

January 15, 2016

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**



Jennifer M. Williams, P. Eng  
Manager, Regulatory Engineering

JMW/cp

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

Thomas Johnson – Consumer Advocate  
Thomas O' Reilly – Cox & Palmer  
Danny Dumaresque

*A REPORT TO  
THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES*

**QUARTERLY REPORT  
ON  
PERFORMANCE OF GENERATING UNITS  
FOR THE QUARTER ENDED DECEMBER 31, 2015**

NEWFOUNDLAND AND LABRADOR HYDRO

January 15, 2016



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1 **1.0 Introduction**

2

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

7

8 The forced outage rates are provided for individual generating units at hydraulic facilities;  
9 the three units at the Holyrood Thermal Generating Station (HTGS) and Hydro's gas turbines  
10 for the current 12-month reporting period of January 1, 2015 to December 31, 2015. The  
11 report also provides, for comparison purposes, the individual generating unit data on forced  
12 outage rates for the previous period January 1, 2014 to December 31, 2014. Further, total  
13 asset class data is presented on an annual basis for years the 2004-2013. This report  
14 provides data on outage rates for forced outages, not planned outages.

15

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

19

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

27

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

1 Included in the forced outage rates are outages that remove the unit from service  
2 completely, as well as instances when units are de-rated. If a unit's output is reduced by  
3 more than 2%, the unit is considered de-rated by Canadian Electricity Association (CEA)  
4 guidelines. Per CEA guidelines, to take into account the de-rated levels of a generating unit,  
5 the operating time at the de-rated 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.

## 2.0 Period Ending December 31, 2015 Overview

Class of Units	January 1, 2014 to December 31, 2014 (%)	January 1, 2015 to December 31, 2015 (%)	Base Planning Assumption (%)
Hydraulic (DAFOR)	5.94	2.66	0.90
Thermal (DAFOR)	13.79	5.04	9.64
Gas Turbine (Combined) (UFOP)	20.28	10.55	10.62
Gas Turbine (Holyrood) (UFOP)	N/A	3.06	5.00

The hydraulic and thermal DAFOR and the combined<sup>1</sup> gas turbine UFOP performance (in table above) all show significant improvement for the current period, the 12-month period ending December 2015 compared to the previous period, the 12-month period ending December 2014.

In the ten year period prior to 2014, the hydraulic units show a somewhat consistent DAFOR. The DAFOR of the current 12-month period compared to the previous ten years is higher, primarily due to vibration problems experienced at Unit 1 at Bay d'Espoir.

The thermal units, in the ten year period prior to 2014, exhibit more variability in DAFOR than the hydraulic units, but in many years were close to a consistent rate of approximately 10%. The forced outage rate of the current period ending December 2015 is 5.04% which is significantly better than the base planning assumption of 9.64%.

Hydro's combined gas turbines' UFOP in the ten year period prior to 2014 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, 2015, performance was mainly affected by the forced outages to both the Stephenville and Happy Valley units. The Holyrood CT, the newest unit in this asset class, is a

<sup>1</sup> Combined Gas Turbines include the Hardwoods, Happy Valley, and Stephenville units. The performance of the Holyrood CT was not included in the combined base planning or sensitivity numbers as these numbers were set prior to the Holyrood CT's in service date.

- 1 123.5 MW unit and the data for this unit started to be measured in March 2015. This unit is
- 2 not included in the combined gas turbine UFOP rate.
- 3
- 4 Note that the data in the charts for 2004 to 2013 are annual numbers (January 1 to
- 5 December 31), while the data for December 2014 and December 2015 are 12-month rolling
- 6 (January 1 to December 31 for each period).

1 **3.0 Generation Planning Assumptions**

2

3 The DAFOR and UFOP indicators used in Hydro’s generation planning model is  
4 representative of a historic average of the actual performance of these units. These  
5 numbers are noted in the table below under the column “Base Planning Assumption”.

