Q. Please provide copies of Hydro's forecasted availability measures and the actual availability measures for 2016-2018 for both hydraulic and thermal production assets.

A. For Newfoundland and Labrador Hydro's ("Hydro") forecast availability measures and actual measures for the last three years please refer to:

- PUB-NLH-015, Attachment 1 for Hydro's "Quarterly Report on Performance of Generating Units for the Quarter Ended March 31, 2016;"
- PUB-NLH-015, Attachment 2 for Hydro's "Quarterly Report on Performance of Generating Units for the Quarter Ended June 30, 2016;"
- PUB-NLH-015, Attachment 3 for Hydro's "Quarterly Report on Performance of Generating Units for the Quarter Ended September 30, 2016;"
- PUB-NLH-015, Attachment 4 for Hydro's "Quarterly Report on Performance of Generating Units for the Quarter Ended December 31, 2016;"
- PUB-NLH-015, Attachment 5 for Hydro's "Quarterly Report on Performance of Generating Units for the Quarter Ended March 31, 2017;"
- PUB-NLH-015, Attachment 6 for Hydro's "Quarterly Report on Performance of Generating Units for the Quarter Ended June 30, 2017;"
- PUB-NLH-015, Attachment 7 for Hydro's "Quarterly Report on Performance of Generating Units for the Quarter Ended September 30, 2017;"

- PUB-NLH-015, Attachment 8 for Hydro's "Quarterly Report on Performance of Generating Units for the Quarter Ended December 31, 2017;"

- PUB-NLH-015, Attachment 9 for Hydro's "Quarterly Report on Performance of Generating Units for the Quarter Ended March 31, 2018;"

- PUB-NLH-015, Attachment 10 for Hydro's "Quarterly Report on Performance of Generating Units for the Quarter Ended June 30, 2018;"

- PUB-NLH-015, Attachment 11 for Hydro's "Quarterly Report on Performance of Generating Units for the Quarter Ended September 30, 2018;" and

- PUB-NLH-015, Attachment 12 for Hydro's "Quarterly Report on Performance of Generating Units for the Quarter Ended December 31, 2018."

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April 14, 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

Tracey L. Pennell
Legal Counsel

TLP/bs

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 MARCH 31, 2016

NEWFOUNDLAND AND LABRADOR HYDRO

APRIL 14, 2016

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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 as well as in relation to assumptions used in Loss of Load Hours (LOLH) calculations for system planning purposes.

The forced outage rates are provided for individual generating units at hydraulic facilities; the three units at the Holyrood Thermal Generating Station (HTGS) and Hydro's gas turbines for the current 12-month reporting period of April 1, 2015 to March 31, 2016. The report also provides, for comparison purposes, the individual generating unit data on forced outage rates for the previous period April 1, 2014 to March 31, 2015. Further, total asset class data is presented on an annual basis for years the 2005-2014. This report provides data on outage rates for forced outages, not planned outages.

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

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

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

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

2.0 Period Ending March 31, 2016 Overview

Class of Units	April 1, 2014 to March 31, 2015 (%)	April 1, 2015 to March 31, 2016 (%)	Base Planning Assumption (%)
Hydraulic (DAFOR)	4.45	2.76	0.90
Thermal (DAFOR)	10.99	13.54	9.64
Gas Turbine (Combined) (UFOP)	18.36	8.29	10.62
Gas Turbine (Holyrood) (UFOP)	0.70[1]	2.81	5.00

The hydraulic DAFOR and the combined[2] gas turbine UFOP performance (in table above) all show improvement for the current period, the 12-month period ending March 2016 compared to the previous period, the 12-month period ending March 2015. There was a decline in Thermal DAFOR performance for the current period compared to the previous period.

In the 10 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 10 years is higher, primarily due to vibration problems experienced at Unit 1 at Bay d'Espoir.

The thermal units, in the 10 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 March 2016 is 13.54% which is above the base planning assumption of 9.64%, and the sensitivity of 11.64%. This is primarily caused by an airflow derating on Unit 1 and boiler tube failures on Units 1 and 2.

Hydro's combined gas turbines' UFOP in the 10 year period prior to 2014 was generally consistent at approximately 10% until the year 2012 when the rate exceeded 50%. Since

[1] Only includes data from March 1, 2015 to March 31, 2015
[2] 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.

2012, the UFOP has been improving each year. For the current 12-month period ending March 31, 2016, performance was mainly affected by the forced outages to both the Stephenville and Happy Valley units. The decline in performance for the Holyrood CT is related to the data collection period. Performance data for the Holyrood CT for the 12-month period ending March 2015 includes one month of data where the 12-month period ending March 2016 includes a full year of data.

Note that the data in the charts for 2004 to 2014 are annual numbers (January 1 to December 31), while the data for March 2015 and March 2016 are 12-month rolling (April 1 to March 31 for each period).

3.0 Generation Planning Assumptions

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

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 March 31, 2016, the gas turbine units performed within this sensitivity range for UFOP, while both the hydraulic and thermal classes performed outside of the for DAFOR. Hydro notes that as part of the ongoing risk review considering energy supply up to Lower Churchill interconnection, Hydro is considering several years of data of DAFOR and UFOP and the resulting implication for meeting reliability criteria.

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

[3] Hydro is currently completing a risk assessment on thermal generation supply for the period up to interconnection with Labrador and Nova Scotia. As part of this risk assessment, Hydro is reviewing the recent availability results. The outcome of this review may reflect a new base planning assumption for various generation sources.

[4] 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

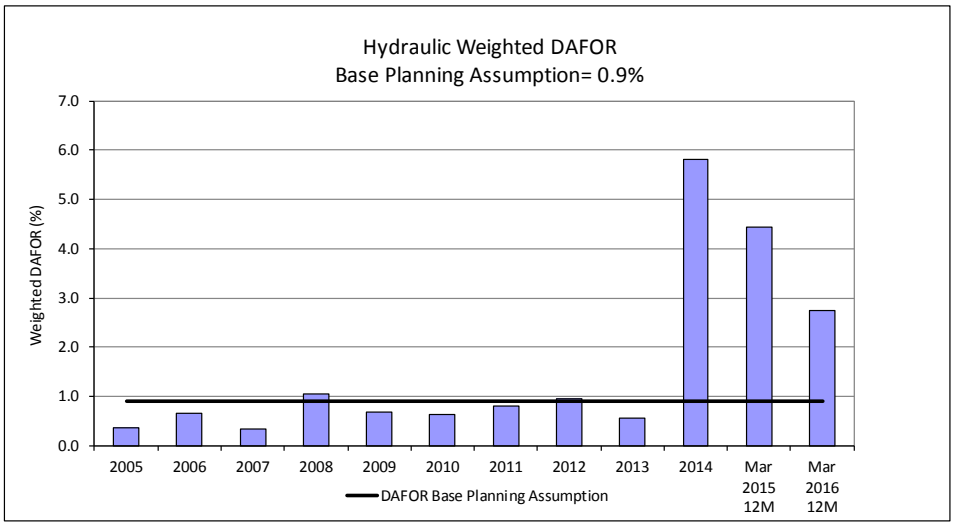
	DAFOR (%)		UFOP (%)	
	Base Planning Assumption	**Sensitivity**	**Base Planning Assumption**	**Sensitivity**
Hydraulic Units	0.90	0.90		
Thermal Units	9.64	11.64		
Gas Turbines - Existing			10.62	20.62
Gas Turbines - New			5.0	10.0[5]

[5] In previous reports this sensitivity value was reported as 5.0%. The generation planning sensitivity for the Holyrood CT was updated to 10 % since the last report for system planning purposes.

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 March 31, 2016 are presented as well as the data for the 12-month period ending March 31, 2015. These are compared to Hydro's generation planning assumption for the forced outage rate.

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending March 2015 (%)	12 months ending March 2016 (%)	Hydro Generation Base Planning Assumption (%)
All Hydraulic Units - weighted	954.4	4.45	2.76	0.90
Hydraulic Units				
Bay D'Espoir 1	76.5	0.03	26.91	0.90
Bay D'Espoir 2	76.5	0.01	0.07	0.90
Bay D'Espoir 3	76.5	0.00	0.00	0.90
Bay D'Espoir 4	76.5	0.64	0.42	0.90
Bay D'Espoir 5	76.5	0.18	3.09	0.90
Bay D'Espoir 6	76.5	45.48	0.00	0.90
Bay D'Espoir 7	154.4	2.10	0.00	0.90
Hinds Lake	75	0.21	0.16	0.90
Upper Salmon	84	2.22	0.00	0.90
Granite Canal	40	0.32	2.07	0.90
Cat Arm 1	67	0.62	0.01	0.90
Cat Arm 2	67	1.34	1.39	0.90
Paradise River	8	0.00	0.24	0.90



The weighted "All Hydraulic Units" DAFOR was 2.76% for the current 12 month period ending March 31, 2016. The forced outage and derating of Unit 1 at Bay d'Espoir was the primary contributor to the DAFOR of 2.76% as compared to a base planning assumption of 0.9%.
Considering the individual units performance, the assumed Hydro generation base planning DAFOR was materially exceeded for Bay d'Espoir Unit 1. Also, there were exceedances compared to base planning assumption for Bay d'Espoir Unit 5, Granite Canal and Cat Arm Unit 2, for the current period.

The Bay d'Espoir Unit 1 DAFOR of 26.91% compared to the base planning assumption of 0.9% was the result of a forced extension of a planned outage. The planned annual maintenance was scheduled from April 26, 2015 to May 15, 2015. The extension is the unanticipated result of having to replace the turbine bearing. It was identified in the annual work plan to check the turbine bearing clearances due to an increase in bearing temperatures. The bearing clearances were checked and damage was found to the turbine bearing. Therefore it was replaced with a new bearing. Vibration issues continued to be experienced at the unit after the bearing was replaced, which extended the planned outage. Two vibration experts, Hydro's Project Execution and Technical Services personnel, as well as the Original Equipment Manufacturer were retained to troubleshooting the issue, with the unit eventually being returned to service at a reduced capacity. The original turbine bearing was reinstalled after being refurbished (with reduced clearances) and, while the vibration issue remained, a further dismantling of the unit revealed other issues including a damaged thrust bearing. Additional repairs were made and a new thrust bearing installed, which resolved the vibration issue, and the unit was returned to service at full capability on September 30, 2015.

The Bay d'Espoir Unit 5 DAFOR of 3.09% compared to the base planning assumption of 0.9% was the result of a forced outage after the completion of planned annual maintenance. The planned annual maintenance was completed from May 27, 2015 to August 7, 2015. Upon starting the unit, a stator ground fault occurred, which required five days to repair before the unit was placed into service on August 12, 2015.

The Granite Canal unit DAFOR of 2.07% compared to the base planning assumption of 0.9% was the result of a forced outage after a lightning strike to transmission line TL263 which connects the unit to the grid. A bearing issue (low water flow on the shaft seal) was experienced on the restart of the unit.

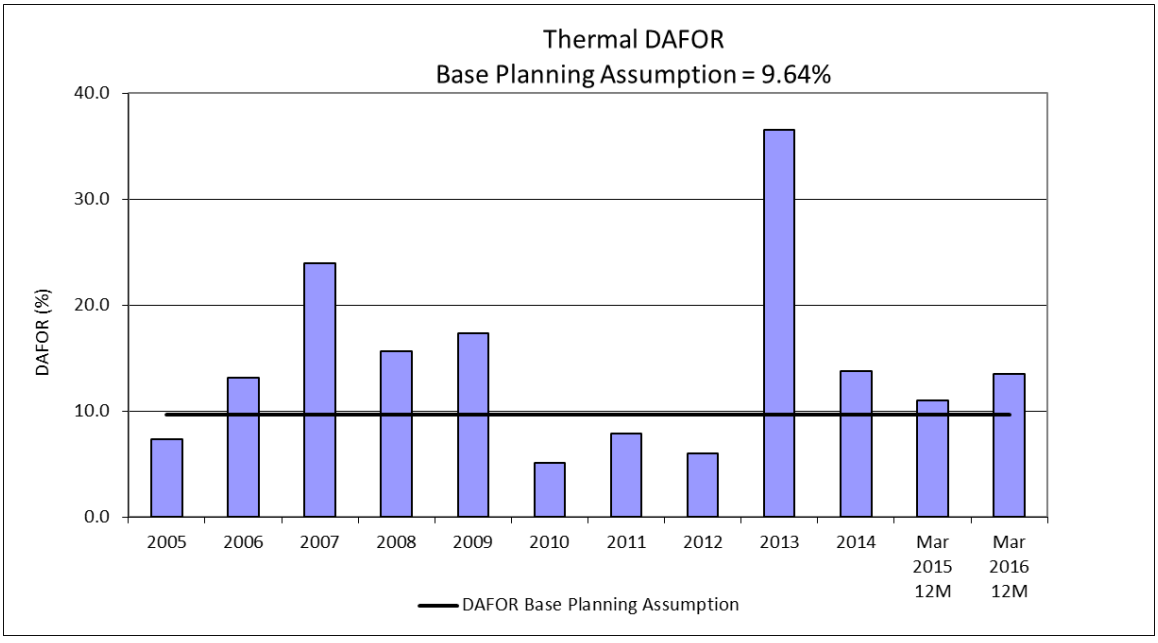
From August 10, 2015 to August 14, 2015, the unit incurred forced unavailability while repairs were completed to resolve this issue. From December 16, 2015 to December 17, 2015, the unit experienced forced unavailability due to debris on the intake trash rack.

The DAFOR for Cat Arm Unit 2 was 1.39% compared to the base planning assumption of 0.9%. On May 12, 2015, the unit experienced a nine hour forced outage due to a faulty unit shutdown relay. On May 21, 2015, the unit experienced a 14 hour forced outage due to a problem with a governor timer on the pump controls. Due a problem with the spherical valve and a governor pressure issue the unit also experienced a forced outage from June 13, 2015 to June 16, 2015.

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 March 31, 2016 are presented as well as the data for the 12-month period ending March 31, 2015. These are compared to Hydro's generation base planning assumption for the forced outage rate.

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending March 2015 (%)	12 months ending March 2016 (%)	Hydro Generation Base Planning Assumption (%)
All Thermal Units - weighted	490	10.99	13.54	9.64
Thermal Units				
Holyrood 1	170	15.45	12.28	9.64
Holyrood 2	170	11.94	18.33	9.64
Holyrood 3	150	5.55	8.98	9.64



For the 12-month period ending March 31, 2016, the weighted DAFOR for, all thermal units, of 13.54% is above the assumed Hydro generation base planning DAFOR value of 9.64%, and also exceeded the previous 12-month period rate of 10.99%. Unit 1 DAFOR was 12.28% and Unit 2

DAFOR was 18.33%, and the performance for both units was above the base planning assumption of 9.64%. Unit 3 DAFOR was 8.98%, which is better than the base planning assumption of 9.64%.

The DAFOR performance for Holyrood Unit 1 (170 MW) was affected by several events in the current 12 MTD period.

From May 14, 2015 to August 1, 2015, a derating to 155 MW occurred due to airflow limitations. During the 2015 planned maintenance outage from August to October, the air heaters were found to be heavily fouled. They were cleaned during the outage. It was expected that the air flow problem that led to the load restriction has been resolved as a result of this clearing. Testing of the air flow controls during the maintenance outage did not reveal any problems

From November 27, 2015 to February 3, 2016 the unit was derated to 155 MW due to airflow limitations, suspected to be related to the new variable frequency drives on the forced draft (FD) fans. This was a continuation of the problems experienced prior to the annual maintenance outage. The air heater fouling that was discovered and corrected during the outage did not solve the problem with air flow. Boiler tuning may be effective in resolving this issue. This is not possible to complete until after the reheater tubes are replaced (see below).

On February 3, 2016 the east FD fan variable frequency drive failed and caused the unit to trip. Investigation by Siemens (the manufacturer of the drives) and plant engineering was conducted. Under a Siemens recommendation, a control card on the drive unit was replaced and the unit was returned to service on February 5, 2016. Siemens is completing a root cause failure analysis on the control card. When the unit was returned to service the load was limited to 140 MW to make the unit more reliable in consideration of the boiler reheater tube failures experienced in Unit 2.

On February 8, 2016 the unit experienced a tube failure in the reheater section of the boiler. The unit was operated with a deration to 50 MW until an opportune time to shut it down for repairs on February 16, 2016. Hydro considered the risk of additional tube failures and the favorable weather forecast at the time and proceeded with the replacement of the lowest wall thickness tubes during this outage. Sixteen lower reheater tubes were replaced at that time. The unit was

returned to service on February 26, 2016 with a derating to 120 MW to improve the reliability of the reheater until the remaining lower reheater tubes can be replaced during the upcoming scheduled annual maintenance outage.

The DAFOR performance for Holyrood Unit 2 (170 MW) was primarily affected by several events.

On January 6, 2016 the unit experienced a tube failure in the reheater section of the boiler. Upon discovery of the failure the unit was taken offline in a controlled shutdown and allowed to cool for internal inspection. Four failed tubes in the lower section of the reheater were identified and replaced. The unit was returned to service after the repairs on January 15, 2016. As is common practice when returning the unit to service, a stepped approach to loading the unit was employed. Between January 15 and January 19, the unit was gradually loaded in steps between 70 MW and 140 MW. On January 19, 2016, when operating at 140 MW, the unit experienced another failure in the lower reheater section of the boiler. Again the unit was taken offline in a controlled shutdown. Hydro considered the risk of additional tube failures and the favorable weather forecast at the time and proceeded with the replacement of the lowest wall thickness tubes during this outage. Over the period since the unit first went out of service January 6, 2016, 27 lower and three upper reheat tubes were replaced prior to the unit going back in service February 3, 2016. The unit was returned to service with a derating to 120 MW to improve the reliability of the reheater until the remaining lower reheater tubes can be replaced during the upcoming scheduled annual maintenance outage.

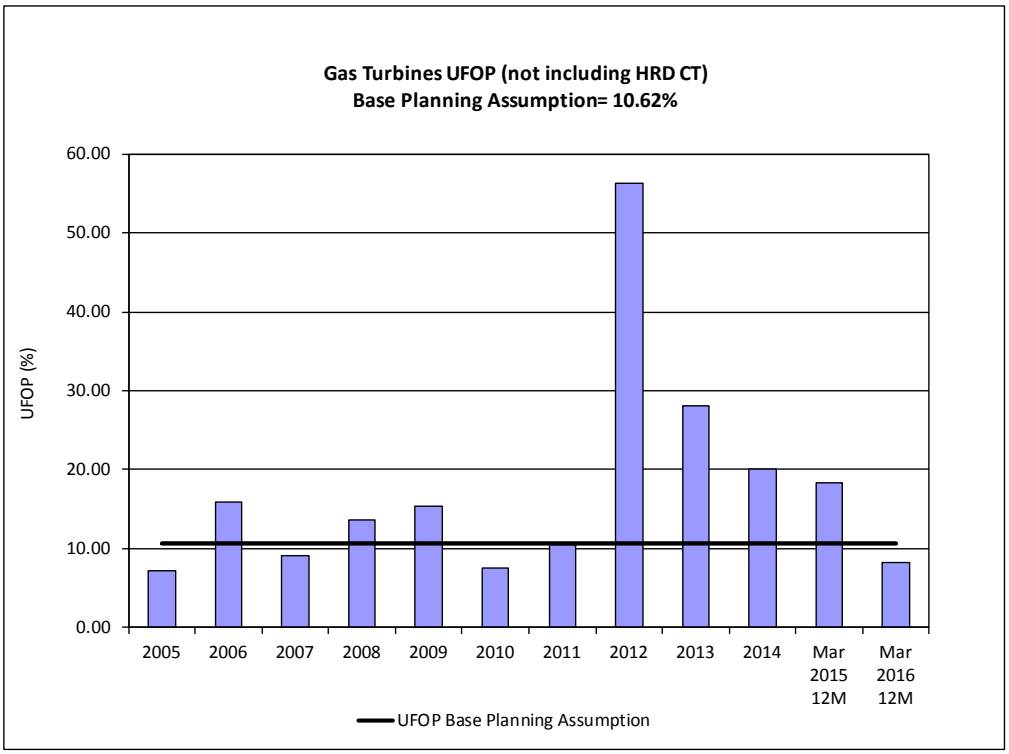
6.0 Gas Turbine UFOP Performance

The combined UFOP for the Hardwoods, Happy Valley and Stephenville gas turbines was 8.29% for the 12-month period ending March 31, 2016. This is better than the base planning assumption of 10.62%. The current period UFOP improved from the previous period UFOP of 18.36%. The Hardwoods UFOP for the current period is 3.05%, which is better than the base planning assumption of 10.62%. The Stephenville unit's current period UFOP is 15.08% compared to that of the previous period of 9.50%. Happy Valley's UFOP is 14.22% for the current period compared to 1.04% in the previous period.

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending March 2015 (%)	12 months ending March 2016 (%)	Hydro Generation Base Planning Assumption (%)
Combined Gas Turbines	125	18.36	8.29	10.62
Stephenville	50	9.50	15.08	10.62
Hardwoods	50	33.82	3.05	10.62
Happy Valley	25	1.04	14.22	10.62

The Holyrood (HRD) CT UFOP of 2.81% for the current period is better than the base planning assumption of 5.00%.

Combustion Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending March 2015 (%)	12 months ending March 2016 (%)	Hydro Generation Base Planning Assumption (%)
Holyrood CT	123.5	0.70	2.81	5.00



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

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

From February 10, 2016 to February 12, 2016, End B was unavailable due to a stuck solenoid on the fuel shut off valve. Minor maintenance was performed on the valve and the unit was returned to service.

As of March 26, 2016, there is a derating of the unit to 25 MW (from 50 MW). End A tripped and has been unavailable. A report on the unit is expected shortly.

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

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

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July 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

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

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Tracey L. Pennell
Senior Counsel, Regulatory

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A REPORT TO
THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

QUARTERLY REPORT
ON
PERFORMANCE OF GENERATING UNITS
FOR THE QUARTER ENDED JUNE 30, 2016

NEWFOUNDLAND AND LABRADOR HYDRO

JULY 15, 2016

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

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

2.0 Period Ending June 30, 2016 Overview

Class of Units	July 1, 2014 to June 30, 2015 (%)	July 1, 2015 to June 30, 2016 (%)	Base Planning Assumption (%)
Hydraulic (DAFOR)	2.85	2.15	0.90
Thermal (DAFOR)	10.06	19.45	9.64
Gas Turbine (Combined) (UFOP)	21.19	5.54	10.62
Gas Turbine (Holyrood) (UFOP)	1.56[1]	2.53	5.00

The hydraulic DAFOR and the combined[2] gas turbine UFOP performance (in table above) all show improvement for the current period, the 12-month period ending June 2016 compared to the previous period, the 12-month period ending June 2015. There was a decline in Thermal DAFOR performance for the current period compared to the previous period.

In the 10 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 10 years is higher, primarily due to vibration problems experienced at Unit 1 at Bay d'Espoir.

The thermal units, in the 10 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 June 2016 is 19.45% which is above the base planning assumption of 9.64%, and the sensitivity of 11.64%. This is primarily caused by an airflow derating on Unit 1 and boiler tube failures on Units 1 and 2.

Hydro's combined gas turbines' UFOP in the 10 year period prior to 2014 was generally consistent at approximately 10% until the year 2012 when the rate exceeded 50%. Since

[1] Only includes data from March 1, 2015 to June 30, 2015
[2] 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.

2012, the UFOP has been improving each year. For the current 12-month period ending June 30, 2016, performance was mainly affected by the forced outages to the Happy Valley unit. The decline in performance for the Holyrood CT is related to the data collection period. Performance data for the Holyrood CT for the 12-month period ending June 2015 includes four months of data where the 12-month period ending June 2016 includes a full year of data.

Note that the data in the charts for 2004 to 2014 are annual numbers (January 1 to December 31), while the data for June 2015 and June 2016 are 12-month rolling (July 1 to June 30 for each period).

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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 the table below under the column "Base Planning Assumption"[3].

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, 2016, the gas turbine units performed well within this sensitivity range for UFOP. Both the hydraulic and thermal classes performed well outside of the sensitivity range for DAFOR. As part of the ongoing risk review considering energy supply up to Lower Churchill interconnection, Hydro is considering several years of data of DAFOR and UFOP and the resulting implication for meeting reliability criteria.

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

[3] Hydro is currently completing a risk assessment on thermal generation supply for the period up to interconnection with Labrador and Nova Scotia. As part of this risk assessment, Hydro is reviewing the recent availability results. The outcome of this review may reflect a new base planning assumption for various generation sources.

[4] 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)*

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

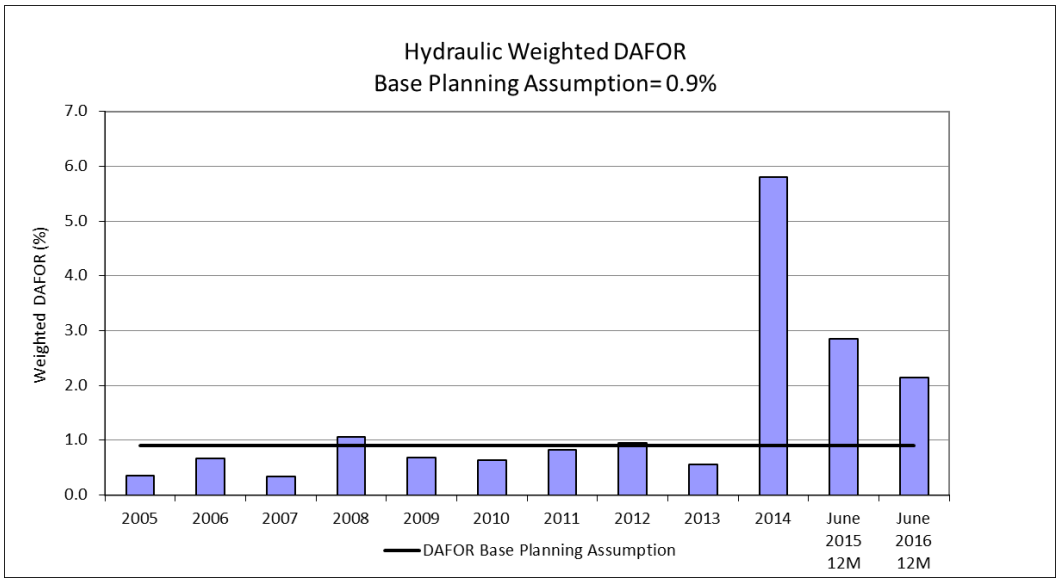
	DAFOR (%)		UFOP (%)	
	Base Planning Assumption	**Sensitivity**	**Base Planning Assumption**	**Sensitivity**
Hydraulic Units	0.90	0.90		
Thermal Units	9.64	11.64		
Gas Turbines - Existing			10.62	20.62
Gas Turbines - New			5.0	10.0[5]

[5] In previous reports this sensitivity value was reported as 5.0%. The generation planning sensitivity for the Holyrood CT was updated to 10 % since the last report for system planning purposes.

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, 2016 are presented as well as the data for the 12-month period ending June 30, 2015. These are compared to Hydro's generation planning assumption for the forced outage rate.

