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February 1, 2018

The Board of Commissioners of Public Utilities
Prince Charles Building
120 Torbay Road, P.O. Box 21040
St. John's, NL A1A 5B2

Attention: Ms. Cheryl Blundon
Director Corporate Services & Board Secretary

Dear Ms. Blundon:

Re: Newfoundland and Labrador Hydro - The Board's Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System – Rolling 12 Month Performance of Hydro's Generating Units

In accordance with item 2.8 of the Liberty Report Recommendations dated December 17, 2014, please find attached one (1) original plus twelve (12) copies of the quarterly *Rolling 12 Month Performance of Hydro's Generating Units report* (the "Report").

During final quality verification, a discrepancy was identified and the Report was held until correct data was confirmed. The data included in this report has been verified as accurate and matches the Generation Equipment Status database.

We trust the foregoing is satisfactory. If you have any questions or comments, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Michael Ladha
Legal Counsel & Assistant Corporate Secretary
ML/skc

cc: Gerard Hayes – Newfoundland Power
Paul Coxworthy – Stewart McKelvey Stirling Scales
Danny Dumaresque
Dennis Browne, Q.C. – Browne, Fitzgerald, Morgan & Avis
Dean Porter – Poole Althouse

ecc: Dennis Fleming – Cox & Palmer
Roberta Frampton Benefiel – Grand Riverkeeper Labrador
Larry Bartlett – Teck Resources Limited

Quarterly Report on Performance of Generating Units

For the Quarter ended December 31, 2017

February 1, 2018

A Report to the Board of Commissioners of Public Utilities

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Table of Contents

1 Introduction

In this report, Newfoundland and Labrador Hydro (Hydro) provides data on forced outage rates of its generating facilities. This data is provided in relation to historical forced outage rates and as well as in relation to assumptions used for system planning purposes.

The forced outage rates are provided for individual generating units at hydraulic facilities, the three units at the Holyrood Thermal Generating Station, and Hydro's gas turbines for the current 12-month reporting period of January 1, 2017 to December 31, 2017. This report also provides, for comparison purposes, the individual generating unit data on forced outage rates for the previous period January 1, 2016 to December 31, 2016. Further, total asset class data is presented on an annual basis for the years 2006-2016. This report provides data on outage rates for forced outages, not planned outages.

The forced outage rates of Hydro's generating units are presented using two measures: Derated Adjusted Forced Outage Rate (DAFOR) for the hydraulic and thermal units and Utilization Forced Outage Probability (UFOP) for the gas turbines.

Derated Adjusted Forced Outage Rate (DAFOR) is a metric that measures the percentage of the time that a unit or group of units is unable to generate at its maximum continuous rating due to forced outages. The DAFOR for each unit is weighted to reflect differences in generating unit sizes in order to provide a company total and reflect the relative impact a unit's performance has on overall generating performance. This measure is applied to hydraulic and thermal units. However, this measure is not applicable to gas turbines because of their nature as standby units, and relatively low operating hours.

Utilization Forced Outage Probability (UFOP) is a metric that measures the percentage of time that a unit or group of units will encounter a forced outage and not be available when required. This metric is used for the gas turbines.

The forced outage rates include outages that remove a unit from service completely, as well as instances when units are derated. If a unit's output is reduced by more than 2%, the unit is considered derated by Canadian Electricity Association (CEA) guidelines. Per CEA guidelines, to take into account the derated levels of a generating unit, the operating time at the derated level is converted into an equivalent outage time.

In addition to forced outage rates, this report provides outage details for those outages that contributed materially to forced outage rates exceeding those used in Hydro's generation planning analysis for both the short and long term.

2 Period Ending December 31, 2017 Overview

Table 1 DAFOR and UFOP Overview

Class of Units	January 1, 2016 to December 31, 2016 (%)	**January 1, 2017 to December 31, 2017 (%)**	Base Planning Assumption (%)	Near-Term Planning Assumption[1] (%)
Hydraulic (DAFOR)	5.51	**2.29**	0.90	2.60
Thermal (DAFOR)	19.42	**14.91**	9.64	14.00
Gas Turbine (Combined) (UFOP)	9.35	**6.93**	10.62	20.00
Gas Turbine (Holyrood) (UFOP)	1.65	**2.02**	5.00	5.00

There was an improvement in hydraulic and thermal DAFOR performance for the current 12-month period ending December 2017, compared to the previous 12-month period ending December 2016 (see Table 1). The combined[2] gas turbine UFOP performance shows an improvement in performance for the current period compared to the previous period.

[1] *Near-Term Generation Adequacy Report*, May 15, 2017, see Section 5.0 for further details.
[2] Combined Gas Turbines (GT) include the Hardwoods, Happy Valley, and Stephenville units. The performance of the Holyrood GT was not included in the combined base planning or sensitivity numbers as these numbers were set prior to the Holyrood GT's in service date.

In the 10-year period prior to 2015, the hydraulic units showed a somewhat consistent DAFOR. The DAFOR of the current 12-month period compared to the previous 10 years is higher, primarily due to penstock issues experienced on Units 1 and 2 at Bay d'Espoir in 2016 and 2017.