6

7 Hydro also provides a sensitivity number for DAFOR and UFOP as part of its generation  
8 planning analysis. This number takes into account a higher level of unavailability, should it  
9 occur, to assess the impact of higher unavailability of these units on overall generation  
10 requirements. During the 12-month period ending December 31, 2015, the thermal and gas  
11 turbine units performed well within this sensitivity range for DAFOR and UFOP. Both classes  
12 were also within the Base Planning assumptions, in particular thermal performance which  
13 showed an improvement of 48%. Further, the analysis demonstrates that with the  
14 implementation of the new gas turbine generating unit and the capacity assistance  
15 arrangements, the LOLH reliability criterion will be met beyond 2018 for the full range of  
16 sensitivity in the table below.

17

18 The new gas turbine (Holyrood CT) has a lower expected rate of unavailability than the  
19 original gas turbines, of 5% compared to 10.62% respectively, due to the fact that the unit is  
20 new and can be expected to have better availability than the older units.<sup>2</sup>

---

<sup>2</sup> Hydro selected a 5% UFOP for the new Holyrood CT following commentary on forced outage rates contained in the *Independent Supply Decision Review – Navigant (September 14, 2011)*.



- 1 Hydro's current generation planning assumptions for DAFOR and UFOP are:
- 2

	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>3</sup>

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<sup>3</sup> In previous reports, this sensitivity value was reported as 5.0%. The generation planning sensitivity for the Holyrood CT was updated to 10% for system planning purposes in the October 19, 2015 report.

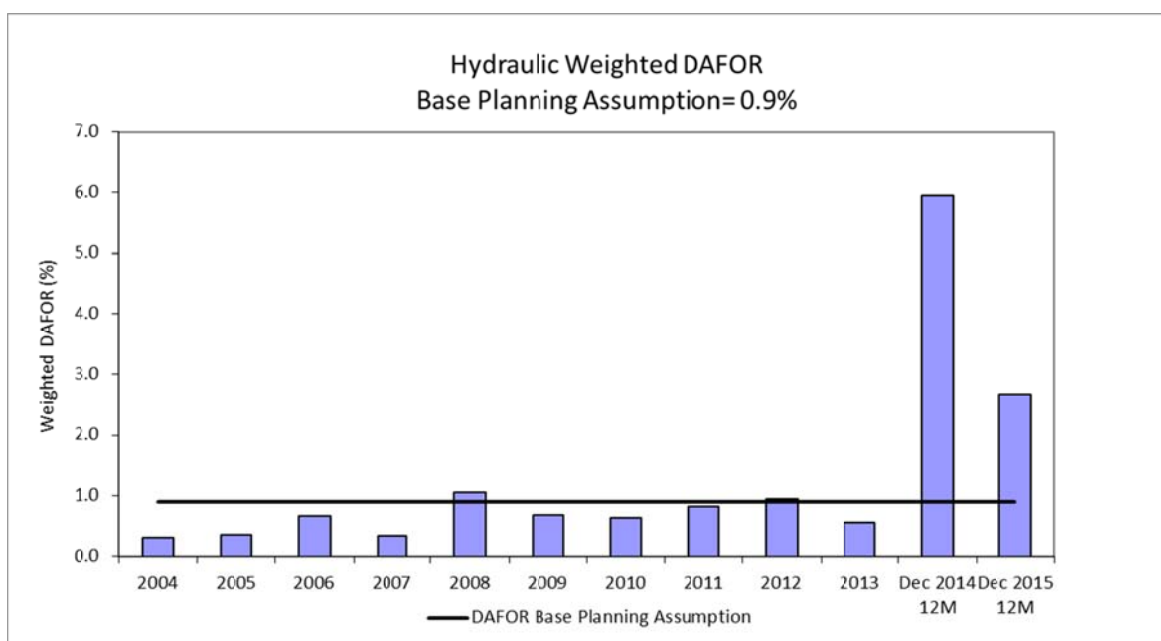
## 2 4.0 Hydraulic Unit Forced Outage Rate Performance

3

7 The hydraulic unit forced outage rates are measured using the CEA metric, DAFOR. Detailed  
 8 results for the 12-month period ending December 31, 2015 are presented as well as the data  
 9 for the 12-month period ending December 31, 2014. These are compared to Hydro's  
 10 generation planning assumption for the forced outage rate.