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending June 2015 (%)	12 months ending June 2016 (%)	Hydro Generation Base Planning Assumption (%)
All Hydraulic Units - weighted	954.4	2.85	2.15	0.90
Hydraulic Units				
Bay D'Espoir 1	76.5	13.75	17.69	0.90
Bay D'Espoir 2	76.5	0.00	7.44	0.90
Bay D'Espoir 3	76.5	0.00	0.00	0.90
Bay D'Espoir 4	76.5	0.23	0.11	0.90
Bay D'Espoir 5	76.5	0.00	3.36	0.90
Bay D'Espoir 6	76.5	15.39	0.00	0.90
Bay D'Espoir 7	154.4	0.84	0.00	0.90
Hinds Lake	75	0.30	0.05	0.90
Upper Salmon	84	1.17	0.00	0.90
Granite Canal	40	0.37	1.83	0.90
Cat Arm 1	67	0.60	0.01	0.90
Cat Arm 2	67	1.91	0.21	0.90
Paradise River	8	0.00	0.31	0.90



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

The Bay d'Espoir Unit 1 DAFOR of 17.69% compared to the base planning assumption of 0.9% was the result of a forced extension of a planned outage. This one forced outage, contributed 52% of the total DAFOR in this asset class. The planned annual maintenance was scheduled from April 26, 2015 to May 15, 2015. The extension is the unanticipated result of having to replace the turbine bearing. It was identified in the annual work plan to check the turbine bearing clearances due to an increase in bearing temperatures. The bearing clearances were checked and damage was found to the turbine bearing. Therefore it was replaced with a new bearing. Vibration issues continued to be experienced at the unit after the bearing was replaced, which extended the planned outage. Two vibration experts, Hydro's Project Execution and Technical Services personnel, as well as the Original Equipment Manufacturer were retained to troubleshoot the issue, with the unit eventually being returned to service at a reduced capacity. The original turbine bearing was reinstalled after being refurbished (with reduced clearances) and, while the vibration issue remained, a further dismantling of the unit revealed other issues including a damaged thrust bearing. Additional repairs were made and a new thrust bearing installed, which resolved the vibration issue, and the unit was returned to service at full capability on September 30, 2015. The Unit 1 DAFOR was also impacted (5.02%) by the Unit being removed from service on May 21, 2016, as a result of a leak in Penstock 1, which provides water to both Units 1 and 2. The following detail relating to the Unit 2 DAFOR applies to Unit 1 as well.

The Bay d'Espoir Unit 2 DAFOR of 7.44% compared to the base planning assumption of 0.9% was the result of a forced outage, caused by a leak in Penstock 1, which supplies both Units 1

and 2. The forced outage started on May 21, 2016 after a leak was reported in the Penstock. A consultant was engaged to conduct an investigation into the issue, and a repair procedure was provided on June 2. The damaged section of penstock was repaired and Unit 1 was returned to service on June 3, 2016 at 1938 hours and Unit 2 was returned to service on June 3, 2016 at 2014 hours.

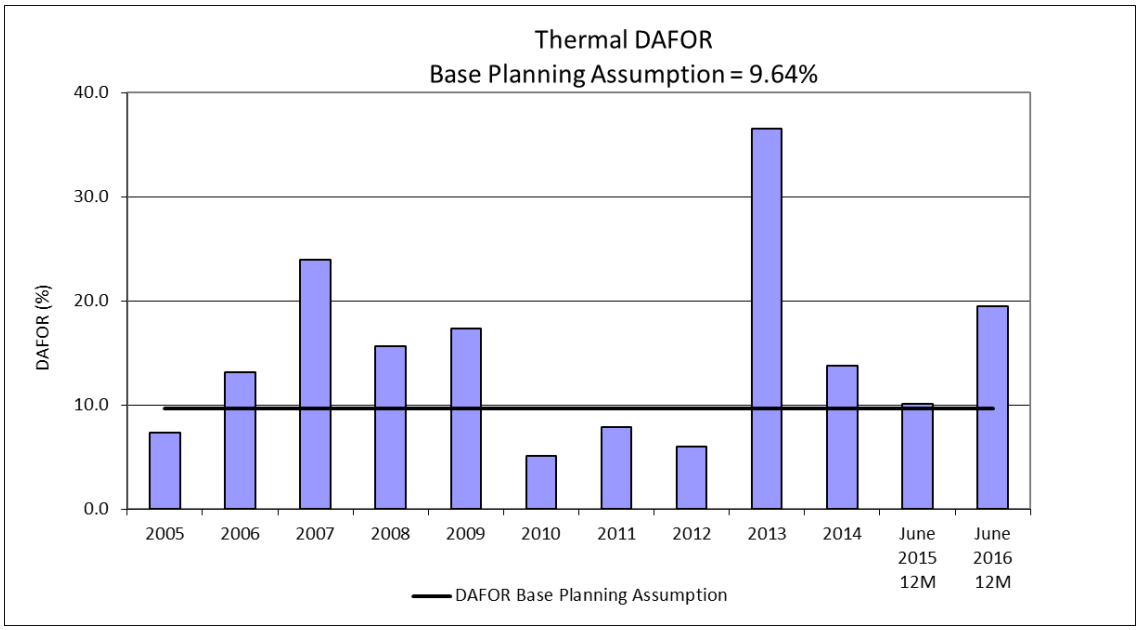
The Bay d'Espoir Unit 5 DAFOR of 3.36% compared to the base planning assumption of 0.9% was the result of a forced outage after the completion of planned annual maintenance. The planned annual maintenance was completed from May 27, 2015 to August 7, 2015. Upon starting the unit, a stator ground fault occurred, which required five days to repair before the unit was placed into service on August 12, 2015.

The Granite Canal unit DAFOR of 1.83% compared to the base planning assumption of 0.9% was the result of a forced outage after a lightning strike to transmission line TL263 which connects the unit to the grid. A bearing issue (low water flow on the shaft seal) was experienced on the restart of the unit. From August 10, 2015 to August 14, 2015, the unit incurred forced unavailability while repairs were completed to resolve this issue. From December 16, 2015 to December 17, 2015, the unit experienced forced unavailability due to debris on the intake trash rack.

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, 2016 are presented as well as the data for the 12-month period ending June 30, 2015. These are compared to Hydro's generation base planning assumption for the forced outage rate.

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending June 2015 (%)	12 months ending June 2016 (%)	Hydro Generation Base Planning Assumption (%)
All Thermal Units - weighted	490	10.06	19.45	9.64
Thermal Units				
Holyrood 1	170	13.20	20.66	9.64
Holyrood 2	170	11.06	26.46	9.64
Holyrood 3	150	5.67	8.91	9.64



For the 12-month period ending June 30, 2016 the weighted DAFOR for all thermal units of 19.45% is above the assumed Hydro generation base planning DAFOR value of 9.64%, and also exceeded the previous 12-month period rate of 10.06%. Unit 1 DAFOR was 20.66% and

Unit 2 DAFOR was 26.46%, and the performance for both units was above the base planning assumption of 9.64%. Unit 3 DAFOR was 8.91%, which is better than the base planning assumption of 9.64%.

The DAFOR performance for Holyrood Unit 1 (170 MW) was affected by several events in the current 12 MTD period.

From May 14, 2015 to August 1, 2015, a derating to 155 MW occurred due to airflow limitations. During the 2015 planned maintenance outage from August to October, the air heaters were found to be heavily fouled. They were cleaned during the outage. It was expected that the air flow problem that led to the load restriction has been resolved as a result of this clearing. Testing of the air flow controls during the maintenance outage did not reveal any problems.

From November 27, 2015 to February 3, 2016 the unit was derated to 155 MW due to airflow limitations, suspected to be related to the new variable frequency drives on the forced draft (FD) fans. This was a continuation of the problems experienced prior to the annual maintenance outage. The air heater fouling that was discovered and corrected during the outage did not solve the problem with air flow. Boiler tuning may be effective in resolving this issue. This is not possible to complete until after the reheater tubes are replaced (see below).

On February 3, 2016 the east FD fan variable frequency drive failed and caused the unit to trip. Investigation by Siemens (the manufacturer of the drives) and plant engineering was conducted. Under a Siemens recommendation, a control card on the drive unit was replaced and the unit was returned to service on February 5, 2016. When the unit was returned to service the load was limited to 140 MW to make the unit more reliable in consideration of the boiler reheater tube failures experienced in Unit 2. Siemens has

been actioned to complete a holistic investigation of all VFD issues that have occurred at Holyrood. This was completed and presented to Hydro on July 7, 2016.

On February 8, 2016 the unit experienced a tube failure in the reheater section of the boiler. The unit was operated with a deration to 50 MW until an opportune time to shut it down for repairs was presented on February 16, 2016. Hydro considered the risk of additional tube failures and the favorable weather forecast at the time and proceeded with the replacement of the lowest wall thickness tubes during this outage. Sixteen lower reheater tubes were replaced at that time. The unit was returned to service on February 26, 2016 with a derating to 120 MW to improve the reliability of the reheater until the remaining lower reheater tubes can be replaced during the upcoming scheduled annual maintenance outage.

The DAFOR performance for Holyrood Unit 2 (170 MW) was primarily affected by several events.

On January 6, 2016 the unit experienced a tube failure in the reheater section of the boiler. Upon discovery of the failure the unit was taken offline in a controlled shutdown and allowed to cool for internal inspection. Four failed tubes in the lower section of the reheater were identified and replaced. The unit was returned to service after the repairs on January 15, 2016. As is common practice when returning the unit to service, a stepped approach to loading the unit was employed. Between January 15 and January 19, the unit was gradually loaded in steps between 70 MW and 140 MW. On January 19, 2016, when operating at 140 MW, the unit experienced another failure in the lower reheater section of the boiler. Again the unit was taken offline in a controlled shutdown. Hydro considered the risk of additional tube failures and the favorable weather forecast at the time and proceeded with the replacement of the lowest wall thickness tubes during this outage. Over the period since the unit first went out of service January 6, 2016, 27 lower and three upper reheat tubes were replaced prior to the unit going back

in service February 3, 2016. The unit was returned to service with a derating to 120 MW to improve the reliability of the reheater until the remaining lower reheater tubes can be replaced during the upcoming scheduled annual maintenance outage.

On May 26, 2016 the west FD fan variable frequency drive failed and caused the unit to trip. Siemens (the manufacturer of the drives) was contacted immediately and a technician was dispatched to travel to site. He did not arrive until late in the day on May 27, 2016. In parallel, the plant Electrical Engineer (in consultation with Siemens), Electricians, and Operations conducted an internal investigation and determined that there were no current faults with the fan and it could be safely started. It was decided to put the unit back on line later in the day on May 26, 2016 while waiting for the Siemens technician. Because the reason for the trip had not been determined, the unit load was restricted to 50 MW (below UFLS).

The Siemens technician performed some on-line diagnostics on May 27, 2016 and May 28, 2016. Overnight on May 28, 2016 the unit was taken offline for a full internal inspection of the drive under direction of the Siemens technician. A control card on the drive unit was replaced and the unit was returned to service the next morning on May 29, 2016. Siemens has been actioned to complete a holistic investigation of all VFD issues that have occurred at Holyrood since the drives were installed. This was completed and presented to Hydro on July 7, 2016.

On June 20, 2016 the annual maintenance outage began on this unit. Included in the scheduled work is the replacement of the lower reheater tubes.

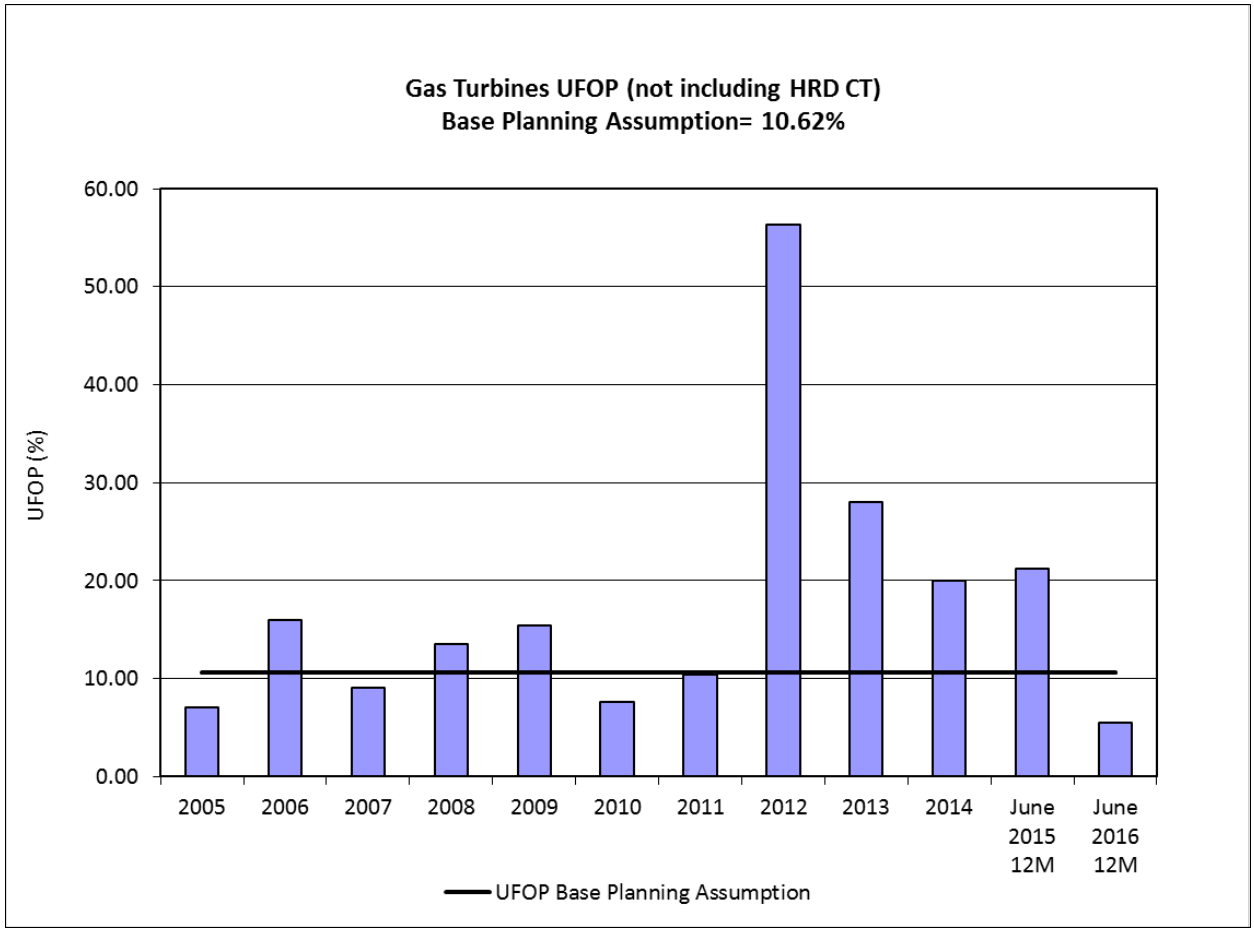
6.0 Gas Turbine UFOP Performance

The combined UFOP for the Hardwoods, Happy Valley and Stephenville gas turbines was 5.54% for the 12-month period ending June 30, 2016. This is better than the base planning assumption of 10.62%. The current period UFOP improved from the previous period UFOP of 21.19%. The Hardwoods UFOP for the current period is 1.84%, which is better than the base planning assumption of 10.62%. The Stephenville unit's current period UFOP is 3.59% compared to that of the previous period of 16.40%. Happy Valley's UFOP is 14.04% for the current period compared to 1.03% in the previous period.

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending June 2015 (%)	12 months ending June 2016 (%)	Hydro Generation Base Planning Assumption (%)
Combined Gas Turbines	125	21.19	5.54	10.62
Stephenville	50	16.40	3.59	10.62
Hardwoods	50	32.44	1.84	10.62
Happy Valley	25	1.03	14.04	10.62

The Holyrood (HRD) CT UFOP of 2.53% for the current period is better than the base planning assumption of 5.00%.

Combustion Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending June 2015 (%)	12 months ending June 2016 (%)	Hydro Generation Base Planning Assumption (%)
Holyrood CT	123.5	1.56	2.53	5.00



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

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October 14, 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

Tracey L. Pennell
Senior Counsel, Regulatory

TLP/bs

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 SEPTEMBER 30, 2016

NEWFOUNDLAND AND LABRADOR HYDRO

OCTOBER 14, 2016

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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 as well as in relation to assumptions used in Loss of Load Hours (LOLH) calculations for system planning purposes.

The forced outage rates are provided for individual generating units at hydraulic facilities; the three units at the Holyrood Thermal Generating Station (HTGS) and Hydro's gas turbines for the current 12-month reporting period of October 1, 2015 to September 30, 2016. The report also provides, for comparison purposes, the individual generating unit data on forced outage rates for the previous period October 1, 2014 to September 30, 2015. Further, total asset class data is presented on an annual basis for years the 2005-2014. This report provides data on outage rates for forced outages, not planned outages.

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

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

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

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

2.0 Period Ending September 30, 2016 Overview

Class of Units	October 1, 2014 to September 30, 2015 (%)	October 1, 2015 to September 30, 2016 (%)	Base Planning Assumption (%)
Hydraulic (DAFOR)	2.82	2.02	0.90
Thermal (DAFOR)	9.86	19.72	9.64
Gas Turbine (Combined) (UFOP)	15.89	5.54	10.62
Gas Turbine (Holyrood) (UFOP)	5.01[1]	1.33	5.00

The hydraulic DAFOR and the combined[2] gas turbine UFOP performance (in table above) show improvement for the current period, the 12-month period ending September 2016 compared to the previous period, the 12-month period ending September 2015. There was a decline in Thermal DAFOR performance for the current period compared to the previous period.

[1] Only includes data from March 1, 2015 to September 30, 2015

[2] 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.

In the 10 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 10 years is higher, primarily due to penstock issues experienced on Units 1 and 2 at Bay d'Espoir.

The thermal units, in the 10 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 September 2016 is 19.72% which is above the base planning assumption of 9.64%, and the sensitivity of 11.64%. This is primarily caused by an airflow derating on Unit 1 and boiler tube failures on Units 1 and 2.

Hydro's combined gas turbines' UFOP in the 10 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 September 30, 2016, performance was mainly affected by forced outages to the Stephenville unit. Performance data for the Holyrood CT for the 12-month period ending September 2015 includes seven months of data where the 12-month period ending September 2016 includes a full year of data.

Note that the data in the charts for 2005 to 2014 are annual numbers (January 1 to December 31), while the data for September 2015 and September 2016 are 12-month rolling (October 1 to September 30 for each period).

3.0 Generation Planning Assumptions

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

[3] Hydro is currently completing a risk assessment on thermal generation supply for the period up to interconnection with Labrador and Nova Scotia. As part of this risk assessment, Hydro is reviewing the recent availability results. The outcome of this review may reflect a new base planning assumption for various generation sources.

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 September 30, 2016, 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. As part of the ongoing risk review considering energy supply up to Lower Churchill interconnection, Hydro is considering several years of data of DAFOR and UFOP and the resulting implication for meeting reliability criteria.

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

Hydro's generation planning assumptions for DAFOR and UFOP for the year 2016 are:

	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]

4.0 Hydraulic Unit Forced Outage Rate Performance

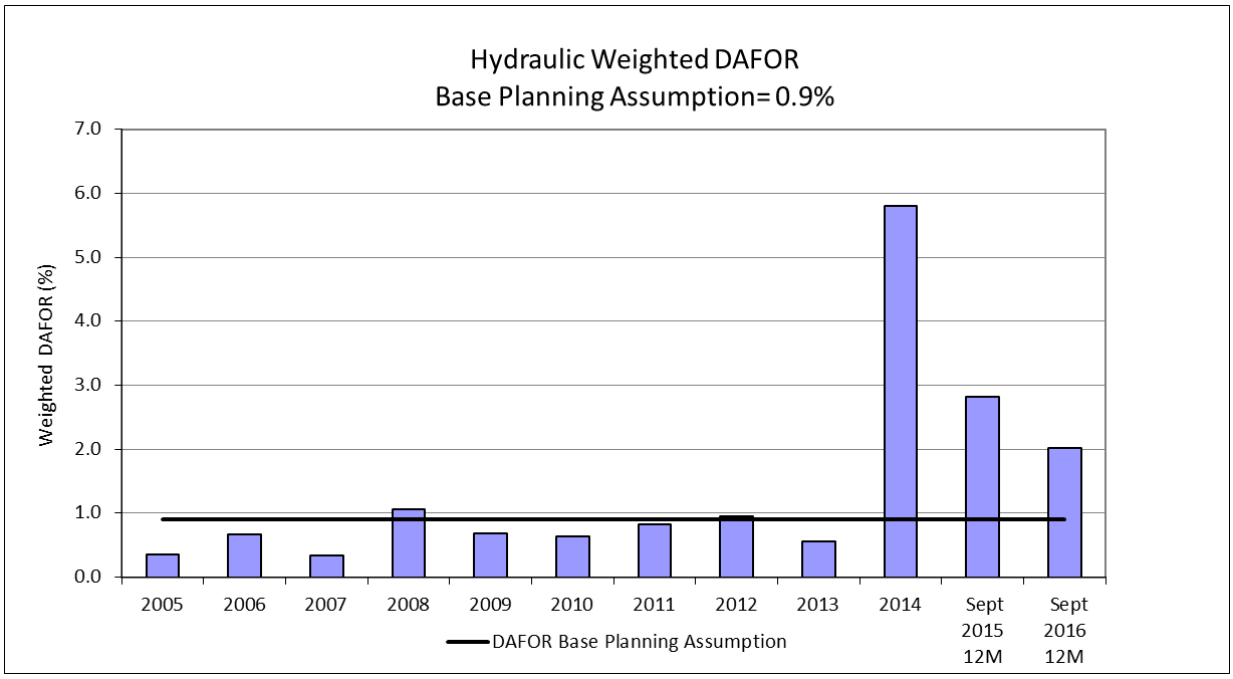
The hydraulic unit forced outage rates are measured using the CEA metric, DAFOR. Detailed results for the 12-month period ending September 30, 2016 are presented as well as the

[4] 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)*

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

data for the 12-month period ending September 30, 2015. These are compared to Hydro's generation planning assumption for the forced outage rate.

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending September 2015 (%)	12 months ending September 2016 (%)	Hydro Generation Base Planning Assumption (%)
All Hydraulic Units - weighted	954.4	2.82	2.02	0.90
Hydraulic Units				
Bay D'Espoir 1	76.5	25.64	10.57	0.90
Bay D'Espoir 2	76.5	0.00	13.52	0.90
Bay D'Espoir 3	76.5	0.00	0.00	0.90
Bay D'Espoir 4	76.5	0.23	1.33	0.90
Bay D'Espoir 5	76.5	2.46	0.63	0.90
Bay D'Espoir 6	76.5	0.00	0.18	0.90
Bay D'Espoir 7	154.4	0.00	0.00	0.90
Hinds Lake	75	0.32	0.06	0.90
Upper Salmon	84	0.98	0.00	0.90
Granite Canal	40	1.51	1.72	0.90
Cat Arm 1	67	0.63	0.13	0.90
Cat Arm 2	67	1.42	0.00	0.90
Paradise River	8	0.19	5.16	0.90



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 4, Granite Canal, and Paradise River for the current period.

The Bay d'Espoir Unit 1 DAFOR of 10.57% and Unit 2 DAFOR of 13.53%, compared to the base planning assumption of 0.9% were impacted by the units being removed from service on two separate occasions as a result of a leak in Penstock 1, which provides water to both Units 1 and 2. The first event occurred on May 21, 2016. A consultant was engaged to conduct an investigation into the issue, which contributed the leak to a localized issue caused by an improper weld. A repair procedure was provided on June 2, 2016, with repairs carried out and completed on June 3, 2016. Unit 1 was returned to service on June 3, 2016, at 1938 hours and Unit 2 returned to service a short time later at 2014 hours.

The second leak in Penstock 1 occurred on September 14, 2016. Considering this leak was similar to the first and located in the same area, a consultant was engaged to conduct a thorough investigation of the welds throughout the penstock, which included cutting a sample coupon, from the penstock wall, for testing. This investigation is ongoing, but actions are now underway to refurbish the welds along the upper section of the penstock between the Intake and Surge Tank. All efforts are being put in place to complete this work in advance of December 1, 2016 and at this time, Hydro has no indication this timeline is at risk. Hydro is committed to keeping the Board informed on the status of this effort.

The Bay d'Espoir Unit 4 DAFOR of 1.33% compared to the base planning assumption of 0.9% was the result of two forced outages. The unit experienced a starting failure on September 20 from 0545 hrs to 1316 hrs, which was related to generator power transformer. A new protection system had been installed on this transformer as part of the capital program, which required that the time settings be increased. A forced outage from September 22 at 0949 hrs to September 23 at 0843 hours, related to an issue with the Governor Permanent Magnetic Generator (PMG). One of the drive pins was broken and another was bent, which

caused erratic speed signals to the governor. The drive pins were replaced and the PMG was function tested, before being reinstalled and the unit returned to service.

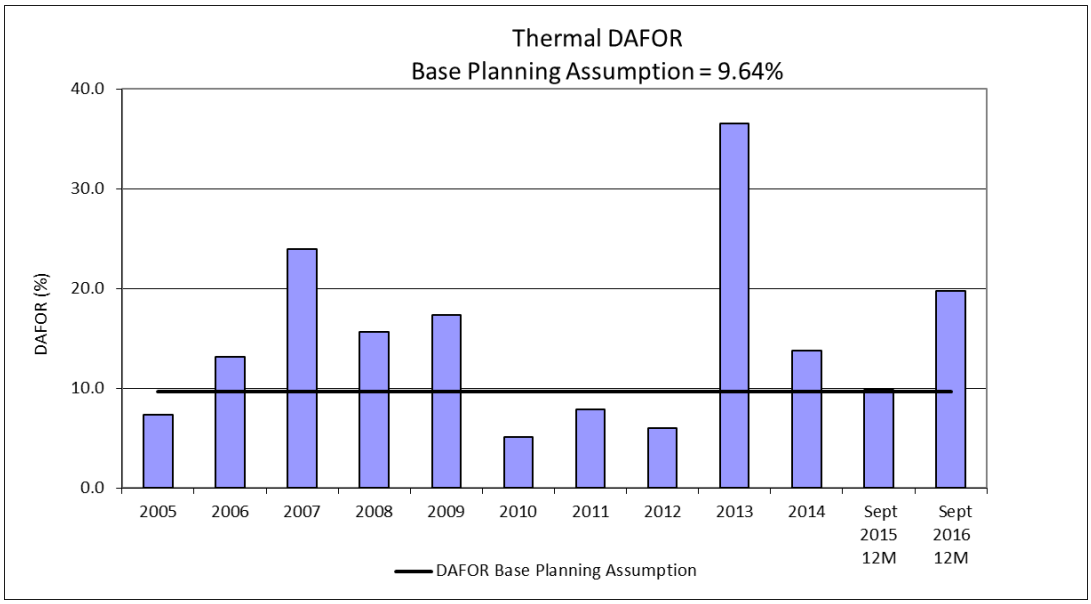
The Granite Canal Unit DAFOR of 1.72% compared to the base planning assumption of 0.9% was the result of the unit being unavailable from December 16, 2015 to December 17, 2015, due to frazil ice accumulation on the intake trash rack.

The Paradise River unit DAFOR of 5.16% compared to the base planning assumption of 0.9% was the result of a forced outage. A forced outage was experienced on September 23 from 0031 hrs to September 30 at 1805 hrs, which related to a governor low oil level alarm. This alarm was caused when a seal broke on one of the Governor servos, releasing oil from the governor oil sump into the powerhouse sump system. A new seal was installed and oil added to the governor system. There have been repeated trips of this plant over the past number of months. Hydro has investigated these trips and has determined that a number of trips that cannot be found to be associated with a plant issue, and may be connected to a distribution system issue. The plant is connected into the local distribution system, which is the original design and is not typical for a generating facility. This structural set up exposes the plant to disturbances on the distribution system potentially causing plant trips. To better understand if the distribution system is causing plant trips, a recloser in the nearby substation is being replaced with a modern recloser that will better capture system information. This information will assist in troubleshooting distribution issues and hopefully, reduce plant trips.

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 September 30, 2016 are presented as well as the data for the 12-month period ending September 30, 2015. These are compared to Hydro's generation base planning assumption for the forced outage rate.

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending September 2015 (%)	12 months ending September 2016 (%)	Hydro Generation Base Planning Assumption (%)
All Thermal Units - weighted	490	9.86	19.72	9.64
Thermal Units				
Holyrood 1	170	12.22	25.46	9.64
Holyrood 2	170	7.15	25.64	9.64
Holyrood 3	150	10.08	2.86	9.64



For the 12-month period ending September 30, 2016, the weighted DAFOR for all thermal units, of 19.72% is above the assumed Hydro generation base planning DAFOR value of 9.64%, and also exceeded the previous 12-month period rate of 9.86%. Unit 1 DAFOR was 25.46% and Unit 2 DAFOR was 25.64%, and the performance for both units was above the base planning assumption of 9.64%. Unit 3 DAFOR was 2.86%, which is significantly better than the base planning assumption of 9.64%.