For the Holyrood thermal units, the forced outage rate of the current period ending December 2017 is 14.91%, which is above the base planning assumption of 9.64%, the sensitivity of 11.64%, and the near-term planning assumption of 14.00%[3]. This is primarily caused by an airflow derating on Unit 1 and Unit 2 that started in the fall of 2016 and continued throughout 2017.

Hydro's combined gas turbines' UFOP in the 10-year period prior to 2015 was generally consistent at approximately 10% until the year 2012 when the rate exceeded 50%. Since 2012, the UFOP has been improving each year. For the current 12-month period ending December 31, 2017, performance was affected by forced outages to the Hardwoods, Happy Valley, and Stephenville units.

Note that the data for 2006 to 2015 in Figures 1, 2, and 3 are annual numbers (January 1 to December 31), while the data for 2016 and 2017 are 12-month rolling numbers (January 1 to December 31 for each year).

3 Generation Planning Assumptions

The DAFOR and UFOP indicators used in Hydro's generation planning model are representative of a historic average of the actual performance of these units. These numbers are noted in Table 2 under the column "Base Planning Assumption". This is a long-term outlook.

[3] Section 7.0 of Hydro's *Near-Term Generation Adequacy Report*, November 15, 2017, presented results for Holyrood plant DAFOR = 15%. A Holyrood Plant DAFOR of 15% does not result in violations of any criteria for the expected case. The 15% plant DAFOR results in no violations of Expected Unserved Energy (EUE) but does result in some violations of Loss of Load Hours (LOLH) for the fully stressed reference case and demand sensitivity cases considered.

Hydro also provides a sensitivity number for DAFOR and UFOP as part of its generation planning analysis. This number takes into account a higher level of unavailability, should it occur, to assess the impact of higher unavailability of these units on overall generation requirements. During the 12-month period ending December 31, 2017, the gas turbine units performed well within this sensitivity range for UFOP, while both the hydraulic and thermal classes performed outside of the sensitivity range for DAFOR.

The new gas turbine (Holyrood GT) has a lower expected rate of unavailability than the original gas turbines, (5% compared to 10.62%), due to the fact that the unit is new and can be expected to have better availability than the older units.[4]

Hydro's generation long-term planning assumptions for DAFOR and UFOP for the year 2017 are noted in Table 2:

Table 2 2017 DAFOR and UFOP Planning Assumptions

	DAFOR (%)		UFOP (%)	
	Base Planning Assumption	**Sensitivity**	**Base Planning Assumption**	**Sensitivity**
Hydraulic Units	0.90	0.90		
Thermal Units	9.64	11.64		
Gas Turbines - Existing			10.62	20.62
Gas Turbines - New			5.0	10.0[5]

As part of Hydro's analysis of energy supply up to Muskrat Falls Interconnection, Hydro completes comprehensive reviews of, and produces reports on, energy supply for the Island Interconnected System. The *Near-Term Generation Adequacy Report*, filed on November 15, 2017, contains analysis based on outlines the near-term DAFOR and Derated Adjusted

[4] Hydro selected a 5% UFOP for the new Holyrood GT following commentary on forced outage rates contained in the *Independent Supply Decision Review – Navigant (September 14, 2011).*

[5] In previous reports this sensitivity value was reported as 5.0%. The generation planning sensitivity for the Holyrood GT was updated to 10% in the September 2015 Q3 report for system planning purposes.

Utilization Forced Outage Probability (DAUFOP)[6] and the resulting implication for meeting reliability criteria until the interconnection with the North American grid. In the *Near-Term Generation Adequacy Report*, Hydro used the DAUFOP metric as the measure of gas turbine unit reliability into the near term. In 2018, Hydro will be measuring and reporting using DAUFOP and UFOP for the gas turbines.

The DAFOR and DAUFOP assumptions used in developing Hydro's November 15, 2017 *Near-Term Generation Adequacy Report* are noted in Table 3:

Table 3 DAFOR and DAUFOP Near-Term Generation Adequacy Analysis Assumptions

	DAFOR (%)	DAUFOP (%)
	Near-Term Generation Adequacy Assumption	**Near-Term Generation Adequacy Assumption**
All Hydraulic Units	2.6	
Bay d'Espoir Hydraulic Units	3.9	
Other Hydraulic Units	0.7	
Holyrood Plant	14.0	
Holyrood Unit 1	15.0	
Holyrood Unit 2	10.0	
Holyrood Unit 3	18.0	
Hardwoods & Stephenville Gas Turbines		30.0
Holyrood Gas Turbine		5.0

4 Hydraulic Unit Forced Outage Rate Performance

The hydraulic unit forced outage rates are measured using the CEA metric, DAFOR. Detailed results for the 12-month period ending December 31, 2017, are presented in Table 4, as well as the data for the 12-month period ending December 31, 2016. These are compared to Hydro's short-term generation adequacy assumptions, as used in the *Near-Term Generation Adequacy Report*, and Hydro's long-term generation planning assumptions for the forced outage rate.

