Q. Further to the response to PUB-NLH-035, explain what unforeseen events prevented the December 1 target from being met in 2013. Include in the response why, given the dates in the response to PUB-NLH-036 for the discovery of problems at the Hardwoods and Stephenville gas turbines, these gas turbines could not have been ready for service by December 1.

A. Please refer to the following sections explaining why the Hardwoods and Stephenville gas turbines were not available for service on December 1, 2013.

Hardwoods Gas Turbine

The Hardwoods gas turbine, located in the St. John's area, is operated as a synchronous condenser for voltage support of the transmission system on the Avalon Peninsula, and to generate power under system peak and Avalon Peninsula emergency/contingency conditions. The unit is also utilized to enable efficient loading and dispatch of the Holyrood Thermal Generating Station by being available to respond to a contingency which would otherwise have to be provided by having an additional unit operating at Holyrood at inefficient loads.[1]

In January 2013, it was determined that the Hardwoods unit could be operated in emergency conditions only. This restriction was based on the recommendations from Brush GMS (Brush), the alternator original equipment manufacturer (OEM), due to conditions identified during an inspection of its sister unit in Stephenville in

[1] The Holyrood generating units cannot be quickly turned on and off like gas turbine units to respond to a system problem. Therefore, to provide the same response as a gas turbine, a Holyrood unit must be placed on line and operated at its minimum output level of 70 MW in order to be available to quickly respond to a problem. As problems are unpredictable, this would result in the Holyrood unit being on for many days consuming large amounts of fuel when there would otherwise be no requirement for them to operate.

2012. During this inspection, it was discovered that the rotor retaining rings on the Stephenville unit had cracks that could have led to a catastrophic failure of the unit if it had continued to operate. Based on these findings, and the fact that the Hardwoods and Stephenville alternators were both installed in the mid-1970s, have been in service for over 35 years and have never had the rotor retaining rings replaced, Brush recommended that the Hardwoods unit be restricted to run only in emergency conditions until a repair/refurbishment of the unit (including replacement of the retaining rings) could be carried out.

This unforeseen repair caused Hydro to re-evaluate its 2013 planned generation outage schedule. Project planning proceeded with the evaluation of the available options for the repair/refurbishment of the unit. At the time there were two options evaluated:

1. **Replacement of the alternator** with a capital cost of $8 million and a 2.5 month outage to the unit. The earliest possible start date was October 1, 2013 due to the timing for the delivery of the replacement alternator from Brush. This date was advanced by almost four months through discussions with the company.

2. **Refurbishment of the alternator** (rewinding the rotor and stator which is similar to the work carried out at Stephenville) with a capital cost of $8.1 million and a 4.5 month outage to the unit. To complete the work prior to the winter of 2013/2014, the unit would have to be removed from service during part of the period when Holyrood is normally shut down. This would have resulted in a unit having to be operated at Holyrood for much of the summer to ensure reliability of the power system for Avalon Peninsula line outage contingencies. This would have significantly disrupted the planned maintenance and capital upgrades for

Holyrood. The cost of operating Holyrood during the summer was estimated at $310,000 per day which further made this option more costly.

Hydro also considered the operating forecast for December which indicated at the time there was appropriate reserves on the system to accommodate the outage and still meet forecast demand. Furthermore, once this outage window for Hardwoods was set, Hydro considered the unavailability of this unit in the scheduling and outage planning of the remaining generation to continue to provide for safe and reliable operation of the power system. It has been past practise, if required, to allow a generation outage to extend into December if the operating load forecast can accommodate it.

Hydro proceeded with the option to replace the alternator, as this afforded the shortest outage window, the least disruption to the Holyrood planned work and was the lowest cost option for customers. Hydro submitted an application to the Board on April 24, 2013 for the approval of the recommended least cost option which was subsequently approved in May 2013.

The scope of work for the alternator replacement was significant and therefore required an outage of 2.5 months. Following is a summary level description of the scope of work required:

- Placing an asphalt pad to support a crane which was required for removal and installation of the alternator assemblies;
- Relocation of the main lube oil cooler to allow crane access to the alternator enclosure;
- Disassembly of the alternator enclosure including the air treatment system and the stator canopy;

- Disconnection of all auxiliary systems including electrical, mechanical, and fire protection systems;
- Removal of the existing alternator;
- Assembly of the new alternator (rotor and stator) once received at site;
- Installation of the new alternator in the enclosure;
- Alignment of the alternator within the unit;
- Reassembly of the alternator enclosure;
- Reconnection of auxiliary systems;
- Reconnection and recertification of the fire protection system; and
- Commissioning.

Prior to the commencement of the outage, all preparation work was completed and the outage began on October 3, 2013, as planned, once Holyrood Unit 2 was in full operation. To ensure the return to service timeline was met, work proceeded on the Hardwoods unit on a six day per week, ten hour per day schedule and the unit was placed on line for testing on December 17, 2013. The unit was tested successfully to full load (50 MW) on December 19, 2013. During run-up tests for remote operation on December 20, 2013 there was an unexpected failure of a fuel control valve that made the unit unavailable again. Following repairs the Hardwoods gas turbine was restored to full service on January 12, 2014.

Stephenville Gas Turbine

The Stephenville gas turbine is operated as a synchronous condenser for voltage support of the transmission system on the west coast, and to generate power under system peak and emergency/contingency conditions. Like Hardwoods, there are two ends to the Stephenville gas turbine (A and B), both rated at 25 MW each.

In June 2013, the unit was released for service after completion of an alternator refurbishment (a stator and rotor rewind). At this time, it was determined that due to deterioration of the insulation blankets[2] on End B, it was limited to an output of 15 MW, a derating of 10 MW from the engine's rated output of 25 MW.

End A was tested and was able to operate reliably at 25 MW. As a result, the unit was released for service with an availability of 25 MW when only End A was operating, 15 MW when only End B was operating, and 30 MW when both ends were operating[3]. The unit was also released for full synchronous condenser capability.

The blankets on End B required replacement to restore the unit to its original operating condition. These were the original blankets on the unit and this was the first replacement. Hydro initiated steps to obtain replacement insulating blankets in July. The blankets are a customized piece of equipment and as such, specifications had to be developed before a quotation could be obtained. On-site inspections and data collection were required to develop the specification in consultation with the supplier. Hydro finalized a specification and obtained a quotation for the supply and installation of the insulating blankets for End B on October 18, 2013. Once the quotation was received, it was determined that the supplier would not be able to meet Hydro's date for winter readiness therefore Hydro sought another supplier resulting in an additional quote being received on

[2] The insulation blankets are specially designed insulating material which wrap around the exhaust area to prevent the engine module from getting too hot while the unit is operating. The engine is housed in a module with other equipment which is critical to the operation of the engine such as control and monitoring equipment. The insulating blankets prevent heat from the engine affecting this other equipment.

[3] When both turbines are in operation the output of each must be equal. Therefore the output of End A is limited to 15 MW when End B is operating to its maximum reliable output of 15 MW. This results in a total unit output limit of 30 MW.

December 3, 2013. Hydro issued a purchase order with this supplier and the blankets were received at the end of the first week of January 2014.

On January 5, 2014, End A was shut down for a maintenance check and it was determined End B could be run at full capacity (25 MW) during cold ambient temperatures. However, on January 8, 2014, End B tripped at 0830 hours. After an assessment it was determined that End B had experienced a failure of its engine and was unavailable for service. Work is ongoing with the service provider to assess the extent of the damage, install a replacement engine and following that, install the insulating blankets on the power turbine. The current status of the unit is an availability of 25 MW on End A. There is also full synchronous condenser capability.