8

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending December 2014 (%)	12 months ending December 2015 (%)	Hydro Generation Base Planning Assumption (%)
<b>All Hydraulic Units - weighted</b>	954.4	5.94	2.66	0.90
<b>Hydraulic Units</b>				
Bay D'Espoir 1	76.5	0.03	25.32	0.90
Bay D'Espoir 2	76.5	0.73	0.06	0.90
Bay D'Espoir 3	76.5	0.00	0.00	0.90
Bay D'Espoir 4	76.5	0.70	0.27	0.90
Bay D'Espoir 5	76.5	0.16	2.54	0.90
Bay D'Espoir 6	76.5	59.25	0.00	0.90
Bay D'Espoir 7	154.4	2.10	0.00	0.90
Hinds Lake	75	0.29	0.16	0.90
Upper Salmon	84	2.28	0.00	0.90
Granite Canal	40	1.28	1.88	0.90
Cat Arm 1	67	0.62	0.01	0.90
Cat Arm 2	67	1.33	1.42	0.90
Paradise River	8	0.62	0.24	0.90



1 The weighted “All Hydraulic Units” DAFOR was 2.66% for the current 12 month period  
2 ending December 31, 2015 and improved compared to the previous 12 month period ending  
3 December 2014. The forced outage and derating of Unit 1 at Bay d’Espoir was the primary  
4 contributor to the DAFOR of 2.66% as compared to a base planning assumption of 0.9%.

5  
6 Considering the individual units performance, the assumed Hydro generation base planning  
7 DAFOR was materially exceeded for Bay d’Espoir Unit 1. Also, there were minor  
8 exceedances compared to base planning assumption for Bay d’Espoir Unit 5, Granite Canal  
9 and Cat Arm Unit 2, for the current period.

10

11 The Bay d’Espoir Unit 1 DAFOR of 25.32% compared to the base planning assumption of  
12 0.9% was the result of a forced extension of a planned outage. The planned annual  
13 maintenance was scheduled from April 26, 2015 to May 15, 2015. The extension was the  
14 unanticipated result of having to replace the turbine bearing. It was identified in the annual  
15 work plan to check the turbine bearing clearances due to an increase in bearing  
16 temperatures. The bearing clearances were checked and damage was found to the turbine  
17 bearing. Therefore, it was replaced with a new bearing. Vibration issues continued to be  
18 experienced at the unit after the bearing was replaced, which extended the planned outage.  
19 Two vibration experts, Hydro’s Project Execution and Technical Services personnel, as well as  
20 the Original Equipment Manufacturer were retained to troubleshoot the issue, with the unit  
21 eventually being returned to service at a reduced capacity. The original turbine bearing was  
22 reinstalled after being refurbished (with reduced clearances) and, while the vibration issue  
23 remained, a further dismantling of the unit revealed other issues including a damaged thrust  
24 bearing. Additional repairs were made and a new thrust bearing installed, which resolved  
25 the vibration issue, and the unit was returned to service at full capability on September 30,  
26 2015.

27

28 The Bay d’Espoir Unit 5 DAFOR of 2.54% compared to the base planning assumption of 0.9%  
29 was the result of a forced outage after the completion of planned annual maintenance. The  
30 planned annual maintenance was completed from May 27, 2015 to August 7, 2015. Upon

1 starting the unit, a stator ground fault occurred, which required five days to repair before  
2 the unit was placed into service on August 12, 2015.