[6] DAUFOP is the probability that a generating unit will not be available due to forced outages or forced deratings when there is demand on the unit to generate. It is essentially the UFOP calculation adjusted to include the effect of deratings on a unit's availability.

Table 4 Hydraulic Weighted DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending December 2016 (%)	12 months ending December 2017 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Hydraulic Units - weighted	954.4	5.51	2.29	0.90	2.60
Hydraulic Units					
Bay D'Espoir 1	76.5	30.87	9.33	0.90	3.90
Bay D'Espoir 2	76.5	33.90	14.11	0.90	3.90
Bay D'Espoir 3	76.5	0.00	0.03	0.90	3.90
Bay D'Espoir 4	76.5	0.93	0.27	0.90	3.90
Bay D'Espoir 5	76.5	0.56	0.00	0.90	3.90
Bay D'Espoir 6	76.5	0.18	1.48	0.90	3.90
Bay D'Espoir 7	154.4	0.00	1.80	0.90	3.90
Cat Arm 1	67	1.02	0.22	0.90	0.70
Cat Arm 2	67	0.00	0.09	0.90	0.70
Hinds Lake	75	0.24	0.89	0.90	0.70
Upper Salmon	84	0.06	0.81	0.90	0.70
Granite Canal	40	1.36	0.11	0.90	0.70
Paradise River	8	7.08	1.70	0.90	0.70

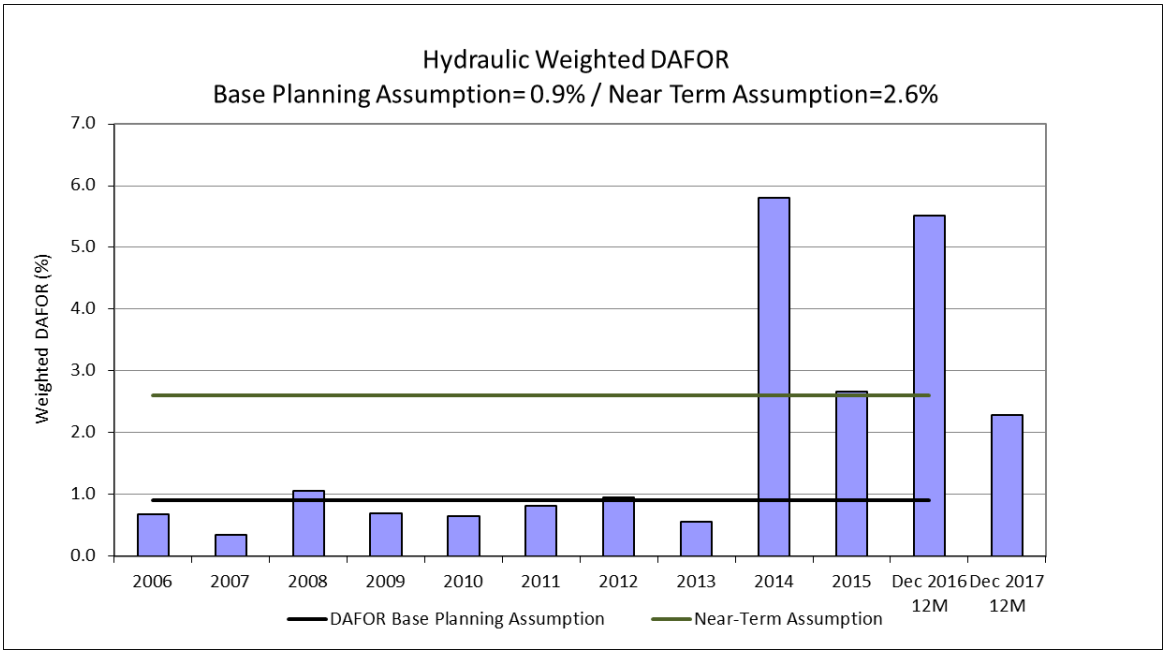

Figure 1 Hydraulic Weighted DAFOR

Considering the individual units' performance, the assumed Hydro generation base planning DAFOR was materially exceeded for Bay d'Espoir Unit 1 and Bay d'Espoir Unit 2. Also, there were exceedances compared to base planning assumption for Bay d'Espoir Unit 6, Bay d'Espoir Unit 7, and Paradise River for the current period.

The Bay d'Espoir Unit 1 DAFOR of 9.33% and Unit 2 DAFOR of 14.11% exceeded the base planning assumption of 0.9% and the near-term assumption of 3.9% for an individual Bay d'Espoir unit. This was due to Units 1 and 2 being removed from service on November 4, 2017 as a result of a leak in Penstock 1 which provides water to both units. The leak occurred in the same area where similar leaks had occurred in 2016, which initiated further investigation and subsequent intervention. A consultant (Hatch) was engaged in the process to provide engineering analysis and recommendations to return the penstock to reliable service. Extensive inspection and testing was completed, which resulted in the damaged section being completely removed, and replaced with a new plate that was overlaid with a second plate. All additional suspect areas were also cleaned, re-welded, and overlaid with additional plates. Additional backfill was placed over a section of the repair area, as this had been part of the proposed 2018 Capital Budget Application resulting from the 2016 leak. The project to increase the backfill amount on Penstock 1 was subsequently approved in P.U. 43(2017). The final report by Hatch to document their findings and analysis is ongoing and is expected by March 31, 2018. A TapRoot® investigation was also conducted to investigate the root causes of the event. The penstock was watered up and both units were returned to service on December 8, 2017.

