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July 20, 2015

The Board of Commissioners of Public Utilities
Prince Charles Building
120 Torbay Road, P.O. Box 21040
St. John's, NL
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ATTENTION: Ms. Cheryl Blundon
Director of Corporate Services & Board Secretary

Dear Ms. Blundon:

Re: Field Investigation for Holyrood Combustion Turbine, March 4, 2015

Enclosed please find the original and 12 copies of Hydro's report entitled "Field Investigation for Holyrood Combustion Turbine Failed Start". This report is the result of Hydro's field investigation regarding the Holyrood Combustion Turbine Failed Start, identifying causes and enhancements to address these causes.

Should you have any questions or comments, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Geoffrey P. Young
Senior Legal Counsel

GPY/bds

A REPORT TO

THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

Field Investigation for Holyrood Combustion Turbine Failed Start, March 4, 2015

July 20, 2015

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1.0 Executive Summary

On the morning of March 4, 2015, Newfoundland and Labrador Hydro (Hydro) was in the process of returning Unit 1 at the Holyrood Thermal Generating Station (Holyrood TGS) to service following a planned emergency maintenance outage. A contingency plan was in place for the duration of that maintenance outage to ensure adequate electricity supply to customers. The Island Interconnected System generation reserves in the days and hours prior to the morning peak of March 4 were monitored and considered adequate for supply to customers.

The contingency plan to have the Holyrood Combustion Turbine (CT) on line for the morning peak had been initiated the previous afternoon. Shortly after 06:00 hours on the morning of March 4, Hydro experienced unanticipated starting issues with the Holyrood CT.

Prior to being placed in service at 07:25 hours, the Holyrood CT experienced three failed starts as a result of high temperatures caused by excessive fuel flow from the fuel bypass valve. Repeated adjustment of the fuel valve was required to establish the required fuel flow rate through the valve and achieve a successful start of the unit. This resulted in a delay of almost one and one half hours in placing the unit in service.

Investigation into the cause of the failed starts revealed that the fuel bypass valve had moved off its previously set position. Analysis of the incident resulted in remedial actions which included:

- Visually marking the required set point position on the valve;
- Installing a locking mechanism on the valve to lock it in the set point position so that it could not be easily moved; and
- Determining whether there was an engineered locking mechanism which could be affixed/applied to the valve.

2.0 Background Information

Holyrood Unit 1 experienced an oil leak on a generator bearing that required a planned emergency repair. The most suitable timeframe for an outage to undertake the repairs to Unit 1 was determined to be Friday, February 27, 2015 at 12:00 hours to Tuesday, March 3, 2015, at 20:00 hours. As part of the planning process for the required outage on Unit 1, Hydro's System Planning Department performed an Avalon load flow analysis to support the appropriate use and associated unit loading of standby generation to successfully cover N-1 contingencies. The results of the load flow analysis indicated Hydro would plan to operate the Hardwoods, Stephenville and Holyrood combustion turbines as required during peak demand periods during the planned Unit 1 outage. Consistent with this plan, the combustion turbine units were operated successfully during the days of February 28 through March 3.

Holyrood Unit 1 was planned to be back in service in the evening of March 3, prior to the morning peak on March 4.

On March 3, in accordance with the expected demand on March 4, the standby units at Hardwoods, Stephenville and Holyrood were scheduled to be placed online by approximately 06:00 hours on March 4, in advance of the morning peak demand.

The new combustion turbine at Holyrood was fully available leading up to the event and had been started eight times without incident in the 14 days prior to March 4, with no failed starts during that period.

3.0 Incident Timeline

The following events occurred on March 4, 2015.

06:00 hours Planned start time for Holyrood CT

06:12 hours Holyrood combustion turbine became unavailable for service due to a failure to start

07:25 hours The Holyrood combustion turbine on line

4.0 Detailed Description of Events

On Wednesday March 4, during start-up of the Holyrood CT, there were a series of failed starts due to an excessive fuel bypass valve flow rate. The bypass valve provides initial flow to the turbine fuel nozzles for starting the unit. The flow rate on this valve had been commissioned following installation to a flow rate in accordance with the original equipment manufacturer (OEM) specifications. This valve is not located on the turbine itself, but is part of the fuel supply system and is located on the fuel, oil, and water injection skid, on an elevated platform within the plant (Photo 4).

