newfoundland labrador hydro
a nalcor energy company

Hydro Place. 500 Columbus Drive.
P.O. Box 12400. St. John's. NL
Canada A1B 4K7
t. 709.737.1400 f. 709.737.1800
www.nlh.nl.ca

July 30, 2018

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

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").

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
MSL/sk

cc: Gerard Hayes – Newfoundland Power
Paul Coxworthy – Stewart McKelvey
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 June 30, 2018

July 30, 2018

A Report to the Board of Commissioners of Public Utilities

newfoundland labrador hydro
a nalcor energy company

Table of Contents

1.0 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 assumptions used for system planning purposes.

The forced outage rates are provided for the 12-month periods of July 1, 2017 to June 30, 2018 and July 1, 2016 to June 30, 2017 and reflect the generating units associated with:

- hydraulic generation facilities;
- Holyrood Thermal Generating Station; and
- gas turbines.

Reporting on the prior 12-month period is included for comparison purposes. Additionally, 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 three measures:

1. Derated Adjusted Forced Outage Rate (DAFOR) for the hydraulic and thermal units;
2. Utilization Forced Outage Probability (UFOP) for the gas turbines; and
3. Derated Adjusted Utilization Forced Outage Probability (DAUFOP) for the gas turbines.

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 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. This measure is not applicable to gas turbines due to their operation as standby units and relatively low operating hours.

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.

DAUFOP is also 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, but also includes impact of unit deratings. 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.

2.0 Period Ending June 30, 2018 Overview

Table 1: DAFOR, UFOP, and DAUFOP Overview (%)

Class of Units	July 1, 2016 to June 30, 2017	July 1, 2017 to June 30, 2018	Base Planning Assumption[1]	Near-Term Planning Assumption[2]
Hydraulic (DAFOR)	4.85	2.04	0.90	2.60
Thermal (DAFOR)	15.27	26.22	9.64	14.00
Gas Turbine (Combined) (UFOP)	8.68	6.78	10.62	20.00
Gas Turbine (Holyrood) (UFOP)	2.46	0.06	5.00	5.00
Gas Turbine (Combined) (DAUFOP)	8.68	24.11	-	30.00
Gas Turbine (Holyrood) (DAUFOP)	2.46	0.06	-	5.00

There was an improvement in hydraulic DAFOR and a decline in thermal DAFOR performance for the current 12-month period ending June 2018, compared to the previous 12-month period ending June 2017 (Table 1). The combined[3] gas turbine UFOP performance shows an improvement in performance for the current period compared to the previous period, while DAUFOP shows a decline in performance.

[1] Hydro is reviewing all base planning assumptions as part of its reliability criteria and supply adequacy assessment, to be submitted to the Board in November 2018.
[2] Near-term Generation Adequacy Report, November 15, 2017, refer to section 5.0 for further details.
[3] Combined Gas Turbines include the Hardwoods, Happy Valley, and Stephenville units. The performance of the Holyrood Gas Turbine was not included in the combined base planning or sensitivity numbers as these numbers were set prior to the Holyrood Gas Turbine'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 June 2018 is 26.22%, which is above the base planning assumption of 9.64%, the sensitivity of 11.64%, and above the near-term planning assumption of 14.00%[4]. This is primarily caused by an airflow derating on Unit 1 and Unit 2 that continued in 2017 and 2018 and an extended forced outage on Unit 1 in February 2018.

The current Holyrood period DAFOR is not an indicator of what to expect for the coming winter season due to the work being completed to improve the unit's performance for airflow limitations. With an interest in shortening Holyrood generating hours (operating time) to avail of more economic purchased electricity, there will be less operating hours in the upcoming fall. The lower operating hours has the effect of negatively impacting the DAFOR calculation as compared to having the units on.

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 June 30, 2018, performance was affected by forced outages to the Hardwoods, Happy Valley, and Stephenville units.

Note that the data for 2006 to 2016 in Figure 1, Figure 2, and Figure 3 are annual numbers (January 1 to December 31), while the data for 2017 and 2018 are 12-month rolling numbers (July 1 to June 30 for each year).

[4] While the near-term planning assumption for thermal was materially exceeded in the preceding 12-month period, there were no supply issues experienced. Improved performance at the other assets contributed to this outcome. Further, the near-term planning assumption is a probabilistic view of system performance under various criteria.

3.0 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. The Base Planning Assumptions are under review as part of the 2018 reliability review work ongoing and this review is being reported to the Board as part of Phase 2 of the Outage Inquiry.

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 June 30, 2018, 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 Holyrood gas turbine 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 considered relatively new and can be expected to have better availability than the older units.[5]

Hydro's generation long-term planning assumptions for DAFOR and UFOP for the year 2018 are noted in Table 2.