The Bay d'Espoir Unit 6 DAFOR of 1.48% exceeded the base planning assumption of 0.9% and is less than the near-term assumption of 3.9% for an individual Bay d'Espoir unit. This was as a result of the unit being unavailable from February 22, 2017, to February 25, 2017 due to a high turbine bearing alarm which caused the unit trip protection to operate and shut the unit down in a controlled fashion. An investigation was completed and it was determined that the Babbitt bearing was damaged. The bearing was repaired and the unit was returned to service. The results of the investigation found no issues for long-term bearing reliability.

The Bay d'Espoir Unit 7 DAFOR of 1.80% exceeded the base planning assumption of 0.9% and is less than the near-term assumption of 3.9% for an individual Bay d'Espoir unit. This was as a result of the unit being unavailable from July 3, 2017, to July 9, 2017 due to a failure in the collector assembly which caused the unit protection to operate and isolate the unit from the

system. An investigation was completed and it was determined that the there was a flash over between the positive and negative slip rings, which was caused by excessive brush wear. The investigation was completed and improvements to the Preventive Maintenance (PM) Program have been implemented across the hydraulic generation fleet of assets. As a short-term measure, all brush gear assemblies had an additional inspection completed prior to December 1, 2017, and no issues were found. The PM Program for the brush gear assemblies will also be reviewed during the 2017-2018 winter season with a revised program in place prior to the start of the 2018 maintenance season.

The Paradise River unit DAFOR of 1.70% exceeded the base planning assumption of 0.9% and the near-term assumption of 0.7%, primarily as a result of a forced outage from May 23, 2017 to May 25, 2017. The unit tripped off on May 23, 2017 shortly after being synchronized to the system and loaded to 8 MW. Several attempts to return the unit to service were unsuccessful which resulted in the unit being unavailable until the investigation was completed. The investigation determined the trip was a result of a high generator terminal voltage, attributed to TL 212 being out of service. The condition was rectified by adjusting the generator excitation voltage, and the unit was returned to service on May 25, 2017. There have been no recurrence of events relating to this issue since that time, and this issue is now considered to be resolved.

5 Thermal Unit Forced Outage Rate Performance

The thermal unit forced outage rates are measured using the CEA metric, DAFOR. Detailed results for the 12-month period ending December 31, 2017 are presented in Table 5, as well as the data for the 12-month period ending December 31, 2016. These are compared to Hydro's short-term generation adequacy assumptions, as used in the *Near-Term Generation Adequacy Report*, and Hydro's long-term generation planning assumptions for the forced outage rate.

Table 5 Thermal DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending December 2016 (%)	12 months ending December 2017 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Thermal Units - weighted	490	19.42	14.91	9.64	14.00
Thermal Units					
Holyrood 1	170	24.55	19.35	9.64	15.00
Holyrood 2	170	26.69	19.14	9.64	10.00
Holyrood 3	150	2.41	5.84	9.64	18.00