The DAFOR performance for Holyrood Unit 1 (170 MW) was affected by several events in the current 12 MTD period.

From November 27, 2015 to February 3, 2016 the unit was derated to 155 MW due to airflow limitations. This was a continuation of the problems experienced prior to the 2015 annual maintenance outage. During the 2015 annual outage the boiler components were internally inspected in an attempt to diagnose and resolve the airflow limitations. Significant air heater fouling was discovered and corrected during that outage. It was thought that the problem had been resolved, however airflow limitations continued once the unit was put back on line after the annual outage. Boiler tuning would have been the next step in resolving this issue. Tuning requires the unit to be operated through a range of high and low loads while control parameters are manipulated. The reheater tube failures in February 2013 and subsequent unit derating (see below) occurred before the tuning could be completed, removing the opportunity. Tuning is currently planned for November 2016, after the annual maintenance outage is completed and when higher unit loads can be reached without significantly increasing risk to electrical system stability in the event of a unit trip.

On February 3, 2016 the east FD fan variable frequency drive failed and caused the unit to trip. Investigation by Siemens (the manufacturer of the drives) and plant engineering was conducted. Under a Siemens recommendation, a control card on the drive unit was replaced and the unit was returned to service on February 5, 2016. When the unit was returned to service the load was limited to 140 MW to make the unit more reliable in consideration of the boiler reheater tube failures experienced in Unit 2. Hydro engaged Siemens to review the VFD reliability. Siemens completed a review and provided a set of recommendations which have been implemented by Hydro.

On February 8, 2016 the unit experienced a tube failure in the reheater section of the boiler. The unit was operated with a deration to 50 MW until an opportune time to shut it down for repairs on February 16, 2016. Hydro considered the risk of additional tube failures and the favorable weather forecast at the time and proceeded with the replacement of the lowest wall thickness tubes during this outage. Sixteen lower

reheater tubes were replaced at that time. The unit was returned to service on February 26, 2016 with a derating to 120 MW to improve the reliability of the reheater until the remaining lower reheater tubes can be replaced during the upcoming scheduled annual maintenance outage.

On July 15, the unit was removed from service to repair a feedwater isolator gland failure, and to perform a wash of the air heaters and to repair cracks in the FD fan ductwork. The unit was returned to service after approximately 35 hours of outage time.

On August 27, 2016 the unit was taken off line in preparation for the annual maintenance outage. The work scope includes replacement of the lower reheater tubes. The boiler gas path work scope includes internal visual inspection and repairs, replacement of degraded steam coil air heaters, and ash removal from the economizer, air heaters, and stack breaching, as well as verifying proper function of the forced draft fans and their variable frequency drives. The unit is scheduled back in service by November 1, 2016. Boiler tuning is planned for November when electrical system conditions permit.

The DAFOR performance for Holyrood Unit 2 (170 MW) was primarily affected by several events.

On January 6, 2016 the unit experienced a tube failure in the reheater section of the boiler. Upon discovery of the failure the unit was taken offline in a controlled shutdown and allowed to cool for internal inspection. Four failed tubes in the lower section of the reheater were identified and replaced. The unit was returned to service on January 15, 2016. As is common practice when returning the unit to service, a stepped approach to loading the unit was employed. Between January 15 and January 19, the unit was gradually loaded in steps between 70 MW and 140 MW. On January 19, 2016, when operating at 140 MW, the unit experienced another failure in the lower reheater section of the boiler. Again the unit was taken offline in

a controlled shutdown. Hydro considered the risk of additional tube failures and the favorable weather forecast at the time and proceeded with the replacement of the lowest wall thickness tubes during this outage. Over the period since the unit first went out of service January 6, 2016, 27 lower and three upper reheat tubes were replaced prior to the unit going back in service February 3, 2016. The unit was returned to service with a derating to 120 MW to improve the reliability of the reheater until the remaining lower reheater tubes were replaced during the scheduled annual maintenance outage.

On May 26, 2016 the west FD fan variable frequency drive failed and caused the unit to trip. Siemens (the manufacturer of the drives) was contacted immediately and a technician was dispatched to travel to site. In parallel, the plant Electrical Engineer (in consultation with Siemens), Electricians, and Operations conducted an internal investigation and determined that there were no current faults with the fan and it could be safely started. It was decided to put the unit back on line later in the day on May 26, 2016 while waiting for the Siemens technician. Because the reason for the trip had not been determined, the unit load was restricted to 50 MW (below UFLS).

The Siemens technician performed on-line diagnostics on May 27, 2016 and May 28, 2016. Overnight on May 28, 2016 the unit was taken offline for a full internal inspection of the drive under direction of the Siemens technician. A control card on the drive unit was replaced and the unit was returned to service the next morning on May 29, 2016. Hydro engaged Siemens to review the VFD reliability. Siemens completed a review and provided a set of recommendations which have been implemented by Hydro.

On June 20, 2016 the annual maintenance outage began on this unit. Included in the scheduled work was the replacement of the lower reheater tubes. The unit was returned to service on September 15, 2016. The unit was derated to 130 MW until

September 20 and to 150 MW until September 29 until on-line testing of the safety valves could be completed.

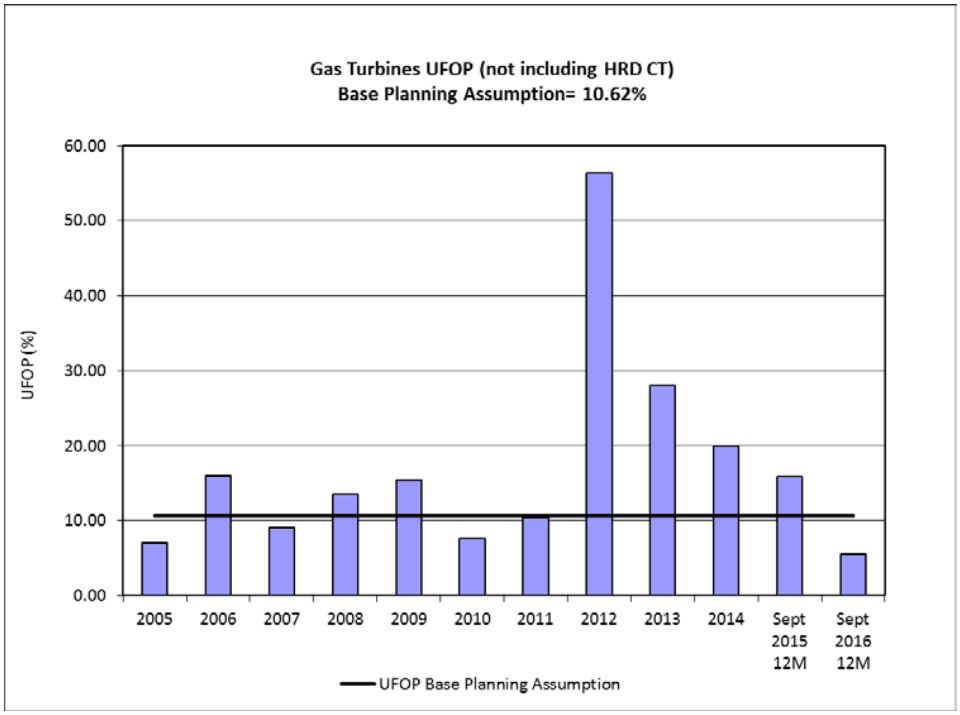
6.0 Gas Turbine UFOP Performance

The combined UFOP for the Hardwoods, Happy Valley and Stephenville gas turbines was 5.54% for the 12-month period ending September 30, 2016. This is better than the base planning assumption of 10.62%. The current period UFOP improved from the previous period UFOP of 15.89%. The Hardwoods UFOP for the current period is 2.16%, which is better than the base planning assumption of 10.62%. The Stephenville unit's current period UFOP is 12.03% compared to that of the previous period of 17.75%. Happy Valley's UFOP is 5.59% for the current period compared to 13.77% in the previous period.

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending September 2015 (%)	12 months ending September 2016 (%)	Hydro Generation Base Planning Assumption (%)
Combined Gas Turbines	125	15.89	5.54	10.62
Stephenville	50	17.75	12.03	10.62
Hardwoods	50	16.14	2.16	10.62
Happy Valley	25	13.77	5.59	10.62

The Holyrood (HRD) CT UFOP of 1.33% for the current period is better than the base planning assumption of 5.00%.

Combustion Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending September 2015 (%)	12 months ending September 2016 (%)	Hydro Generation Base Planning Assumption (%)
Holyrood CT	123.5	5.01	1.33	5.00



The Stephenville unit UFOP was primarily affected by the following events in the reporting period.

The UFOP for the Stephenville gas turbine was impacted by a forced outage from August 2 to August 5, 2016 due to a lube oil leak in the alternator module. The source of the leak was determined and the repair completed. The area was cleaned of oil and the unit returned to service.

There was another forced outage in August, from August 9 to August 19, 2016. This outage was due to the presence of debris on the metallic chip detectors during a routine inspection. A review of unit operation was completed in consultation with the overhaul facility, and the unit was returned to service with continued monitoring. No further issues have been found to date. The debris was analyzed and found to be minor very fine particles and not a cause of concern. The lubricating oil was analyzed and found to be in satisfactory condition for continued operation.

A REPORT TO

THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

QUARTERLY REPORT

ON

PERFORMANCE OF GENERATING UNITS

FOR THE QUARTER ENDED DECEMBER 31, 2016

NEWFOUNDLAND AND LABRADOR HYDRO

January 16, 2017

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 as well as in relation to assumptions used in Loss of Load Hours (LOLH) calculations for system planning purposes.

The forced outage rates are provided for individual generating units at hydraulic facilities; the three units at the Holyrood Thermal Generating Station (HTGS) and Hydro's gas turbines for the current 12-month reporting period of January 1, 2016 to December 31, 2016. The report also provides, for comparison purposes, the individual generating unit data on forced outage rates for the previous period January 1, 2015 to December 31, 2015. Further, total asset class data is presented on an annual basis for years the 2005-2014. This report provides data on outage rates for forced outages, not planned outages.

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

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

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

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

2.0 PERIOD ENDING DECEMBER 31, 2016 OVERVIEW

Class of Units	January 1, 2015 to December 31, 2015 (%)	January 1, 2016 to December 31, 2016 (%)	Base Planning Assumption (%)
Hydraulic (DAFOR)	2.66	5.51	0.90
Thermal (DAFOR)	5.04	19.42	9.64
Gas Turbine (Combined) (UFOP)	12.94	9.35	10.62
Gas Turbine (Holyrood) (UFOP)	3.06[1]	1.65	5.00

The combined[2] gas turbine UFOP performance (in table above) shows improvement for the current period, the 12-month period ending December 2016 compared to the previous period, the 12-month period ending December 2015. There was a decline in Hydraulic and Thermal DAFOR performance for the current period compared to the previous period.

In the 10 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 10 years is higher, primarily due to penstock issues experienced on Units 1 and 2 at Bay d'Espoir.

The thermal units, in the 10 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 2016 is 19.42% which is above the base planning assumption of 9.64%, and the sensitivity of 11.64%. This is primarily caused by an airflow derating on Unit 1 and boiler tube failures on Units 1 and 2.

[1] Only includes data from March 1, 2015 to December 31, 2015
[2] 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.

Hydro's combined gas turbines' UFOP in the 10 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, 2016, performance was mainly affected by forced outages to the Stephenville unit. Performance data for the Holyrood CT for the 12-month period ending December 2015 includes nine months of data where the 12-month period ending December 2016 includes a full year of data.

Note that the data in the charts for 2005 to 2014 are annual numbers (January 1 to December 31), and the data for December 2015 and December 2016 are 12-month rolling (January 1 to December 31 for this period).

3.0 GENERATION PLANNING ASSUMPTIONS

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

Hydro also provides a sensitivity number for DAFOR and UFOP as part of its generation planning analysis. This number takes into account a higher level of unavailability, should it occur, to assess the impact of higher unavailability of these units on overall generation requirements. During the 12-month period ending December 31, 2016, 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. As part of the ongoing risk review considering energy supply up to Lower Churchill interconnection, Hydro is considering several years of data of DAFOR and UFOP and the resulting implication for meeting reliability criteria.

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

Hydro's generation planning assumptions for DAFOR and UFOP for the year 2016 are:

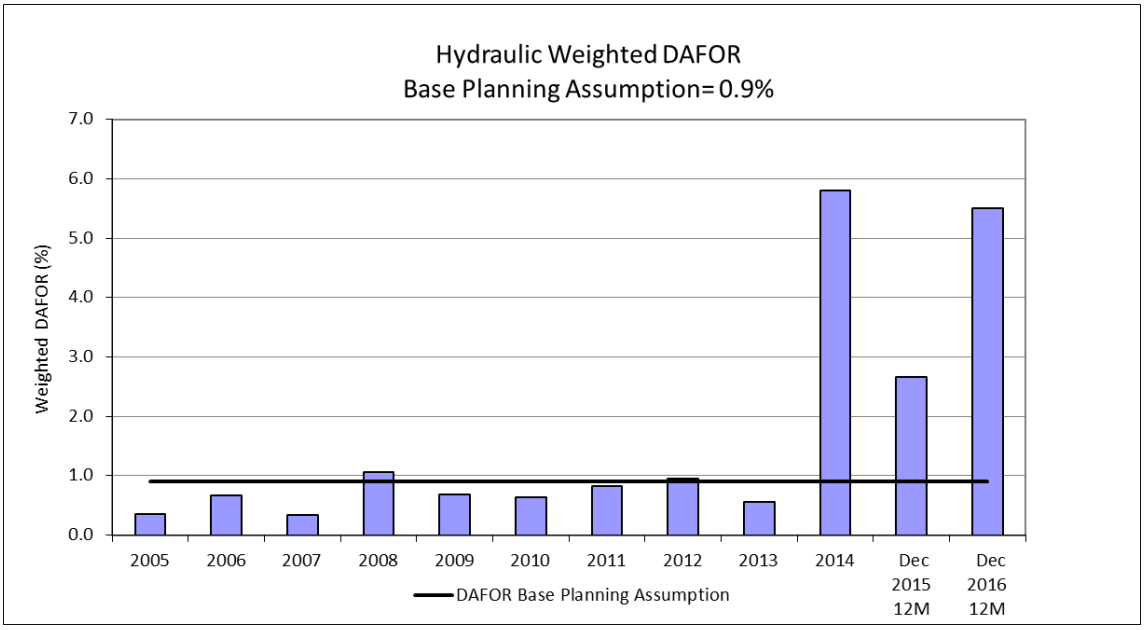
	DAFOR (%)		UFOP (%)	
	Base Planning Assumption	**Sensitivity**	**Base Planning Assumption**	**Sensitivity**
Hydraulic Units	0.90	0.90		
Thermal Units	9.64	11.64		
Gas Turbines - Existing			10.62	20.62
Gas Turbines - New			5.0	10.0[5]

[3] Hydro has completed a risk assessment on thermal generation supply for the period up to interconnection with Labrador and Nova Scotia. As part of this risk assessment, Hydro reviewed the recent availability results, no final decision has been made on new base planning assumption for various generation sources.
[4] 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)*
[5] In previous reports this sensitivity value was reported as 5.0%. The generation planning sensitivity for the Holyrood CT was updated to 10 % in the September 2015 Q3 report for system planning purposes.

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 December 31, 2016 are presented as well as the data for the 12-month period ending December 31, 2015. These are compared to Hydro's generation planning assumption for the forced outage rate.

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending December 2015 (%)	12 months ending December 2016 (%)	Hydro Generation Base Planning Assumption (%)
All Hydraulic Units - weighted	954.4	2.66	5.51	0.90
Hydraulic Units				
Bay D'Espoir 1	76.5	25.35	30.87	0.90
Bay D'Espoir 2	76.5	0.06	33.90	0.90
Bay D'Espoir 3	76.5	0.00	0.00	0.90
Bay D'Espoir 4	76.5	0.28	0.93	0.90
Bay D'Espoir 5	76.5	2.54	0.56	0.90
Bay D'Espoir 6	76.5	0.00	0.18	0.90
Bay D'Espoir 7	154.4	0.00	0.00	0.90
Hinds Lake	75	0.16	0.24	0.90
Upper Salmon	84	0.00	0.06	0.90
Granite Canal	40	1.88	1.36	0.90
Cat Arm 1	67	0.01	1.02	0.90
Cat Arm 2	67	1.41	0.00	0.90
Paradise River	8	0.24	7.08	0.90



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 Granite Canal, Cat Arm Unit 1 and Paradise River for the current period.

The Bay d'Espoir Unit 1 DAFOR of 30.87% and Unit 2 DAFOR of 33.90%, compared to the base planning assumption of 0.9% were impacted by the units being removed from service on two separate occasions as a result of a leak in Penstock 1, which provides water to both Units 1 and 2. The first event occurred on May 21, 2016. A consultant was engaged to conduct an investigation into the issue, which contributed the leak to a localized issue caused by, what was suspected to be, a defect at the weld. A repair procedure was provided on June 2, 2016, with repairs carried out and completed on June 3, 2016. Unit 1 was returned to service on June 3, 2016, at 1938 hours and Unit 2 returned to service a short time later at 2014 hours.

The second leak in Penstock 1 occurred on September 14, 2016. Considering this leak was similar to the first and located in the same area, a consultant was engaged to conduct a thorough investigation of the welds throughout the penstock, which included cutting sample sections from the penstock wall, for testing. This investigation is ongoing, but action was taken to refurbish the welds along the

upper section of the penstock between the Intake and Surge Tank. Both units were returned to service on November 30, 2016.

The Granite Canal Unit DAFOR of 1.36% compared to the base planning assumption of 0.9% was the result of the unit being unavailable from July 19, 2016 to July 22, 2016, due to water in the generator bearing oil. An investigation revealed that the generator bearing oil cooler experienced a leak, which resulted in water getting into the bearing oil. The damaged cooler was replaced with a new cooler and the unit returned to service.

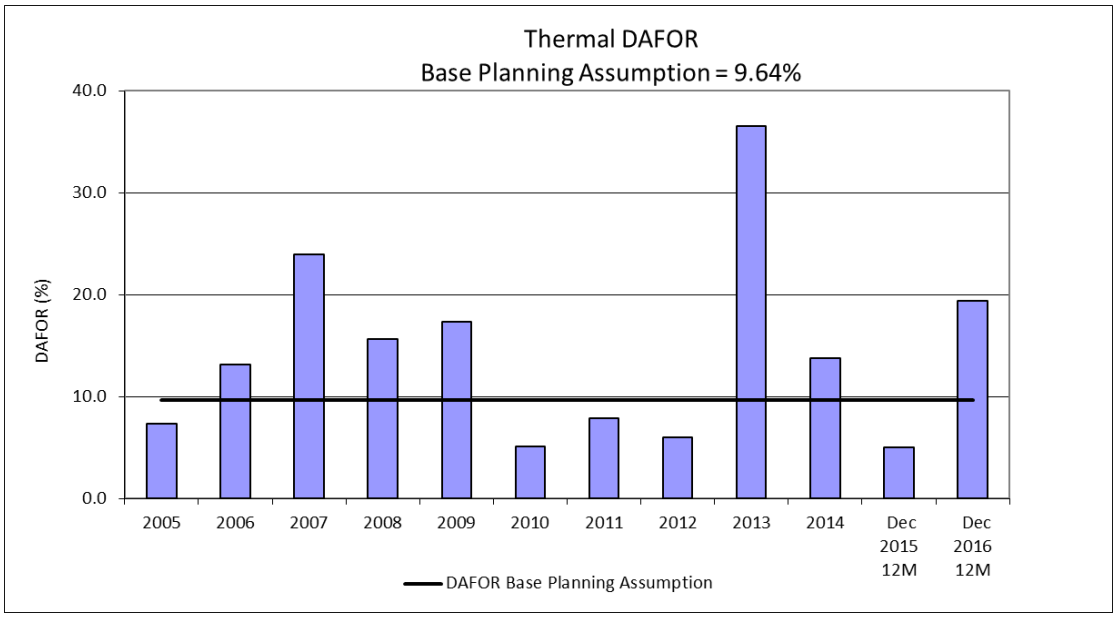
The Cat Arm Unit 1 DAFOR of 1.02% compared to the base planning assumption of 0.9% was the result of the unit being unavailable from November 23, 2016 to November 25, 2016, due to a governor oil pump trip. An investigation into the issue revealed that the internal seals in the pump had failed, preventing the pump from maintaining the governor oil pressure. The oil system was completely cleaned, flushed and replaced with new oil. A new oil pump was installed and the unit returned to service.

The Paradise River unit DAFOR of 7.08% compared to the base planning assumption of 0.9% was the result of a forced outage. A forced outage was experienced on September 23 from 0031 hrs to September 30 at 1805 hrs, which related to a governor low oil level alarm. This alarm was caused when a seal broke on one of the Governor servos, releasing oil from the governor oil sump into the powerhouse sump system. A new seal was installed and oil added to the governor system. There was another trip due to governor low pressure on October 23, 2016 to October 27, 2016. There have been repeated trips of this plant over the past number of months that had no obvious cause. Hydro investigated these trips and determined that it was most likely not a plant related issue, and likely due to distribution system disturbances. In consultation with Newfoundland Power regarding their equipment at the nearby Monkstown Substation, they agreed to replace the recloser with one having the capability to capture system information and assist in troubleshooting distribution issues. Since the recloser has been replaced there have been no associated cause-undetermined trips.

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 December 31, 2016 are presented as well as the data for the 12-month period ending December 31, 2015. These are compared to Hydro's generation base planning assumption for the forced outage rate.

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending December 2015 (%)	12 months ending December 2016 (%)	Hydro Generation Base Planning Assumption (%)
All Thermal Units - weighted	490	5.04	19.42	9.64
Thermal Units				
Holyrood 1	170	4.94	24.55	9.64
Holyrood 2	170	1.89	26.69	9.64
Holyrood 3	150	9.37	2.41	9.64



For the 12-month period ending December 31, 2016, the weighted DAFOR for all thermal units, of 19.42% is above the assumed Hydro generation base planning DAFOR value of 9.64%, and also exceeded the previous 12-month period rate of 5.04%. Unit 1 DAFOR was 24.55% and Unit 2 DAFOR was 26.69%, and the performance for both units was above the base planning assumption of 9.64%. Unit 3 DAFOR was 2.41%, which is better than the base planning assumption of 9.64%. It is estimated that approximately half of the 19.42% DAFOR for the plant in 2016 is due to deratings and complications from the boiler tubes.

The DAFOR performance for Holyrood Unit 1 (170 MW) was affected by several events in the current 12 MTD period.

From November 27, 2015 to February 3, 2016, the unit was derated to 155 MW due to airflow limitations. This was a continuation of the problems experienced prior to the 2015 annual maintenance outage. During the 2015 annual outage the boiler components were internally inspected in an attempt to diagnose and resolve the airflow limitations. Significant air heater fouling was discovered and corrected during that outage. It was thought that the problem had been resolved, however airflow limitations continued once the unit was put back on line after the annual outage. Boiler tuning would have been the next step in resolving this issue. Tuning requires the unit to be operated through a range of high and low loads while control parameters are manipulated. The reheater tube failures in February 2013 and subsequent unit derating (see below) occurred before the tuning could be completed, removing the opportunity.

On February 3, 2016, the east forced draft fan variable frequency drive failed and caused the unit to trip. Investigation by Siemens (the manufacturer of the drives) and plant engineering was conducted. Under a Siemens recommendation, a control card on the drive unit was replaced and the unit was returned to service on February 5, 2016. When the unit was returned to service the load was limited to 140 MW to make the unit more reliable in consideration of the boiler reheater tube failures experienced in Unit 2. Hydro engaged Siemens to review the VFD reliability. Siemens completed a review and provided a set of recommendations which have been implemented by Hydro.

On February 8, 2016, the unit experienced a tube failure in the reheater section of the boiler. The unit was operated with a deration to 50 MW until an opportune time to shut it down for planned tube replacements on February 16, 2016. Hydro considered the risk of additional tube failures and the favorable weather forecast at the time and proceeded with the replacement of the lowest wall thickness tubes only during this maintenance outage. Sixteen lower reheater tubes were replaced at that time. The unit was returned to service on February 26, 2016 with a derating to 120 MW to maintain the reliability of the reheater until the remaining lower reheater tubes can be replaced during the upcoming scheduled annual maintenance outage.

On July 15, 2016, the unit was removed from service to repair a feedwater isolator gland failure, and to perform a wash of the air heaters and to repair cracks in the FD fan ductwork. The unit was returned to service after approximately 35 hours of outage time.

On August 27, 2016, the unit was taken off line in preparation for the annual maintenance outage. The work scope included replacement of the lower reheater tubes. The boiler gas path work scope included internal visual inspection and repairs, replacement of degraded steam coil air heaters, and ash removal from the economizer, air heaters, and stack breaching, as well as verifying proper function of the forced draft fans and their variable frequency drives.

During return to service from annual maintenance on October 29, 2016, a Mark V governor control card failed, causing a forced outage. The failed card was replaced and the unit was synchronized on November 2, 2016.

When the unit was first returned to service it remained derated due to air flow issues. As planned, combustion tuning was completed during the week of November 14, 2016 to diagnose the air flow issues on this unit. Tuning was completed by an expert from Foxboro (supplier of the distributed control system) with assistance from a boiler field expert from B&W. They determined that the air flow issues that Hydro is experiencing are due to fouling through various stages of the boiler, and air heater leakage. After an air heater wash, 160 MW was achieved. Further improvements require an outage to fully correct and this is being

planned for TH 2017 annual maintenance outage. Work will include boiler cleaning and air heater upgrades. Full load capability is expected upon completion of this work.

The DAFOR performance for Holyrood Unit 2 (170 MW) was primarily affected by several events.

On January 6, 2016, the unit experienced a tube failure in the reheater section of the boiler. Upon discovery of the failure the unit was taken offline in a controlled shutdown and allowed to cool for internal inspection. Four failed tubes in the lower section of the reheater were identified and replaced. The unit was returned to service on January 15, 2016. As is common practice when returning the unit to service, a stepped approach to loading the unit was employed. Between January 15, 2016 and January 19, 2016 the unit was gradually loaded in steps between 70 MW and 140 MW. On January 19, 2016, when operating at 140 MW, the unit experienced another failure in the lower reheater section of the boiler. Again the unit was taken offline in a controlled shutdown. Hydro considered the risk of additional tube failures and the favorable weather forecast at the time and proceeded with the replacement of the lowest wall thickness tubes during this outage. Over the period since the unit first went out of service January 6, 2016, 27 lower and three upper reheat tubes were replaced prior to the unit going back in service February 3, 2016. The unit was returned to service with a derating to 120 MW to improve the reliability of the reheater until the remaining lower reheater tubes were replaced during the scheduled annual maintenance outage.

On May 26, 2016, the west FD fan variable frequency drive failed and caused the unit to trip. Siemens (the manufacturer of the drives) was contacted immediately and a technician was dispatched to travel to site. In parallel, the plant Electrical Engineer (in consultation with Siemens), Electricians, and Operations conducted an internal investigation and determined that there were no current faults with the fan and it could be safely started. It was decided to put the unit back on line later in the day on May 26, 2016 while waiting for the Siemens technician. Because the reason for the trip had not been determined, the unit load was restricted to 50 MW (below UFLS).

The Siemens technician performed on-line diagnostics on May 27, 2016 and May 28, 2016.

Overnight on May 28, 2016, the unit was taken offline for a full internal inspection of the drive under direction of the Siemens technician. A control card on the drive unit was replaced and the unit was returned to service the next morning on May 29, 2016. Hydro engaged Siemens to review the VFD reliability. Siemens completed a review and provided a set of recommendations which have been implemented by Hydro.