Table 2: DAFOR and UFOP Long-Term 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] 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).*

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 the near-term DAFOR and DAUFOP and the resulting implication for meeting reliability criteria until the interconnection with the North American grid. In the November 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 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 and Stephenville Gas Turbines		30.0
Holyrood Gas Turbine		5.0

4.0 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 June 30, 2018, are presented in Table 4, as well as the data for the 12-month period ending June 30, 2017. 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 4: Hydraulic Weighted DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending June 2017 (%)	12 months ending June 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Hydraulic Units - weighted	954.4	4.85	2.04	0.90	2.60
Hydraulic Units					
Bay D'Espoir 1	76.5	23.04	8.67	0.90	3.90
Bay D'Espoir 2	76.5	26.75	12.41	0.90	3.90
Bay D'Espoir 3	76.5	0.02	0.01	0.90	3.90
Bay D'Espoir 4	76.5	0.97	0.15	0.90	3.90
Bay D'Espoir 5	76.5	0.00	0.00	0.90	3.90
Bay D'Espoir 6	76.5	1.30	0.21	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	1.14	0.02	0.90	0.70
Upper Salmon	84	0.86	0.16	0.90	0.70
Granite Canal	40	1.15	0.15	0.90	0.70
Paradise River	8	7.58	0.69	0.90	0.70

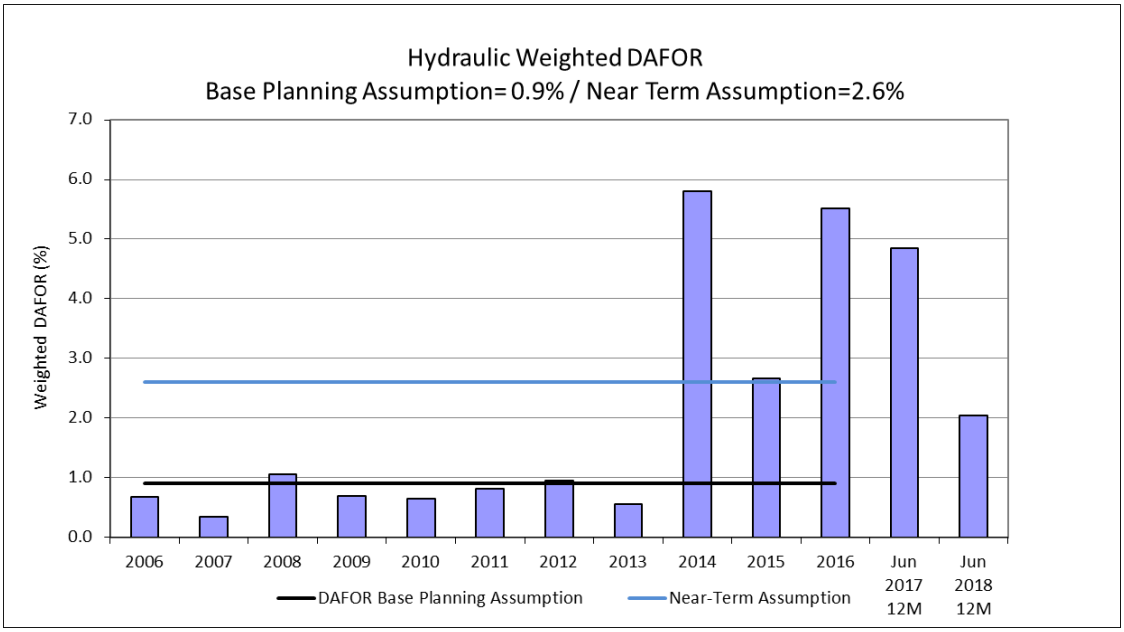

Figure 1: Hydraulic Weighted DAFOR

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 7 for the current period.

The Bay d'Espoir Unit 1 DAFOR of 8.67% and Unit 2 DAFOR of 12.41%, 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. A consultant 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 replaced. All additional suspect areas were also cleaned and refurbished and additional backfill was placed over a section of the ruptured area as this had been part of the approved capital plan resulting from the 2016 leak. Findings from the final

root cause report are being implemented and the Board approved Condition Assessment work[6] is currently underway. The penstock was returned to service on December 8, 2017.

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, as a result of the unit being unavailable from July 3, 2017, to July 9, 2017, due to a failure in the collector assembly. An investigation was completed, and it was determined that there was a flash over between the slip rings, which was caused by excessive brush wear. As a result of the investigation, improvements to the preventive maintenance (PM) program have been implemented across the hydraulic generation fleet of assets. As a result of this event, all brush gear assemblies had an additional inspection completed prior to December 1, 2017 and no issues were found.

5.0 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 June 30, 2018, are presented in Table 5, as well as the data for the 12-month period ending June 30, 2017. 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 June 2017 (%)	12 months ending June 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Thermal Units - weighted	490	15.27	26.22	9.64	14.00
Thermal Units					
Holyrood 1	170	21.33	32.30	9.64	15.00
Holyrood 2	170	19.57	26.62	9.64	10.00
Holyrood 3	150	3.29	16.60	9.64	18.00

[6] P.U. 23(2018).