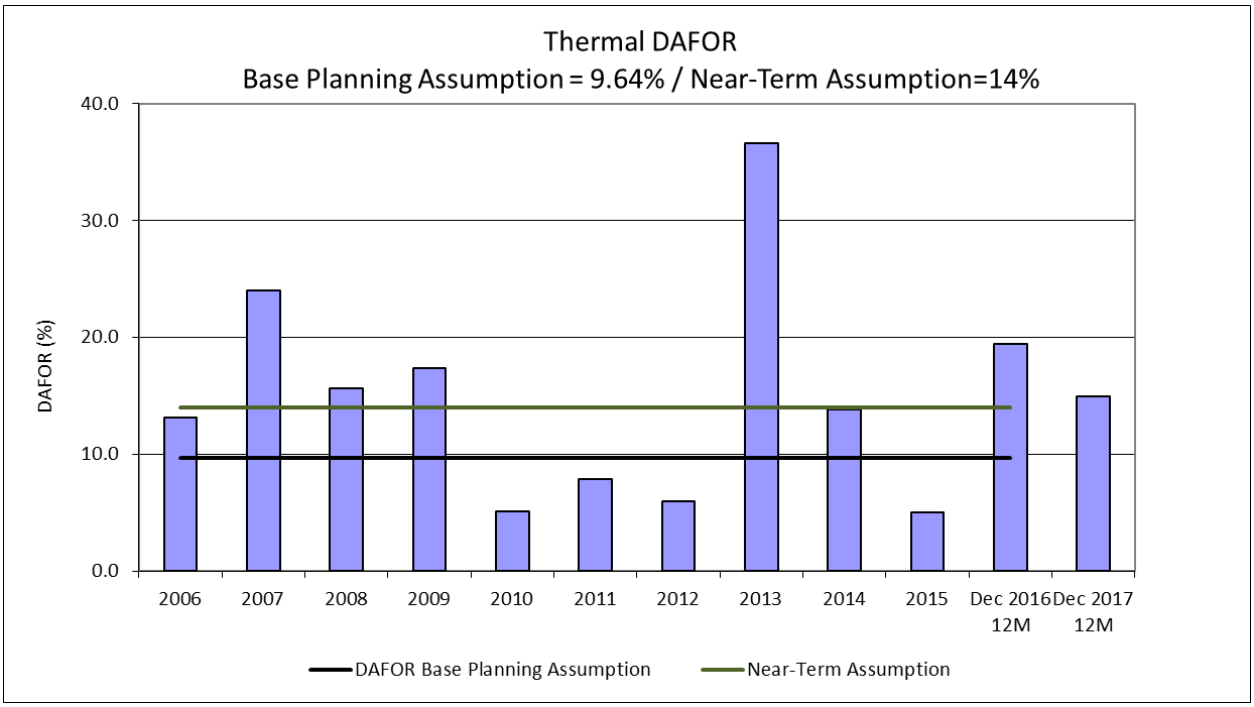

Figure 2 Thermal DAFOR

For the 12-month period ending December 31, 2017 the weighted DAFOR for all thermal units of 14.91% is above the assumed Hydro generation base planning DAFOR value of 9.64% and the near-term assumption of 14.00%[7]. Unit 1 DAFOR was 19.35% and Unit 2 DAFOR was 19.14%.The performance for both Units 1 and 2 was above the base planning assumption of 9.64% and the near-term assumption of 15% (Unit 1) and 10% (Unit 2). Unit 3 DAFOR was

[7] Section 7.0 of Hydro's *Near-Term Generation Adequacy Report*, November 15, 2017, presented results for Holyrood plant DAFOR = 15%. A Holyrood Plant DAFOR of 15% does not result in violations of any criteria for the expected case. . The 15% plant DAFOR results in no violations of EUE but does result in some violations of LOLH for the fully stressed reference case and demand sensitivity cases considered.

5.84% which is better than the base planning assumption of 9.64% and near-term assumption of 18.0%. The majority of the 14.91% DAFOR for the plant is due to deratings from airflow issues on Unit 1 and Unit 2.

The DAFOR performance for Holyrood Unit 1 (170 MW) was affected by the following events in the current 12 month to date period:

- At the start of 2017, Unit 1 was derated to 160 MW due to air flow issues. The load capability continued to deteriorate as a result of fouling. Load capability was reduced to 145 MW on January 20, 2017, due to increased fouling, particularly in the air heater. An air heater wash was completed on a maintenance outage from January 26, 2017 to January 27, 2017, which restored the load capability to the pre-wash condition of 160 MW. However, the capability was further reduced due to continued fouling in the economizer; and at the end of February, 2017 the unit was derated to 150 MW. On March 4, 2017, the unit capability was rated at 140 MW, and by the end of March 2017 this had further reduced to 135 MW. When the unit was taken off-line for the 2017 maintenance outage at the end of June, it was capable of 120 MW.
- On March 8, 2017, it was necessary to take a short forced outage to repair two air heater bearing cooling water leaks. Unit 1 was taken off-line in a controlled manner and was returned to service approximately 23 hours later after completion of the repairs.
- The 2017 maintenance outage on Unit 1 was from July 5, 2017 until September 11, 2017. The unit was put on-line on September 17, 2017 to allow for on-line commissioning of the new exciter controls system by the Original Equipment Manufacturer, ABB.
- Unit 1 tripped at 70 MW on September 18, 2017 during commissioning of the new exciter controls on that unit. The unit was derated to 50 MW, below Under Frequency Load Shed (UFLS) limits until September 21, 2017, when the cause of the trip was determined. This was to ensure that any further trips would not impact customers. Investigation determined that this trip, which happened when starting a boiler feed pump, was due to low unit board voltages. Starting the pump caused the already low

voltage to drop below acceptable levels and this engaged under voltage protection and a unit trip. Voltages had been reduced intentionally as part of the exciter commissioning and were not returned to normal levels prior to starting the pump. This issue was addressed with commissioning activities to ensure that it would not reoccur.

