8 period for the shortfall of power delivery of between 0MW and 58.8MW
9 in the event of the loss of one of the electrode line conductors whilst in
10 mono-polar operation.
11
- 12 **PUB-NLH-586** Reference PUB-NLH-504: What would be the cost of uprating the
13 electrode line conductors to have the same current capability as the main
14 HVDC OHL conductors (ignoring the cost of any required strengthening
15 of the HVDC transmission towers)?
16
- 17 **PUB-NLH-587** Reference PUB-NLH-504: What would be the cost of an additional
18 50MW GT?
19
- 20 **PUB-NLH-588** Reference PUB-NLH-509: Please provide the extracts from PUB-NLH-
21 124 and PUB-NLH-212 Attachment 2 which provides the reliability
22 information for the HVDC switching stations at the intersection of the
23 HVDC OHL and the HVDC cables at the Strait of Belle Isle (referred to
24 as the transition compounds in your reply to PUB-NLH-509).
25
- 26 **PUB-NLH-589** Reference PUB-NLH-217, pages 9-10: Does the total power capacity of
27 1650MW to 1680MW include or exclude 300MW import from ML? If it
28 does include the 300MW from ML, what would be the LOLH resulting
29 from one bipolar trip with a repair time of 4 hours, 24 hours and 2 weeks
30 without 300MW from ML in the years from 2020 forward?
31
- 32 **PUB-NLH-590** Reference PUB-NLH-008: Please explain how generation reserves will
33 be impacted by the reliability and the availability of the LIL. In
34 particular, will Hydro plan for the total outage of the LIL plus an outage
35 of the largest generator in the IIS?
36
- 37 **PUB-NLH-591** Reference PUB-NLH-008: How will the Maritime Link (ML) be taken
38 into account in the planning of the generation reserves post
39 interconnection?
40
- 41 **PUB-NLH-592** Reference PUB-NLH-280: Please explain the status of the discussions
42 with NSPI and New Brunswick Power.
43
- 44 **PUB-NLH-593** Reference PUB-NLH-502: Please provide an update on the progress of
45 the working group in respect of emergency assistance and reserve

sharing, outlining the definition of the scope, model preparation, study contingencies and project schedule.

PUB-NLH-594

Please explain how the planning of additional power generation in the IIS will be impacted by the predicted reliability and availability of the LIL. In the response include:

- the impact of doubling the assumed pole outage rate, retaining the same average outage time
- the impact of doubling the assumed pole outage time, retaining the same average outage rate
- the impact of doubling the assumed bipolar outage rate, retaining the same average outage time
- the impact in of doubling the assumed bipolar outage time, retaining the same average outage rate
- the impact in each case of reducing the available emergency power from ML from 300MW to 150MW

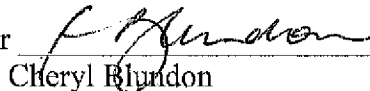
In each case, please state how the LOLH would change if the original assumption was used but the different conditions were to apply.

Please also state how the provision of additional generation resources would change if the planning assumptions were changed to provide for the different conditions listed.

DATED at St. John's, Newfoundland this 18th day of March 2016.

BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

Per



Cheryl Blundon
Board Secretary