The unit was returned to service on September 15, 2016, after its annual maintenance. The unit was derated to 130 MW until September 20, 2016 and to 150 MW until September 29, 2016 until on-line testing of the safety valves could be completed.

On November 6, 2016, the main steam inlet flange to the upper control valves was found leaking and the unit was derated to 70 MW until it was removed from service for gasket replacement on November 8, 2016. The unit was returned to service on November 10, 2016 but had to be taken off-line for another failure of the same gasket on November 16, 2016. This time the gasket was changed and a contractor was hired to provide a supplementary seal of the gasket. The unit was returned to service on November 21, 2016. This problematic joint is expected to be reliable for the remainder of the season and will be replaced during the planned outage in 2017.

On November 18, 2016, when attempting to go back on line after repair of the November 16 inlet flange leak, there was an issue discovered with turbine speed indication. After trouble shooting, it was determined that the speed probes had to be repositioned. The unit was returned to service on November 21, 2016.

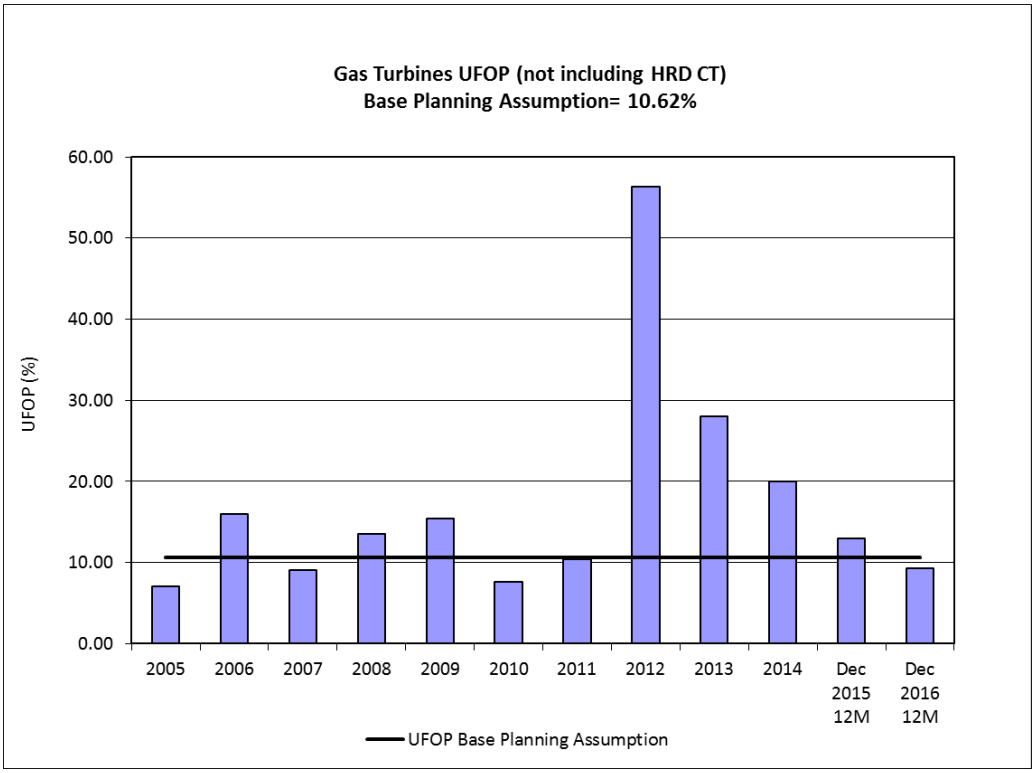
6.0 GAS TURBINE UFOP PERFORMANCE

The combined UFOP for the Hardwoods, Happy Valley and Stephenville gas turbines was 9.35% for the 12-month period ending December 31, 2016. This is better than the base planning assumption of 10.62%. The current period UFOP improved from the previous period UFOP of 12.94%. The Hardwoods UFOP for the current period is 7.83%, which is better than the base planning assumption of 10.62%. The Stephenville unit's current period UFOP is 15.40% compared to that of the previous period of 15.71%. Happy Valley's UFOP is 5.03% for the current period compared to 14.45% in the previous period.

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2015 (%)	12 months ending December 2016 (%)	Hydro Generation Base Planning Assumption (%)
Combined Gas Turbines	125	12.94	9.35	10.62
Stephenville	50	15.71	15.40	10.62
Hardwoods	50	6.39	7.83	10.62
Happy Valley	25	14.45	5.03	10.62

The Holyrood (HRD) CT UFOP of 1.65% for the current period is better than the base planning assumption of 5.00%.

Combustion Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2015 (%)	12 months ending December 2016 (%)	Hydro Generation Base Planning Assumption (%)
Holyrood CT	123.5	3.06	1.65	5.00



The Stephenville unit UFOP was primarily affected by the following events in the reporting period.

The UFOP for the Stephenville gas turbine was impacted by a forced outage from August 2, 2016 to August 5, 2016 due to a lube oil leak in the alternator module. The source of the leak was determined and the repair completed. The area was cleaned of oil and the unit returned to service.

There was another forced outage in August, from August 9 to August 19, 2016. This outage was due to the presence of debris on the metallic chip detectors during a routine inspection. A review of unit operation was completed in consultation with the overhaul facility, and the unit was returned to service with continued monitoring. No further issues have been found to date. The debris was analyzed and found to be minor in nature as very fine particles and not a cause of concern. The lubricating oil was analyzed and found to be in satisfactory condition for continued operation.

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April 28, 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
TLP/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 March 31, 2017

April 28, 2017

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 as well as in relation to assumptions used in Loss of Load Hours (LOLH) calculations for system planning purposes.

The forced outage rates are provided for individual generating units at hydraulic facilities, the three units at the Holyrood Thermal Generating Station, and Hydro's gas turbines, for the current 12-month reporting period of April 1, 2016 to March 31, 2017. The report also provides, for comparison purposes, the individual generating unit data on forced outage rates for the previous period April 1, 2015 to March 31, 2016. Further, total asset class data is presented on an annual basis for the years 2006-2015. This report provides data on outage rates for forced outages, not planned outages.

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

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

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

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

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

2.0 Period Ending March 31, 2017 Overview

Table 1: DAFOR and UFOP Overview

Class of Units	April 1, 2015 to March 31, 2016 (%)	April 1, 2016 to March 31, 2017 (%)	Base Planning Assumption (%)	ESRA Assumption[1] (%)
Hydraulic (DAFOR)	2.71	5.53	0.90	2.60
Thermal (DAFOR)	11.51	14.56	9.64	14.00
Gas Turbine (Combined) (UFOP)	11.68	12.49	10.62	20.00
Gas Turbine (Holyrood) (UFOP)	1.70	3.71	5.00	5.00

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

[1] Energy Supply Risk Assessment, November 30, 2016, see section 5.0 for further details.
[2] 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.

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. The effect on the 12 month DAFOR results is still in the current period, and will be in the current 12 month period until after November 2017.

The Holyrood thermal units, in the 10-year period prior to 2015, exhibited 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 March 2017 is 14.56%, which is above the base planning assumption of 9.64%, the sensitivity of 11.64%, and slightly above the ESRA assumption of 14.00%. This is primarily caused by an airflow derating on Unit 1 that started in the fall of 2016 and will continue until this unit is taken down for maintenance in 2017, as well as derating after the repairs of boiler tube failures on Units 1 and 2 during 2016.

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 March 31, 2017, performance was affected by forced outages to the Hardwoods and Stephenville units.

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

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 the following table under the column "Base Planning Assumption". This is a long term outlook.

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 March 31, 2017, the gas turbine units performed well within this sensitivity range for UFOP, while both the hydraulic and thermal classes performed outside of the sensitivity range for DAFOR.

The new gas turbine (Holyrood CT) has a lower expected rate of unavailability than the original gas turbines, (5% compared to 10.62%), due to the fact that the unit is new and can be expected to have better availability than the older units.[3]

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

Table 2: 2017 DAFOR and UFOP Planning Assumptions

	DAFOR (%)		UFOP (%)	
	Base Planning Assumption	**Sensitivity**	**Base Planning Assumption**	**Sensitivity**
Hydraulic Units	0.90	0.90		
Thermal Units	9.64	11.64		
Gas Turbines - Existing			10.62	20.62
Gas Turbines - New			5.0	10.0[4]

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 most recent report was filed on November 30, 2016. The report,

[3] 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).*

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

"Energy Supply Risk Assessment", (ESRA) outlines the shorter term DAFOR and UFOP and the resulting implication for meeting reliability criteria until the interconnection with the North American grid. This report is currently being updated for submission to the Board of Commissioners of Public Utilities (the Board) in May 2017.

Hydro's generation ESRA short term planning assumptions for DAFOR and UFOP are noted in Table 3:

Table 3: DAFOR and UFOP ESRA Analysis Assumptions

	DAFOR (%)	**UFOP (%)**
	ESRA Assumption	**ESRA 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

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 March 31, 2017, are presented in Table 4, as well as the data for the 12-month period ending March 31, 2016. These are compared to Hydro's generation planning and ESRA assumptions for the forced outage rate.

Table 4: Hydraulic Weighted DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending March 2016 (%)	12 months ending March 2017 (%)	Hydro Generation Base Planning Assumption (%)	ESRA Planning Assumption (%)
All Hydraulic Units - weighted	954.4	2.76	5.55	0.90	2.60
Hydraulic Units					
Bay D'Espoir 1	76.5	26.91	30.54	0.90	3.90
Bay D'Espoir 2	76.5	0.07	31.30	0.90	3.90
Bay D'Espoir 3	76.5	0.00	0.02	0.90	3.90
Bay D'Espoir 4	76.5	0.42	0.69	0.90	3.90
Bay D'Espoir 5	76.5	3.09	0.48	0.90	3.90
Bay D'Espoir 6	76.5	0.00	1.31	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	1.39	0.00	0.90	0.70
Hinds Lake	75	0.16	0.25	0.90	0.70
Upper Salmon	84	0.00	0.91	0.90	0.70
Granite Canal	40	2.07	1.16	0.90	0.70
Paradise River	8	0.24	6.94	0.90	0.70

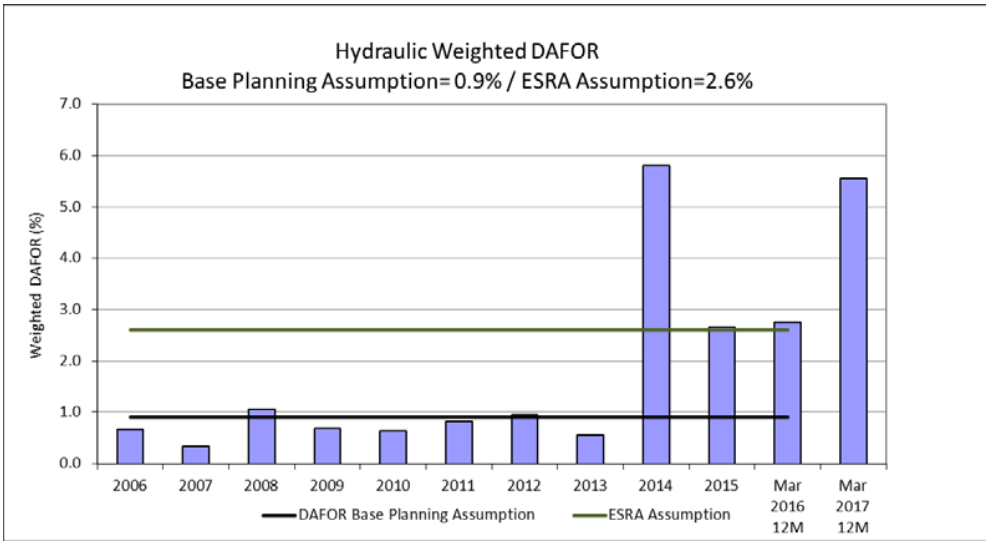

Figure 1: Hydraulic Weighted DAFOR

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

The Bay d'Espoir Unit 1 DAFOR of 30.54% and Unit 2 DAFOR of 31.30%, exceeded the base planning assumption of 0.9% and the ESRA assumption of 3.9%, due to the units being removed from service on two separate occasions as a result of a leak in Penstock 1, which provides water to both Units 1 and 2. These penstock issues contributed 99.9% of the DAFOR for this period. After the first event occurred on May 21, 2016, a consultant was engaged to conduct an investigation into the issue, with the conclusion that the leak was a localized issue caused by, what was suspected to be, a defect at the weld. A repair procedure was proposed on June 2, 2016, with repairs carried out and completed on June 3, 2016. Unit 1 was returned to service on June 3, 2016, at 1938 hours and Unit 2 returned to service a short time later at 2014 hours.

The second leak in Penstock 1 occurred on September 14, 2016. Considering this leak was similar to the first and located in the same area, a new consultant was engaged to conduct a thorough investigation of the welds throughout the penstock, which included cutting sample sections from the penstock wall, for testing. An investigation was completed, and action was taken to refurbish a significant proportion of the welds along the upper section of the penstock between the Intake and Surge Tank. Both units were then returned to service on November 30, 2016.

The completed weld refurbishment provided a long term solution for the penstock. The investigation into this outage identified two additional long term recommendations to extend the reliable life of Penstock 1. The first recommendation is to add structural backfill to the upper portion of the penstock, planned for 2018. The second is to replace the internal protective coating, planned to start in 2021.

The Bay d'Espoir Unit 6 DAFOR of 1.31% exceeded the base planning assumption of 0.9% and the ESRA assumption of 3.9%, as a result of the unit being unavailable from February 22, 2017, to February 25, 2017, due to a high turbine bearing alarm, which caused the unit trip protection to operate and shut the unit down in a controlled fashion. An investigation was completed, and it was determined that the Babbitt bearing was damaged. The bearing was repaired and the unit was returned to service. The results of the investigation found no issues for long term bearing reliability.

The Granite Canal Unit DAFOR of 1.16% exceeded the base planning assumption of 0.9% and the ESRA assumption of 0.7%, as a result of the unit being unavailable from July 19, 2016, to July 22, 2016, due to water in the generator bearing oil. An investigation revealed that the generator bearing oil cooler experienced a leak, which resulted in water getting into the bearing oil. The leaking cooler was replaced with a new cooler and the unit was returned to service.

The Cat Arm Unit 1 DAFOR of 1.02% exceeded the base planning assumption of 0.9% and the ESRA assumption of 0.7%, as a result of the unit being unavailable from November 23, 2016, to November 25, 2016, due to a governor oil pump trip. An investigation into the issue revealed that the internal seals in the pump had failed, preventing the pump from maintaining the governor oil pressure. The oil system was completely cleaned, flushed and replaced with new oil. A new oil pump was installed and the unit returned to service. This issue has been resolved, and further improvements are under review from a long term reliability perspective.

The Paradise River unit DAFOR of 6.94% exceeded the base planning assumption of 0.9% and the ESRA assumption of 0.7%, primarily as a result of a forced outage from September 23, 2016, to September 30, 2016, which was related to a governor low oil level alarm. This alarm was caused when a seal broke on one of the governor servo motors, releasing oil from the governor oil sump into the powerhouse sump system. A new seal was installed and oil was added to the

governor system. The results of the investigation found no issues regarding long term governor reliability.

There were also repeated trips of the Paradise River unit in 2016 that had no obvious cause. Hydro investigated these trips and determined that it was most likely not a unit related issue, and was likely due to distribution system disturbances. In consultation with Newfoundland Power regarding their equipment at the nearby Monkstown Substation Newfoundland Power agreed to replace their recloser with one having the capability to capture system information, and assist in troubleshooting distribution issues. Since Newfoundland Power replaced the recloser, there have been no associated trips without identifiable cause. Newfoundland Power's recloser is the interconnection point of the Paradise River Unit to the grid.

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 March 31, 2017, are presented in Table 5, as well as the data for the 12-month period ending March 31, 2016. These are compared to Hydro's generation base planning assumption for the forced outage rate.

Table 5: Thermal DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending March 2016 (%)	12 months ending March 2017 (%)	Hydro Generation Base Planning Assumption (%)	ESRA Planning Assumption (%)
All Thermal Units - weighted	490	13.54	13.96	9.64	14.00
Thermal Units					
Holyrood 1	170	12.28	20.49	9.64	15.00
Holyrood 2	170	18.33	14.92	9.64	10.00
Holyrood 3	150	8.98	3.06	9.64	18.00

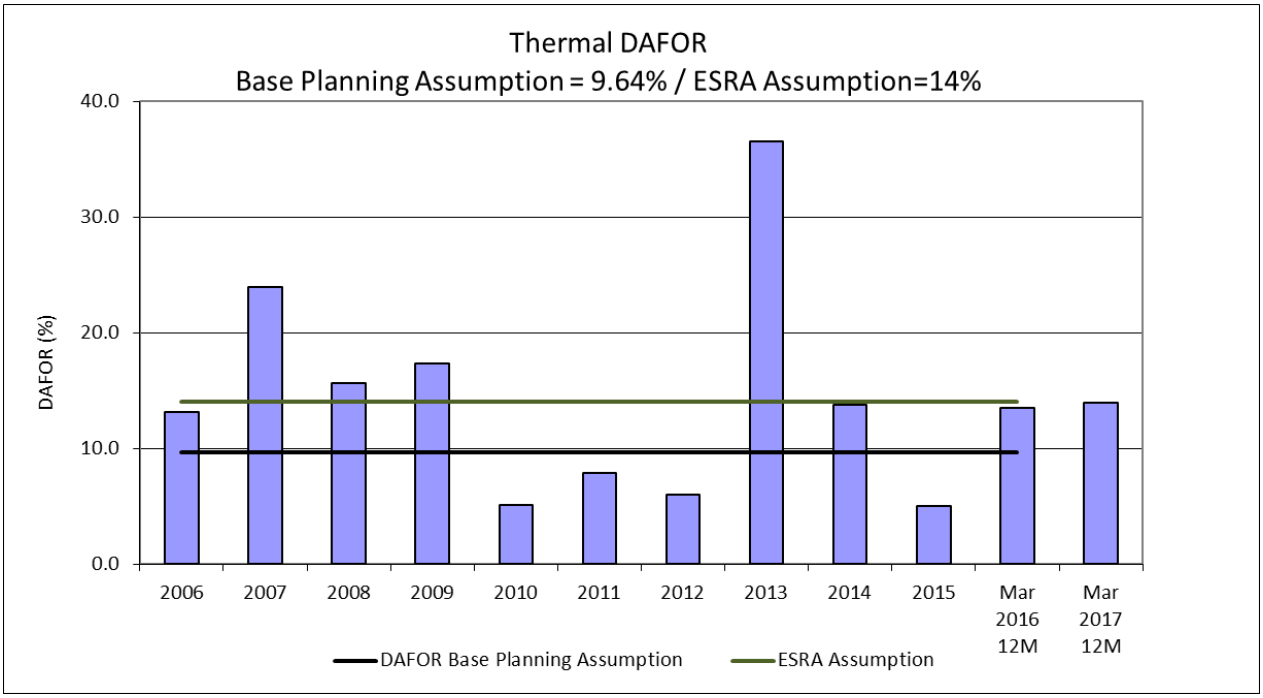

Figure 2: Thermal DAFOR

For the 12-month period ending March 31, 2017, the weighted DAFOR for all thermal units, of 14.56% is above the assumed Hydro generation base planning DAFOR value of 9.64%, and comparable to the ESRA assumption of 14.00%. Unit 1 DAFOR was 20.49% and Unit 2 DAFOR was 14.92%.The performance for both Units 1 and 2 was above the base planning assumption of 9.64% and the ESRA assumption of 15% (Unit 1) and 10% (Unit 2). Unit 3 DAFOR was 3.06%, which is better than the base planning assumption of 9.64% and ESRA assumption of 18.0%. The majority of the 13.96% DAFOR for the plant is due to deratings from airflow issues in the 2016/2017 winter season and deration after the replacement of failed boiler tubes in 2016.

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

Following a forced outage to replace failed lower reheater tubes, the unit was returned to service on February 26, 2016, with a derating to 120 MW until its annual planned outage, which started on August 27, 2016. This derating was imposed to ensure the reliability of the

reheater until the remaining lower reheater tubes could be replaced during the 2016 annual maintenance outage. Prior to the tube failures, the unit had been derated to 155 MW due to air flow issues.

On July 15, 2016, the unit was removed from service to repair a feedwater isolator gland failure, to perform a wash of the air heaters, and to repair cracks in the forced draft fan ductwork. The unit was returned to service after approximately 35 hours of outage time.

On August 27, 2016, the unit was taken off line to commence the annual maintenance outage. The work scope included complete replacement of the lower reheater tubes, intended to eliminate the derating due to risk of boiler tube failure, and other work to address the air flow issues that resulted in the derating prior to the boiler tube concerns.

During return to service from annual maintenance on October 29, 2016, a turbine control system (Mark V) governor control card failed, causing a forced outage. The failed card was replaced and the unit was synchronized on November 2, 2016.

When Unit 1 was first returned to service, it remained derated due to air flow issues, although there was an improvement to 160 MW from 155 MW before the outage. As planned, combustion tuning was completed during the week of November 14, 2016, to diagnose the air flow issues on this unit. Tuning was completed by an expert from Foxboro (supplier of the distributed control system) with assistance from a boiler field expert from Babcock & Wilcox (B&W.) They determined that the air flow issues that Hydro was experiencing are due to fouling through various stages of the boiler and air heater leakage. Further improvements require an outage to fully correct this, which is planned for completion during the 2017 annual planned maintenance outage. Work will include boiler cleaning and air heater upgrades. Full load capability is expected upon completion of this work. Hydro recently completed work to address similar air flow restrictions on Unit 2

during two weeks in April 2017. Prior to this work, Unit 2 had been derated to 135MW, and is now rated at 165 MW.

Unit 1 load capability was reduced to 145 MW on January 20, 2017, due to increased fouling, particularly in the air heater. An air heater wash was completed on a maintenance outage from January 26 to 27, 2017, which restored the load capability to the pre-wash condition of 160 MW. However, the capability was further reduced due to continued fouling in the economizer, and at the end of February the unit was derated to 150 MW. On March 4, 2017, the unit capability was rated at 140 MW, and by the end of March this had further reduced to 135 MW. Correction of this problem requires an extended outage and the work has been planned for the 2017 annual outage. Full load capability is expected after the unit is returned to service after the outage.

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

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

At the beginning of the current reporting period, Unit 2 was operating with a forced derating of 120 MW. The derating had been applied to ensure reliable operation until the complete lower reheater tube section could be replaced during the 2016 annual outage.

On May 26, 2016, the west forced draft fan variable frequency drive failed and caused the unit to trip. Siemens (the manufacturer of the drives) was contacted immediately and a technician was dispatched to travel to site. In parallel, the plant Electrical Engineer (in consultation with Siemens), Electricians, and Operations conducted an internal investigation and determined that there were no current faults with the fan and it could be safely

started. It was decided to put the unit back on line later in the day on May 26, 2016 while waiting for the Siemens technician. Because the reason for the trip had not been determined at that point, the unit load was restricted to 50 MW (below under-frequency load shedding limits in the event of a subsequent unit trip).

The Siemens technician performed on-line diagnostics on May 27, 2016, and May 28, 2016. Overnight on May 28, 2016, the unit was taken offline for a full internal inspection of the drive under direction of the Siemens technician. A control card on the drive unit was replaced and the unit was returned to service the next morning on May 29, 2016. Hydro engaged Siemens to review the variable frequency drive reliability. Siemens completed a review and provided a set of recommendations which have been implemented by Hydro.

Unit 2's annual planned maintenance outage started on June 20, 2016, and the unit was returned to service on September 15, 2016. During the outage all remaining lower reheater tubes were replaced, thus eliminating the 120 MW derating that had been previously applied. Upon start-up, the unit was derated to 130 MW until September 20, 2016, and to 150 MW until September 29, 2016 until on-line testing of the boiler safety valves could be completed. The unit was then capable of generating full load.

On November 6, 2016, the main steam inlet flange to the upper control valves was found leaking and the unit was derated to 70 MW until it was removed from service for gasket replacement on November 8. The unit was returned to service on November 10, 2016, but had to be taken off-line for another failure of the same gasket on November 16, 216. This time the gasket was changed and a contractor was hired to provide a supplementary seal of the gasket, further encapsulating the replaced gasket. The unit was returned to service on November 21, 2016. This problematic joint is scheduled for replacement during the planned outage in 2017.

On November 18, 2016, when attempting to go back on line after repair of the November 16, 2016, inlet flange leak, there was an issue discovered with turbine speed indication. After trouble shooting, it was determined that the speed probes had to be repositioned. The unit was returned to service at full capacity on November 21, 2016.

On January 20, 2017, the unit load capacity was reduced to 150 MW due to boiler fouling, particularly in the air heater and economizer. An air heater wash was completed on February 18, 2017, but due to economizer fouling, the unit remained derated to 150 MW at the end of February. Continued fouling during operation further reduced the load capability of the unit. On March 6, 2017, the capability was rated at 140 MW. On March 21, 2017, this was further reduced to approximately 135 MW. Hydro completed an early two week duration outage on Unit 2 on April 23, 2017. The outage addressed the fouling related air flow issues that were considered a significant effort and could not be completed during an air heater wash, or during peak winter season demand. Activities included, but were not limited to, cleaning and removal of hardened ash in the economizer section of the gas path. Issues affecting air flow restrictions were addressed and Unit 2 is now rated at 165 MW following this work, as tested on April 26, 2017. Additional work is scheduled during the 2017 planned annual outage to address air flow issues.

6.0 Gas Turbine UFOP Performance

The combined UFOP for the Hardwoods, Happy Valley and Stephenville gas turbines was 12.32% for the 12-month period ending March 31, 2017 (see Table 6). This is above the base planning assumption of 10.62%., but better than the ESRA assumption of 20.00%. The current period UFOP declined from the previous period UFOP of 8.29%. The Hardwoods UFOP for the current period is 15.97%, which is above than the base planning assumption of 10.62%, but better than the ESRA assumption of 20.00%. The Stephenville unit's current period UFOP is 15.96% compared to that of the previous period of 15.08%. Happy Valley's UFOP is 2.61% for the current period compared to 14.22% in the previous period. Hydro has determined an additional or replacement measure is appropriate for analyzing gas turbine performance with

respect to reliability. This measure will be discussed more in the next Energy Supply Risk Assessment planned for submittal to the Board in May 2017.

Table 6: Gas Turbine UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending March 2016 (%)	12 months ending March 2017 (%)	Hydro Generation Base Planning Assumption (%)	ESRA Planning Assumption (%)
Combined Gas Turbines	125	8.29	12.32	10.62	20.00
Stephenville	50	15.08	15.96	10.62	20.00
Hardwoods	50	3.05	15.97	10.62	20.00
Happy Valley	25	14.22	2.61	10.62	20.00

The Holyrood (HRD) CT UFOP of 2.24% for the current period is better than the base planning and ESRA assumptions of 5.00% (see Table 7).