- Unit 1 tripped on October 5, 2017 and was derated to a precautionary load of 35 MW while the reason for the trip was being investigated and corrected. It was determined that the trip was caused by frayed wires in one of the Forced Draft (FD) fan motors and, following repairs, the unit was returned to full capability on October 10, 2017.
- From October 17, 2017 to October 22, 2017, Unit 1 was derated to 154 MW due to low steam pressure while waiting for safety valve testing to be completed. The safety valve testing was completed on October 24, 2017, but the unit was further derated to 145 MW from October 22, 2017 to October 24, 2017, and to 135 MW until the end of October 2017 due to overheating motor windings in the west FD fan. Plans were established to replace this motor after completion of the Unit 2 exciter commissioning. The spare motor was brought to site and the winding temperature was monitored regularly for changes. The spare motor was installed during an outage from November 7, 2017 to November 11, 2017. Unit 1 was returned to service on November 12, 2017 but remained derated to 145 MW as a result of high furnace pressure due to fouling.
- On November 14, 2017 Unit 1 was taken off-line to repair a piping leak at the condenser flash tank. This was repaired and the unit returned to service on November 15, 2017. However another leak developed in the area and the unit was removed from service on November 15, 2017 for 12 hours for additional repair.
- Unit 1 remained limited to 145 MW until it was taken off-line on November 30, 2017 to perform an air heater wash and additional maintenance to restore capacity. This included a pressure wash of the top air heater baskets. The unit was returned to service

on December 4, 2017. A load test completed on December 5, 2017 confirmed a capacity of 150 MW[8] with the unit load limited by high furnace pressure.

The DAFOR performance for Holyrood Unit 2 (170 MW) was primarily affected by the following events:

- Unit 2 started 2017 rated at 165 MW. On January 20, 2017, the unit load capacity was reduced to 150 MW due to boiler fouling, particularly in the air heater and economizer. An air heater wash was completed on February 18, 2017, but as a result of economizer fouling, the unit remained derated to 150 MW at the end of February. Continued fouling during operation further reduced the load capability of the unit and on March 6, 2017, the capability was rated at 140 MW. On March 21, 2017 the load capacity was further reduced to approximately 135 MW. Hydro completed an early two-week duration outage on Unit 2 on April 23, 2017. The outage addressed the fouling-related air flow issues that were considered to be a significant effort and could not be completed during an air heater wash or during peak winter season demand. Activities included, but were not limited to, cleaning and removal of hardened ash in the economizer section of the gas path. Issues affecting air flow restrictions were addressed and, following this work, Unit 2 was then rated at 165 MW, as tested on April 26, 2017. Additional work was scheduled for the 2017 planned annual outage to further address air flow issues.
- On April 22, 2017 a brief outage was required to repair a section of flexible ductwork on the ignitor air system which had come apart during start-up after the boiler cleaning outage.
- On May 1, 2017, Unit 2 experienced a forced outage when a section of flexible ductwork adjacent to the location that failed on April 22, 2017, also failed and allowed hot gas to escape from the boiler. This hot gas caused a cable tray fire adjacent to the north east corner of the boiler on the second floor. Refurbishment work was completed by May 28, 2017 and included asbestos abatement, as loose asbestos fibres were found in the cable

[8] Hydro continues to work towards restoring full load on Unit 1 and Unit 2. Further analysis and planning is required. Hydro has set up an engineering team to work with the boiler service provider and other industry experts to identify and, if appropriate, implement the appropriate actions.

tray. While the unit was off-line for repairs work protection permits were issued to allow other work, which was planned for the annual outage, to proceed in parallel. At this time, Unit 3 was recalled from its planned outage to provide generation to satisfy system requirements.

- In parallel to the refurbishment work noted above, the cause of the failure of the ignitor flex hoses was investigated. This was the first such incident on record at the plant. All of the Unit 2 flexible hoses on the ignitor system were upgraded as required. This included extending the rigid pipe in the corner that failed such that the gap could be spanned by one flexible hose length. Two sections of flexible hose had been spliced together in the area of the failure and this was concluded to be part of the reason for the failure. On Unit 1, which was in operation at the time, additional clamps were installed to verify the hoses were secure. During the annual 2017 outages all hoses on Unit 1 and Unit 2 were positively secured to prevent this failure from reoccurring. Unit 3 is not of the same design, does not have flexible ignitor air ducting, and is not susceptible to a similar failure.
- On June 3, 2017 the unit tripped. The unit was returned to service a few hours later on June 3, 2017 but was limited to 50 MW until the reason for the trip could be confirmed and mitigated. A GE representative was brought to site to diagnose the problem and determined that during the trip, the control valves closed while the governor was calling for them to remain open. This pointed to three possibilities; loose wire, control card failure, or servo failure. A card failure was ruled out since all other functions of the card were working normally. The wires were tested with the unit at 25 MW and no issues were found. An outage was then completed on June 8, 2017 to June 11, 2017 to replace the servo and change out the hydraulic fluid and filters. During this same outage, the turbine speed probe cables were replaced and probe clearance gaps were adjusted. This corrected a reliability issue that previously occurred on November 18, 2016 and was planned to be completed during the annual outage.
- On June 16, 2017, there was an incident on one of the two approximately 50% duty boiler feed pumps. It appeared that some debris went through one of the bearings of

the west pump and caused a spike in temperature and vibration. The temperature and vibration returned to normal, but the pump was taken out of service to change the oil and clean out the lube oil tank. The unit was derated to 70 MW while the pump was out of service. It was successfully tested and returned to service on June 17, 2017.

