

July 31, 2017

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 the original plus 12 copies of the quarterly report *Rolling 12  
Month Performance of Hydro's Generating Units*.

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/bs

cc: Gerard Hayes – Newfoundland Power  
Paul Coxworthy – Stewart McKelvey Stirling Scales  
Sheryl Nisenbaum – Praxair Canada Inc.  
ecc: Roberta Frampton Benefiel – Grand Riverkeeper Labrador

Dennis Browne, Q.C. – Consumer Advocate  
Thomas O' Reilly, Q.C. – Cox & Palmer  
Danny Dumaresque

Quarterly Report on Performance of Generating Units  
For the Quarter ended June 30, 2017

July 31, 2017

*A Report to the Board of Commissioners of Public Utilities*



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1 **1.0 Introduction**

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

5  
6 The forced outage rates are provided for individual generating units at hydraulic facilities, the  
7 three units at the Holyrood Thermal Generating Station, and Hydro's gas turbines, for the  
8 current 12-month reporting period of July 1, 2016, to June 30, 2017. The report also provides,  
9 for comparison purposes, the individual generating unit data on forced outage rates for the  
10 previous period July 1, 2015, to June 30, 2016. Further, total asset class data is presented on an  
11 annual basis for the years 2006 to 2015. This report provides data on outage rates for forced  
12 outages, not planned outages.

13  
14 The forced outage rates of Hydro's generating units are presented using two measures, Derated  
15 Adjusted Forced Outage Rate (DAFOR) for the hydraulic and thermal units and Utilization  
16 Forced Outage Probability (UFOP) for the gas turbines.

17  
18 DAFOR is a metric that measures the percentage of the time that a unit or group of units is  
19 unable to generate at its maximum continuous rating due to forced outages. The DAFOR for  
20 each unit is weighted to reflect differences in generating unit sizes in order to provide a  
21 company total and reflect the relative impact a unit's performance has on overall generating  
22 performance. This measure is applied to hydraulic and thermal units. However, this measure is  
23 not applicable to gas turbines because of their nature as standby units, and relatively low  
24 operating hours.

25  
26 UFOP is a metric that measures the percentage of time that a unit or group of units will  
27 encounter a forced outage and not be available when required. This metric is used for the gas  
28 turbines.

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

6  
 7 In addition to forced outage rates, this report provides outage details for those outages that  
 8 contributed materially to forced outage rates exceeding those used in Hydro’s generation  
 9 planning analysis for both the short and long term.

10

11 **2.0 Overview of Period Ending June 30, 2017**

**Table 1: DAFOR and UFOP Overview**

Class of Units	July 1, 2015 to June 30, 2016 (%)	July 1, 2016 to June 30, 2017 (%)	Base Planning Assumption (%)	Near Term Planning Assumption <sup>1</sup> (%)
Hydraulic (DAFOR)	2.15	4.85	0.90	2.60
Thermal (DAFOR)	19.45	15.45	9.64	14.00
Gas Turbine (Combined) (UFOP)	4.19	8.68	10.62	20.00
Gas Turbine (Holyrood) (UFOP)	2.53	2.46	5.00	5.00

12 There was a decline in hydraulic DAFOR performance for the current 12-month period ending  
 13 June 2017, compared to the previous 12-month period ending June 2016 (see Table 1). The

<sup>1</sup> Near-term Generation Adequacy Report, May 15, 2017, see section 5.0 for further details.

1 combined<sup>2</sup> gas turbine UFOP performance shows a decline in performance for the current  
2 period compared to the previous period.

3

4 In the 10-year period prior to 2015, the hydraulic units showed a somewhat consistent DAFOR.  
5 The DAFOR of the current 12-month period compared to the previous 10 years is higher,  
6 primarily due to penstock issues experienced on Units 1 and 2 at Bay d'Espoir in 2016. The  
7 effect on the 12 month DAFOR result is still in the current period, and will be in this 12 month  
8 period until after November 2017.

9

10 The Holyrood thermal units, in the 10-year period prior to 2015, exhibited more variability in  
11 DAFOR than the hydraulic units, but in many years were close to a consistent rate of  
12 approximately 10%. The forced outage rate of the current period ending June 2017 is 15.27%,  
13 which is above the base planning assumption of 9.64%, the sensitivity of 11.64%, and slightly  
14 above the near-term planning assumption of 14.00%. This is primarily caused by an airflow  
15 derating on Unit 1 that started in the fall of 2016 and will continue until this unit is taken down  
16 for maintenance in 2017, as well as derating after the repairs of boiler tube failures on Units 1  
17 and 2 during 2016.

18

19 Hydro's combined gas turbines' UFOP in the 10-year period prior to 2015 was generally  
20 consistent at approximately 10% until the year 2012 when the rate exceeded 50%. Since 2012,  
21 the UFOP has been improving each year. For the current 12-month period ending June 30,  
22 2017, performance was affected by forced outages to the Hardwoods and Stephenville units.