Table 7: Holyrood CT UFOP

Combustion Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending March 2016 (%)	12 months ending March 2017 (%)	Hydro Generation Base Planning Assumption (%)	ESRA Planning Assumption (%)
Holyrood CT	123.5	2.81	2.24	5.00	5.00

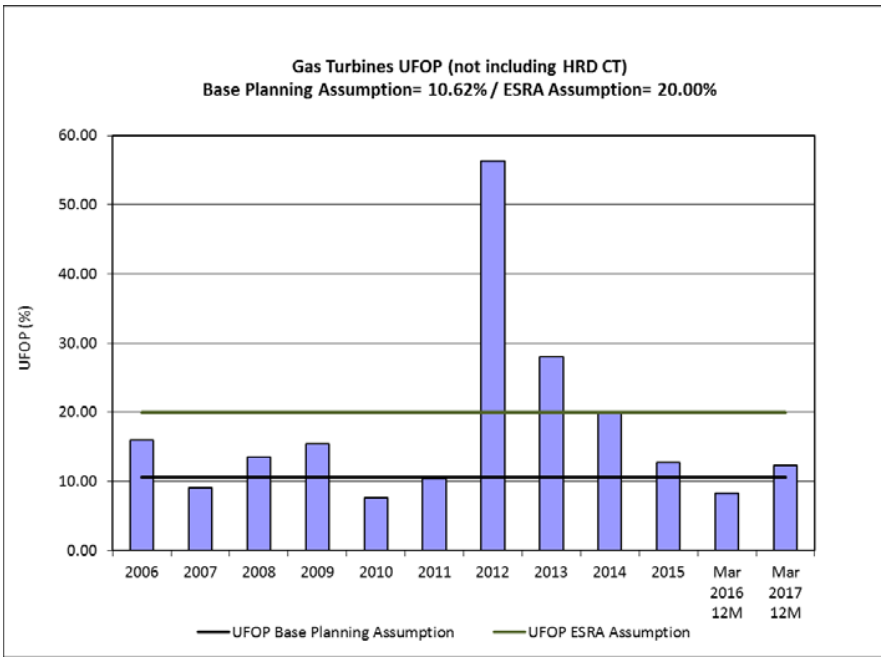

Figure 3: Gas Turbine UFOP

The Hardwoods unit UFOP was primarily affected by the following events in the reporting period:

On October 3, 2016, the Hardwoods gas turbine tripped due to a loss of fuel pressure when starting End B. It was determined that the main fuel valve was periodically closing during start up, resulting in intermittent failed starts. The unit remained available for service while the fuel valve issue was diagnosed. The fuel valve was replaced on February 10, 2017. No further issues have been experienced with this system since replacing the valve.

Also in October 2016, the Hardwoods gas turbine experienced four trips due to mounting and wiring issues with the vibration accelerometers installed on the alternator. The accelerometers were remounted and the wiring replaced. The repairs were completed and the unit was released for service on October 26, 2016. No further issues have been experienced with this system.

On November 24, 2016, Hardwoods experienced an extended outage following a lightning storm resulting in the trip of the unit while operating in synchronous condense mode. Post

trip, the unit was not able to synchronize to the electrical system. Hydro's investigation found blown fuses in the alternator's voltage sensing circuit and a fault on the automatic voltage regulator (AVR). The fuses were replaced and the AVR fault was diagnosed and corrected with technical support from the AVR manufacturer. The unit was tested and released for service on December 2, 2016.

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

A forced outage occurred from August 2 to August 5, 2016, due to a lube oil leak in the alternator module. The source of the leak was determined and the repair completed. The unit was then returned to service. No further issues have been experienced with this system.

A second forced outage occurred from August 9 to August 19, 2016. This outage was due to the presence of debris on the metallic chip detectors during a routine inspection. A review of unit operation was completed in consultation with the overhaul facility, and the unit was returned to service with continued monitoring. The debris was analyzed and found to be minor very fine particles and not a cause of concern. The lubricating oil was analyzed and found to be in satisfactory condition for continued operation. No further issues have been experienced to date.

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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

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Yours truly,

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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 in relation to assumptions used for system planning purposes.

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

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

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

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

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

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

2.0 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[1] (%)
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

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

[1] Near-term Generation Adequacy Report, May 15, 2017, see section 5.0 for further details.

combined[2] gas turbine UFOP performance shows a decline in performance for the current period compared to the previous period.

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. The effect on the 12 month DAFOR result is still in the current period, and will be in this 12 month period until after November 2017.

The Holyrood thermal units, in the 10-year period prior to 2015, exhibited 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 June 2017 is 15.27%, which is above the base planning assumption of 9.64%, the sensitivity of 11.64%, and slightly above the near-term planning assumption of 14.00%. This is primarily caused by an airflow derating on Unit 1 that started in the fall of 2016 and will continue until this unit is taken down for maintenance in 2017, as well as derating after the repairs of boiler tube failures on Units 1 and 2 during 2016.

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, 2017, performance was affected by forced outages to the Hardwoods and Stephenville units.

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

[2] 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.

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 the Table 2 under the column "Base Planning Assumption", which is a long term outlook.

Hydro also provides a sensitivity number for DAFOR and UFOP as part of its generation planning analysis. These numbers take 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, 2017, the gas turbine units performed well within this sensitivity range for UFOP, while both the hydraulic and thermal classes performed outside of the sensitivity range for DAFOR.

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

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

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

[3] 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[4]

As part of Hydro's analysis of energy supply prior 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 May 15, 2017, contained analysis based on the near-term DAFOR and UFOP and the resulting implication for meeting reliability criteria until the interconnection with the North American grid. As stated in the May 15 report submission, Hydro intends on filing its "Near-term Generation Adequacy" report semi-annually, on May 15 and November 15 of each year through interconnection.

The DAFOR and UFOP assumptions used in developing Hydro's Near-term Generation Adequacy report are noted in Table 3.

[4] 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

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, 2017, are presented in Table 4, as well as the data for the 12-month period ending June 30, 2016. These are compared to Hydro's short-term generation adequacy assumptions, as used in the "Near-term Generation Adequacy" report and Hydro's long-term generation planning assumptions for the forced outage rate.

Table 4: Hydraulic Weighted 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 (%)
All Hydraulic Units - weighted	954.4	2.15	4.85	0.90	2.60
Hydraulic Units					
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

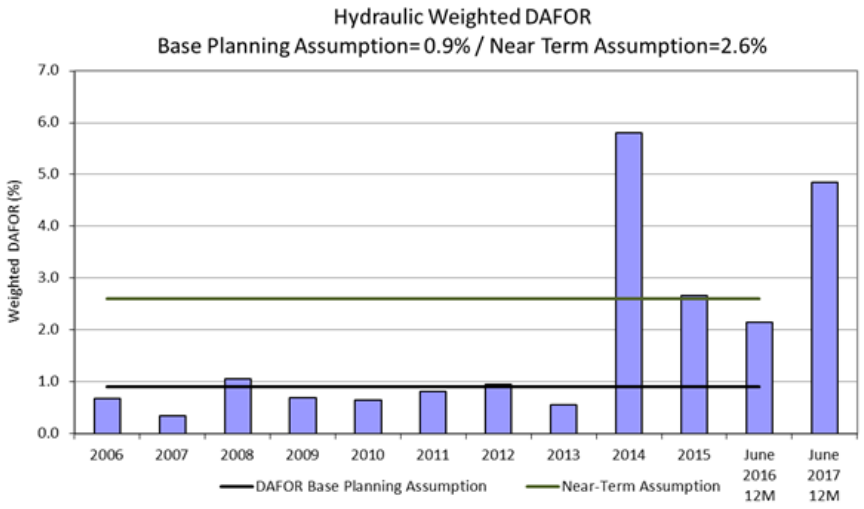

Figure 1: Hydraulic Weighted DAFOR

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

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

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

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

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

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

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

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

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

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

the powerhouse sump system. A new seal was installed and oil was added to the governor system. The results of the investigation found no issues regarding long term governor reliability.

There were repeated trips of the Paradise River unit in 2016. Hydro investigated these trips and determined that it was most likely not a unit related issue and was likely due to distribution system disturbances. In consultation with Newfoundland Power regarding their equipment at the nearby Monkstown Substation, Newfoundland Power agreed to replace their recloser with one having the capability to capture system information and assist in troubleshooting distribution issues. Since replacement of the recloser, there have been no associated trips without identifiable cause. Newfoundland Power's recloser is the interconnection point of the Paradise River Unit to the grid.

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, 2017, are presented in Table 5, as well as the data for the 12-month period ending June 30, 2016. These are compared to Hydro's short term generation adequacy assumptions, as used in the Near-term Generation Adequacy report, and Hydro's long-term generation planning assumptions for the forced outage rate.

Table 5: Thermal DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending June 2016 (%)	12 months ending June 2017 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Thermal Units - weighted	490	19.45	15.27	9.64	14.00
Thermal Units					
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

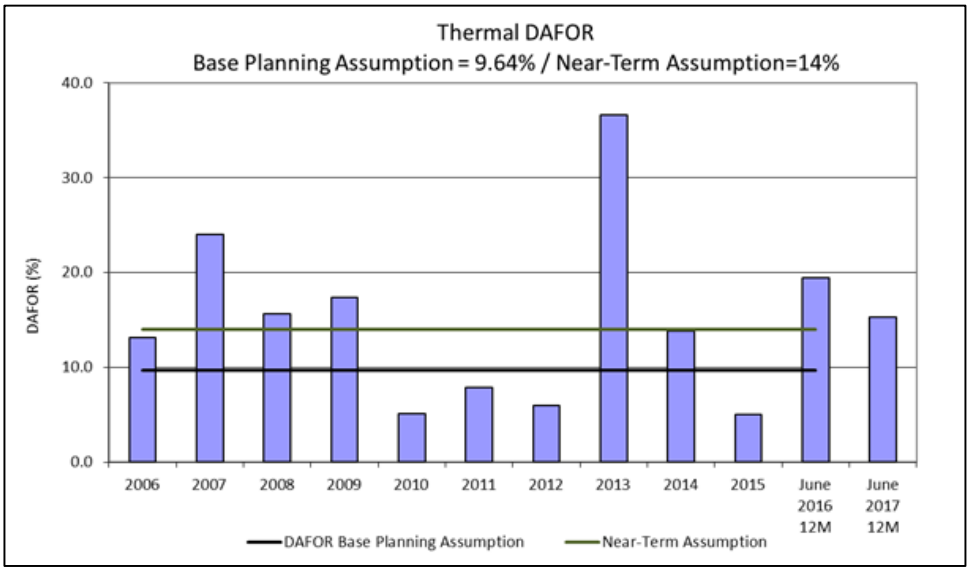

Figure 2: Thermal DAFOR

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

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

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

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

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

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

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

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

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

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

on November 16, 2016. This time the gasket was changed and a contractor was hired to provide a supplementary seal of the gasket, further encapsulating the replaced gasket. The unit was returned to service on November 21, 2016. This problematic joint is scheduled for replacement during the planned maintenance outage in 2017.

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

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

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

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

6.0 Gas Turbine UFOP Performance

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

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

Probability (DAUFOP)[5] metric as an alternate or additional measure of gas turbine unit reliability. Hydro will present its findings and make a recommendation on this metric in its next 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 (%)
Combined Gas Turbines	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

The Holyrood (HRD) GT UFOP of 2.46% for the current period is better than the base planning 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

[5] 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.

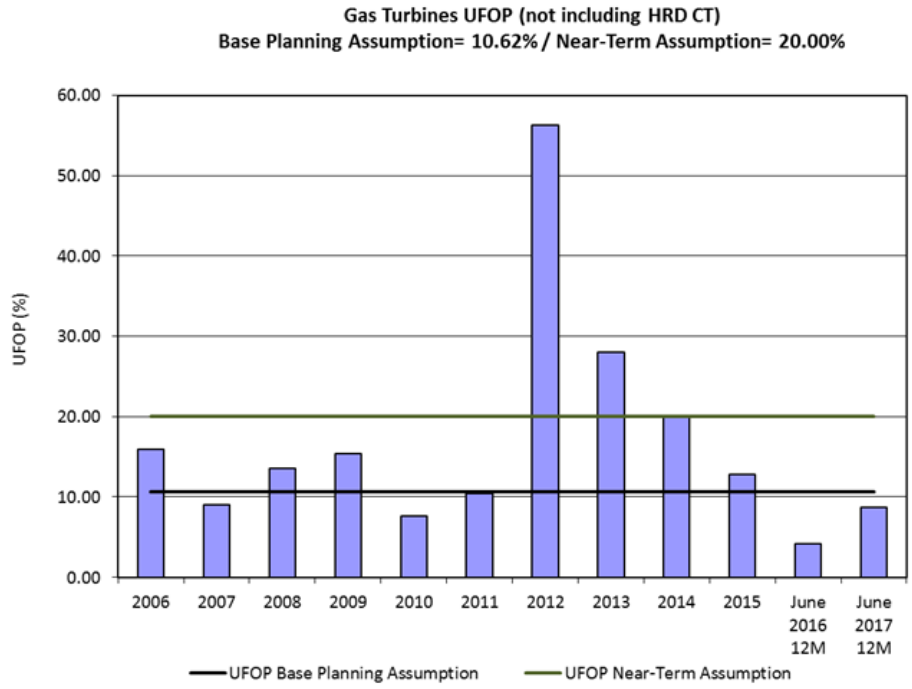

Figure 3: Gas Turbine UFOP

The Hardwoods unit UFOP was primarily affected by the following events in the reporting period:

- On October 3, 2016, the Hardwoods gas turbine tripped due to a loss of fuel pressure when starting End B. It was determined that the main fuel valve was periodically closing during start up, resulting in intermittent failed starts. The unit remained available for service while the fuel valve issue was diagnosed. The fuel valve was replaced on February 10, 2017. No further issues have been experienced with this system since replacing the valve.
- In October 2016, the Hardwoods gas turbine experienced four trips due to mounting and wiring issues with the vibration accelerometers installed on the alternator. The accelerometers were remounted and the wiring replaced. The repairs were completed and the unit was released for service on October 26, 2016. No further issues have been experienced with this system.

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

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

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

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October 30, 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
Danny Dumaresque
ecc: Roberta Frampton Benefiel – Grand Riverkeeper Labrador
Dennis Browne, Q.C. – Consumer Advocate
Sheryl Nisenbaum – Praxair Canada Inc.
Dennis Fleming – Cox & Palmer

Quarterly Report on Performance of Generating Units

For the Quarter ended September 30, 2017

October 30, 2017

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 as well as in relation to assumptions used for system planning purposes.

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

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

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

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

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

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

2.0 Period Ending September 30, 2017 Overview

Table 1: DAFOR and UFOP Overview

Class of Units	October 1, 2015 to September 30, 2016 (%)	October 1, 2016 to September 30, 2017 (%)	Base Planning Assumption (%)	Near-term Planning Assumption[1] (%)
Hydraulic (DAFOR)	2.02	4.17	0.90	2.60
Thermal (DAFOR)	19.72	13.77	9.64	14.00
Gas Turbine (Combined) (UFOP)	5.54	7.06	10.62	20.00
Gas Turbine (Holyrood) (UFOP)	1.33	2.10	5.00	5.00

There was a decline in hydraulic DAFOR performance for the current 12-month period ending September 30, 2017, compared to the previous 12-month period ending September 30, 2016

[1] Near-term Generation Adequacy Report, May 15, 2017, see section 5.0 for further details.

(see Table 1). The combined[2] gas turbine UFOP performance shows a decline in performance for the current period compared to the previous period.

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. The effect on the 12 month DAFOR results is still in the current period, and will be in the current 12 month period until after November 2017.

The Holyrood thermal units, in the 10-year period prior to 2015, exhibited 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 September 2017 is 13.77%, which was above the base planning assumption of 9.64%, the sensitivity of 11.64%, but below the near-term planning assumption of 14.00%. This is primarily caused by an airflow derating on Unit 1 and Unit 2 that started in the fall of 2016 and continued until the units were taken down for maintenance in 2017.

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

Note that the data for 2006 to 2015 in Figures 1, 2 and 3 are annual numbers (January 1 to December 31), while the data for 2016 and 2017 are 12-month rolling numbers (for this report they are October 1 to September 30 for each year).

[2] 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.

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.

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 September 30, 2017, the gas turbine units performed well within this sensitivity range for UFOP, while both the hydraulic and thermal classes performed outside of the sensitivity range for DAFOR.

The new gas turbine (Holyrood GT) has a lower expected rate of unavailability than the original gas turbines, (5% compared to 10.62%), due to the fact that the unit is new and can be expected to have better availability than the older units.[3]

As noted in Hydro's Near-term Generation Adequacy report, dated May 15, 2017, Hydro evaluated the appropriateness of the DAUFOP metric as an alternate or additional measure of gas turbine unit reliability. Hydro will present its findings and make a recommendation on this metric in its next Near-term Generation Adequacy report, to be filed with the Board on November 15, 2017.

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

[3] 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[4]

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 May 15, 2017, contains analysis based on the near-term DAFOR and UFOP and the resulting implication for meeting reliability criteria until the interconnection with the North American grid.

The DAFOR and UFOP assumptions used in developing Hydro's Near-term Generation Adequacy report are noted in Table 3.

[4] 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

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 September 30, 2017, are presented in Table 4, as well as the data for the 12-month period ending September 30, 2016. These are compared to Hydro's short term generation adequacy assumptions, as used in the Near-term Generation Adequacy report, and Hydro's long-term generation planning assumptions for the forced outage rate.

Table 4: Hydraulic Weighted DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending September 2016 (%)	12 months ending September 2017 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Hydraulic Units - weighted	954.4	2.02	4.17	0.90	2.60
Hydraulic Units					
Bay D'Espoir 1	76.5	10.57	19.88	0.90	3.90
Bay D'Espoir 2	76.5	13.52	25.77	0.90	3.90
Bay D'Espoir 3	76.5	0.00	0.03	0.90	3.90
Bay D'Espoir 4	76.5	1.33	0.23	0.90	3.90
Bay D'Espoir 5	76.5	0.63	0.00	0.90	3.90
Bay D'Espoir 6	76.5	0.18	1.35	0.90	3.90
Bay D'Espoir 7	154.4	0.00	1.80	0.90	3.90
Cat Arm 1	67	0.13	1.06	0.90	0.70
Cat Arm 2	67	0.00	0.08	0.90	0.70
Hinds Lake	75	0.06	1.09	0.90	0.70
Upper Salmon	84	0.00	0.87	0.90	0.70
Granite Canal	40	1.72	0.00	0.90	0.70
Paradise River	8	5.16	4.05	0.90	0.70

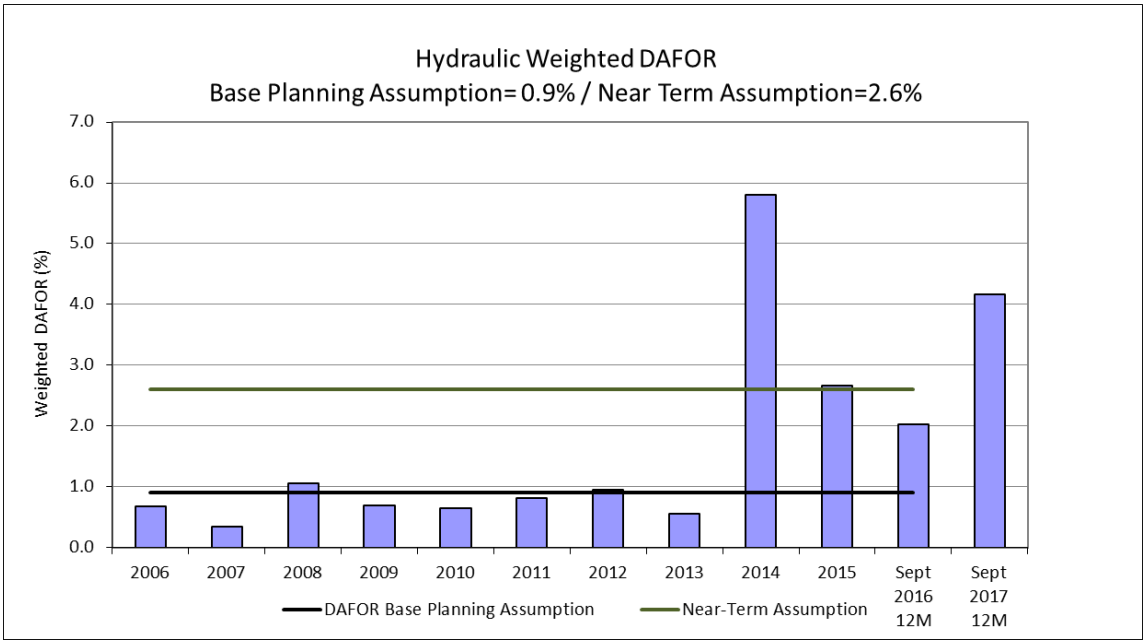

Figure 1: Hydraulic Weighted DAFOR

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

The Bay d'Espoir Unit 1 DAFOR of 19.88% and Unit 2 DAFOR of 25.77%, exceeded the base planning assumption of 0.9% and the near-term assumption of 3.9%, due to the units being removed from service on two separate occasions as a result of a leak in Penstock 1, which provides water to both Unit 1 and Unit 2. These penstock issues contributed 99.9% of the DAFOR for this period.

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

The Bay d'Espoir Unit 6 DAFOR of 1.35% exceeded the base planning assumption of 0.9% and is less than the near-term assumption of 3.9%. This is a result of the unit being unavailable from February 22, 2017, to February 25, 2017, due to a high turbine bearing alarm, which caused the unit trip protection to operate and shut the unit down in a controlled fashion. An investigation was completed, and it was determined that the Babbitt bearing was damaged. The bearing was repaired and the unit was returned to service. The results of the investigation found no issues for long term bearing reliability.

The Bay d'Espoir Unit 7 DAFOR of 1.80% exceeded the base planning assumption of 0.9% and is less than the near-term assumption of 3.9%, as a result of the unit being unavailable from July 3, 2017, to July 9, 2017, due to a failure in the collector assembly, which caused the unit protection to operate and isolate the unit from the system. An investigation was completed, and it was determined that the there was a flash over between the positive and negative slip rings which was caused by excessive brush wear. The investigation resulted in improvements to the preventive maintenance (PM) program for brush gear inspections across the hydraulic

generation fleet of assets. As a short term measure, all brush gear assemblies have been scheduled for an additional inspection prior to December 1, 2017. The PM Program for the brush gear assemblies will also be reviewed during the 2017/2018 winter season with a revised program in place prior to the start of the 2018 maintenance season.

The Cat Arm Unit 1 DAFOR of 1.06% exceeded the base planning assumption of 0.9% and the near-term assumption of 0.7%, as a result of the unit being unavailable from November 23, 2016, to November 25, 2016, due to a governor oil pump trip. An investigation into the issue revealed that the internal seals in the pump had failed, preventing the pump from maintaining the governor oil pressure. The oil system was completely cleaned, flushed and replaced with new oil. A new oil pump was installed and the unit returned to service, and the issue has been resolved. An additional consideration to improving the system is with respect to changing how the plant alarms are grouped. This will permit minor anomalies to be initiated as such, and not as major anomalies, which have the potential to take the unit off line. Recommendations will be finalized by end of Q4.

The Hinds Lake Unit DAFOR of 1.09% exceeded the base planning assumption of 0.9% and the near-term assumption of 0.7%, as a result of the unit being unavailable from April 19, 2017, to April 22, 2017, due to water in the generator bearing oil. An investigation revealed that the generator bearing oil cooler experienced a leak, which resulted in water getting into the bearing oil. Testing revealed that three of the six coolers were leaking. The damaged coolers were isolated from the system, with tests conducted to confirm adequacy of reduced cooling capacity. These tests confirmed that cooling with the three remaining coolers were adequate at ambient air and water temperatures. A planned maintenance outage was arranged from May 24, 2017 to May 30, 2017, to repair the damaged coolers, as well as to conduct extensive testing of the three in-service coolers. All work was completed, with no further issues being identified, and the unit was returned to service with 100% cooling capacity. Further testing is planned during the November maintenance outage. A complete set of spare coolers (6) are also

presently being purchased as part of the critical spares program. Hydro is planning to replace these coolers in 2018.

The Paradise River unit DAFOR of 4.05% exceeded the base planning assumption of 0.9% and the near-term assumption of 0.7%, primarily as a result of a forced outage from September 23, 2016, to September 30, 2016, which was related to a governor low oil level alarm. This alarm was caused when a seal broke on one of the governor servo motors, releasing oil from the governor oil sump into the powerhouse sump system. A new seal was installed and oil was added to the governor system. The results of the investigation found no issues regarding long term governor reliability.

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 September 30, 2017, are presented in Table 5, as well as the data for the 12-month period ending September 30, 2016. These are compared to Hydro's short term generation adequacy assumptions, as used in the Near-Term Generation Adequacy report, and Hydro's long-term generation planning assumptions for the forced outage rate.

Table 5: Thermal DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending September 2016 (%)	12 months ending September 2017 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Thermal Units - weighted	490	19.72	13.77	9.64	14.00
Thermal Units					
Holyrood 1	170	25.46	18.23	9.64	15.00
Holyrood 2	170	25.64	18.27	9.64	10.00
Holyrood 3	150	2.86	4.44	9.64	18.00

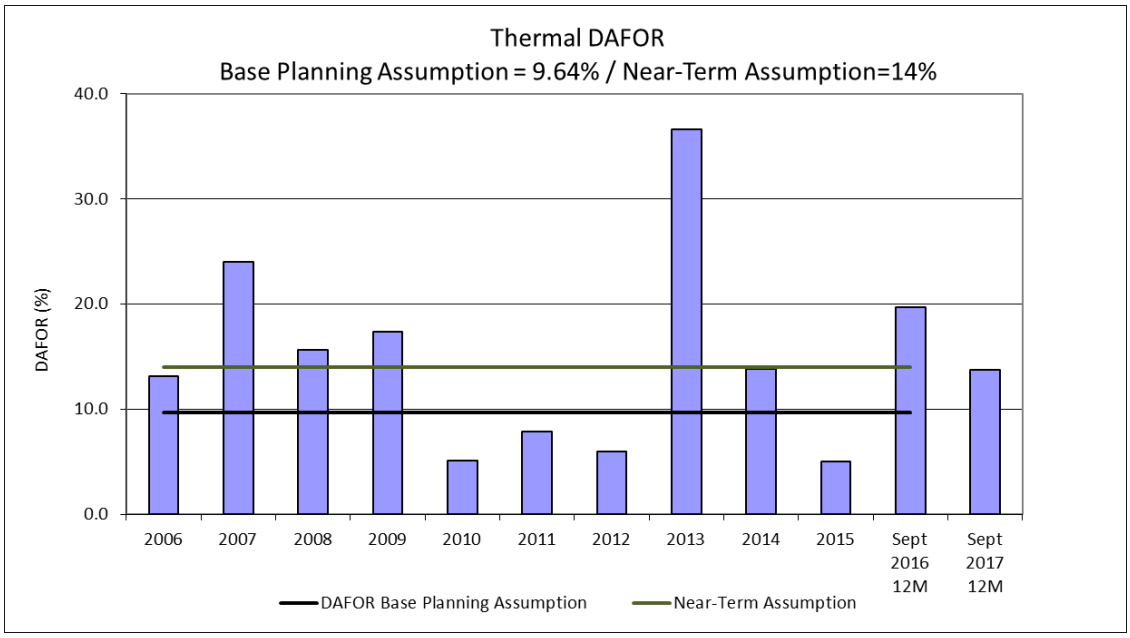

Figure 2: Thermal DAFOR

For the 12-month period ending September 30, 2017, the weighted DAFOR for all thermal units, 13.77%, was above the assumed Hydro generation base planning DAFOR value of 9.64%; however, below the near-term assumption of 14.00%. Unit 1 DAFOR was 18.23% and Unit 2 DAFOR was 18.27%.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 4.44%, which is better than the base planning assumption of 9.64% and near-term assumption of 18.0%. The majority of the 13.77% DAFOR for the plant is due to deratings from airflow issues in the 2016/2017 winter season on Unit 1 and Unit 2.

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

During return to service from annual maintenance on October 29, 2016, a turbine control system (Mark V) governor control card failed, causing a forced outage. The failed card was replaced and the unit was synchronized on November 2, 2016.

When Unit 1 was first returned to service after the 2016 annual outage, it remained derated due to air flow issues, although there was an improvement to 160 MW from 155 MW before the outage. As planned, combustion tuning was completed during the week of November 14, 2016, to diagnose the air flow issues on this unit. Tuning was completed by an expert from Foxboro (supplier of the distributed control system) with assistance from a boiler field expert from Babcock & Wilcox (B&W.) They determined that the air flow issues that Hydro was experiencing are due to fouling through various stages of the boiler and air heater leakage. Further improvements required an outage to fully correct this, which was completed during the 2017 annual planned maintenance outage. Work included boiler cleaning and air heater upgrades. Full load capability is expected after completion of this work and at the end of the reporting period the unit had returned to service with encouraging results. The furnace pressure was much lower than seen at comparable loads during the previous operating season, which indicated a significant reduction in fouling through the boiler and air heaters. The unit has not been load tested due to system constraints.