- On June 29, 2017, vibration and temperature excursions occurred on the same motor inboard bearing. At this point failure of the bearing was suspected. The pump was again taken out of service causing another derate to 70MW. Failure of the bearing was confirmed and the spare boiler feed pump motor was brought to site and installed in place of the motor with the failed bearing. This was the most expedient option to get the pump back in service. This work was completed on July 2, 2017 and Unit 2 returned to 165 MW capability. Additional checks have been added to pump rebuilds to check for issues witnessed on this pump.
- Unit 2 was removed from service at the end of July 2017 to accommodate the planned total plant outage and the unit annual maintenance outage. During the unit outage, additional work was completed to address air flow issues. This included additional boiler cleaning and air heater upgrades.
- Unit 2 returned from the annual planned outage and was placed on-line for commissioning of new exciter controls on October 28, 2017 with a scheduled derating of 35 MW. Exciter commissioning was interrupted by two forced outages. From October 28, 2017 to October 30, 2017 the unit was taken off-line due to a combustion upset in the boiler. The unit was returned to service with load restricted to 50 MW. It was determined that the upset was due to incomplete set-up of a new fuel flow transmitter. Set up of this transmitter was completed on November 2, 2017. From October 30, 2017 to November 1, 2017 the unit was removed from service to replace some oil-soaked turbine insulation that resulted from a previously corrected oil leak at a turbine bearing.
- From November 3, 2017, until November 4, 2017 Unit 2 was derated to 70 and 110 MW while completing commissioning of the new exciter controls. From November 4, 2017 to November 8, 2017 the unit was derated to 150 MW while waiting for safety valve testing to be completed. From November 8, 2017 to November 20, 2017, the unit was

rated to 165 MW until a leaking safety valve could be restored. This work required an outage to complete. The unit was taken off-line on November 20, 2017, and returned to service on November 24, 2017. An air heater wash was also completed during this outage. A load test on November 28, 2017 revealed that the unit was capable of 160 MW, limited by high furnace pressure.

- On December 19, 2017, Unit 2 experienced a 14-hour deration to 70 MW as a result of a trip of one forced draft fan on the unit. The cause of the fan trip was corrected and the fan returned to service later that day in time for the evening peak, with the unit again capable of 160 MW.

6 Gas Turbine UFOP Performance

The combined UFOP for the Hardwoods, Happy Valley and Stephenville gas turbines was 6.93% for the 12-month period ending December 31, 2017 (see Table 6 and Figure 3). This is below the base planning assumption of 10.62% and the near-term assumption of 20.00%. The current period UFOP declined from the previous period UFOP of 9.35%. The Hardwoods UFOP for the current period is 2.91%, which is better than the base planning assumption of 10.62%. The Stephenville UFOP for the current period is 5.59%, which is better than the base planning assumption of 10.62%. Happy Valley's UFOP is 19.32% for the current period compared to 5.03% in the previous period.

Hydro will begin using DAUFOP as a reliability measure in addition to UFOP going forward. Beginning in January 2018, Hydro will report on the gas turbines using DAUFOP. Targets for this measure will be set based on historical data as well as planned improvements. This was discussed in Hydro's updated *Near-Term Generation Adequacy Report*, filed with the Board on November 15, 2017.

Table 6 Gas Turbine UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2016 (%)	12 months ending December 2017 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Combined Gas Turbines	125	9.35	6.93	10.62	20.00
Stephenville	50	15.40	5.59	10.62	20.00
Hardwoods	50	7.83	2.91	10.62	20.00
Happy Valley	25	5.03	19.32	10.62	20.00

1 The Holyrood (HRD) GT UFOP of 2.02% for the current period is better than the base planning
2 and near-term assumptions of 5.00% (see Table 7 and Figure 4).

Table 7 Holyrood GT UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2016 (%)	12 months ending December 2017 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Holyrood GT	123.5	1.65	2.02	5.00	5.00

