



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.

cc. **Newfoundland and Labrador Hydro**
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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

- 1 **PUB-NLH-533** Does Hydro still consider under frequency load shedding ("UFLS")
2 acceptable for loss of generation in the IIS post Muskrat Falls
3 interconnection? If the answer is yes, will the targets for UFLS for
4 Newfoundland Power and Hydro customers remain less than 4 or 5 per
5 year respectively?
6
- 7 **PUB-NLH-534** Reference PUB-NLH-265: It is stated that the present UFLS has df/dt
8 settings at 0.5Hz/s, 0.6Hz/s and 0.7Hz/s. What will be the range of df/dt
9 when the LIL is in service providing minimum or maximum power to the
10 IIS?
11
- 12 **PUB-NLH-535** Reference PUB-NLH-265: Has Hydro made any progress towards
13 determining an appropriate protection scheme for post LIL? If so, please
14 explain the general principles of the proposed new scheme. If not, when
15 will it be completed?
16
- 17 **PUB-NLH-536** Reference PUB-NLH-265: Does Hydro believe that a wide range of the
18 rate of frequency change would complicate the design of the protection,
19 or make the design of the protection easier? Please explain your answer
20 in detail.
21
- 22 **PUB-NLH-537** Reference PUB-NLH-277: What is the status of the design of the load
23 shedding protection system for post LIL? If complete, provide a copy of
24 the study setting out the proposed load shedding scheme. If not complete,
25 when will it be?
26
- 27 **PUB-NLH-538** Reference PUB-NLH-278: Please state what black start facilities will be
28 available in the IIS.
29
- 30 **PUB-NLH-539** Reference PUB-NLH-279: Please state how the review of Hydro's
31 operations capacity planning requirements for post LIL and Maritime
32 Link is progressing, and provide an indication of the expectation of the
33 outcome.
34
- 35 **PUB-NLH-540** Reference PUB-NLH-279: Please state whether a different LOLH will be
36 used for the planning of the standby generation resources post LIL.
37
- 38 **PUB-NLH-541** Reference PUB-NLH-279: Please explain whether Hydro takes into
39 account (i) the risk of two concurrent HVDC cable failures (not
40 necessarily both at the same time); (ii) the risk of an electrode line
41 failures; and (iii) the risk of an electrode line conductor failure in its
42 planning of standby and reserve generation resources for LIL and
43 Maritime Link.
44
- 45 **PUB-NLH-542** Reference PUB-NLH-279: Please state whether or not Hydro expects to
46 provide sufficient generation capacity within the IIS so that the peak

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

8
 9 **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.

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 17 **PUB-NLH-544**

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

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 20 **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.

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 24 **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?

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 32 **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.

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 40 **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?

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 43 **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?