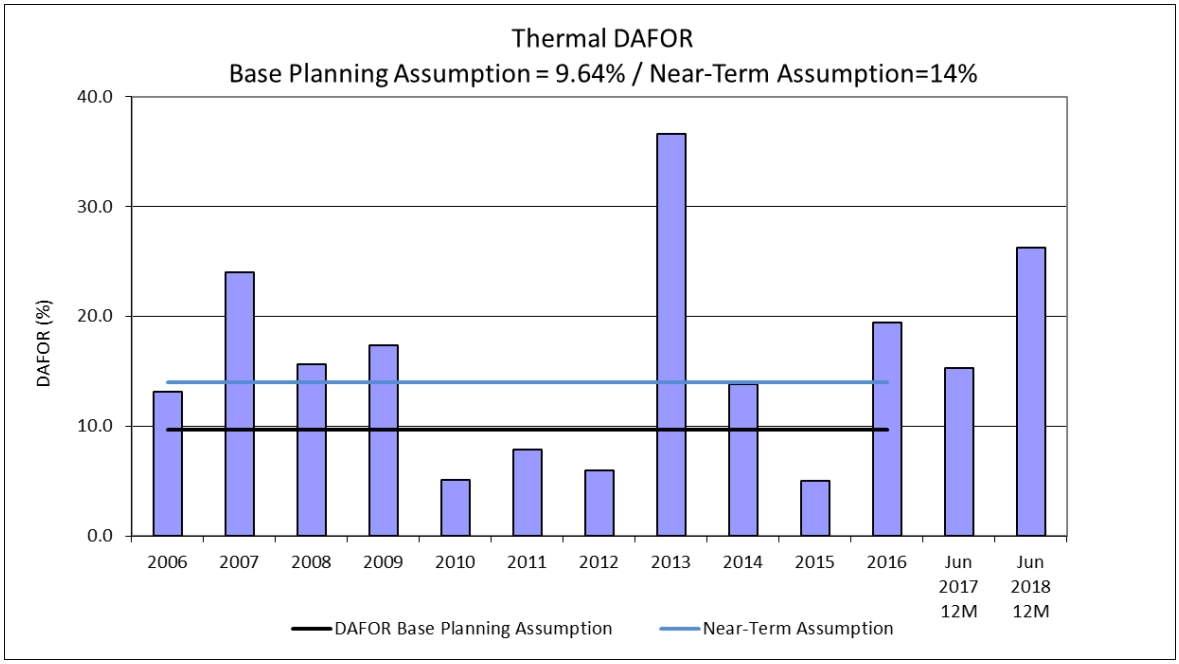

Figure 2: Thermal DAFOR

For the 12-month period ending June 31, 2018, the weighted DAFOR of 26.22% for all thermal units 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 32.30% and Unit 2 DAFOR was 26.62%. 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 16.60%, which is above the base planning assumption of 9.64% but below the near-term assumption of 18.0%.

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

- 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. The unit tripped at 70 MW on September 18, 2017 during commissioning of the new exciter controls on that unit. The unit was de-rated to 50 MW

[7] See Hydro's Near-term Generation Adequacy Report, November 15, 2017, section 7.0 for results discussing Holyrood plant DAFOR at 15% compared to 14%. Plant DAFOR of 15% does result in minor differences only, and these differences result only in the extreme sensitivity cases, not the expected system operating cases.

(below under frequency load shedding 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. An 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 appropriately 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 has been addressed with commissioning activities to ensure that it will not reoccur.

- Unit 1 tripped on October 5, 2017 and was de-rated 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 fan motors and, following repairs, the unit was returned to full capability on October 10, 2017.
- From October 17, 2017 to October 22, 2017, the Unit was de-rated 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 de-rated to 145 MW from October 22, 2017 to October 24, 2017 and to 135 MW until the end of the month due to overheating motor windings in the west forced draft fan. Plans were established to replace this motor after completion of 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. The Unit was returned to service on November 12, 2017 but remained de-rated to 145 MW due to high furnace pressure.
- On November 14, 2017 the Unit 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 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. The Unit was returned to

service on December 4, 2017, after completion of a maintenance outage to perform an air heater wash and additional maintenance work to restore capacity. This included a pressure wash of the top air heater baskets. A load test completed on December 5, 2017 confirmed a capacity of 150 MW[8] with the unit load limited by high furnace pressure.