After the tuning, and prior to the planned 2017 outage, the Unit 1 load capability continued to deteriorate as a result of fouling. Load capability was reduced to 145 MW on January 20, 2017, due to increased fouling, particularly in the air heater. An air heater wash was completed on a maintenance outage from January 26, 2017 to January 27, 2017, which restored the load capability to the pre-wash condition of 160 MW. However, the capability was further reduced due to continued fouling in the economizer, and at the end of February the unit was derated to 150 MW. On March 4, 2017, the unit capability was rated at 140 MW, and by the end of March this had further reduced to 135 MW. When the unit was taken off-line for the 2017 maintenance outage at the end of June, it was capable of 120 MW. For the coming 2017/2018 winter season, the 2017 annual maintenance outage is expected to materially reduce the effects of fouling discussed here.

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

The 2017 maintenance outage on Unit 1 was from July 5, 2017 until September 11, 2017. The unit was put on-line on September 17, 2017 to allow for on-line commissioning of the new exciter controls system by the Original Equipment Manufacturer, ABB.

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 (below Under Frequency Load Shed limits) until September 21, 2017, when the cause of the trip was determined. This was to ensure that any further trips would not impact customers. Investigation determined that this trip, which happened when starting a boiler feed pump, was due to low unit board voltages. Starting the pump caused the already low voltage to drop below acceptable levels and this engaged under voltage protection and a unit trip. Voltages had been reduced intentionally as part of the exciter commissioning and were not returned to normal levels prior to starting the pump. This issue has been addressed with commissioning activities to ensure that it will not reoccur.

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

On November 6, 2016, the main steam inlet flange to the upper control valves was found leaking and the unit was derated to 70 MW until it was removed from service for gasket replacement on November 8, 2016. The unit was returned to service on November 10, 2016, but had to be taken off-line for another failure of the same gasket on November 16, 2016. This time the gasket was changed and a contractor was hired to provide a supplementary seal of the gasket, further encapsulating the replaced gasket. The unit was returned to service on November 21, 2016. This problematic joint was removed and replaced with a section of pipe during the planned outage in 2017.

On November 18, 2016, when attempting to go back on line after repair of the November 16, 2016, inlet flange leak, there was an issue discovered with turbine speed indication. After trouble shooting, it was determined that the speed probes had to be repositioned. The unit was returned to service at full capacity on November 21, 2016. During an outage on June 3, 2017 (see below) a GE expert ensured the proper adjustment of these probes.

On January 20, 2017, the unit load capacity was reduced to 150 MW due to boiler fouling, particularly in the air heater and economizer. An air heater wash was completed on February 18, 2017, but due to economizer fouling, the unit remained derated to 150 MW at the end of February. Continued fouling during operation further reduced the load capability of the unit. On March 6, 2017, the capability was rated at 140 MW. On March 21, 2017, this was further reduced to approximately 135 MW. Hydro completed an early two week duration outage on Unit 2 on April 23, 2017. The outage addressed the fouling related air flow issues that were considered to be a significant effort and could not be completed during an air heater wash, or during peak winter season demand. Activities included, but were not limited to, cleaning and removal of hardened ash in the economizer section of the gas path. Issues affecting air flow restrictions were addressed and Unit 2 was then rated at 165 MW following this work, as tested on April 26, 2017. Additional work was scheduled for the 2017 planned annual outage to further address air flow issues.

On April 22, 2017 there was a brief outage required to repair a section of flexible ductwork on the ignitor air system that had come apart during start-up after the boiler cleaning outage.

On May 1, 2017 the unit experienced a forced outage when a section of flexible ductwork adjacent to the location that failed on April 22, 2017, also failed and allowed hot gas to escape from the boiler. This hot gas caused a cable tray fire adjacent to the north east corner of the boiler on the second floor. Refurbishment work was completed by May 28, 2017 and included asbestos abatement, as loose asbestos fibres were found in the cable

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

In parallel to the refurbishment work noted above, the cause of the failure of the ignitor flex hoses was investigated. This was the first such incident on record at the plant. All of the Unit 2 flexible hoses on the ignitor system were upgraded as required. This included extending the rigid pipe in the corner that failed such that the gap could be spanned by one flexible hose length. Two had been spliced together in the area of the failure and this was concluded to be part of the reason for the failure. On Unit 1, which was in operation at the time, additional clamps were installed to verify the hoses were secure. During the annual 2017 outages all hoses on Unit 2 and Unit 1 were positively secured to ensure this failure can not re-occur. Unit 3 is not of the same design, does not have flexible ignitor air ducting, and is not susceptible to a similar failure.

On June 3, 2017 the Unit 2 tripped. The unit was returned to service a few hours later on June 3, 2017 but was limited to 50 MW until the reason for the trip could be confirmed and mitigated. A GE representative was brought to site to diagnose the problem and determined that during the trip, the control valves closed while the governor was calling for them to remain open. This pointed to three possibilities; loose wire, control card failure, or servo failure. A card failure was ruled out since all other functions of the card were working normally. The wires were tested with the unit at 25 MW and no issues were found. An outage was then completed on June 8, 2017, to June 11, 2017, to replace the servo and change out the hydraulic fluid and filters. During this same outage, the turbine speed probe cables were replaced and probe clearance gaps were adjusted. This corrected a reliability issue that previously occurred on November 18, 2016 and was planned to be done during the annual outage.

On June 16 there was an incident on one of the two approximately 50% duty boiler feed pumps. It appeared that some debris went through one of the bearings of the west pump and caused a spike in temperature and vibration. The temperature and vibration returned to normal, but the pump was taken out of service to change the oil and clean out the lube oil tank. The unit was derated to 70 MW while the pump was out of service. It was successfully tested and returned to service on June 17.

On June 29, 2017 vibration and temperature excursions occurred on the same motor inboard bearing. At this point failure of the bearing was suspected. The pump was again taken out of service causing another de-rate to 70MW. Failure of the bearing was confirmed, and the spare boiler feed pump motor was brought to site and installed in place of the motor with the failed bearing. This was the most expedient option to get the pump back in service. This work was completed on July 2, 2017 and the unit returned to 165 MW capability. Additional checks have been added to pump rebuilds to check for issues witnessed on this pump.

Unit 2 was removed from service at the end of July, 2017 to accommodate the planned total plant outage and the unit annual maintenance outage. During the unit outage additional work was completed to address air flow issues. This included additional boiler cleaning and air heater upgrades. At the time of writing of this report, Unit 2 was in the process of coming back online following its annual maintenance, which included several upgrades.

6.0 Gas Turbine UFOP Performance

The combined UFOP for the Hardwoods, Happy Valley and Stephenville gas turbines was 7.06% for the 12-month period ending September 30, 2017 (see Table 6). This is below the base planning assumption of 10.62%, and the near-term assumption of 20.00%. The current period UFOP declined from the previous period UFOP of 5.54%. The Hardwoods UFOP for the current period is 6.47%, which is better than the base planning assumption of 10.62%. Happy Valley's

UFOP is 6.81% for the current period compared to 5.59% in the previous period. Hydro will begin using DAUFOP as a reliability measure in addition to UFOP going forward. Beginning in January, 2018 Hydro will report on the gas turbines using DAUFOP. Targets for this measure will be set based on historical data as well as planned improvements. This will discussed further in Hydro's next 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 September 2016 (%)	12 months ending September 2017 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Combined Gas Turbines	125	5.54	7.06	10.62	20.00
Stephenville	50	12.03	8.02	10.62	20.00
Hardwoods	50	2.16	6.47	10.62	20.00
Happy Valley	25	5.59	6.81	10.62	20.00

The Holyrood gas turbine UFOP of 2.10% for the current period is better than the base planning 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 September 2016 (%)	12 months ending September 2017 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Holyrood CT	123.5	1.33	2.10	5.00	5.00

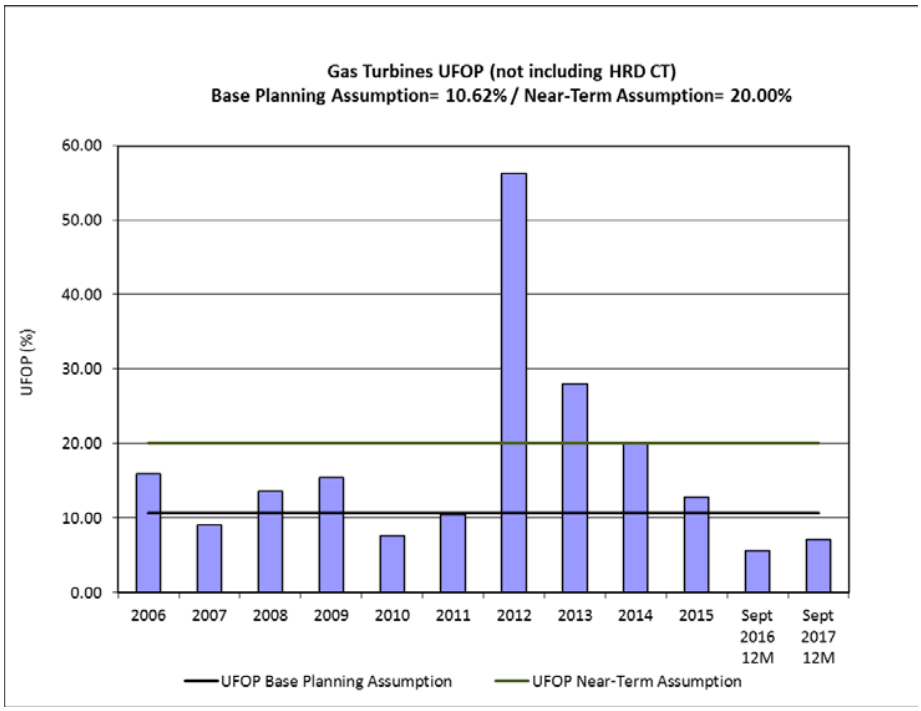

Figure 3: Gas Turbine UFOP – Hardwoods/Happy Valley/Stephenvile Units

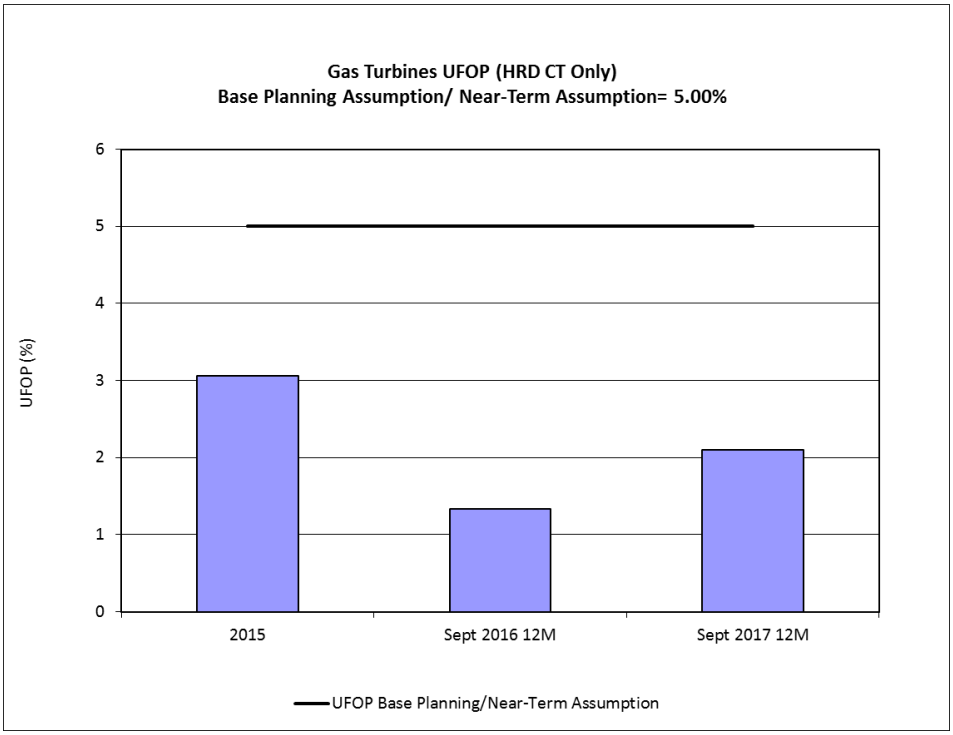

Figure 4: Gas Turbine UFOP – Holyrood Gat Turbine Only

Hydro continues to mitigate extended outages to the Hardwoods and Stephenville gas turbines by utilizing spare engines to allow for timely replacement of failed engines to return the units to full or near-full capacity. During the winter 2017/2018, Hydro will have two spare engines available for this purpose.

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February 1, 2018

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

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

Dear Ms. Blundon:

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

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

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

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

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Michael Ladha
Legal Counsel & Assistant Corporate Secretary
ML/skc

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

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

Quarterly Report on Performance of Generating Units

For the Quarter ended December 31, 2017

February 1, 2018

A Report to the Board of Commissioners of Public Utilities

newfoundland labrador hydro
a nalcor energy company

Table of Contents

1. Introduction

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

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

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

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

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

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

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

2. Period Ending December 31, 2017 Overview

Table 1 DAFOR and UFOP Overview

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

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

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

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

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

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

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

3. Generation Planning Assumptions

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

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

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

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

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

Table 2 2017 DAFOR and UFOP Planning Assumptions

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

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

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

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

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

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

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

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

4. Hydraulic Unit Forced Outage Rate Performance

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

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

Table 4 Hydraulic Weighted DAFOR

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

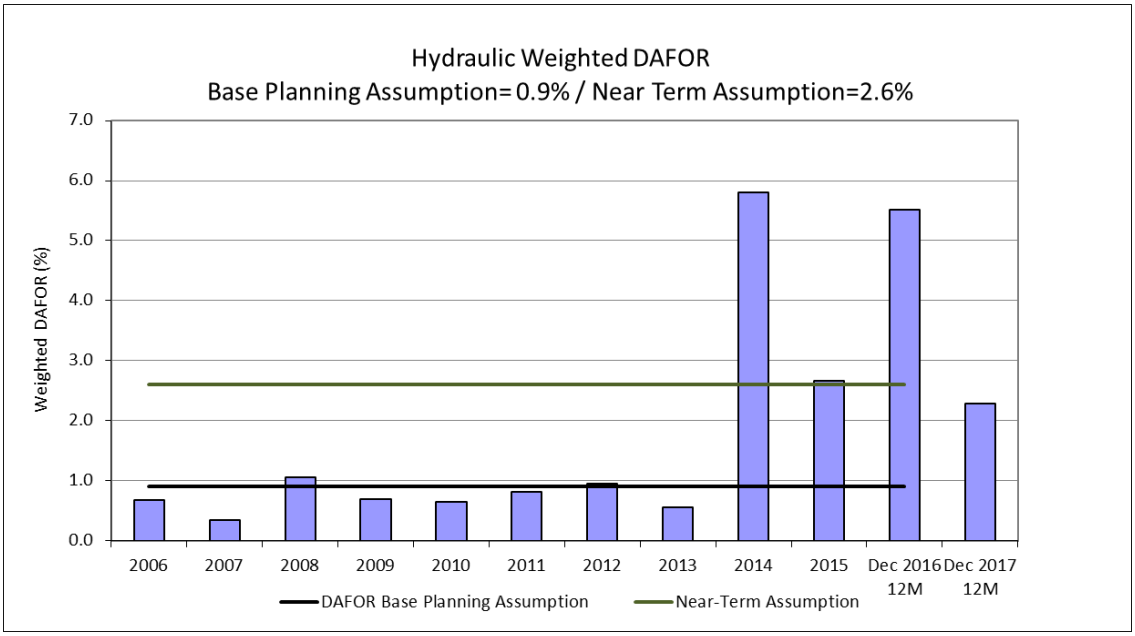

Figure 1 Hydraulic Weighted DAFOR

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

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

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

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

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

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

5. Thermal Unit Forced Outage Rate Performance

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

Table 5 Thermal DAFOR

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

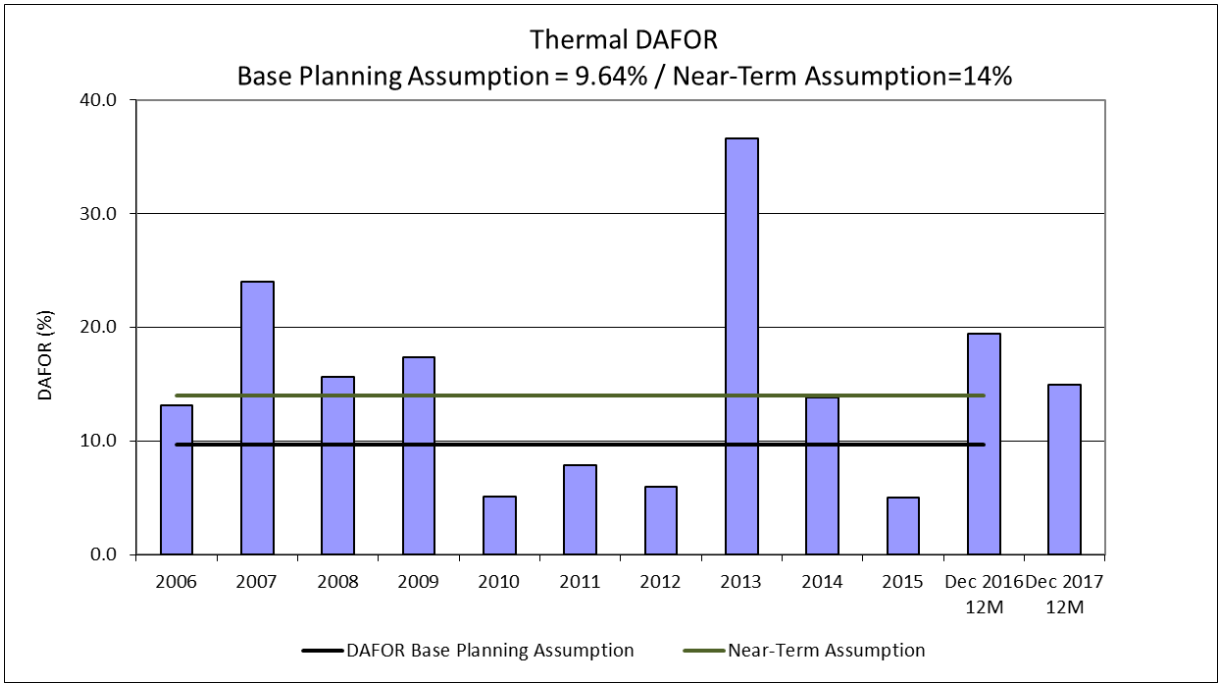

Figure 2 Thermal DAFOR

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

6. Gas Turbine UFOP Performance

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

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

Table 6 Gas Turbine UFOP

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

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

Table 7 Holyrood GT UFOP

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

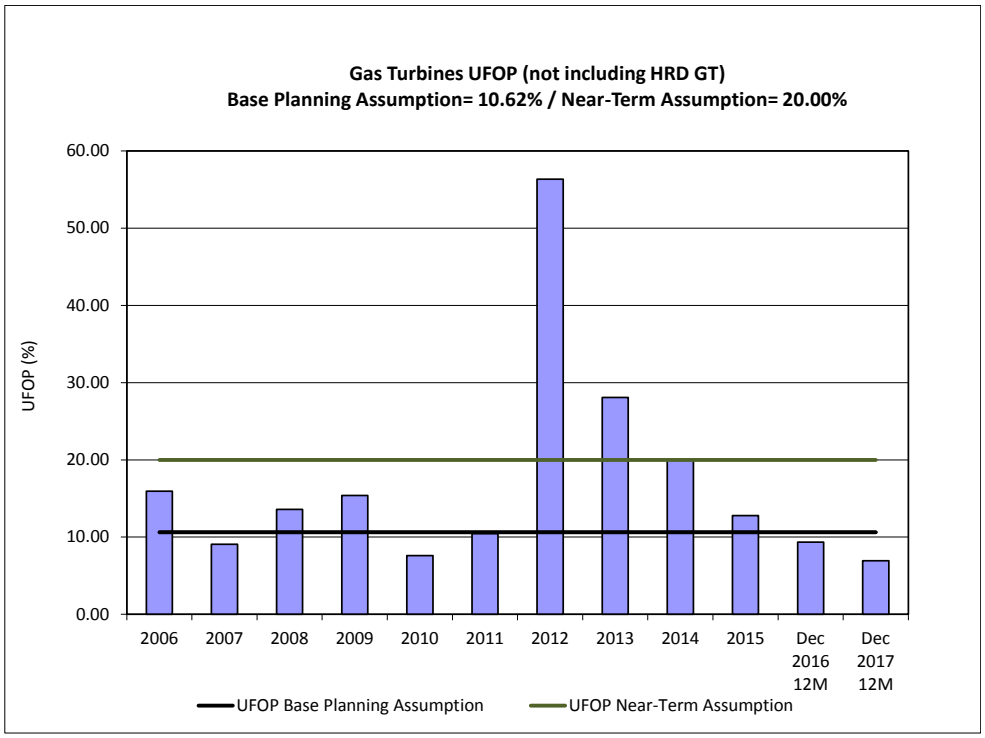

Figure 3 Gas Turbine UFOP – HWD/HVY/SVL Units

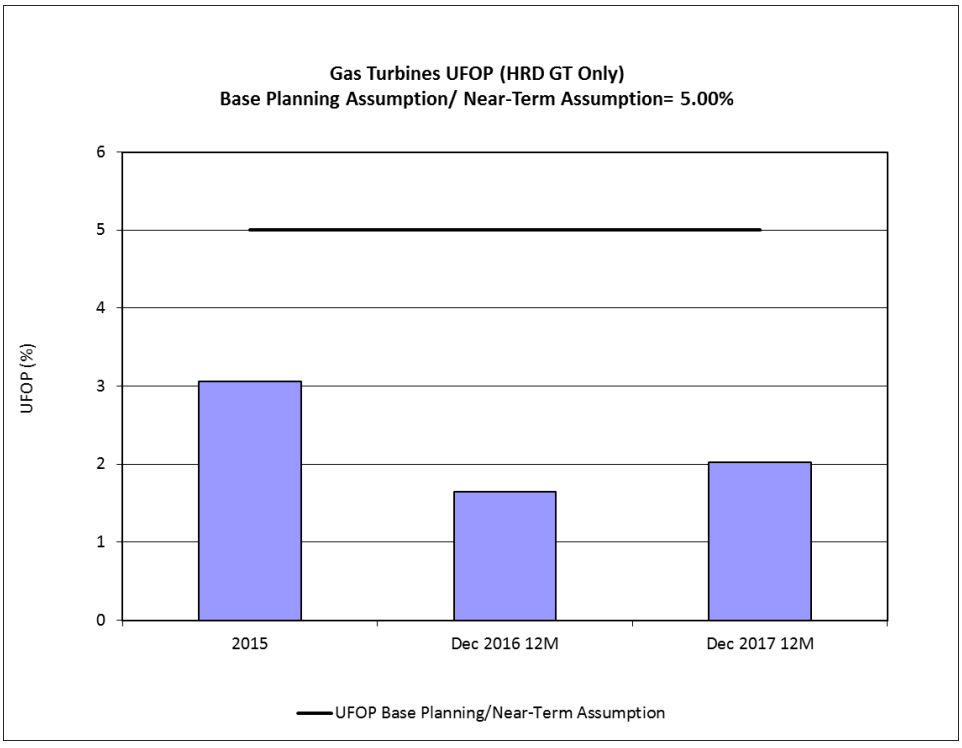

Figure 4 Gas Turbine UFOP – HRD Unit

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

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

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April 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/skc

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 March 31, 2018

April 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 in relation to assumptions used for system planning purposes.

The forced outage rates are provided for individual generating units at hydraulic facilities; the three units at the Holyrood Thermal Generating Station; and Hydro's gas turbines for the current 12-month reporting period of April 1, 2017 to March 31, 2018. The report also provides, for comparison purposes, the individual generating unit data on forced outage rates for the previous period April 1, 2016 to March 31, 2017. Further, total asset class data is presented on an annual basis for the years 2006-2016. This report provides data on outage rates for forced outages, not planned outages.

The forced outage rates of Hydro's generating units are presented using three measures: (i) Derated Adjusted Forced Outage Rate (DAFOR) for the hydraulic and thermal units; (ii) Utilization Forced Outage Probability (UFOP) for the gas turbines; and (iii) Derated Adjusted Utilization Forced Outage Probability (DAUFOP)[1] for the gas turbines.

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

[1] First report in which DAUFOP is reported.

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

Derated Adjusted Utilization Forced Outage Probability (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 March 31, 2018 Overview

Table 1: DAFOR, UFOP, and DAUFOP Overview

Class of Units	April 1, 2016 to March 31, 2017 (%)	**April 1, 2017 to March 31, 2018 (%)**	Base Planning Assumption[2] (%)	Near-term Planning Assumption[3] (%)
Hydraulic (DAFOR)	5.55	**2.13**	0.90	2.60
Thermal (DAFOR)	13.96	**24.10**	9.64	14.00
Gas Turbine (Combined) (UFOP)	12.32	**7.26**	10.62	20.00
Gas Turbine (Holyrood) (UFOP)	2.24	**0.07**	5.00	5.00
Gas Turbine (Combined) (DAUFOP)	33.37	**20.93**	-	30.00
Gas Turbine Holyrood) (DAUFOP)	2.24	**0.07**	-	5.00

There was an improvement in hydraulic DAFOR and a decline in thermal DAFOR performance for the current 12-month period ending March 2018, compared to the previous 12-month period ending March 2017 (see Table 1). The combined[4] gas turbine UFOP and DAUFOP performance shows an improvement in performance for the current period compared to the previous period.

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 March 2018 is 24.10%, which is above the base planning assumption of 9.64%, the sensitivity of

[2] 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.
[3] Near-term Generation Adequacy Report, November 15, 2017, see Section 5.0 for further details.
[4] 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.

11.64%, and above the near-term planning assumption of 14.00%.[5] This is primarily caused by an airflow derating on Unit 1 and Unit 2 that continued in 2017 and an extended forced outage on Unit 1 in February 2018.

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 March 31, 2018, performance was affected by forced outages to the Hardwoods, Happy Valley, and Stephenville units.

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

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.

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 March 31, 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.

[5] 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.

The new gas turbine (Holyrood GT) has a lower expected rate of unavailability than the original gas turbines (5% compared to 10.62%) due to the fact that the unit is new and can be expected to have better availability than the older units.[6]

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

Table 2: 2017 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

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.

[6] 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 3: DAFOR and DAUFOP Near-term Generation Adequacy Analysis Assumptions

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

4.0 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 March 31, 2018, are presented in Table 4, as well as the data for the 12-month period ending March 31, 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 March 2017 (%)	12 months ending March 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Hydraulic Units - weighted	954.4	5.55	2.13	0.90	2.60
Hydraulic Units					
Bay D'Espoir 1	76.5	30.54	8.86	0.90	3.90
Bay D'Espoir 2	76.5	31.30	13.79	0.90	3.90
Bay D'Espoir 3	76.5	0.02	0.01	0.90	3.90
Bay D'Espoir 4	76.5	0.69	0.29	0.90	3.90
Bay D'Espoir 5	76.5	0.48	0.00	0.90	3.90
Bay D'Espoir 6	76.5	1.31	0.00	0.90	3.90
Bay D'Espoir 7	154.4	0.00	1.80	0.90	3.90
Cat Arm 1	67	1.02	0.22	0.90	0.70
Cat Arm 2	67	0.00	0.09	0.90	0.70
Hinds Lake	75	0.25	0.87	0.90	0.70
Upper Salmon	84	0.91	0.05	0.90	0.70
Granite Canal	40	1.16	0.11	0.90	0.70
Paradise River	8	6.94	1.45	0.90	0.70

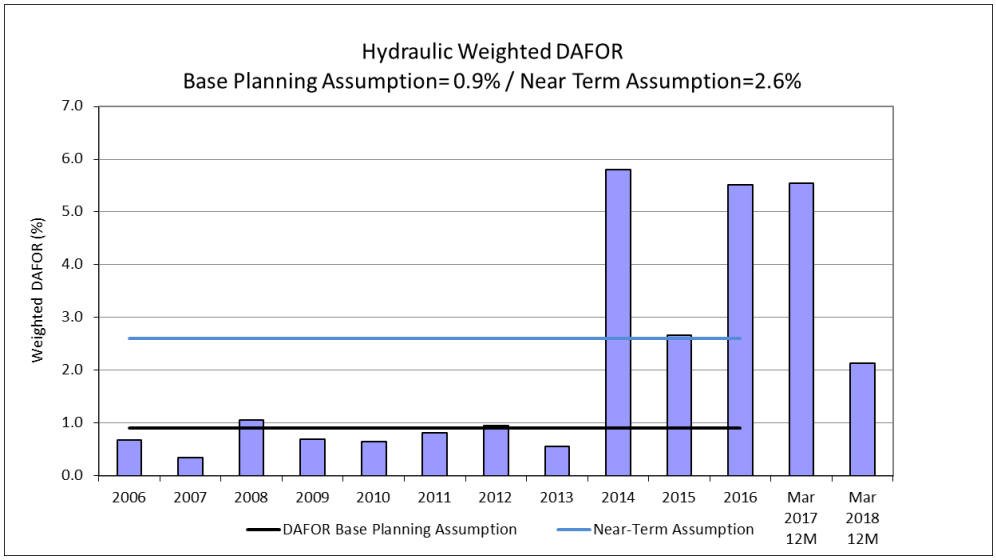

Figure 1: Hydraulic Weighted DAFOR

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, and Paradise River for the current period.

