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1    Q.    **2015 Capital Plan**

2            At page 7 of the 2015 Capital Projects Overview, Hydro states that the retirement of  
3            the Hardwoods and Stephenville gas turbines is not expected until 2025 and 2028,  
4            respectively. At page 5 of the Capital Plan section of the Application, Hydro states  
5            that “These facilities accumulate few operating hours generating electricity but are  
6            crucial sources of power and energy during emergencies and system peaks and  
7            provide voltage support, especially when operating as synchronous condensers.”

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9            Explain, in detail, why and how, after full commissioning of the 100 MW  
10           combustion turbine at Holyrood and of the Post-Isolated Island System, and the  
11           conversion of Holyrood plant to synchronous condenser mode, these gas turbines  
12           will continue to be an essential component of the Provincial electrical grid for the  
13           supply of power to Island customers?

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16    A.    The Labrador-Island Link (LIL) HVdc transmission system has been planned and  
17           designed based on a single pole failure, such that there will be no customer load  
18           shedding on the Island system. For the loss of two poles on LIL, a more onerous but  
19           less frequent occurrence, controlled under frequency load shedding will be  
20           permitted but the system will be designed with a protection and restoration system  
21           to provide an orderly restoration of affected customers utilizing Island generation  
22           and imports of up to 300 MW via the Maritime Link. The combustion turbines at  
23           Hardwoods and Stephenville are an integral part of the restoration effort.

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25           The LIL will be capable of operating in bipolar mode and monopolar mode (i.e., one  
26           pole out of service) with ground or metallic return. The system has the following  
27           characteristics:

- 1           • Rated voltage:  $\pm 350$  kV dc;
- 2           • Bipolar operation;
- 3               ○ Rated power at rectifier (Muskrat Falls): 900 MW (450 MW per pole).
- 4               ○ Rated power at inverter (Soldiers Pond): 830 MW<sup>1</sup> (415 MW per
- 5               pole).
- 6               ○ Rated current: 1286 A per pole.
- 7           • Ten minute monopolar operation; and
- 8               ○ Rated power at rectifier (Muskrat Falls): 900 MW.
- 9               ○ Rated power at inverter (Soldiers Pond): 662 MW.
- 10              ○ Rated current: 2572 A.
- 11           • Continuous monopolar operation – earth return;
- 12               ○ Rated power at rectifier (Muskrat Falls): 675 MW.
- 13               ○ Rated power at inverter (Soldiers Pond): 552 MW.
- 14               ○ Rated current: 1929 A.

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16           During normal operation with the LIL loaded to 900 MW at the Muskrat Falls

17           rectifier, a nominal 170 MW<sup>2</sup> is designated for delivery to Nova Scotia with the

18           remaining 730 MW potentially designated for delivery to the Island Interconnected

19           System. With the LIL operating at maximum transfer, the generation on the Island

20           Interconnected System must be dispatched to have sufficient spinning reserve to

21           maintain system frequency for the loss of the largest hydroelectric unit (i.e., 154

22           MW Bay d’Espoir Unit 7) as the LIL will have no capacity remaining to supply the

23           reserve.

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<sup>1</sup> Actual delivered power is dependent upon overhead line resistance, which varies with ambient temperature.

<sup>2</sup> The Emera NL block consists of 0.98 TWh delivered in a 16 hour per day, seven day per week product. The capacity equals 167.8 MW.

For permanent loss of a pole on the LIL, the system has a ten minute, monopolar rating of 662 MW at the Soldiers Pond inverter. Under the LIL full load scenario, this will result in a 168 MW deficiency in transfer capacity when compared to the full bipole transfer capacity. However, with the loss of a pole on the LIL, in order to prevent load interruption on the Island, the export of the Emera block (nominal 157 MW) will be curtailed by an automated protection scheme leaving the full 662 MW ten minute rating of the LIL at Soldiers Pond for the support of the Island Interconnected System load. Under the LIL full load scenario after removing the Nova Scotia Block, the nominal delivery via LIL to Soldiers Pond for use on the Island in the bipole mode is 673 MW. Comparing this amount to the LIL ten minute, monopolar rating of 662 MW, results in a maximum 11 MW deficiency on the Island Interconnected System. The 11 MW deficiency would be made up by the spinning reserve on the Island Interconnected System in this operating mode thus preventing any customer load loss<sup>3</sup>.