- On January 3, 2018 the Unit capability was reduced from 150 to 135 MW as a result of oscillations in the turbine control valve hydraulic ram. An outage was taken from January 5 to 6 replace a loose control cable on the hydraulic ram and to complete an air heater wash. After this work the load was restored to 145 MW, limited by high furnace pressure, and it was noted that the control valve oscillations had not been eliminated. On January 18, 2018 the oscillations had increased and the load was reduced to 140 MW as a result. On January 20, 2018 the Unit was taken off-line to replace another control cable as recommended by GE to resolve the oscillation issue. While the Unit was off-line for this work the boiler stop valve failed, which resulted in an extension to the outage. The Unit remained off-line until February 2, 2018 while stop valve refurbishment was ongoing. During this time, the hydraulic ram was removed from the turbine and sent off-site for refurbishment to ensure that the oscillation problem had been resolved. Also, a high pressure wash was completed on the air heater baskets to 12,500 psi.
- The outage due to the boiler stop valve failure extended from January 20, 2018 until February 21, 2018, following several solutions which attempted to address the leak. On February 21, 2018 the stop valve work was complete and the unit was returned to service.
- On February 22, 2018 the Unit had to be taken off-line due to a turbine bearing issue. Lube oil had leaked, undetected, from the bearing during the stop valve outage. This led to a smoldering underneath the bearing when the components heated. The

[8] Hydro continues to work towards restoring full load on all three units. Hydro set up an engineering team to work with the boiler service provider and other industry experts. This team has recommended replacement of air heater baskets on all three units, correction of excessive air heater leakage on Unit 3, cleaning of economizers on Unit 1 and Unit 2, and use of fuel additive on all three units to prevent continued fouling. These recommendations address the issues of high furnace pressure in Unit 1 and Unit 2 and the issues of high air heater fouling and air flow limitations on Unit 3. They are currently being pursued with the intent to complete this work during the 2018 annual overhauls.

contaminated insulation was replaced and an inspection of the bearing confirmed no active leak. The Unit was returned to service on February 25, 2018.

- On February 28, 2018 a load test was completed to 148 MW, with load limited by high furnace pressure due to boiler and air heater fouling. By the end of March 2018 the Unit's capability had reduced to 137 MW as a result of continued fouling in the boiler and air heaters.
- There were two unit trips related to forced draft fan variable frequency draft trips. These occurred on March 19, 2018 and March 26, 2018. In both instances the Unit was returned to service using replacement parts from inventory. During the outage related to the March 19, 2018 trip, a problem with the Mark V turbine governor system was also resolved. Hydro is continuing to work towards resolving the problems with variable frequency drive reliability.
- On April 12, 2018 the load was reduced to 126 MW, limited by high furnace pressure as a result of continued boiler and air heater fouling. The capability of the unit continued to decline for the same reason. On May 6, 2018 the unit capability was 122 MW and on May 15, 2018 it was 116 MW.
- On May 21, 2018 the unit tripped at 70 MW on high boiler drum level. The cause was suspected to be a trip of the east boiler feed pump, which caused unstable water level in the drum and led to the trip. The unit was returned to service later that same day with only the west boiler feed pump in service and the load restricted temporarily to 70 MW until the health of the east pump was verified. The Unit was returned to 116 MW on May 21, 2018 once the health of the east pump was verified. The pump was ruled out as the cause of the trip, and the cause was determined to be a failure of a turbine control valve stem. There is a scheduled turbine valve outage in 2018 and the contractor will replace the stem as part of this project.
- On June 4, 2018 the Unit was further de-rated to 100 MW, limited by high furnace pressure as a result of on-going boiler and air heater fouling. By the end of June this had further reduced to 88 MW.

- On June 16, 2018, while on a brief planned outage to change worn generator brushes, a pressure gauge failed on the fuel oil system resulting in a spill that had to be cleaned up before the Unit could be safely returned to service. On June 17, 2018 while starting up the unit, a bearing failed on the east forced draft fan and required replacement. The Unit was returned to service on June 18, 2018; however, the same bearing failed after a few hours of operation. The bearing was again replaced and the Unit was successfully returned to service on June 19, 2018. Hydro has made arrangements for a field representative from the fan original equipment manufacturer to assist with the failure analysis once the Unit is removed from service for the annual outage.

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

- 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.
- The Unit returned from the annual planned outage and was placed on-line for commissioning of new exciter controls on October 28, 2017 with a scheduled de-rating 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 the incomplete set-up of a new fuel flow transmitter. Set-up of the transmitter was completed on November 2, 2017. Also, from October 30, 2017 to November 1, 2017 the Unit was removed from service to replace oil-soaked turbine insulation that resulted from an oil leak at a turbine bearing.
- From November 3, 2017 until November 4, 2017, the Unit was de-rated to 70 MW and subsequently to 110 MW while completing commissioning of the new exciter controls. From November 4, 2017 to November 8, 2017, the Unit was de-rated to 150 MW while waiting for safety valve testing to be completed. From November 8, 2017 to November