23

24 Note that the data for 2006 to 2015 in Figures 1, 2 and 3 are annual numbers (January 1 to  
25 December 31), while the data for 2016 and 2017 are 12-month rolling numbers (July 1 to June  
26 30 for each year).

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<sup>2</sup> Combined Gas Turbines 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.

1 **3.0 Generation Planning Assumptions**

2 The DAFOR and UFOP indicators used in Hydro’s generation planning model are representative  
3 of a historic average of the actual performance of these units. These numbers are noted in the  
4 Table 2 under the column “Base Planning Assumption”, which is a long term outlook.

5  
6 Hydro also provides a sensitivity number for DAFOR and UFOP as part of its generation planning  
7 analysis. These numbers take into account a higher level of unavailability, should it occur, to  
8 assess the impact of higher unavailability of these units on overall generation requirements.

9 During the 12-month period ending June 30, 2017, the gas turbine units performed well within  
10 this sensitivity range for UFOP, while both the hydraulic and thermal classes performed outside  
11 of the sensitivity range for DAFOR.

12  
13 The Holyrood gas turbine (Holyrood GT) had a lower expected rate of unavailability than the  
14 original gas turbines, (5% compared to 10.62%), due to the fact that the unit is new and can be  
15 expected to have better availability than the older units.<sup>3</sup>

16  
17 As noted in Hydro’s “Near-term Generation Adequacy” report, dated May 15, 2017, Hydro  
18 continues to evaluate the appropriateness of the DAUFOP metric as an alternate or additional  
19 measure of gas turbine unit reliability. Hydro will present its findings and make a  
20 recommendation on this metric in its next “Near-term Generation Adequacy” report, to be filed  
21 with the Board on November 15, 2017.

22  
23 Hydro’s generation long term planning assumptions for DAFOR and UFOP for the year 2017 are  
24 noted in Table 2.

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<sup>3</sup> 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)*.

**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 <sup>4</sup>

- 1 As part of Hydro’s analysis of energy supply prior to Muskrat Falls Interconnection, Hydro  
2 completes comprehensive reviews of, and produces reports on, energy supply for the Island  
3 Interconnected System. The “Near-term Generation Adequacy” report, filed on May 15, 2017,  
4 contained analysis based on the near-term DAFOR and UFOP and the resulting implication for  
5 meeting reliability criteria until the interconnection with the North American grid. As stated in  
6 the May 15 report submission, Hydro intends on filing its “Near-term Generation Adequacy”  
7 report semi-annually, on May 15 and November 15 of each year through interconnection.  
8
- 9 The DAFOR and UFOP assumptions used in developing Hydro’s Near-term Generation Adequacy  
10 report are noted in Table 3.

<sup>4</sup> 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.

**Table 3: DAFOR and UFOP Near-term Generation Adequacy Analysis Assumptions**

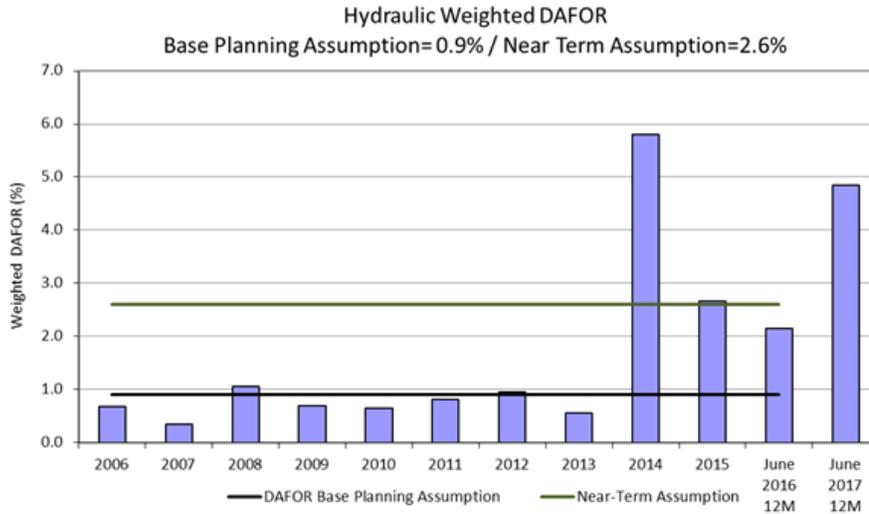
	DAFOR (%)	UFOP (%)
	Near-term Generation Adequacy Assumption	Near-term Generation Adequacy Assumption
All Hydraulic Units	2.6	
Bay d’Espoir Hydraulic Units	3.9	
Other Hydraulic Units	0.7	
Holyrood Plant	14.0	
Holyrood Unit 1	15.0	
Holyrood Unit 2	10.0	
Holyrood Unit 3	18.0	
Hardwoods & Stephenville Gas Turbines		20.0
Holyrood Gas Turbine		5.0