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- 1 **PUB-NLH-550** Reference MHI Report, Review of the Muskrat Falls and Labrador Island
 2 HVDC Link and the Isolated Island Option, October 2012, Section 2,
 3 section 2.2.2, page 28: MHI mentions that there could be some advantage
 4 in providing some overload capability of the LIL when in bipolar mode.
 5 Did Hydro investigate the possibility and benefits of providing such
 6 overloads? If so, what conclusions were reached? If not, why not?
 7
- 8 **PUB-NLH-551** Reference MHI Report, Review of the Muskrat Falls and Labrador Island
 9 HVDC Link and the Isolated Island Option, October 2012, Section 2,
 10 section 2.2.2, page 28: MHI also recommend that a small signal study be
 11 performed to confirm the need or otherwise of power system stabilisers.
 12 Has Hydro performed or does it plan to perform such studies? If a study
 13 has been performed what was the outcome of the study? If not, why not?
 14
- 15 **PUB-NLH-552** Reference MHI Report, Review of the Muskrat Falls and Labrador Island
 16 HVDC Link and the Isolated Island Option, October 2012, Section 2,
 17 section 2.2.2, page 28: In section 2.2.5 MHI recommends that Hydro
 18 should consider the synchronous condensers when determining the
 19 harmonic impedance of the system. Has Hydro performed new studies
 20 following the changes to the synchronous condensers? If so, what was the
 21 impact of the new studies? If not, why not?
 22
- 23 **PUB-NLH-553** Reference PUB-NLH-231: Please explain how the equipment at the
 24 neutral of the converter station is protected from surge voltages resulting
 25 from lightning strikes to the electrode line, particularly at Soldiers Pond.
 26 In the response, include:
 27
 - The risk of a breakdown across converter station insulation in such
 28 event
 - The consequence of sustained arcing to ground from the neutral
 29 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
 30 minimise the current flow in the ground connection if the scheme is
 31 operated with the neutral point connected to the ground mat.
 32
- 33 **PUB-NLH-554** Reference CA-NLH-034 and PUB-NLH-157: Please provide an update
 34 on the work needed to minimise the consequences of breaker failures on
 35 system outages.
 36
- 37 **PUB-NLH-555** Reference PUB-NLH-241: What design changes would have to be made
 38 to the ac switchyard at Muskrat Falls and the ac switchyard at Soldiers
 39 Pond to prevent a stuck breaker resulting in the need for under frequency
 40 load shedding? In the response provide an estimate of the cost of such a
 41 change at each ac switchyard. Also, please provide a list of breaker
 42
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- 1 failure events on the IIS during the past 20 years, and a brief description
2 of the impact of each of these events.
3
- 4 **PUB-NLH-556** Reference PUB-NLH-268 and PUB-NLH-270: Given the distance
5 between the midpoints of the AC OHL and the HVDC OHL in the two
6 figures provided, there seem to be a risk that in the event of a collapse of
7 the HVDC OHL tower both the HVDC OHL and the AC OHL could
8 collapse. Has Hydro considered this scenario? If so, what would be the
9 impact on the supply of energy to consumers? If not, why not?
10
- 11 **PUB-NLH-557** Reference PUB-NLH-518: Operation with one of the stations having a
12 connection to the station ground mat would result in the risk that a
13 temporary or permanent pole fault could become a complete bipolar
14 outage. What precautions would Hydro take before operating in this
15 mode?
16
- 17 **PUB-NLH-558** Please provide the maximum power that can be delivered to Soldiers
18 Pond during monopolar operation with metallic return.
19
- 20 **PUB-NLH-559** Reference PUB-NLH-505: Please provide an estimate of the cost of a
21 study to evaluate the impact on the HVDC OHL tower of replacing the
22 current electrode line conductors with new conductors capable of
23 meeting the 1.5 pu over current requirement during period of high loads
24 on the LIL, i.e. during winter peaks and also provide the cost of actually
25 replacing the electrode line conductors with larger conductors, if this was
26 decided.
27
- 28 **PUB-NLH-560** Reference PUB-NLH-444: Please confirm the number of synchronous
29 condensers in service for the study presented in this response.
30
- 31 **PUB-NLH-561** Reference PUB-NLH-488: Please state the status of the reactive power
32 study at Bottom Brook.
33
- 34 **PUB-NLH-562** Reference PUB-NLH-488: Please state whether or not there is still a
35 potential issue with high over voltages at Bottom Brook during some
36 operating conditions and faults.
37
- 38 **PUB-NLH-563** Reference PUB-NLH-264, Attachment 4 and PUB-NLH-484: Please
39 state whether or not Hydro still consider it acceptable for faults at Bay
40 d'Espoir to result in instability of the IIS, post LIL.
41
- 42 **PUB-NLH-564** Reference PUB-NLH-264, Attachment 4 and PUB-NLH-484: Please
43 state whether the occurrence of three phase faults at Bay d'Espoir under
44 peak load conditions could lead to instability both when 2 and 3 high
45 inertia synchronous condensers are in service at Soldiers Pond.

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

3
4 **PUB-NLH-566** Reference PUB-NLH-531: Please provide a copy of the updated
5 preliminary interconnection study.

6
7 **PUB-NLH-567** Please confirm that the HVDC manufacturer has included the following
8 studies, in addition to the evaluation of fundamental frequency induction
9 during normal operating conditions:

- 10
11
- 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.

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

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

- 26
27
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.

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

40
41 **PUB-NLH-569** Has Hydro identified any LIL failure conditions that could result in a
42 blackout of the IIS? In this response state whether an assessment of such
43 a risk been performed for all conceivable system states prior to a failure
44 of the LIL.