20, 2017, the Unit was de-rated to 165 MW until a leaking safety valve could be restored. To complete this work an outage was required. 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, the Unit 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.
- The capability of the Unit continued to decline due to ongoing fouling during operation. On January 4, 2018, the capability had reduced to 154 MW. On January 25, 2018, the capability had reduced to 135 MW due to high furnace pressure as a result of boiler and air heater fouling. On February 14, 2018, the capability had reduced to 117 MW. At the end of February the capability had reduced to 100 MW. System requirements, given the issues with Unit 1, had precluded an air heater wash on this Unit during the month of February 2018. An air heater wash was completed from March 5, 2018 to March 6, 2018; however, this was not successful in restoring any load. By the end of March 2018, the Unit capability had reduced to 90 MW as a result of continued boiler and air heater fouling during operation.
- On February 7, 2018, the Unit was taken offline for a short, planned outage to replace generator brushes. There was a forced extension to this outage when a unit board breaker tripped during restart of the Unit. Electricians were called in to reset the breaker.
- The Unit was further de-rated to 70 MW from March 1, 2018 to March 2, 2018 due to an issue with the west boiler feed pump. A water leak from a reference line nearby caused contamination of the pump lube oil and the pump was taken off-line until the repairs were completed.
- On March 22, 2018, one of the turbine reheat intercept valves became stuck during regular on-line testing and the Unit had to be taken off-line for approximately eight

hours to replace the valve servos. Hydraulic fluid contamination will be addressed during the annual outage to prevent recurrence.

- At the beginning of April 2018 the unit was rated at 80 MW due to high furnace pressure as a result of boiler and air heater fouling. This capability further reduced to 70 MW on April 24, 2018 and remained at this level until the unit was taken off line for the annual outage.
- On April 3, 2018 the unit was taken offline on a forced outage to repair a leak in the turbine control valve hydraulic ram. The ram was rebuilt and the unit returned to service on April 4, 2018; however, once installed the seals required additional adjustment. The Unit was returned to service April 5, 2018. Return to service after this outage was delayed by approximately eight hours on April 5, 2018 due to an issue in the switchyard with the B2B11 breaker. TRO is replacing this breaker during the 2018 annual outage.
- Unit 2 was available but not operating from April 26, 2018 to May 18, 2018 with the available load de-rated to 70 MW due to high furnace pressure as a result of boiler and air heater fouling. During this time the Unit was kept in hot standby, maintaining an eight hour return to service time if recalled. On May 18, 2018 the Unit was taken offline to address a suspected stress failure of a tube in the lower waterwall (not in the area of previous boiler tube thinning failure issues). The two failed tubes will be sent to an independent lab to determine the failure cause and any recommended mitigation, to be implemented during the annual maintenance outage. At the time of the failure, it was determined that the Unit was no longer required for system reliability requirements and could be placed on planned outage in preparation for the annual outage. The tube leak will be corrected during the annual outage.

The DAFOR performance for Holyrood Unit 3 (150 MW) was primarily affected by the following events:

- On December 13, 2017, Unit 3 was de-rated to 135 MW as a result of air flow issues. The unit capability declined steadily to 105 MW until an air heater wash could be completed on December 31. The wash was successful in restoring the load to 131 MW. The available load continued to decline due to ongoing air heater fouling. On January 18 the available load was determined to be 120 MW and on February 10, this had further reduced to 100 MW. An air heater wash outage was completed from February 10 - 11, 2018. System requirements, with Unit 1 already off-line, had precluded an air heater wash on this unit until that time. When the Unit was returned to service there was a de-rating to 70 MW for approximately 10 hours when the west boiler feed pump failed to start.
- This was resolved and the available load was determined to be 110 MW, still limited by air heater fouling. The Unit was capable of 100 MW at the beginning of March 2018. This capability had further reduced to 75 MW on March 20, 2018. An air heater wash outage was completed on March 28, 2018 and the predicted load after this wash was 110 MW. This Unit was not required for the system and was left on standby until the planned unit outage in early April 2018. On June 1, 2018 the Unit 3 generator was put in service in synchronous condenser mode.
- On January 11, 2018, a ¾" diameter domestic water pipe located above the Unit 3 exciter ruptured at a cap and the resulting water leak contacted the exciter causing a Unit trip. There was no significant equipment damage resulting from this incident and once the exciter was safely dried, the Unit was returned to service on January 12, 2018. This event was investigated and the leak repaired. A shut off valve was relocated for improved access in the event of a further trip, regular inspections of the area were implemented, and a plan was formulated to replace this piping during the annual outages. On February 14, 2018, the Unit load was reduced to 50 MW for approximately eight hours as a precautionary measure due to another leak in a domestic water line in

close proximity to the exciter. After this event, the piping was relocated so that further leaks would not impact the exciter.