#### 1 4.0 Hydraulic Unit Forced Outage Rate Performance

2 The hydraulic unit forced outage rates are measured using the CEA Metric, DAFOR. Detailed  
3 results for the 12-month period ending June 30, 2017, are presented in Table 4, as well as the  
4 data for the 12-month period ending June 30, 2016. These are compared to Hydro’s short-term  
5 generation adequacy assumptions, as used in the “Near-term Generation Adequacy” report and  
6 Hydro’s long-term generation planning assumptions for the forced outage rate.

**Table 4: Hydraulic Weighted DAFOR**

Generating Unit	Maximum	12 months	Hydro Generation		
	Continuous Unit Rating (MW)	ending June 2016 (%)	12 months ending June 2017 (%)	Base Planning Assumption (%)	Near-Term Planning Assumption (%)
<i>All Hydraulic Units - weighted</i>	954.4	2.15	4.85	0.90	2.60
<b>Hydraulic Units</b>					
Bay D’Espoir 1	76.5	17.69	23.04	0.90	3.90
Bay D’Espoir 2	76.5	7.44	26.75	0.90	3.90
Bay D’Espoir 3	76.5	0.00	0.02	0.90	3.90
Bay D’Espoir 4	76.5	0.11	0.97	0.90	3.90
Bay D’Espoir 5	76.5	3.36	0.00	0.90	3.90
Bay D’Espoir 6	76.5	0.00	1.30	0.90	3.90
Bay D’Espoir 7	154.4	0.00	0.00	0.90	3.90
Cat Arm 1	67	0.01	1.02	0.90	0.70
Cat Arm 2	67	0.21	0.00	0.90	0.70
Hinds Lake	75	0.05	1.14	0.90	0.70
Upper Salmon	84	0.00	0.86	0.90	0.70
Granite Canal	40	1.83	1.15	0.90	0.70
Paradise River	8	0.31	7.58	0.90	0.70



**Figure 1: Hydraulic Weighted DAFOR**

1 Considering the individual units’ performance, the assumed Hydro generation base planning  
 2 DAFOR was materially exceeded for Bay d’Espoir Unit 1 and Bay d’Espoir Unit 2. Also, there  
 3 were exceedances compared to base planning assumption for Bay d’Espoir Unit 6, Granite  
 4 Canal, Cat Arm Unit 1, Hinds Lake and Paradise River for the current period.

5  
 6 The Bay d’Espoir Unit 1 DAFOR of 23.04% and Unit 2 DAFOR of 26.75%, exceeded the base  
 7 planning assumption of 0.9% and the near-term assumption of 3.9%, due to the units being  
 8 removed from service on two separate occasions as a result of a leak in Penstock 1, which  
 9 provides water to both Units 1 and 2. These penstock issues contributed 99.9% of the DAFOR  
 10 for this period. After the first event, that occurred on May 21, 2016, a consultant was engaged  
 11 to conduct an investigation into the issue, with the conclusion that the leak was a localized  
 12 issue caused by, what was suspected to be, a defect at the weld. A repair procedure was  
 13 proposed on June 2, 2016, with repairs completed on June 3, 2016. Unit 1 was returned to  
 14 service on June 3, 2016, at 1938 hours and Unit 2 returned to service at 2014 hours.

15  
 16 The second leak in Penstock 1 occurred on September 14, 2016. Considering this leak was  
 17 similar to the first and located in the same area, a new consultant was engaged to conduct a  
 18 thorough investigation of the welds throughout the penstock, which included cutting sample

1 sections from the penstock wall for testing. An investigation was completed and action taken to  
2 refurbish a significant proportion of the welds along the upper section of Penstock 1 between  
3 the Intake and Surge Tank. Both units were then returned to service on November 30, 2016.

4  
5 The completed weld refurbishment provided a long term solution for the penstock. The  
6 investigation into this outage identified two additional long term recommendations to extend  
7 the reliable life of Penstock 1. The first recommendation is to add structural backfill to the  
8 upper portion of the penstock, planned for 2018. The second is to replace the internal  
9 protective coating, which is currently being planned as part of the capital refurbishment  
10 program to coincide with the generation outage schedules.

11  
12 The Bay d’Espoir Unit 6 DAFOR of 1.30% exceeded the base planning assumption of 0.9% and  
13 the near-term assumption of 3.9%, as a result of the unit being unavailable from February 22,  
14 2017, to February 25, 2017, due to a high turbine bearing alarm, which caused the unit trip  
15 protection to operate and shut the unit down in a controlled fashion. An investigation was  
16 completed and it was determined that the Babbitt bearing was damaged. The bearing was  
17 repaired and the unit was returned to service. The results of the investigation found no issues  
18 for long term bearing reliability.

