Q. **Re: PUB-NLH-217**

**Citation 1 (p. 8):**

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.

**Citation 2 (p. 9):**

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.

A total of 276.2 MW of standby generation, if not already on line, would be available in ten to 20 minutes.

**Please confirm that, in the event of a full loss of the LIL under the circumstances described:**

- **immediate load shedding of 673 MW would be required;**
- **within 20 minutes, this amount could be reduced to 396.8 MW (673 - 276.2), due to the availability of standby generation.**

A. In the event of a full loss of the LIL under the circumstances described:

- **Immediate load shedding of 673 MW would be required.** This is confirmed in

the event that the LIL is loaded to capacity (i.e., 830 MW delivered at Soldiers Pond) prior to the loss of the LIL.

The magnitude of the "immediate" load shed on the Island Interconnected System following the complete loss of the LIL is dependent upon the magnitude of the LIL loading prior to the loss of the LIL[1]. In the event that the LIL is loaded to capacity prior to the loss of the LIL, the load shed on the Island Interconnected System will be 673 MW as noted above. The 673 MW load shed value is the maximum load shed value. If the LIL is loaded to a lower loading, say 500 MW prior to the sudden loss of the LIL, then the load shed value on the Island Interconnected System would be lower. In this example with 500 MW delivered to Soldiers Pond on the LIL and 157 MW exported to Nova Scotia on the Maritime Link, the load shed on the Island Interconnected System for the sudden loss of the LIL would be 343 MW.

- **Within 20 minutes, this amount could be reduced to 396.8 MW (673 - 276.2), due to the availability of standby generation.** This is not confirmed. As noted in the response to PUB-NLH-217, the available stand by generation on the Island equals 276.2 MW comprised of:
    - NLH standby generation of 234.7 MW including:
        - Hardwoods Combustion Turbine at 50 MW;
        - Stephenville Combustion Turbine at 50 MW;
        - Holyrood Combustion Turbine at 120 MW;
        - Hawke's Bay Diesel Plant at 5 MW;
        - St. Anthony Diesel Plant at 9.7 MW; and

[1] Detailed load shedding studies for all LIL loading scenarios have not been completed to date. These studies will be completed as part of the detailed operational studies to be completed in 2015 -2016.

- Newfoundland Power generation of 41.5 MW.

Not all thermal resources will be fully available within 20 minutes, as explained below.

From Hydro's response to GT-PUB-NLH-045[2] from the *2014 Capital Budget Supplemental Application – Supply and Install 100 MW Combustion Turbine Generator* application:

> Given a time from standstill to full load of approximately 40 minutes for the Holyrood CT, a total of 156.2 MW of stand by generation could be brought on line and fully loaded in the 10 to 20 minute time frame. At the 20 minute mark, the Holyrood CT would be ready to synchronize to the system and the additional 120 MW of standby generation would be fully in service within the subsequent 20 minutes. That is, 156.2 MW available in 10 to 20 minutes with an additional 120 MW available in 40 minutes from the start of the event.

Also from the response to GT-PUB-NLH-045:

> The 21-minute start up time referenced in Hydro's response to GT-CA-NLH-005 and the 10 to 20 minutes referenced in response to GT-PUB-NLH-006 were based upon the start time provided by the vendor at the bid submission stage.

[2] Attached as GRK-NLH-125 Attachment 1.

The vendor has provided additional information from the equipment manufacturer.

**GT-PUB-NLH-045**
**100 MW Combustion Turbine Generation - Holyrood**



Q. The response to GT-NP-NLH-007 states the start up time for the proposed 100 MW (nominal) CT is 40 minutes. The response to GT-CA-NLH-005, Attachment, page 1 of 2, states the start up time is 21 minutes. The response to GT-PUB-NLH-006, page 9, states that a total of 276.2 MW of standby generation, including the new CT, would be available in 10 to 20 minutes, if not already online. Confirm the start time for the proposed new Holyrood CT and explain how its full capability could be available in 10- 20 minutes as stated in GT-PUB-NLH-006.

A. The 21-minute start up time referenced in Hydro's response to GT-CA-NLH-005 and the 10 to 20 minutes referenced in response to GT-PUB-NLH-006 were based upon the start time provided by the vendor at the bid submission stage.

The vendor has provided additional information from the equipment manufacturer. In starting the Holyrood CT, the units must first be in a ready to start condition. That is, the unit must not be undergoing maintenance and the auxiliaries are available for example. To start the unit, it must be accelerated from standstill to 3600 rpm (i.e., rated speed). The manufacturer requires that the acceleration time to 3600 rpm be no faster than 20.0 minutes. Acceleration rates faster than 20 minutes may result in compressor disc migration resulting in subsequent issues with the machine (i.e., damage). Once the unit is rotating at rated speed the machine is ready to be synchronized to the Island Interconnected System. The time to synchronize the unit and pick up minimum load is estimated at 0.5 minutes. This brings the fastest total time to connect the Holyrood CT to the Island Interconnected System equal to 20.5 minutes. From this point in time the unit loading is increased. The manufacturer indicates a minimum total time of 7.5 minutes to load from minimum load to the unit’s ISO rating. Assuming a minimum

load of 5 MW, the manufacturer has set the maximum load rate (ramp rate) from minimum load to ISO base load (i.e., 123 MW) at approximately 15.7 MW per minute. Therefore the total time to start and fully load the Holyrood CT is 28 minutes (i.e., 20 min acceleration + 0.5 min synchronize + 7.5 min to full load). The 28 minute start time is the fastest start time for the Holyrood CT.

Based upon Hydro's operating experience with its combustion turbines, a more practical ramp rate would be between 5 and 7 MW per minute to ensure continued operability of the unit long term. For the Hardwoods and Stephenville CTs this results in a 0 to 50 MW loading in seven to ten minutes. For the Holyrood CT if one assumes a ramp rate of 6 MW/min, it would take approximately 19.5 minutes to fully load the machine. The total time to start and load the Holyrood CT under normal circumstances equals 40 minutes (i.e., 20 min acceleration + 0.5 min synchronize + 19.5 min to full load). The 40 minute practical start time is consistent with the response to GT-NP-NLH-007.

Given a time from standstill to full load of approximately 40 minutes for the Holyrood CT, a total of 156.2 MW of stand by generation could be brought on line and fully loaded in the 10 to 20 minute time frame. At the 20 minute mark, the Holyrood CT would be ready to synchronize to the system and the additional 120 MW of standby generation would be fully in service within the subsequent 20 minutes. That is, 156.2 MW available in 10 to 20 minutes with an additional 120 MW available in 40 minutes from the start of the event.