6.0 Gas Turbine UFOP Performance

The combined UFOP for the Hardwoods, Happy Valley and Stephenville gas turbines was 6.78% for the 12-month period ending June 30, 2018 (refer to Table 6). This is below the base planning assumption of 10.62% and the near-term assumption of 20.00%. The current period UFOP is lower than the previous period UFOP of 12.32%. For the current period, the Hardwoods UFOP is 1.35% and the Stephenville UFOP 4.62%, both of which are better than the base planning assumption of 10.62%. Happy Valley's UFOP is 19.27% for the current period compared to 0.00% in the previous period.

Table 6: Gas Turbine UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending June 2017 (%)	12 months ending June 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Combined Gas Turbines	125	8.68	6.78	10.62	20.00
Stephenville	50	13.10	4.62	10.62	20.00
Hardwoods	50	10.14	1.35	10.62	20.00
Happy Valley	25	0.00	19.27	10.62	20.00

The Holyrood (HRD) GT UFOP of 0.06% for the current period is better than the base planning and near-term assumptions of 5.00% (refer to Table 7).

Table 7: Holyrood GT UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending June 2017 (%)	12 months ending June 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Holyrood GT	123.5	2.46	0.06	5.00	5.00

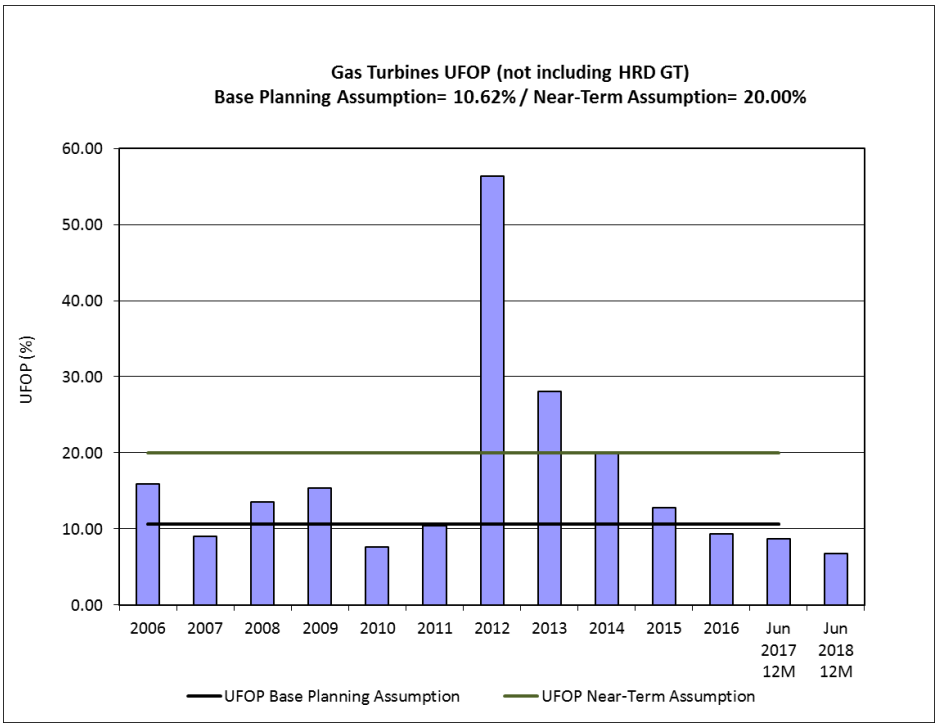

Figure 3: Gas Turbine UFOP – HWD/HVY/SVL Units

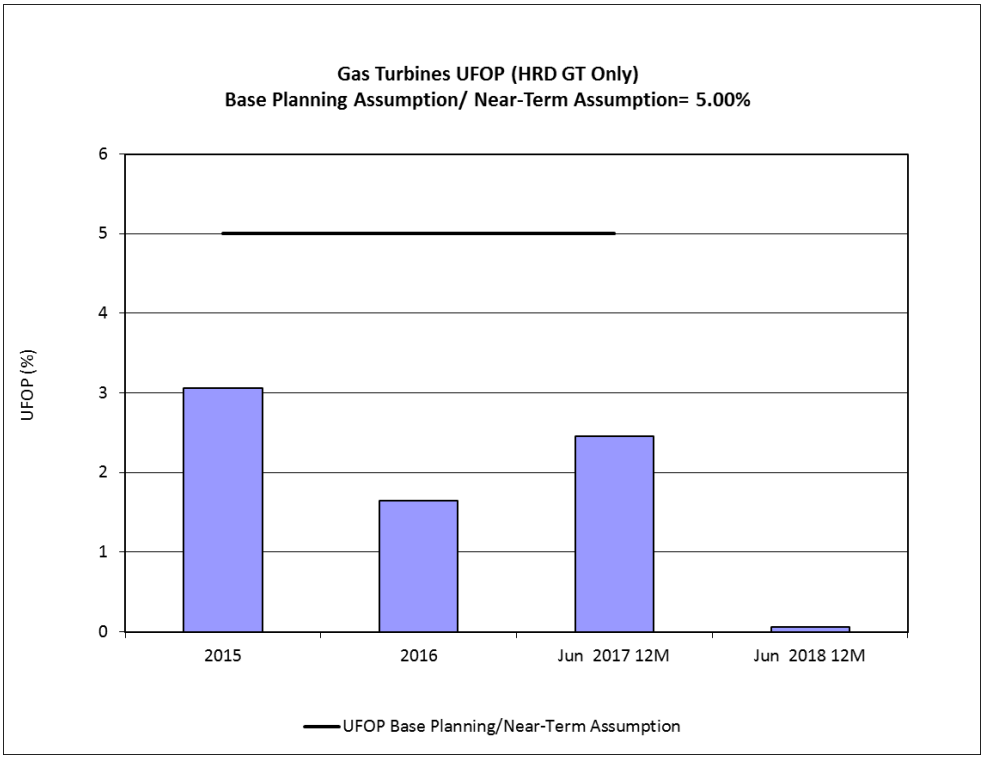

Figure 4: Gas Turbine UFOP – HRD Unit

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 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 fuel shut-off valve solenoid. The failure of the solenoid caused the 3-way valve to divert a portion of fuel away from the engine, as is its design. The reduced fuel flow was not able to sustain the required load and resulted in the unit shutting down. A replacement solenoid was sourced and repairs made with the engine released for service on November 9, 2017.