The Bay d'Espoir Unit 1 DAFOR of 8.86% and Unit 2 DAFOR of 13.79% exceeded the base planning assumption of 0.9% and the near-term assumption of 3.9% for an individual Bay d'Espoir unit. This was due to Units 1 and 2 being removed from service on November 4, 2017 as a result of a leak in Penstock 1, which provides water to both units. The leak occurred in the same area where similar leaks had occurred in 2016 which initiated further investigation and subsequent refurbishment. 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 completely removed, and replaced with a new plate that was overlaid with a second plate; all additional suspect areas were also cleaned, re-welded, and overlaid with additional plates; 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. The draft report of findings and analysis has been received and is presently being reviewed. 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 which caused the unit protection to operate and isolate the unit from the system. An investigation was completed, and it was determined that the there was a flash-over between the positive and negative slip rings which was caused by excessive brush wear. The investigation was completed and improvements to the preventative maintenance (PM) program have been implemented across the hydraulic generation fleet of assets. As a short-term measure, all brush gear assemblies had an additional inspection completed prior to December 1, 2017 and no issues were found.

The Paradise River Unit DAFOR of 1.45% exceeded the base planning assumption of 0.9% and the near-term assumption of 0.7%, primarily as a result of outages from May 23, 2017 to May 25, 2017. The Unit tripped off on May 23, 2017 shortly after being synchronized to the system and loaded to 8 MW. Several attempts to return the unit to service were unsuccessful, which

resulted in the unit being unavailable until the investigation was completed. The investigation determined the trip was a result of a high generator terminal voltage, attributed to TL 212 being out of service. The condition was rectified by adjusting the generator excitation voltage, and the Unit was returned to service on May 25, 2017. There have been no recurrence of events relating to this issue since that time, and this issue is now considered to be resolved.

5.0 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 March 31, 2018, are presented in Table 5, as well as the data for the 12-month period ending March 31, 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 March 2017 (%)	12 months ending March 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Thermal Units - weighted	490	13.96	24.10	9.64	14.00
Thermal Units					
Holyrood 1	170	20.49	31.66	9.64	15.00
Holyrood 2	170	14.92	25.36	9.64	10.00
Holyrood 3	150	3.06	14.03	9.64	18.00

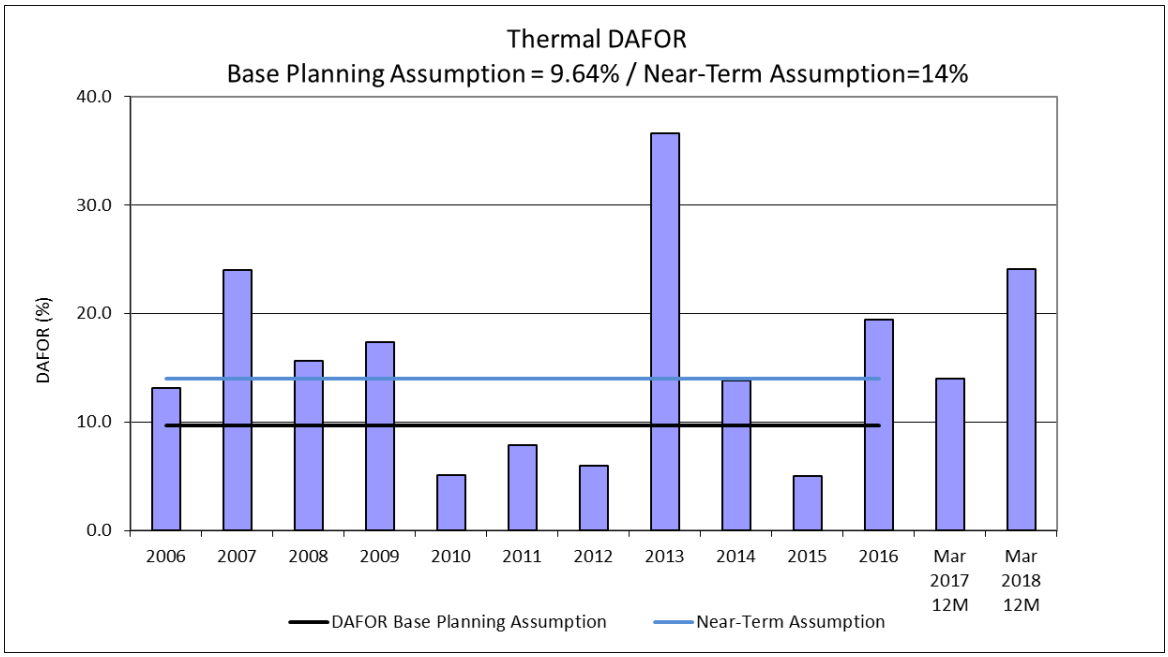

Figure 2: Thermal DAFOR

For the 12-month period ending March 31, 2018, the weighted DAFOR for all thermal units of 24.90% 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 31.66% and Unit 2 DAFOR was 25.36%.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 14.03%, 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 online on September 17, 2017 to allow for online commissioning of the new exciter controls system by the original equipment manufacturer, ABB. The Unit tripped at 70 MW on September 18, 2017 during

[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.

commissioning of the new exciter controls on that unit. The Unit was derated to 50 MW (below UFLS) until September 21, 2017, when the cause of the trip was determined. This was to ensure that any further trips would not impact customers. Investigation determined that this trip, which happened when starting a boiler feed pump, was due to low unit board voltages. Starting the pump caused the already low voltage to drop below acceptable levels and this 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 derated to a precautionary load of 35 MW, while the reason for the trip was being investigated and corrected. It was determined that the trip was caused by frayed wires in one of the forced draft (FD) fan motors and, following repairs, the Unit was returned to full capability on October 10, 2017.
- From October 17, 2017 to October 22, 2017, the Unit was derated to 154 MW due to low steam pressure while waiting for safety valve testing to be completed. The safety valve testing was completed on October 24, 2017, but the Unit was further derated to 145 MW from October 22, 2017 to October 24, 2017 and to 135 MW until the end of the month due to overheating motor windings in the west FD 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 derated to 145 MW due to high furnace pressure.
- On November 14, 2017 the Unit was taken offline 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 offline 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, 2018 to January 6, 2016 to 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 observed 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 offline to replace another control cable as recommended by GE to resolve the oscillation issue. While the Unit was offline for this work, the boiler stop valve failed, which resulted in an extension to the outage. The Unit remained offline 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, 2017, following several solutions attempted to address the leak. On

[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.

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 offline 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 up. The contaminated insulation was replaced and close 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 this 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 drive 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.

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

- On April 22, 2017 there was a brief outage required to repair a section of flexible ductwork on the ignitor air system that had failed during start-up after the boiler cleaning outage.
- On May 1, 2017, the Unit experienced a forced outage when a section of flexible ductwork adjacent to the location that failed on April 22, 2017, also failed and allowed hot gas to escape from the boiler. This hot gas caused a cable tray fire adjacent to the north east corner of the boiler on the second floor. Refurbishment work was completed by May 28, 2017 and included asbestos abatement, as loose asbestos fibres were found in the cable tray. While the Unit was offline for repairs,

work protection permits were issued to allow other work that was planned for the annual outage, to proceed in parallel. Also, Unit 3 was recalled from its planned outage to provide generation to satisfy system requirements.

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

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

- On June 29, 2017, vibration and temperature excursions occurred on same the motor inboard bearing. At this point failure of the bearing was suspected. The pump was again taken out of service causing another derate to 70MW. Failure of the bearing was confirmed and the spare boiler feed pump motor was brought to site and installed in place of the motor with the failed bearing. This was the most expedient option to get the pump back in service. This work was completed on July 2, 2017 and the Unit returned to 165 MW capability. Additional checks have been added to pump rebuilds to check for the issues experienced on this pump.
- Unit 2 was removed from service at the end of July 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 online for commissioning of new exciter controls on October 28, 2017 with a scheduled derating of 35 MW. Exciter commissioning was interrupted by two forced outages. From October 28, 2017 to October 30, 2017 the Unit was taken offline 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 incomplete setup of a new fuel flow transmitter. Setup of this transmitter was completed on November 2, 2017. Also, from October 30, 2017 to November 1, 2017 the Unit was removed from service to replace some 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 derated to 70 MW and then to 110 MW while completing commissioning of the new exciter controls.

From November 4, 2017 to November 8, 2017 the Unit was derated to 150 MW while waiting for safety valve testing to be completed. From November 8, 2017 to November 20, 2017, the Unit was derated to 165 MW until a leaking safety valve could be restored. This work required an outage to complete. The Unit was taken offline 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 derated 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 line nearby caused

contamination of the pump lube oil and the pump was taken offline until the repairs were completed.

- On March 22, 2018, one of the turbine reheat intercept valves became stuck during regular online testing and the Unit had to be taken offline for approximately eight hours to replace the valve servos. Hydraulic fluid contamination will be addressed during the annual outage to prevent recurrence.

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

- On December 13, 2017, Unit 3 was derated 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, 2017. 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, 2018 the available load was determined to be 120 MW and on February 10, 2018 this had further reduced to 100 MW. An air heater wash outage was completed from February 10, 2018 to February 11, 2018. System requirements, with Unit 1 already offline, had precluded an air heater wash on this Unit until that time. When the Unit was returned to service there was a derating 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 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 was 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 (HWD), Happy Valley (HVY), and Stephenville (SVL) gas turbines was 7.26% for the 12-month period ending March 31, 2018 (see Table 6). This is below the base planning assumption of 10.62%, and the near-term assumption of 20.00%. The current period UFOP declined from the previous period UFOP of 12.32%. The Hardwoods UFOP for the current period is 1.09%, which is better than the base planning assumption of 10.62%. The Stephenville UFOP for the current period is 5.57%, which is better than the base planning assumption of 10.62%. Happy Valley's UFOP is 20.87% for the current period compared to 2.61% in the previous period.

Table 6: Gas Turbine UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending March 2017 (%)	12 months ending March 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Combined Gas Turbines	125	12.32	7.26	10.62	20.00
Stephenville	50	15.96	5.57	10.62	20.00
Hardwoods	50	15.97	1.09	10.62	20.00
Happy Valley	25	2.61	20.87	10.62	20.00

The Holyrood (HRD) GT UFOP of 0.07% for the current period is better than the base planning and near-term assumptions of 5.00% (see Table 7).

Table 7: Holyrood GT UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending March 2017 (%)	12 months ending March 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Holyrood GT	123.5	2.24	0.07	5.00	5.00

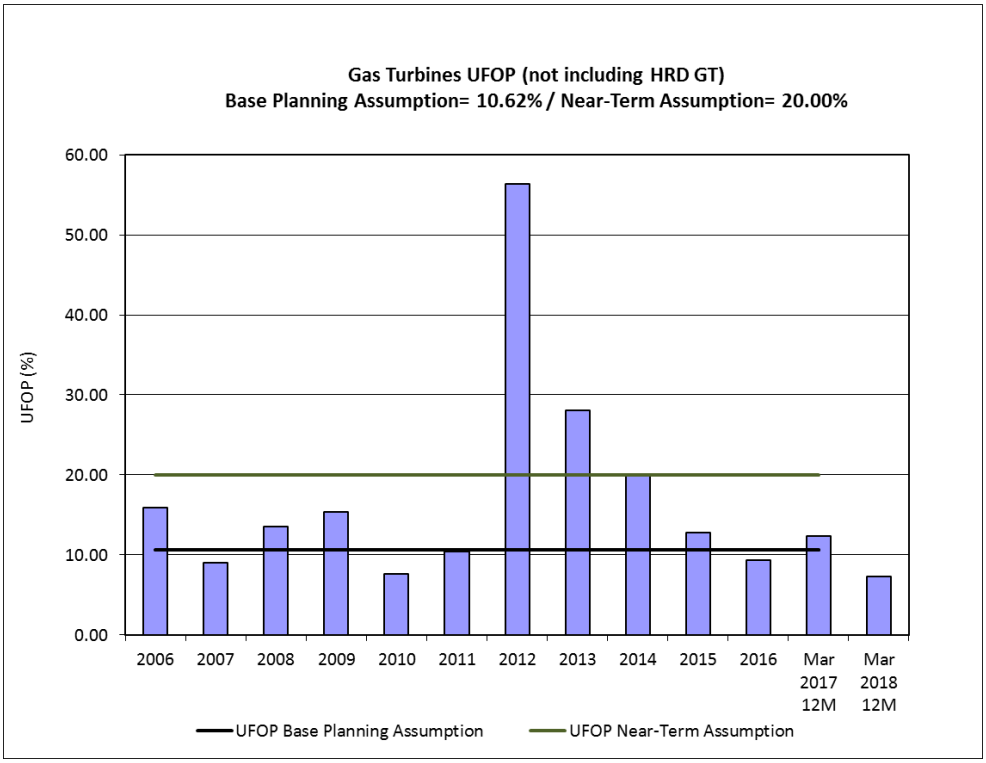

Figure 3: Gas Turbine UFOP – HWD/HVY/SVL Units

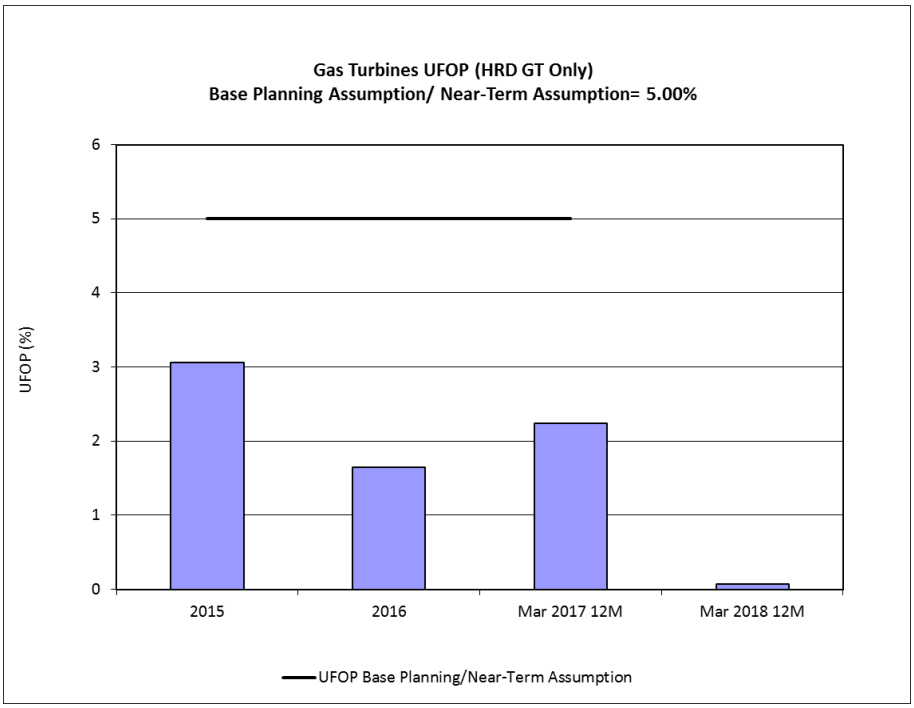

Figure 4: Gas Turbine UFOP – HRD Unit

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 shutoff valve solenoid. The failure of the solenoid caused the three-way valve to divert some fuel away from the engine as is its design. The reduced fuel flow to the engine

caused the engine to be unable to sustain the required load and this resulted in the unit shutting down. A replacement solenoid was sourced, and when received the valve was repaired and the engine was released for service on November 9, 2017.

7.0 Gas Turbine DAUFOP Performance

The combined DAUFOP for the Hardwoods, Happy Valley, and Stephenville gas turbines was 20.93% for the 12-month period ending March 31, 2018 (see Table 8). This is below the near-term assumption of 30.00%. The Hardwoods DAUFOP for the current period is 5.01%, which is significantly better than the near-term assumption of 30.00%. The Stephenville UFOP for the current period is 52.11%, which is above the near-term assumption of 30.00%. Happy Valley's DAUFOP is 20.87% 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 March 2017 (%)	12 months ending March 2018 (%)	Near-Term Planning Assumption (%)
Combined Gas Turbines	125	33.37	20.93	30.00
Stephenville	50	46.46	52.11	30.00
Hardwoods	50	32.79	5.01	30.00
Happy Valley	25	2.61	20.87	30.00

The Holyrood (HRD) GT DAUFOP of 0.07% for the current period is better than the near-term assumptions of 5.00% (see Table 9).

Table 9: Holyrood GT DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending March 2017 (%)	12 months ending March 2018 (%)	Near-Term Planning Assumption (%)
Holyrood GT	123.5	2.24	0.07	5.00

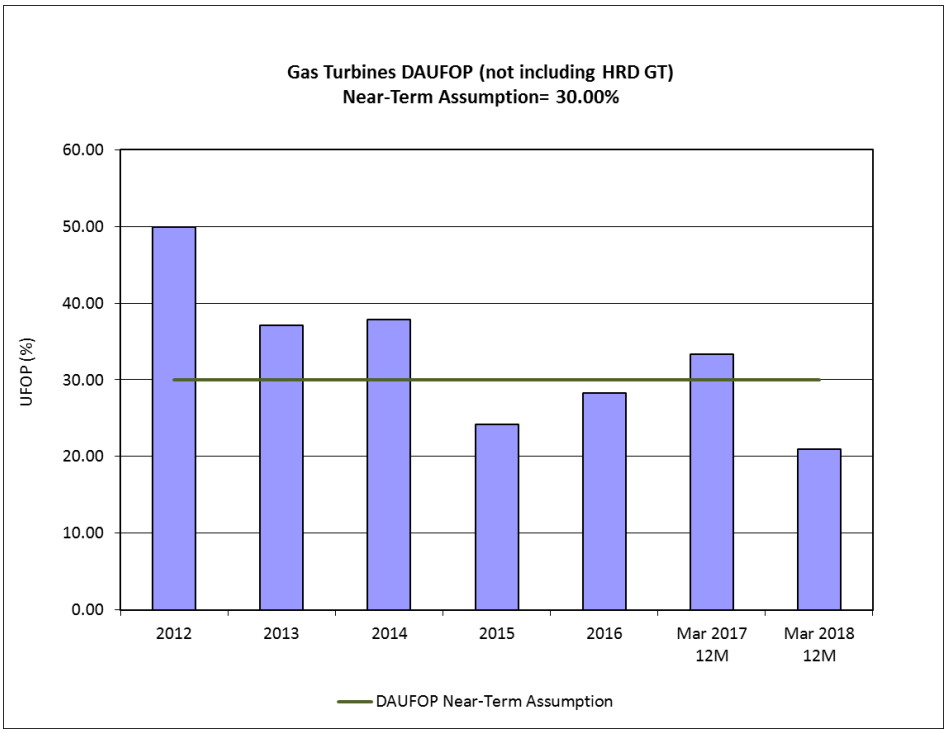

Figure 5: Gas Turbine DAUFOP – HWD/HVY/SVL Units

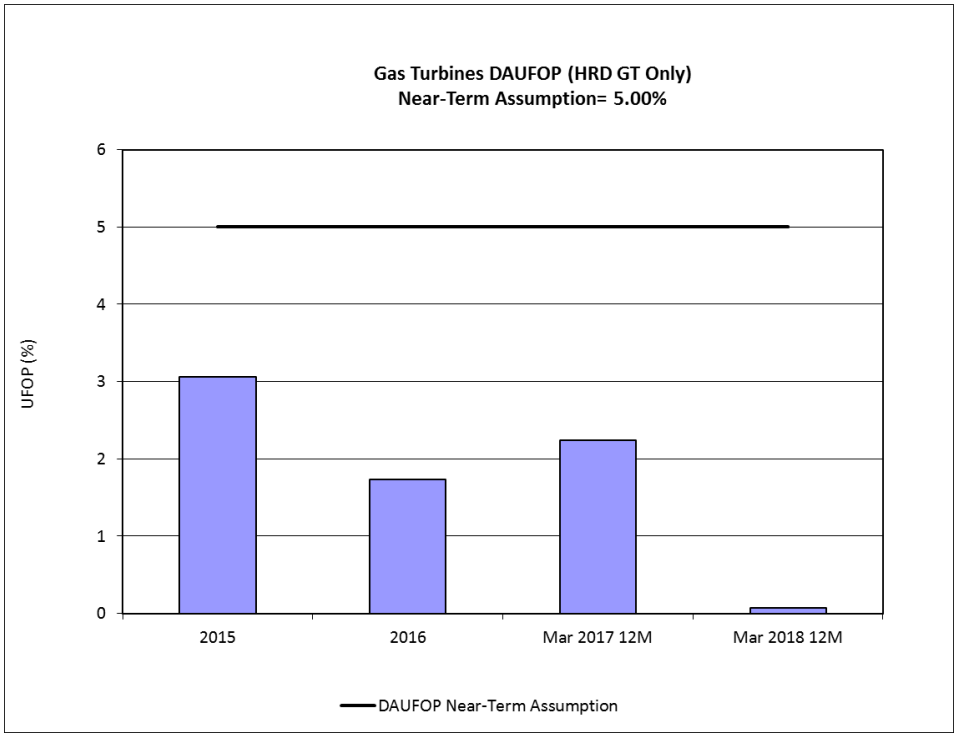

Figure 6: Gas Turbine DAUFOP – HRD Unit

The Stephenville Gas Turbine DAUFOP for the period is 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 at the end of July 2018.

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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
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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

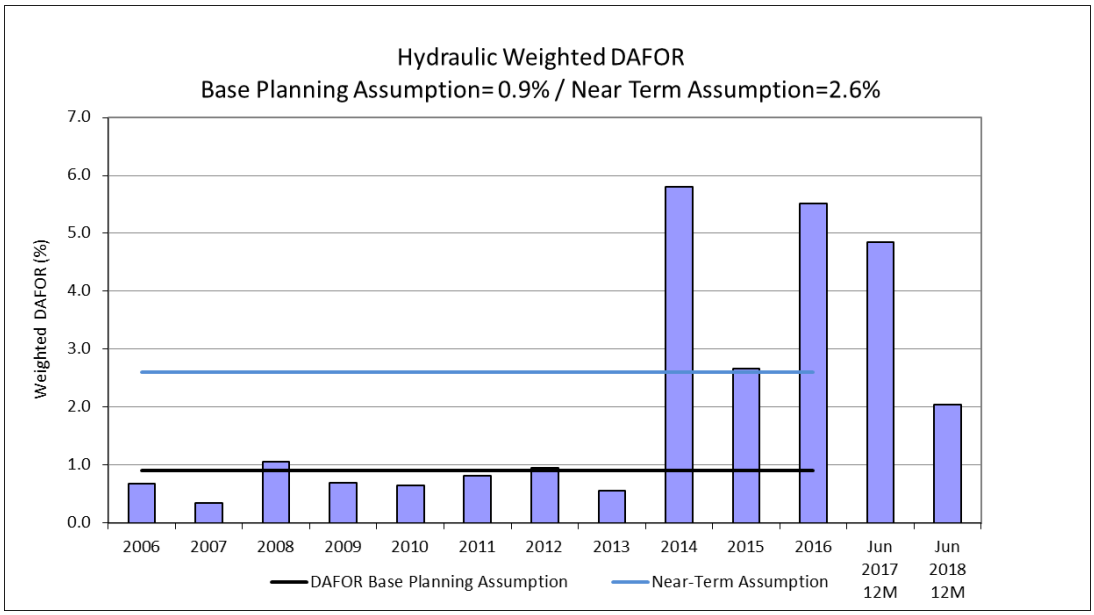

Figure 1: Hydraulic Weighted DAFOR

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).