19  
20 The Granite Canal Unit DAFOR of 1.15% exceeded the base planning assumption of 0.9% and  
21 the near-term assumption of 0.7%, as a result of the unit being unavailable from July 19, 2016,  
22 to July 22, 2016, due to water in the generator bearing oil. An investigation revealed that the  
23 generator bearing oil cooler experienced a leak, which resulted in water getting into the  
24 bearing oil. The leaking cooler was replaced with a new cooler and the unit was returned to  
25 service. All future cooler replacements have now been scheduled as part of a cooler  
26 replacement program and the preventative maintenance (PM) program has been revised to  
27 reflect these changes.

1 The Cat Arm Unit 1 DAFOR of 1.02% exceeded the base planning assumption of 0.9% and the  
2 near-term assumption of 0.7%, as a result of the unit being unavailable from November 23,  
3 2016, to November 25, 2016, due to a governor oil pump trip. An investigation into the issue  
4 revealed that the internal seals in the pump had failed, preventing the pump from maintaining  
5 the governor oil pressure. The oil system was completely cleaned, flushed, and replaced with  
6 new oil. A new oil pump was installed and the unit returned to service. This issue has been  
7 resolved and the preventative maintenance (PM) program is being revised to reflect changes to  
8 scope and frequency. Research is also ongoing to identify direct replacement pumps that are  
9 more robust with a longer service life.

10

11 The Hinds Lake Unit DAFOR of 1.14% exceeded the base planning assumption of 0.9% and the  
12 near-term assumption of 0.7%, as a result of the unit being unavailable from April 19, 2017, to  
13 April 22, 2017, due to water in the generator bearing oil. An investigation revealed that the  
14 generator bearing oil cooler experienced a leak, which resulted in water getting into the  
15 bearing oil. Testing revealed that three of the six coolers were leaking. The damaged coolers  
16 were isolated from the system, with tests conducted to confirm adequacy of reduced cooling  
17 capacity. These tests confirmed that cooling with the three remaining coolers were adequate at  
18 ambient air and water temperatures. A planned maintenance outage was arranged from May  
19 24-30, 2017, to repair the damaged coolers, as well as to conduct extensive testing of the three  
20 in-service coolers. All work was completed, with no further issues being identified, and the unit  
21 was returned to service with 100% cooling capacity. Further testing is planned during the  
22 November 2017 maintenance outage. Presently, a complete set of spare coolers (6) are also  
23 being purchased as part of the critical spares program.

24

25 The Paradise River unit DAFOR of 7.58% exceeded the base planning assumption of 0.9% and  
26 the near-term assumption of 0.7%, primarily as a result of a forced outage from September 23-  
27 30, 2016, which was related to a governor low oil level alarm. This alarm was caused when a  
28 seal broke on one of the governor servo motors, releasing oil from the governor oil sump into

1 the powerhouse sump system. A new seal was installed and oil was added to the governor  
 2 system. The results of the investigation found no issues regarding long term governor reliability.  
 3  
 4 There were repeated trips of the Paradise River unit in 2016. Hydro investigated these trips and  
 5 determined that it was most likely not a unit related issue and was likely due to distribution  
 6 system disturbances. In consultation with Newfoundland Power regarding their equipment at  
 7 the nearby Monkstown Substation, Newfoundland Power agreed to replace their recloser with  
 8 one having the capability to capture system information and assist in troubleshooting  
 9 distribution issues. Since replacement of the recloser, there have been no associated trips  
 10 without identifiable cause. Newfoundland Power’s recloser is the interconnection point of the  
 11 Paradise River Unit to the grid.

13 **5.0 Thermal Unit Forced Outage Rate Performance**

14 The thermal unit forced outage rates are measured using the CEA metric, DAFOR. Detailed  
 15 results for the 12-month period ending June 30, 2017, are presented in Table 5, as well as the  
 16 data for the 12-month period ending June 30, 2016. These are compared to Hydro’s short term  
 17 generation adequacy assumptions, as used in the Near-term Generation Adequacy report, and  
 18 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 2016 (%)	12 months ending June 2017 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
<i>All Thermal Units - weighted</i>	490	19.45	15.27	9.64	14.00
<b>Thermal Units</b>					
Holyrood 1	170	20.66	21.33	9.64	15.00
Holyrood 2	170	26.46	19.57	9.64	10.00
Holyrood 3	150	8.91	3.29	9.64	18.00