On May 13, 2018 the Hardwoods gas turbine tripped while operating in synchronous condense mode due to a system under voltage and current phase imbalance. The alternator experienced excessive vibration when attempting to restart the Unit on May 14, 2018. Extensive mechanical and electrical testing was conducted on the alternator to determine its condition, with no damage found prior to returning it to service on June 2, 2018.

On June 13, 2018 the Hardwoods gas turbine tripped due to excessive alternator vibration while being returned to service after a planned maintenance outage. Inspection of the Unit determined that cause of the vibration was a loss of lube oil due to a faulty check valve in the lube oil supply piping to one of the alternator bearings. The bearing which had the faulty check

valve was found to be damaged and required replacement with a spare bearing. The Unit was released for service on June 30, 2018.

7.0 Gas Turbine DAUFOP Performance

The combined DAUFOP for the Hardwoods, Happy Valley and Stephenville gas turbines was 24.11% for the 12-month period ending June 30, 2018 (refer to Table 8). This is below the near-term assumption of 30.00%. The Hardwoods DAUFOP for the current period is 6.51%, which significantly exceeds the near-term assumption of 30.00%. The Stephenville UFOP for the current period is 51.35%, which is above the near-term assumption of 30.00%. Happy Valley's DAUFOP is 19.27% which is below the near-term assumption of 30.00%.

Table 8: Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending June 2017 (%)	12 months ending June 2018 (%)	Near-Term Planning Assumption (%)
Combined Gas Turbines	125	8.68	24.11	30.00
Stephenville	50	13.10	51.35	30.00
Hardwoods	50	10.14	6.51	30.00
Happy Valley	25	0.00	19.27	30.00

The Holyrood (HRD) GT DAUFOP of 0.06% for the current period is better than the near-term assumptions of 5.00% (refer to Table 9).

Table 9: Holyrood GT DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending June 2017 (%)	12 months ending June 2018 (%)	Near-Term Planning Assumption (%)
Holyrood GT	123.5	2.46	0.06	5.00