During the initial start-up sequence, the operators onsite received an alarm indicating high temperature differential in the wheel space thermocouples which lead to an immediate shut down of the unit. A high temperature spread is typically a result of all fuel nozzles not firing and the safety parameters on the machine will not allow continued combustion. Staff on site at the CT immediately began to troubleshoot the failed start. An assessment was made from the control monitor that fuel flow through the fuel bypass valve was high. A valve adjustment was made to decrease flow rate through the valve.

At approximately 06:20 hours, a second attempt to start the unit ended with the unit shutting down shortly after the start signal again due to high temperature differential. The flow rate through the bypass valve was once again adjusted.

At approximately 06:30 hours, a third attempt was made to start the unit which failed shortly after initiating the start signal due to excessive temperature differential. It was noted that although the fuel flow had been decreased it was still excessive. The bypass valve was adjusted to decrease flow once again.

At approximately 07:00 hours the unit started successfully.

At 07:25 hours, the unit was on line and loaded to 118 MW.[1]

5.0 Analysis

Analysis of the cause of the failed starts included a review of the operation of the fuel bypass valve and the potential reasons for the change in valve position which had occurred prior to the events of March 4.

A review of the prior operation of this valve indicated that it was known to be sensitive across its flow range with small adjustments in valve position resulting in relatively large changes in flow rate. The valve is manually operated and is set to provide the required flow rate on start up.

During previous runs of the unit there had been no issues with the flow rate through the fuel bypass valve. The flow rates had been within the acceptable operating range and there were no starting issues with the unit which were a result of problems with this valve. In the 14 days prior to March 4, the unit had been started 8 times without incident.

[1] The start time for the unit is approximately 28 minutes. Starting and acceleration to 3600 rpm takes 20 minutes, with synchronization and loading taking a further 8 minutes.

The reason for the changes in the flow rate on the valve could not be conclusively determined. It was, however, determined that no changes had been made to the valve position by the construction, commissioning and operations staff. The potential causes for the changed valve position include inadvertent contact with the valve through some sort of bump or external agitation, or vibration. As the valve flow rate changes significantly with small changes in valve position, the increased flow rate could have been caused by either method.

6.0 Action Plan

The following actions were taken to reduce the risk of this situation occurring again:

- The valve set position corresponding to the required flow rate was immediately marked on the valve so that if moved, the valve could be quickly returned to the proper position (Photo 3);
- The valve was locked in position so that it could not be easily moved (Photo 2);
- A pre-start up verification of the valve position was instituted; and
- The valve manufacturer was contacted to determine whether there was an engineered locking mechanism which could be affixed/applied to the valve.

The valve manufacturer has provided information on a modification which can be made to the valve to allow it to be locked in position. The details of this modification are provided in Appendix A.

7.0 Pictures

Photo 1: Fuel bypass valve

Photo 2: Fuel bypass valve locked and tagged

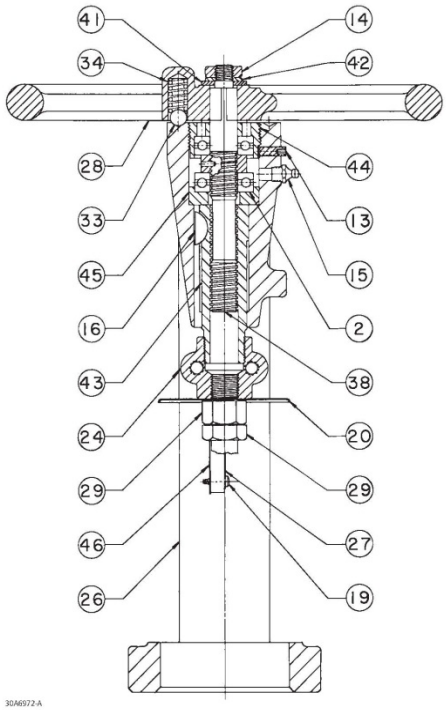
Photo 3: Close up of fuel bypass valve position indicator

Photo 4: Fuel bypass valve location within the plant

APPENDIX A

PROPOSED VALVE MODIFICATION

Figure 3. Fisher 1008 Handwheel Actuator Sizes 40 and 50



The figure above shows the valve hand wheel and actuator. The locking mechanism proposed has the detent section, parts 33 & 34, drilled out and threaded. A new set screw will be installed and tightened at this location to lock down the hand wheel. Parts included in the modification are as identified in the table below.

Remove	1	34	SPRING,COMPENSATOR
Remove	1	33	BALL
Add	1	48	SCREW,SET,SQ HD
Remove	1	28	HANDWHEEL
Add	1	28	HANDWHEEL