3

4 Granite Canal unit DAFOR of 1.88% compared to the base planning assumption of 0.9% was  
5 the result of a forced outage after a lightning strike to transmission line TL263 which  
6 connects the unit to the grid. A bearing issue (low water flow on the shaft seal) was  
7 experienced on the restart of the unit. From August 10, 2015 to August 14, 2015, the unit  
8 incurred forced unavailability while repairs were completed to resolve this issue. From  
9 December 16, 2015 to December 17, 2015, the unit experienced forced unavailability due to  
10 debris on the intake trash rack.

11

12 The DAFOR for Cat Arm Unit 2 was 1.42% compared to the base planning assumption of  
13 0.9%. From May 12, 2015, the unit experienced a nine hour forced outage due to a faulty  
14 unit shutdown relay. On May 21, 2005, the unit experienced a 14 hour forced outage due to  
15 a problem with a governor timer on the pump controls. Due a problem with the Spherical  
16 valve and a governor pressure issue the unit experienced a forced outage from June 13,  
17 2015 to June 16, 2015.

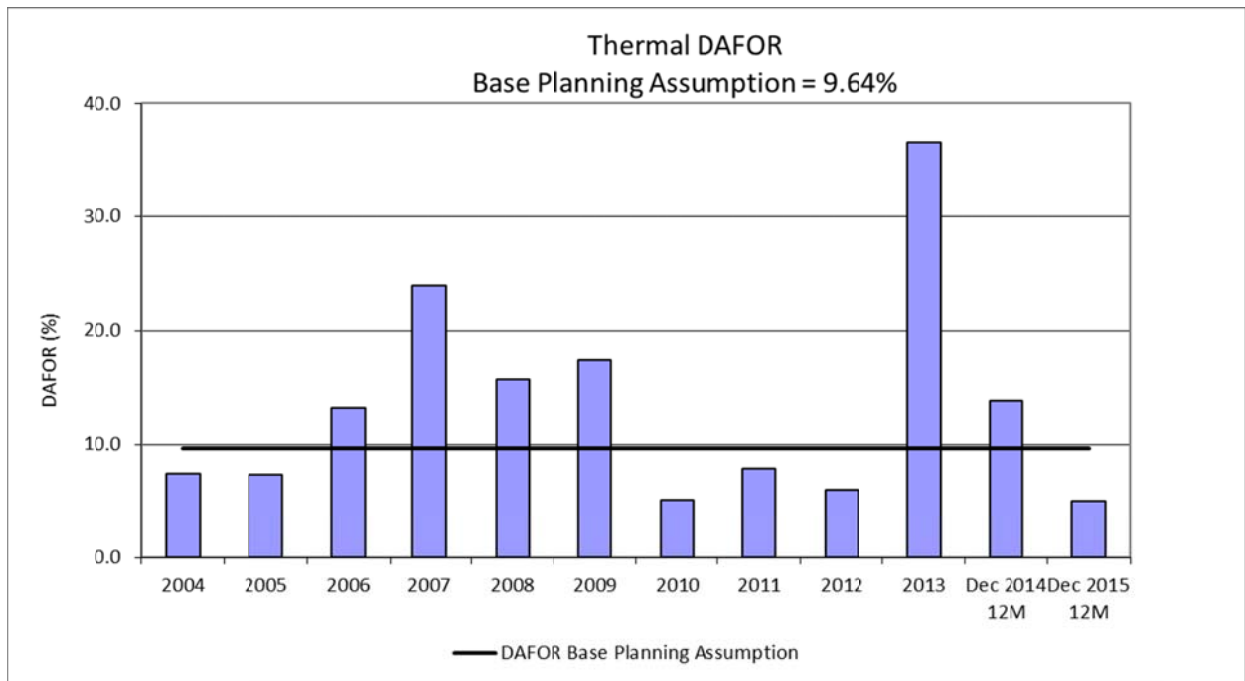
2 **5.0 Thermal Unit Forced Outage Rate Performance**

3

7 The thermal unit forced outage rates are measured using the CEA metric, DAFOR. Detailed  
 8 results for the 12-month period ending December 31, 2015 are presented as well as the data  
 9 for the 12-month period ending December 31, 2014. These are compared to Hydro’s  
 10 generation base planning assumption for the forced outage rate.