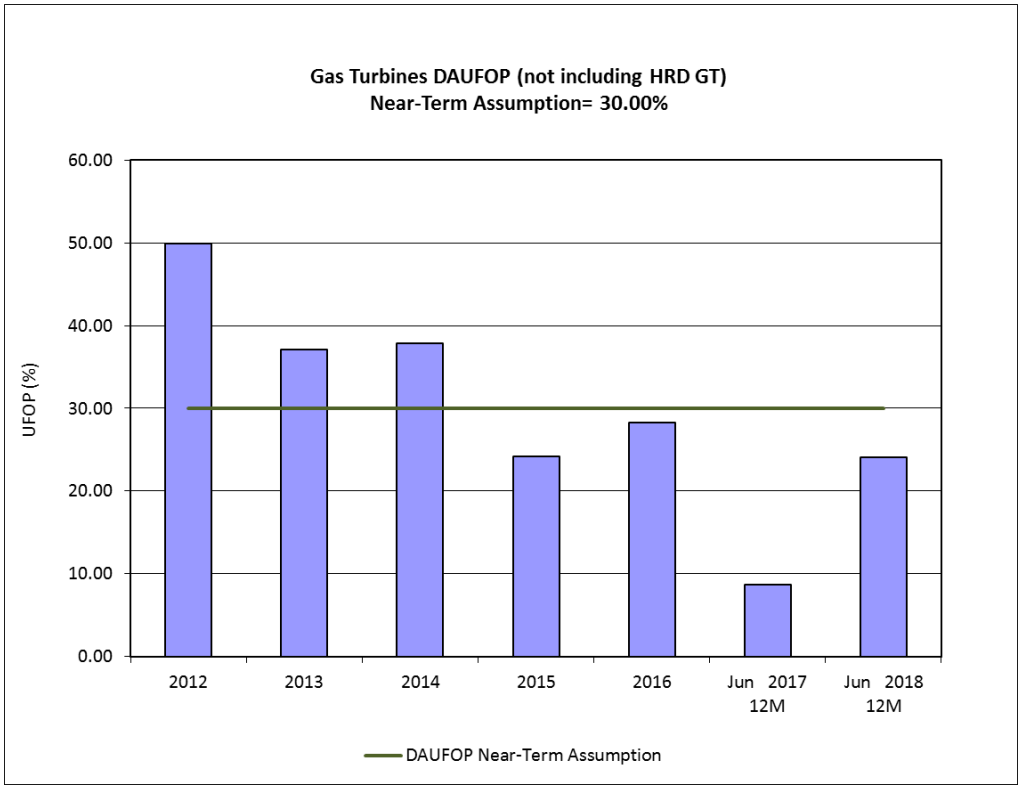

Figure 5: Gas Turbine DAUFOP – HWD/HVY/SVL Units

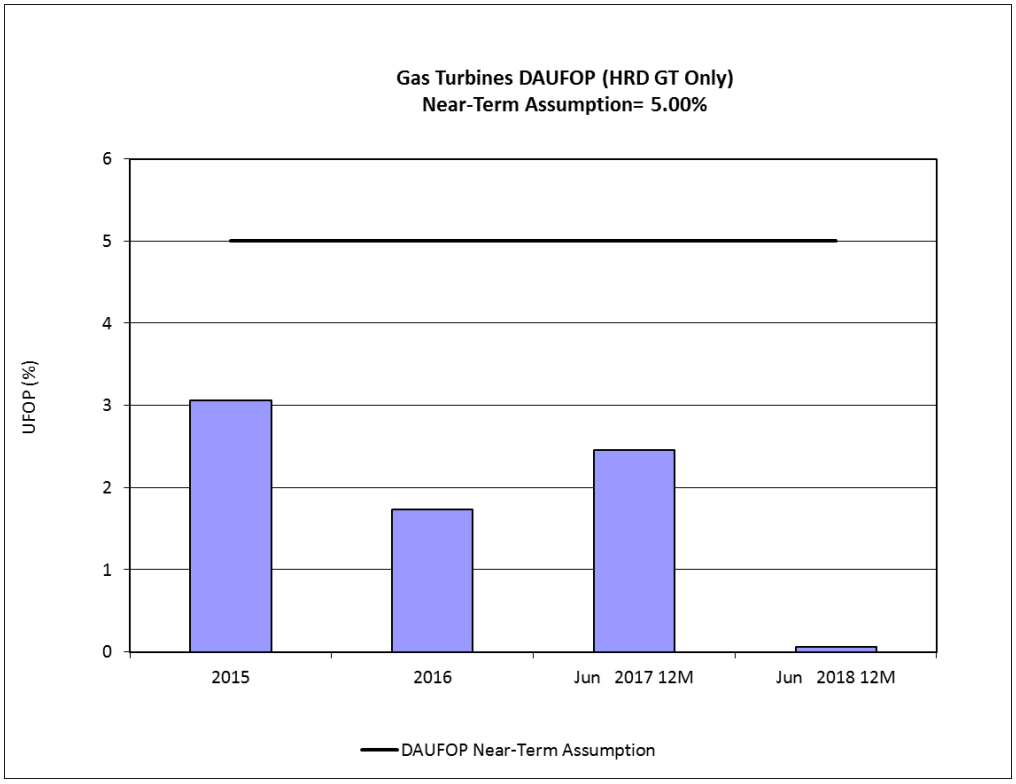

Figure 6: Gas Turbine DAUFOP – HRD Unit

The Stephenville gas turbine DAUFOP for the period was impacted by the unavailability of End A as a result of an exhaust bellows failure at Hardwoods gas turbine End A on December 28, 2017. End A was unavailable at this time due to issues with the power turbine rear bearing which requires the bearing to be replaced. Hydro decided to remove the bellows from End A at Stephenville and install it at Hardwoods End A to return that Unit to full capacity. It is currently expected that the Stephenville gas turbine will be returned to full capacity in August 2018.

The Hardwoods gas turbine DAUFOP for the period is impacted by the unavailability of End A due to an exhaust bellows failure on May 28, 2018. End A remains unavaliable with a planned return to service at the end of July 2018.