- 1 **PUB-NLH-570** Have any of Hydro's studies identified any conditions where a
2 curtailment of the ML could be used to prevent under frequency load
3 shedding, but penalties might be payable? If so, please outline these
4 circumstances. In the response please explain how the time limited
5 operation of the ML, i.e. the time that the MF power block is being
6 transmitted to Nova Scotia, is taken into account in Hydro's assessment.
7
- 8 **PUB-NLH-571** Please clarify whether curtailment of the ML (to 0MW) will result in the
9 HVDC scheme being instantaneously blocked (and tripped) or in the
10 gradual ramping down of the power to 0MW, with the ML continuing to
11 provide reactive power control even after reaching 0MW.
12
- 13 **PUB-NLH-572** Please provide details of the proposed frequency control for the IIS in the
14 ML control design. In the response state whether dead-bands will be
15 used; have payments for this service been agreed and if so, please
16 provide details.
17
- 18 **PUB-NLH-573** Reference PUB-NLH-252: Please state whether or not the HVDC
19 manufacturer has included in his guarantee for bipolar outages the failure
20 of the second pole, whilst the first pole is out for maintenance or repair.
21
- 22 **PUB-NLH-574** Reference PUB-NLH-513: In this response Hydro predicts the frequency
23 of a pole outage, followed by a second pole outage during the winter
24 months at once every 3 years. Please confirm that this would be in
25 addition to the bipole outage rate as stated in PUB-NLH-212 Attachment
26 2. If yes, please explain why this has not been reflected in the table
27 provided in GRK-NLH-060. If the scenario described is not in addition to
28 the bipole outage rate as stated in PUB-NLH-212 Attachment 2, please
29 explain where this scenario is reflected in the tables provided in PUB-
30 NLH-212 Attachment 2 and in the tables provided in GRK-NLH-060.
31
- 32 **PUB-NLH-575** Reference PUB-NLH-513: Please provide the most up to date predicted
33 overall outage rate and availability for the LIL, including bipolar and
34 monopolar outages, providing information both for scheduled and forced
35 outages and update the information in GRK-NLH-060 or confirm that
36 information.
37
- 38 **PUB-NLH-576** Reference GRK-NLH-060, Bipole Outage Rate: Please provide
39 justification for Hydro's reduction of the Bipole outage rate of the HVDC
40 converter stations of 0.1 in the table provided in GRK-NLH-060, rather
41 than the value of 0.4 provided in the report by SNC Lavalin, Reliability
42 & Availability of the HVDC Island Link, 10 Apr-2012 filed as
43 Attachment 2 with PUB-NLH-212.
44
- 45 **PUB-NLH-577** Reference GRK-NLH-060, Reduced Power Operation: Please explain
46 why the 3-day outage per pole for converter maintenance has not been

- 1 included in the table provided in GRK-NLH-060, when this outage was
2 included in the report by SNC Lavalin, Reliability & Availability of the
3 HVDC Island Link, 10 Apr-2012. Please explain why the outage rate for
4 the converter poles in the table has been taken as the original value of
5 3.28 in the report by SNC Lavalin, Reliability & Availability of the
6 HVDC Island Link, 10 Apr-2012, filed as Attachment 2 with PUB-NLH-
7 212, rather than the higher value guaranteed by the manufacturer.
8
- 9 **PUB-NLH-578** Please provide a copy of the probabilistic reliability study for the
10 converters, considering all major components and systems of the LIL
11 converter stations completed by the manufacturer of the HVDC converter
12 stations. Please provide the main results of the study and explain the
13 study methodology.
14
- 15 **PUB-NLH-579** Please explain why Hydro has not performed an overall probabilistic
16 reliability evaluation, as was recommended by MHI in their 2012 report
17 "Report on Two Generation Expansion Alternatives for the Island
18 Interconnected Electrical System, Volume 2: Studies".
19
- 20 **PUB-NLH-580** Reference DD-NLH-051: The C-Core report recommends that additional
21 observations should be performed to confirm the iceberg rolling
22 frequency, indicating that some uncertainty exists relative to the
23 prediction of the frequency of potential iceberg strikes to the HVDC
24 cables. Have such further observations been performed? If so, do the
25 results change the conclusions of the report, e.g. the probability of ice
26 berg strikes to the HVDC cables? If not, please explain why such further
27 observation has not been performed.
28
- 29 **PUB-NLH-581** It is noted that the review undertaken by Manitoba Hydro International in
30 2012 "Report on Two Generation Expansion Alternatives for the Island
31 Interconnected Electrical System, Volume 1: Summary of Reviews"
32 commented in section 4.4.3 on the scour data in the area, which
33 surprisingly had shown scouring at depth of 70 to 75m. It is stated that
34 these marks may be from earlier glacial periods, but this cannot be
35 positively confirmed. Therefore, a risk of iceberg damage may still exist
36 even with the deeper exit points of the HDD. Please comment on this
37 potential risk, and provide additional data if available.
38
- 39 **PUB-NLH-582** Please state the intended minimum separation distance between the 3
40 HVDC cables.
41
- 42 **PUB-NLH-583** Please state the actual minimum depth at which the HDD delivers the
43 HVDC cables to the sea bed and the minimum cable depth during the
44 crossing from Forteau Point to Mistaken Cove. If the minimum depth is
45 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.
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- 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

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PUB-NLH-594

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

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*
Cheryl Blundon
Board Secretary