8

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending December 2014 (%)	12 months ending December 2015 (%)	Hydro Generation Base Planning Assumption (%)
<b>All Thermal Units - weighted</b>	490	13.79	5.04	9.64
<b>Thermal Units</b>				
Holyrood 1	170	19.76	4.94	9.64
Holyrood 2	170	12.16	1.89	9.64
Holyrood 3	150	9.51	9.37	9.64



9

13 For the 12-month period ending December 31, 2015, the weighted, all thermal units, DAFOR  
 14 of 5.04% is significantly better than the assumed Hydro generation base planning DAFOR  
 15 value of 9.64%, and improved compared to the previous 12-month period rate of 13.79%.  
 16 Unit 1 DAFOR was 4.94% and Unit 2 DAFOR was 1.89%, both were significantly better than

- 1 the base planning assumption of 9.64%. Unit 3 DAFOR improved to 9.37%, also better when
- 2 compared to the planning rate of 9.64%.

## 1 6.0 Gas Turbine UFOP Performance

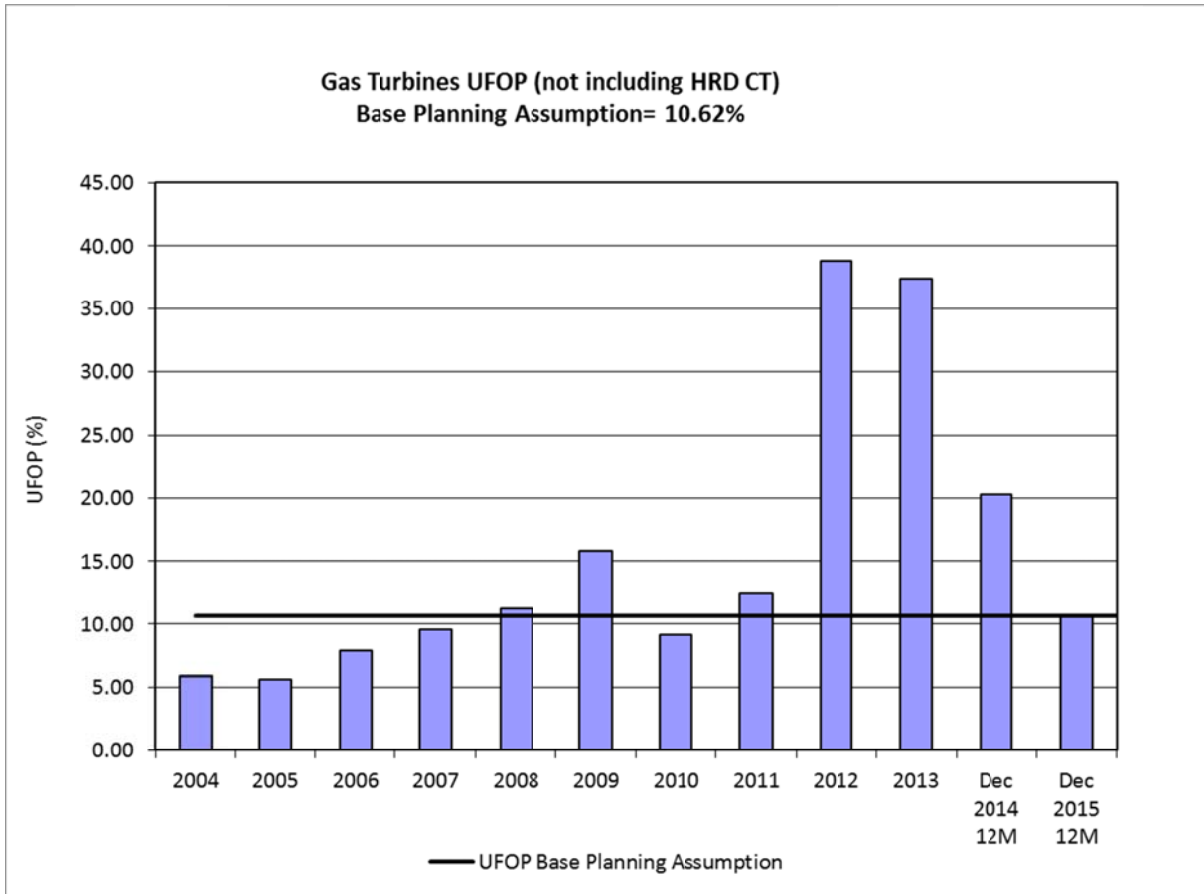
2  
 3 The combined UFOP for the Hardwoods, Happy Valley and Stephenville gas turbines was  
 4 10.55% for the 12-month period ending December 31, 2015. This is comparable to the base  
 5 planning assumption of 10.62%. The current period UFOP improved significantly from the  
 6 previous period UFOP of 20.28%. The Hardwoods UFOP for the current period is 6.39%,  
 7 which is well within the base planning assumption of 10.62%. The Stephenville unit's  
 8 current period UFOP is 15.71% compared to that of the previous period of 13.81%. Happy  
 9 Valley's UFOP is 14.56% for the current period compared to that of 0.59% in the previous  
 10 period.  
 11