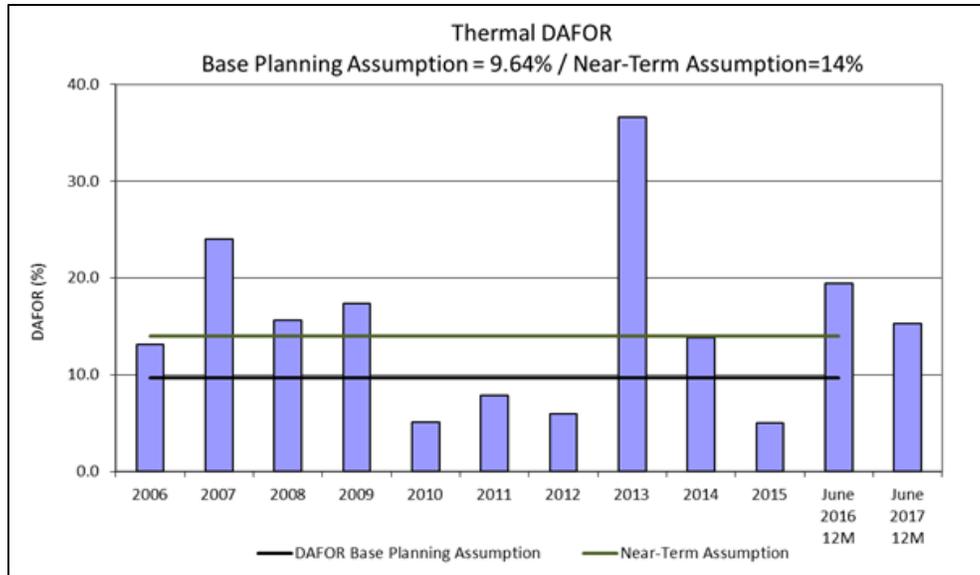


Figure 2: Thermal DAFOR

1 For the 12-month period ending June 30, 2017, the weighted DAFOR for all thermal units, of  
 2 15.27% is above the assumed Hydro generation base planning DAFOR value of 9.64%, and  
 3 comparable to the near-term assumption of 14.00%. Unit 1 DAFOR was 21.33% and Unit 2  
 4 DAFOR was 26.46%.The performance for both Units 1 and 2 was above the base planning  
 5 assumption of 9.64% and the near-term assumption of 15% (Unit 1) and 10% (Unit 2). Unit 3  
 6 DAFOR was 3.29%, which is better than the base planning assumption of 9.64% and near-term  
 7 assumption of 18.0%. The majority of the 15.27% DAFOR for the plant is due to deratings from  
 8 airflow issues in the 2016/2017 winter season and deration after the replacement of failed  
 9 boiler tubes in 2016.

10

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

- 13 • Following a forced outage to replace failed lower reheater tubes, the unit was returned  
 14 to service on February 26, 2016, with a derating to 120 MW until its annual planned  
 15 outage, which started on August 27, 2016. This derating was imposed to ensure the  
 16 reliability of the reheater until the remaining lower reheater tubes could be replaced

1 during the 2016 annual maintenance outage. Prior to the tube failures, the unit had  
2 been derated to 155 MW due to air flow issues.

- 3 • On July 15, 2016, the unit was removed from service to repair a feedwater isolator gland  
4 failure, to perform a wash of the air heaters, and to repair cracks in the forced draft fan  
5 ductwork. The unit was returned to service after approximately 35 hours of outage time.
- 6 • On August 27, 2016, the unit was taken off line to commence the annual maintenance  
7 outage. The work scope included complete replacement of the lower reheater tubes,  
8 intended to eliminate the derating due to risk of boiler tube failure, and other work to  
9 address the air flow issues that resulted in the derating prior to the boiler tube  
10 concerns.
- 11 • During return to service from annual maintenance on October 29, 2016, a turbine  
12 control system (Mark V) governor control card failed, causing a forced outage. The failed  
13 card was replaced and the unit was synchronized on November 2, 2016.
- 14 • When Unit 1 was first returned to service, it remained derated due to air flow issues,  
15 although there was an improvement from 155 MW, before the outage, to 160 MW. As  
16 planned, combustion tuning was completed during the week of November 14, 2016, to  
17 diagnose the air flow issues on this unit. Tuning was completed by an expert from  
18 Foxboro (supplier of the distributed control system) with assistance from a boiler field  
19 expert from Babcock & Wilcox (B&W.) They determined that the air flow issues that  
20 Hydro was experiencing were due to fouling through various stages of the boiler and air  
21 heater leakage. Further improvements require an outage to fully correct this, which is  
22 planned for completion during the 2017 annual planned maintenance outage. Work will  
23 include boiler cleaning and air heater upgrades. Full load capability is expected upon  
24 completion of this work. Hydro recently completed work to address similar air flow  
25 restrictions on Unit 2 during two weeks in April 2017. Prior to this work, Unit 2 had been  
26 derated to 135MW and is now rated at 165 MW.
- 27 • Unit 1 load capability was reduced to 145 MW on January 20, 2017, due to increased  
28 fouling, particularly in the air heater. An air heater wash was completed on a  
29 maintenance outage from January 26-27, 2017, which restored the load capability to the

1 pre-wash condition of 160 MW. However, the capability was further reduced due to  
2 continued fouling in the economizer, and at the end of February the unit was derated to  
3 150 MW. On March 4, 2017, the unit capability was rated at 140 MW and by the end of  
4 March this had further reduced to 135 MW. As previously stated, correction of this  
5 problem requires an extended outage and the work has been planned for the 2017  
6 annual outage. Full load capability is expected after the unit is returned to service after  
7 the outage.