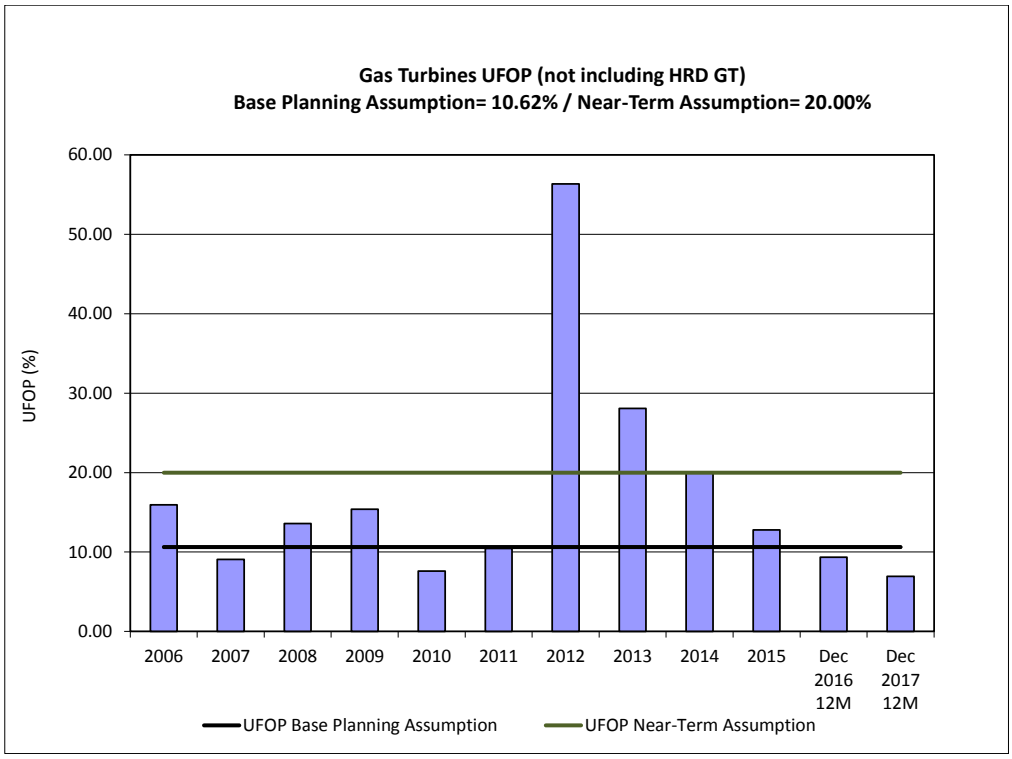

Figure 3 Gas Turbine UFOP – HWD/HVY/SVL Units

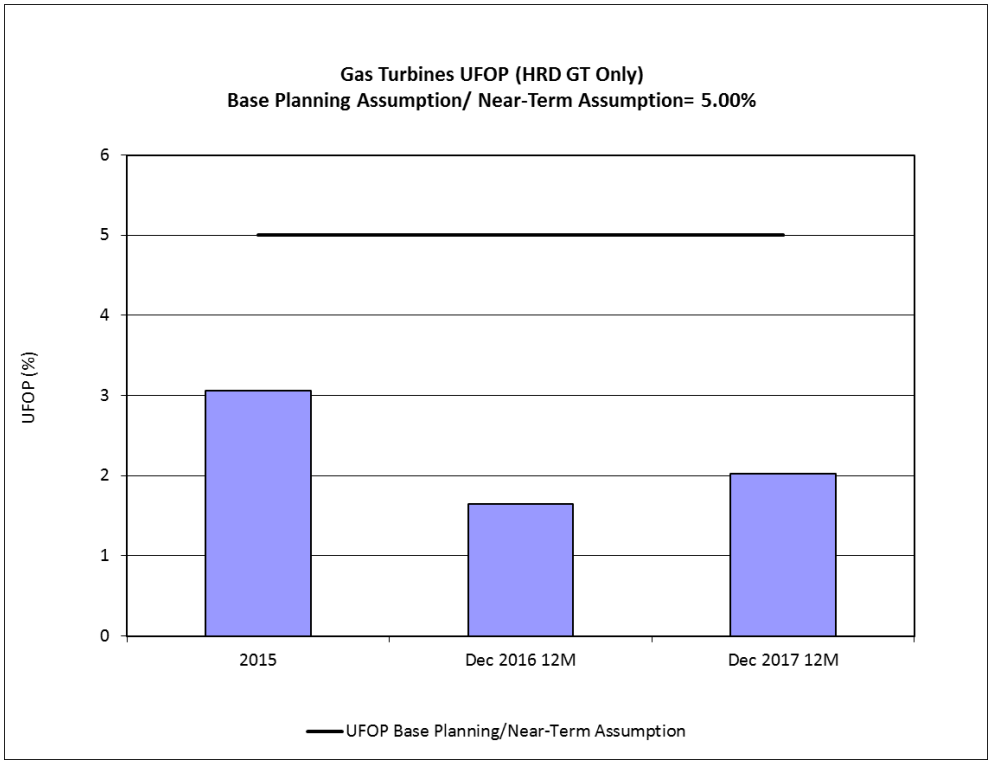

Figure 4 Gas Turbine UFOP – HRD Unit

On September 16, 2017, the Happy Valley gas turbine tripped when attempting a black start of the unit to support an unplanned outage in the Happy Valley area. Hydro's investigation found that the cause of the trip was related to the operation of a voltage protection relay in the terminal station. Upon review of the relevant procedures, drawings, and settings it was determined that a setting change was required to the protection relay. The setting was changed and the unit was returned to service on September 21, 2017. During the investigation, it was found, that prior to the trip, the power turbine had developed higher than normal vibration - though it was not the cause of the trip. Further investigation of the higher than normal vibration found the source to be a high temperature exhaust gas leak from the power turbine. Repairs were made to the power turbine and vibration levels returned to normal on October 7, 2017.

On October 15, 2017 the Happy Valley gas turbine experienced a trip while operating at near full load. Hydro's investigation determined that the trip was the result of the failure of an emergency shutoff valve solenoid. The failure of the solenoid caused the 3-way valve to divert some fuel away from the engine as is its design. The reduced fuel flow to the engine caused the engine to be unable to sustain the required load and this resulted in the unit shutting down. A replacement solenoid was sourced, and when received the valve was repaired and the engine was released for service on November 9, 2017.