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2014 (%)	12 months ending December 2015 (%)	Hydro Generation Base Planning Assumption (%)
<b>Combined Gas Turbines</b>	<b>125</b>	20.28	10.55	<b>10.62</b>
Stephenville	50	13.81	15.71	10.62
Hardwoods	50	35.43	6.39	10.62
Happy Valley	25	0.59	14.56	10.62

12  
 13 The Holyrood (HRD) CT UFOP of 3.06% for the current period is better than the base  
 14 planning assumption of 5.00%.  
 15

Combustion Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2014 (%)	12 months ending December 2015 (%)	Hydro Generation Base Planning Assumption (%)
Holyrood CT*	123.5		3.06	5.00

\*data presented from March to December 2015 only



2

3 The Stephenville unit UFOP was affected by two notable events in the reporting period.

4

16 Following a similar failure of a fuel line at Hardwoods on December 12, 2014, the  
 17 Stephenville gas turbine was removed from service for generation until the issue with  
 18 the fuel lines was thoroughly investigated and the unit was verified safe for ongoing  
 19 operation. The root cause of the fuel line failures was determined to be a manufacturing  
 20 defect. Hydro removed the affected fuel lines from service and completed quality  
 21 assurance checks on the remaining fuel lines to assure their suitability for service. It was  
 22 determined that the remaining fuel lines were suitable and Stephenville End A was  
 23 returned to service on December 21, 2014. There were insufficient fuel lines available to  
 24 return End B to service at this time. Replacement fuel lines were ordered, quality  
 25 assurance checks of all new fuel lines were completed, and End B was returned to service  
 26 on January 29, 2015. This resulted in a 29 day outage for one end of the unit in the  
 27 reporting period.



1       The UFOP for Stephenville gas turbine was primarily impacted in 2015 by a forced outage  
2       from May 1 to May 27, 2015, due to an alternator bearing problem. The bearing was  
3       inspected, repaired, and all operating parameters checked and confirmed prior to  
4       returning the unit to service.

5

6       The Happy Valley unit UFOP was primarily affected by the following event in the reporting  
7       period.

8

9       In 2015, the UFOP for the Happy Valley gas turbine was primarily impacted by a forced  
10       outage from September 9 to September 21, due to a vibration issue. The vibration issue  
11       was determined to be a result of a broken air pipe which was repaired and the unit was  
12       then tested and returned to service.