- 8 • On March 8, 2017, it was necessary to take a short forced outage to repair two air  
9 heater bearing cooling water leaks. The unit was taken off-line in a controlled manner  
10 and was returned to service approximately 23 hours later after completion of the  
11 repairs.

12 For the remainder of the operating season, the available load continued to reduce as the boiler  
13 fouling condition continued to deteriorate. On June 6 an air heater wash was completed, which  
14 restored the load to 120 MW, up from 94 MW prior to the wash. The unit was shut down for  
15 the annual maintenance outage at the end of June with a capability of 120 MW.

16  
17 The DAFOR performance for Holyrood Unit 2 (170 MW) was primarily affected by the following  
18 events:

- 19 • Unit 2's annual planned maintenance outage for 2016 started on June 20, 2016, and the  
20 unit was returned to service on September 15, 2016. During the outage all remaining  
21 lower reheater tubes were replaced, thus eliminating the 120 MW derating that had  
22 been previously applied. Upon start-up, the unit was derated to 130 MW until  
23 September 20, 2016, and to 150 MW until September 29, 2016, until on-line testing of  
24 the boiler safety valves could be completed. The unit was then capable of generating at  
25 full load.
- 26 • On November 6, 2016, the main steam inlet flange to the upper control valves was  
27 found leaking and the unit was derated to 70 MW until it was removed from service for  
28 gasket replacement on November 8, 2016. The unit was returned to service on  
29 November 10, 2016, but had to be taken off-line for another failure of the same gasket

1 on November 16, 2016. This time the gasket was changed and a contractor was hired to  
2 provide a supplementary seal of the gasket, further encapsulating the replaced gasket.

3 The unit was returned to service on November 21, 2016. This problematic joint is  
4 scheduled for replacement during the planned maintenance outage in 2017.

- 5 • On November 18, 2016, when attempting to place back online after repair of the  
6 November 16, 2016 inlet flange leak, there was an issue discovered with turbine speed  
7 indication. After trouble shooting, it was determined that the speed probes had to be  
8 repositioned. The unit was returned to service at full capacity on November 21, 2016.
- 9 • On January 20, 2017, the unit load capacity was reduced to 150 MW due to boiler  
10 fouling, particularly in the air heater and economizer. An air heater wash was completed  
11 on February 18, 2017, but due to economizer fouling the unit remained derated to 150  
12 MW. Continued fouling during operation further reduced the load capability of the unit.  
13 On March 6, 2017, the capability was rated at 140 MW. On March 21, 2017, this was  
14 further reduced to approximately 135 MW. Hydro completed an early two week  
15 duration outage on Unit 2 starting on April 23, 2017. The outage addressed the fouling  
16 related air flow issues that were considered a significant effort and could not be  
17 completed during an air heater wash, or during peak winter season demand. Activities  
18 included, but were not limited to, cleaning and removal of hardened ash in the  
19 economizer section of the gas path. Issues affecting air flow restrictions were addressed  
20 and Unit 2 was then rated at 165 MW following this work, as tested on April 26, 2017.  
21 Additional work is scheduled during the 2017 planned annual outage to address air flow  
22 issues.
- 23 • On April 22 there was a brief outage required to repair a section of flexible ductwork on  
24 the ignitor air system that had come apart during start-up after the boiler cleaning  
25 outage.
- 26 • On May 1, 2017, the unit experienced a forced outage when a section of flexible  
27 ductwork adjacent to the location that had failed on April 22 also failed and allowed hot  
28 gas to escape from the boiler. This hot gas caused a cable tray fire adjacent to the north  
29 east corner of the boiler on the second floor. The fire was extinguished very quickly by

1 the Holyrood Emergency Response Team, but cable replacement took until May 28,  
2 2017, to complete. This work included asbestos abatement, as loose asbestos fibres  
3 were found in the cable tray. While the unit was off line, work protection permits were  
4 issued to allow other work that was planned for the annual outage to proceed in  
5 parallel. Unit 3 was re-called from its planned outage to provide generation to satisfy  
6 system requirements.