The ten minute overload capability on the LIL provides the Energy Control Centre with sufficient time to start off-line generation if necessary, such that, starting at the ten minute mark, over the next ten minutes, loading on the LIL at Soldiers Pond is reduced from 662 MW to 552 MW (the monopole continuous rating). This additional 110 MW will be met from the 154 MW of spinning reserve at the time of the event. Following the use of this reserve, additional spinning reserve will be obtained by starting available standby plants such as the combustion turbine plants.

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<sup>3</sup> Historically, with the Island Interconnected System isolated from the North American grid, operating experience demonstrates that a 25 MW generation rejection under light load conditions does not result in under-frequency load shedding events. Consequently, with the addition of high inertia synchronous condensers included in the LIL project and 154 MW of spinning reserve on the Island, an 11 MW deficiency on the Soldiers Pond inverter during a monopole contingency will not result in loss of supply to customers as there will be sufficient inertia and governor response from the Island hydroelectric units to maintain acceptable system frequency.

Once the Island and Labrador Interconnected Systems reach a steady state operating point at approximately 20 minutes post LIL pole failure, redispatch of generation is necessary to re-establish deliveries of the Nova Scotia Block on a pro-rata basis of the scheduled firm deliveries on the LIL prior to the pole outage (with the firm deliveries being the Nova Scotia Block and NL native load). With the LIL limited to 552 MW in continuous monopolar mode, the allocations become 104 MW for Nova Scotia and 448 MW for the Island Interconnected System. With the original maximum Island Interconnected System allocation via LIL being 673 MW and the continuous monopolar allocation being 448 MW, there is a maximum deficiency of 225 MW, which is covered by Island generation reserves (i.e., spinning and standby). Consequently, there is no loss of customer load as long as there is a combination of 225 MW available in spinning and standby reserves on the Island.

A full loss of the LIL, referred to as a permanent bipole failure, will result in immediate curtailment of the export of the Nova Scotia capacity and loss of a maximum of 673 MW of capacity on the Island Interconnected System. The loss of 673 MW to the Island Interconnected System will require load shedding of up to 673 MW in order to rebalance on Island generation with load and return system frequency to normal. This load shedding scheme is under study to determine appropriate trigger levels and allocation across the Island.

Once the Island Interconnected reaches a stable mode following loss of the LIL, standby Island generation, if not already on line, would be brought on line to restore load curtailed during the event. The standby generation would include:

- NLH standby combustion turbines and diesel 234.7 MW ( including the new 120 MW Holyrood CT); and
- Newfoundland Power standby thermal generation 41.5 MW.

1 A total of 276.2 MW of standby generation, if not already on line, would be  
2 available in ten to 40 minutes.

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4 In the event of a complete LIL outage, capacity available to supply Island load would  
5 include approximately:

- 6 • 1013 to 1043 MW of on Island hydro-electric (variation due to reservoir  
7 levels);
- 8 • 276 MW of on Island thermal generation;
- 9 • Up to 300 MW of import via the Maritime Link; and
- 10 • Potential interruptible customer loads of 60 MW or more.

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12 Resulting in a total capacity in the range of approximately 1650 MW to 1680 MW to  
13 supply load in the event of a permanent LIL outage. Based on current load forecasts,  
14 the NLH system load will exceed 1650 MW in around the year 2025. Without the  
15 Hardwoods and Stephenville combustion turbines, the total capacity would be in the  
16 range of approximately 1550 MW to 1580 MW to supply load in the event of a  
17 permanent LIL outage, requiring additional capacity to be added to the system  
18 sooner than the anticipated 2025 time frame. Options available to supplement the  
19 capacity requirement would include:

- 20 • Additional industrial and commercial interruptible load arrangements;
- 21 • Customer demand side management initiatives;
- 22 • Additional imports via the Maritime Link when existing constraints in the  
23 Maritime/New England systems are mitigated; and
- 24 • Potential on-Island capacity additions.