- 7 • In parallel to the cable tray restoration work, the cause of the failure of the ignitor flex  
8 hoses was investigated. This was the first such incident on record at the plant. All of the  
9 Unit 2 flexible hoses on the ignitor system were upgraded as required. This included  
10 extending the rigid pipe in the corner that failed such that the gap could be spanned by  
11 one flexible hose length. A splice was in the area of the failure, which was concluded to  
12 be part of the reason for the failure. Additional clamps were installed on Unit 1, which  
13 was in operation at the time, to verify that the hoses were secure. During the annual  
14 2017 maintenance outages, all hoses on Unit 2 and Unit 1 will be positively secured to  
15 ensure this failure cannot re-occur.
- 16 • Unit 2 tripped on June 03, 2017. The unit was returned to service a few hours later on  
17 the same day, but was limited to 50 MW until the reason for the trip could be confirmed  
18 and mitigated. A General Electric (GE) representative was brought to the site to  
19 diagnose the problem. The representative determined that during the trip, the control  
20 valves closed while the governor was calling for them to remain open. This pointed to  
21 three possibilities, including: loose wire, control card failure, or servo failure. A card  
22 failure was ruled out since all other functions of the card were working normally. The  
23 wires were tested with the unit at 25 MW and no issues were found. An outage was  
24 then completed from June 8-11, 2017, to replace the servo and change out the hydraulic  
25 fluid and filters. During this same outage, the turbine speed probe cables were replaced  
26 and probe clearance gaps were adjusted. This corrected a reliability issue that previously  
27 occurred on November 18, 2016, and was planned to be completed during the annual  
28 outage.

- 1 • On June 16, 2017, there was an issue with one of the two boiler feed pumps. The west  
2 pump had recently completed a rebuild and it appeared that there was some debris that  
3 went through one of the bearings and caused a spike in temperature and vibration. The  
4 temperature and vibration returned to normal, but the pump was taken out of service  
5 to change the oil and clean out the lube oil tank. The unit was derated to 70 MW while  
6 the pump was out of service. It was successfully tested and returned to service on June  
7 17, 2017.
- 8 • On June 29, 2017, Unit 2 experienced vibration and temperature excursions on the  
9 motor inboard bearing, with failure of the bearing being suspected. The pump was again  
10 taken out of service causing another derate to 70MW. Failure of the bearing was  
11 confirmed by opening the bearing. The capital spare boiler feed pump motor was  
12 brought to site and installed in place of the motor with the failed bearing, as this was  
13 the most expedient option to get the pump back in service. This work was completed on  
14 July 2, 2017, and the unit returned to 165 MW. Work instructions for boiler feed pump  
15 rebuilds have been updated to ensure that a lube oil flush is completed before returning  
16 the pumps back to service.

## 18 **6.0 Gas Turbine UFOP Performance**

19 The combined UFOP for the Hardwoods, Happy Valley, and Stephenville gas turbines was 8.68%  
20 for the 12-month period ending June 30, 2017 (see Table 6). This is better than both the base  
21 planning assumption of 10.62% and the near-term assumption of 20.00%. The current period  
22 UFOP declined from the previous period UFOP of 4.19%. The Hardwoods UFOP for the current  
23 period is 10.14%, which is better than the base planning assumption of 10.62%. The  
24 Stephenville UFOP for the current period is 13.10%, which is higher than the base planning  
25 assumption of 10.62%. Happy Valley's UFOP is 0.00% for the current period compared to  
26 13.31% in the previous period.

27  
28 As noted in Hydro's Near-term Generation Adequacy report, dated May 15, 2017, Hydro  
29 continues to evaluate the appropriateness of the Derating Adjusted Utilization Forced Outage

- 1 Probability (DAUFOP)<sup>5</sup> metric as an alternate or additional measure of gas turbine unit
- 2 reliability. Hydro will present its findings and make a recommendation on this metric in its next
- 3 Near-term Generation Adequacy report, to be filed with the Board on November 15, 2017.

**Table 6: Gas Turbine UFOP**

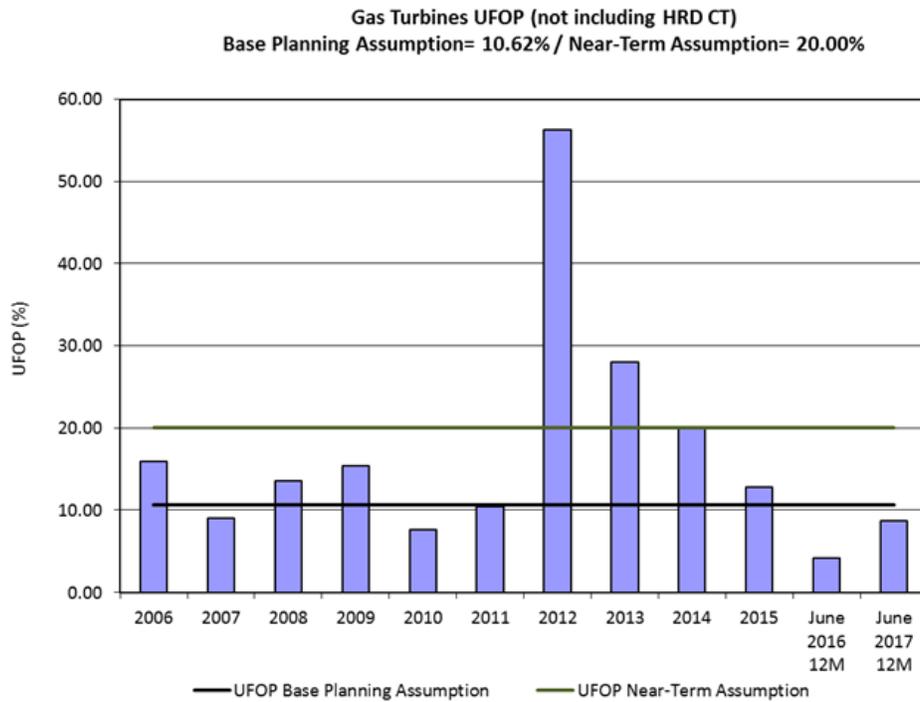
Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending June 2016 (%)	12 months ending June 2017 (%)	Hydro Generation	
				Base Planning Assumption (%)	Near-Term Planning Assumption (%)
<i>Combined Gas Turbines</i>	125	4.19	8.68	10.62	20.00
Stephenville	50	2.88	13.10	10.62	20.00
Hardwoods	50	1.42	10.14	10.62	20.00
Happy Valley	25	13.31	0.00	10.62	20.00

- 4 The Holyrood (HRD) GT UFOP of 2.46% for the current period is better than the base planning
- 5 and near-term assumptions of 5.00% (see Table 7).

**Table 7: Holyrood GT UFOP**

Combustion Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending June 2016 (%)	12 months ending June 2017 (%)	Hydro Generation	
				Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Holyrood CT	123.5	2.53	2.46	5.00	5.00

<sup>5</sup> 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.



**Figure 3: Gas Turbine UFOP**

- 1 The Hardwoods unit UFOP was primarily affected by the following events in the reporting
- 2 period:
  - 3 • On October 3, 2016, the Hardwoods gas turbine tripped due to a loss of fuel pressure
  - 4 when starting End B. It was determined that the main fuel valve was periodically closing
  - 5 during start up, resulting in intermittent failed starts. The unit remained available for
  - 6 service while the fuel valve issue was diagnosed. The fuel valve was replaced on
  - 7 February 10, 2017. No further issues have been experienced with this system since
  - 8 replacing the valve.
  - 9 • In October 2016, the Hardwoods gas turbine experienced four trips due to mounting
  - 10 and wiring issues with the vibration accelerometers installed on the alternator. The
  - 11 accelerometers were remounted and the wiring replaced. The repairs were completed
  - 12 and the unit was released for service on October 26, 2016. No further issues have been
  - 13 experienced with this system.

- 1       • On November 24, 2016, Hardwoods experienced an extended outage following a  
2 lightning storm resulting in the trip of the unit while operating in synchronous condense  
3 mode. Post trip, the unit was not able to synchronize to the electrical system. Hydro's  
4 investigation found blown fuses in the alternator's voltage sensing circuit and a fault on  
5 the automatic voltage regulator (AVR). The fuses were replaced and the AVR fault was  
6 diagnosed and corrected with technical support from the AVR manufacturer. The unit  
7 was tested and released for service on December 2, 2016.

8  
9 The Stephenville unit UFOP was primarily affected by the following events in the reporting  
10 period:

- 11       • A forced outage occurred from August 2-5, 2016, due to a lube oil leak in the alternator  
12 module. The source of the leak was determined and the repair completed. The unit was  
13 then returned to service. No further issues have been experienced with this system.
- 14       • A second forced outage occurred from August 9-19, 2016. This outage was due to the  
15 presence of debris on the metallic chip detectors during a routine inspection. A review  
16 of unit operation was completed in consultation with the overhaul facility, and the unit  
17 was returned to service with continued monitoring. The debris was analyzed and found  
18 to be minor very fine particles and not a cause of concern. The lubricating oil was  
19 analyzed and found to be in satisfactory condition for continued operation. No further  
20 issues have been experienced to date.
- 21       • A forced outage occurred from June 21st to June 22nd. This outage was due to the  
22 activation of the fire suppression system resulting in a trip of the Unit. The investigation  
23 of the trip found that the fire suppression system activated due to a fire in End B. The  
24 fire was caused by a loose connection on a fuel hose to one of the gas turbine fuel  
25 burners. Engine was inspected and a small number of fuel hoses were found to be  
26 damaged in the fire. The damaged hoses were replaced and the Unit was released for  
27 service.