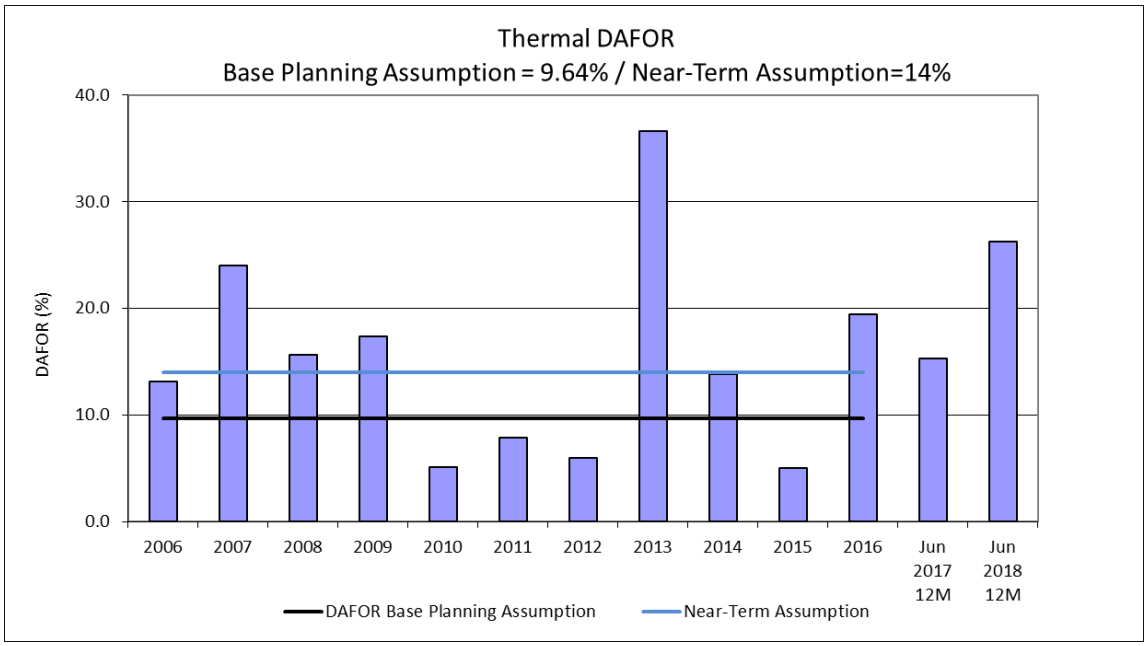

Figure 2: Thermal DAFOR

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

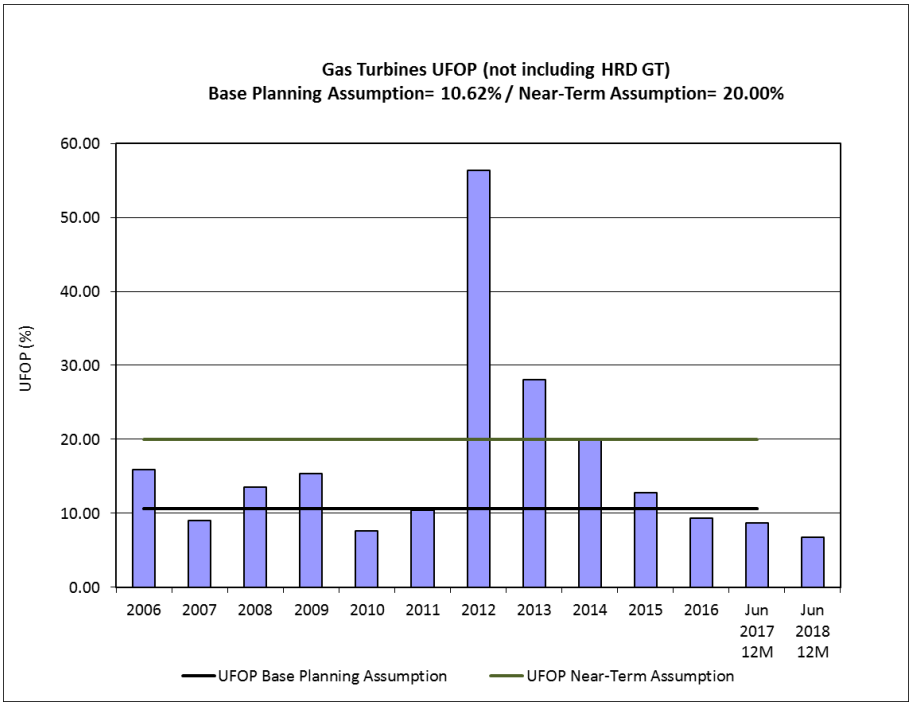

Figure 3: Gas Turbine UFOP – HWD/HVY/SVL Units

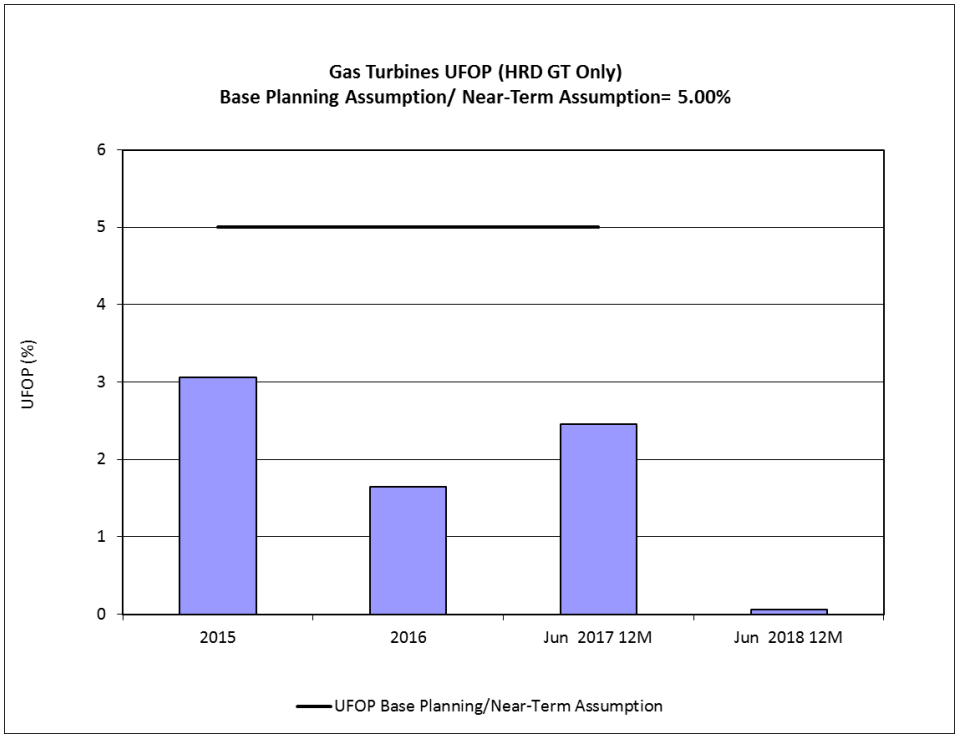

Figure 4: Gas Turbine UFOP – HRD Unit

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

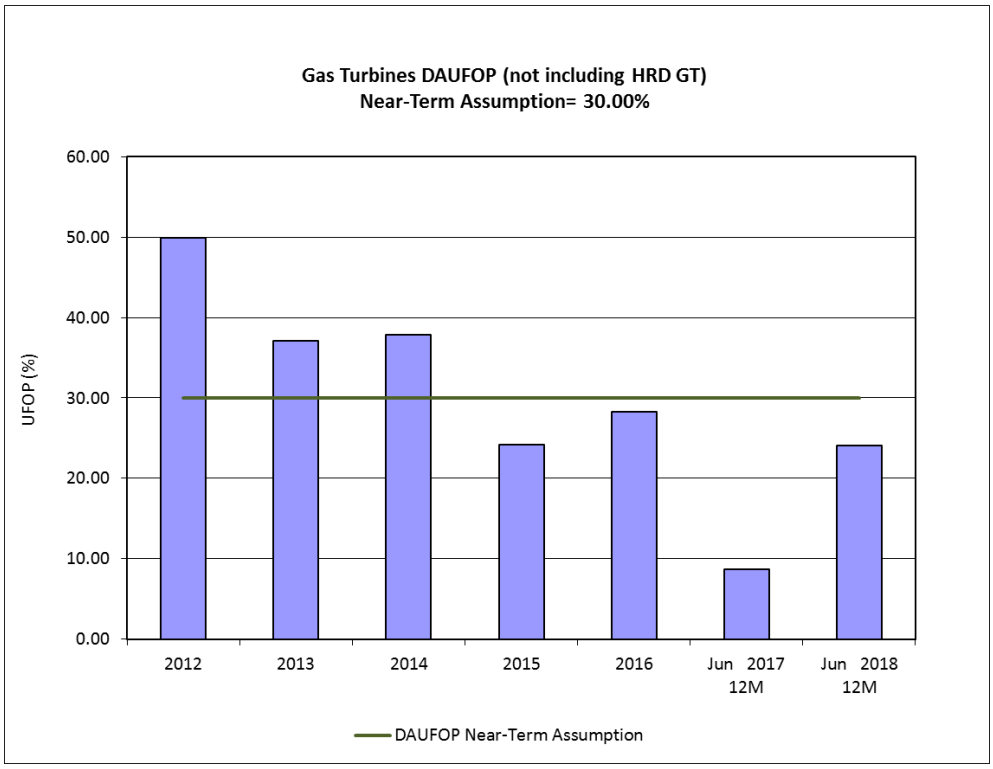

Figure 5: Gas Turbine DAUFOP – HWD/HVY/SVL Units

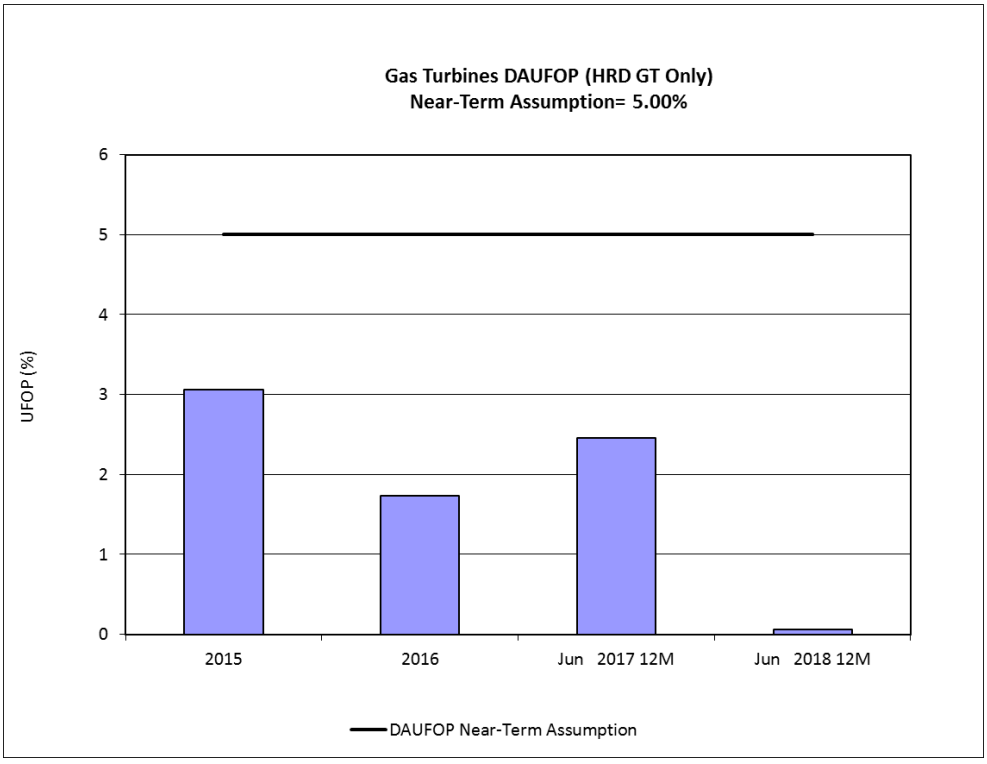

Figure 6: Gas Turbine DAUFOP – HRD Unit

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.

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October 31, 2018

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

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

Dear Ms. Blundon:

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

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

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

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

SWalsh

Shirley Walsh
Senior Legal Counsel – Regulatory
SW/kd

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 September 30, 2018

October 31, 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[1] of its generating facilities. This data provided pertains to historical forced outage rates, and assumptions used for system planning purposes.

The report contains forced outage rates for the current 12-month reporting period of October 1, 2017 to September 30, 2018 for individual generating units at hydraulic facilities, the Holyrood Thermal Generating Station, and Hydro's gas turbines. The report also provides, for comparison purposes, the individual generating unit data on forced outage rates for the previous period October 1, 2016 to September 30, 2017. Further, total asset class data is presented based on a calendar year for the years 2006-2016.

The forced outage rates of Hydro's generating units are calculated using three measures: Derated Adjusted Forced Outage Rate ("DAFOR") for the hydraulic and thermal units; and Utilization Forced Outage Probability ("UFOP") and 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 in order to provide a company total and reflect the relative impact a unit's performance has on overall generating performance. This measure is applied to hydraulic and thermal units; however, it is not applicable to gas turbines because of their operation as standby units, and their relatively low operating hours.

UFOP and DAUFOP are measures used for Gas Turbines. UFOP measures the percentage of time that a unit or group of units will encounter a forced outage and not be available when required. DAUFOP is a metric that measures the percentage of time that a unit or group of units will

[1] This report provides data on outage rates for forced outages, not planned outages.

encounter a forced outage and not be available when required, but this metric includes impact of unit deratings.

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 under Canadian Electricity Association ("CEA") guidelines. CEA guidelines state to calculate derated levels of a generating unit a by converting the operating time at the derated level into an equivalent outage time.

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

Note that the data for 2006 to 2016 in Figures 1 through 7 are annual numbers (January 1 to December 31), while the data for 2017 and 2018 are 12-month rolling numbers (October 1 to September 30 for each year).

2.0 Overview for Period Ending September 30, 2018

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

Class of Units	Oct 1, 2016 to Sept 30, 2017	Oct 1, 2017 to Sept 30, 2018	Base Planning Assumption[2]	Near-term Planning Assumption[3]
Hydraulic (DAFOR)	4.17	1.79[4]	0.90	2.60
Thermal (DAFOR)	13.77	29.77[5]	9.64	14.00
Gas Turbine (Combined) (UFOP)	7.06	7.03	10.62	20.00
Gas Turbine (Holyrood) (UFOP)	2.10	0.08	5.00	5.00
Gas Turbine (Hardwoods/ Stephenville) (DAUFOP)	22.30	24.83	-	30.00
Gas Turbine (Happy Valley) (DAUFOP)	12.25	15.39	-	15.00
Gas Turbine (Holyrood) (DAUFOP)	2.10	0.08	-	5.00

There was an improvement in hydraulic DAFOR and a decline in thermal DAFOR performance for the current 12-month period ending September 2018, compared to the previous 12-month period ending September 2017 (see Table 1). The combined[6] 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.

[2] 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.
[3] Near-term Generation Adequacy Report, November 15, 2017, see section 5.0 for further details.
[4] The Hydraulic DAFOR is 0.20% with the Penstock issues removed.
[5] The Thermal DAFOR is 13.53% with the Airflow derating removed.
[6] 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.

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 Bay d'Espoir Units 1 and 2 in 2016 and 2017.

For the Holyrood thermal units, the forced outage rate of the current period ending September 2018 is 29.77%[4], which is above the base planning assumption of 9.64%, the sensitivity of 11.64% (refer to Section 3), and above the near-term planning assumption of 14.00%.[7] 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 2018/2019 winter season due to the work being completed to improve the unit's performance for Air Flow limitations. Unit 2 has been successfully tested to 175 MW.[8]

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

Hydro began reporting DAUFOP performance beginning in January 2018, but for the purpose of this report, data over the full 12-month period ending September 30, 2018 is included. For the current 12-month period, the combined gas turbines DAUFOP (Hardwoods and Stephenville units only) performance is primarily impacted by a lengthy forced outage to the Stephenville

[7] 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.

[8] The unit has normally been considered capable of sustained running at 170 MW. Under the right conditions and with the boiler in very clean condition, it is able to go to 175 MW. However, at this maximum limit, the unit is unable to respond to load increases and as normal fouling from operation progresses, it might not be available. Therefore, this 5 MW is not part of the continuous rating and is not used for planning purposes, but would be used if available and required by the system.

unit. The Happy Valley gas turbine DAUFOP performance is impacted by a single forced outage that occurred in October 2017.

3.0 Generation Planning Assumptions

Hydro's generation long term planning assumptions for 2018 DAFOR and UFOP are noted in Table 2. The DAFOR and UFOP indicators used in the generation planning model represent an 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 ongoing 2018 Reliability Review. Hydro will report the review results in the Supply Adequacy report in November 2018.

Hydro also currently provides a sensitivity number for long term planning DAFOR and UFOP as part of its generation planning analysis. This number assumes a higher level of unavailability to assess the impact of higher unavailability of these units on overall generation requirements. During the 12-month period ending September 30, 2018, the gas turbine units performed well within this sensitivity range for UFOP, while both the hydraulic and thermal classes were above the sensitivity range for long term planning DAFOR.

The Holyrood gas turbine has a lower expected rate of unavailability than the older gas turbines, (5% compared to 10.62%), due to the fact that the unit is new and can be expected to have better availability than the older units.[9]

Table 2: 2017 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

[9] 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).*

Hydro produces reports based on comprehensive reviews of energy supply for the Island Interconnected System ("IIS"). This is part of Hydro's analysis of energy supply up to the Muskrat Falls interconnection. The most recent Near-Term Generation Adequacy report, filed on May 22, 2018, 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. The near-term analysis has been updated since that time to reflect changes in assumptions around the in-service of the Labrador-Island Link ("LIL"). The results of this analysis were presented to the Board as part of the LIL In-Service Update submitted October 1, 2018. This analysis will be updated accordingly if asset assumptions change materially.

The DAFOR and DAUFOP assumptions used in developing Hydro's May 2018 Near-Term Generation Adequacy report are noted in Table 3.

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

	DAFOR (%) Near-Term Generation Adequacy Assumption	DAUFOP (%) Near-Term Generation Adequacy Assumption
All Hydraulic Units	2.6	
Bay d'Espoir Hydraulic Units	3.9	
Other Hydraulic Units	0.7	
Holyrood Plant	15.0	
Hardwoods & Stephenville Gas Turbines		30.0
Happy Valley Gas Turbine		15.0
Holyrood Gas Turbine		5.0

4.0 Hydraulic Unit DAFOR Performance

Detailed results for the 12-month period ending September 30, 2018, are presented in Table 4, as well as the data for the 12-month period ending September 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 September 2017 (%)	12 months ending September 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Hydraulic Units - weighted	954.4	4.17	1.79	0.90	2.60
Hydraulic Units					
Bay D'Espoir 1	76.5	19.88	8.24	0.90	3.90
Bay D'Espoir 2	76.5	25.77	11.66	0.90	3.90
Bay D'Espoir 3	76.5	0.03	0.00	0.90	3.90
Bay D'Espoir 4	76.5	0.23	0.14	0.90	3.90
Bay D'Espoir 5	76.5	0.00	0.00	0.90	3.90
Bay D'Espoir 6	76.5	1.35	0.43	0.90	3.90
Bay D'Espoir 7	154.4	1.80	0.00	0.90	3.90
Cat Arm 1	67	1.06	0.98	0.90	0.70
Cat Arm 2	67	0.08	0.00	0.90	0.70
Hinds Lake	75	1.09	0.03	0.90	0.70
Upper Salmon	84	0.87	0.14	0.90	0.70
Granite Canal	40	0.00	0.49	0.90	0.70
Paradise River	8	4.05	0.00	0.90	0.70

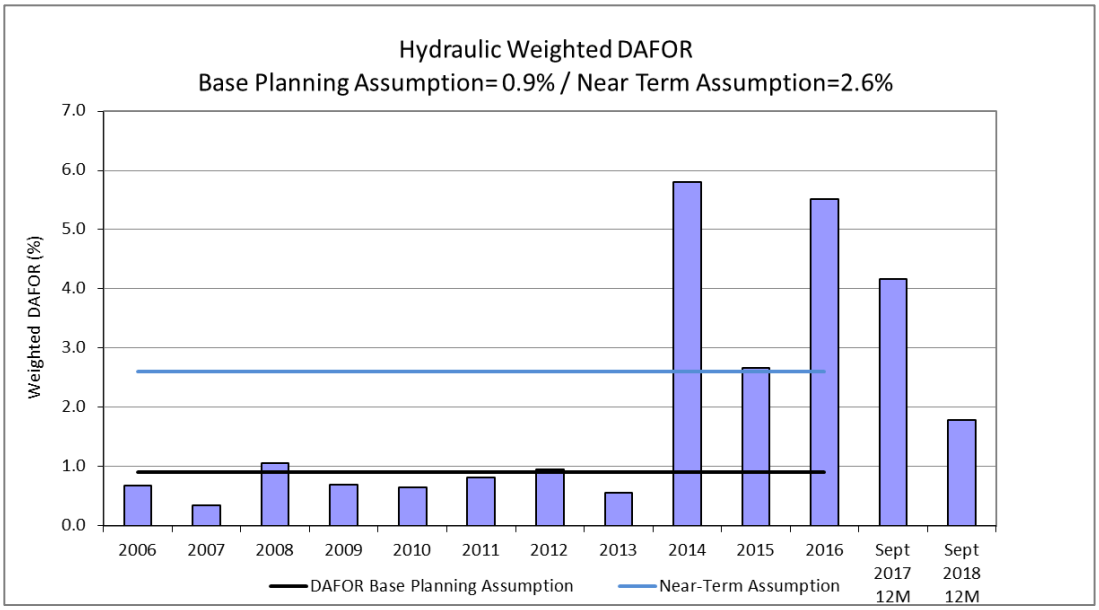

Figure 1: Hydraulic Weighted DAFOR

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.[10] Also, Cat Arm Unit 1 exceeded the base planning assumption for the current period.

The Bay d'Espoir Unit 1 DAFOR of 8.24%[11] and Unit 2 DAFOR of 11.66%[12] 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 and contractor were engaged in the process to provide recommendations for refurbishment, and to return the penstock to reliable service. The penstock was returned to service on December 8, 2017. Hydro received the final root cause report and is implementing the findings, including the execution of condition assessment work approved by the Board in P.U. 23(2018). The 2018 condition assessment, field inspection component, of the three Bay d'Espoir penstocks is now complete. Hydro is working with its consultant on a detailed report that will interpret the results of the three penstocks Level 2 condition assessments and provide recommendations for reliable operation of each penstock. Based on the findings of the inspection, Hydro expects the penstocks to perform reliably this winter given that there were no identified issues with the penstocks.

The Cat Arm Unit 1 DAFOR of 0.98% exceeded the base planning assumption of 0.9% and the near-term assumption of 0.7% for an individual Cat Arm unit. This was due to a forced derating of Cat Arm Unit 1 from 67 MW to 57 MW for the period of July 5 to August 6, 2018 as a result of a malfunction with Needle #1 transducer feedback. This issue has since been resolved by replacement of the needle feedback transducer during the annual maintenance outage for the unit.

[10] Penstock 1 supplies Bay d'Espoir Unit 1 and Bay d'Espoir Unit 2. The penstock went back into service December 8, 2017 and therefore is still affecting the 12 month rolling generation performance. Performance will continue to be affected for the next quarterly rolling generation performance report but will no longer affect performance in the subsequent reports. The overall Hydraulic DAFOR would be 0.20% with the Penstock issues removed for this period.
[11] Bay d'Espoir Unit 1 DAFOR with the Penstock issues removed was 0.01% for this period.
[12] Bay d'Espoir Unit 2 DAFOR with the Penstock issues removed was 0.84% for this period.

5.0 Thermal Unit DAFOR Performance

Detailed results for the 12-month period ending September 30, 2018, are presented in Table 5, as well as the data for the 12-month period ending September 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 September 2017 (%)	12 months ending September 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Thermal Units - weighted	490	13.77	29.77	9.64	14.00
Thermal Units					
Holyrood 1	170	18.23	35.49	9.64	15.00
Holyrood 2	170	18.27	30.64	9.64	10.00
Holyrood 3	150	4.44	18.17	9.64	18.00

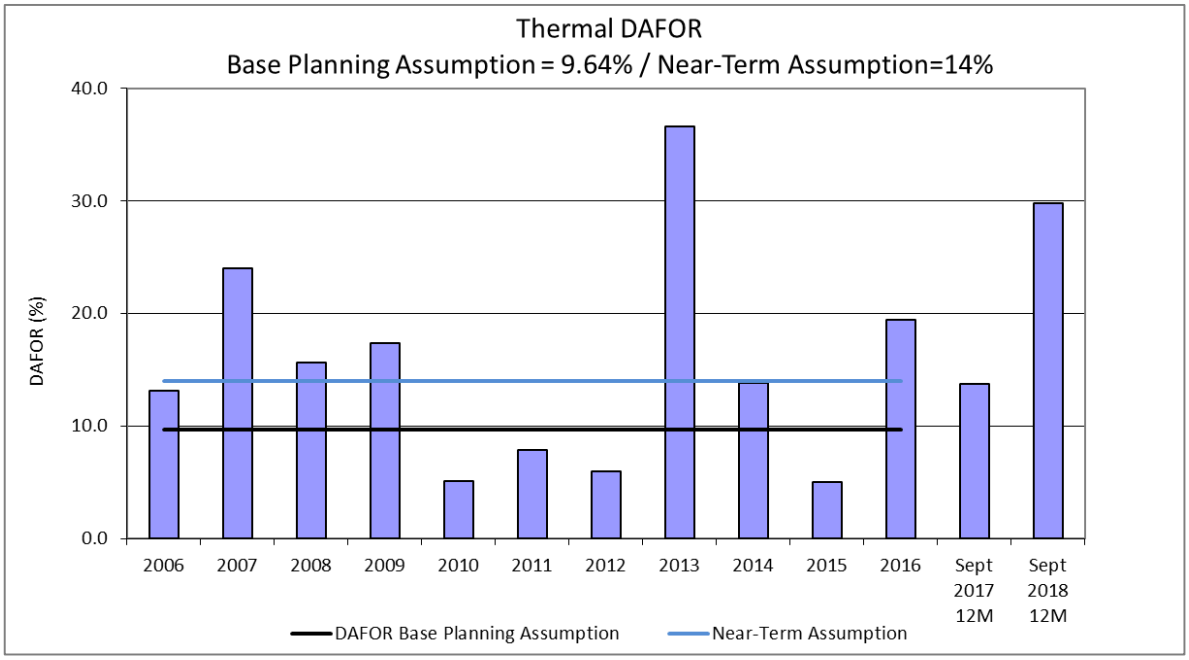

Figure 2: Thermal DAFOR

For the 12-month period ending September 31, 2018, the weighted DAFOR for all thermal units of 29.77%[13] is above the assumed Hydro generation base planning DAFOR value of 9.64%, and the near-term assumption of 14.00%. Unit 1 DAFOR was 35.49% and Unit 2 DAFOR was 30.64%. 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 18.17%, which is above the base planning assumption of 9.64% and 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:

- 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 drive ("FD") fan motors and, following repairs, the unit was returned to full capability on October 10, 2017.
- From October 17, 2017 to October 22, 2017, 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 FD fan. The unit was monitored while waiting for an opportunity to replace the motor. The spare motor was installed and 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

[13] The Thermal DAFOR is 13.53% with the Airflow derating removed.

service on December 4, 2017. A load test completed on December 5, 2017, confirmed a capacity of 150 MW[14] 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 address the issue. 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 the oscillations had increased and the load was reduced to 140 MW as a result. On January 20 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 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 (12,500 psi) was completed on the air heater baskets.
- 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 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 up. The contaminated insulation was replaced and close inspection of the bearing confirmed no active leak. The unit was returned to service on February 25, 2018.

[14] Hydro has completed work to eliminate the furnace pressure issues on Unit 1 and Unit 2, including changing hot end air heater baskets and chemically washing the economizers. A two week outage on Unit 3 will be completed in October to replace the hot end baskets and correct an air heater air leakage problem. Hydro has also reinstated the fuel additive system on all three units to prevent continued fouling. Unit 2 has since returned to service and load testing confirmed the capability of the unit at 175 MW. Similar results are expected for Unit 1 and Unit 3 when they return to service later in the fall.

- On February 28 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 FD fan variable frequency drive ("VFD") 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 VFD 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 capability was 122 MW and on May 15, 2018 it was 116 MW.
- On May 21 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 later on May 21, 2018 once the east pump was ruled out as the cause of the trip. The cause was determined to be a failure of a turbine control valve stem. Once this was confirmed the valve stem was replaced during the planned 2018 turbine valve outage.
- 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 2018 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. This 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 had to be replaced. The unit

returned to service on June 18, 2018 but the same bearing failed after only a few hours of operation. The bearing was again replaced and the unit was successfully returned to service on June 19, 2018. A field representative from the fan's original equipment manufacturer travelled to site to assist with the failure analysis of these bearings. It was concluded that the bearing liner babbitted surface failed. Additional checks have been added to the Preventive Maintenance work for these bearings to prevent such a failure.

- The planned maintenance outage for Unit 1 started on July 27, 2018. Outage work included a chemical wash of the economizer, and replacement of the hot end air heater baskets. Based on an engineering study completed prior to the outage season, and the results of the work completed, Hydro expects that Unit 1 will be capable of full load or near full load operation when it is returned to service later in the fall of 2018.

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

- Unit 2 returned from the 2017 annual planned outage on October 28, 2017. During the outage work was completed to address air flow issues, which included additional boiler cleaning and air heater upgrades. The unit 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 offline 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 incomplete set-up of a new fuel flow transmitter. Setup of this transmitter was completed on November 2, 2017. Also, from October 30, 2017 to November 1, 2017 the unit was removed from service to replace some oil-soaked turbine insulation that resulted from an oil leak at a turbine bearing. The source of the leak was also corrected.
- From November 3, 2017, until November 4, 2017 the unit was de-rated to 70 MW and then 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 due to a leaking safety valve. Corrective work required an outage to complete. The unit was taken off line on November 20, 2017, and returned to service on November 24, 2017. An air heater wash was also completed during this outage. A load test on November 28, 2017 revealed that the unit was capable of 160 MW, limited by high furnace pressure.

- On December 19, 2017, 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 2018 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 capacity. 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 off for a short, planned outage to replace generator brushes. There was a forced extension to this outage when a unit board breaker tripped during re-start 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 servos on these valves. To address this problem, the hydraulic fluid was replaced and the system flushed during the 2018 annual outage.
- 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 off line 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. TRO replaced the B2T2 breaker during the 2018 annual outage, which should resolve this issue.
- 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, not a thinning failure, of a tube in the lower waterwall (not in the area of previous boiler tube issues). At the time of the failure, it was determined that the unit was no longer required for system reliability reasons prior to the schedule planned outage and could be placed on planned outage in preparation for the annual overhaul.
- The tube leak was corrected during the overhaul. Two adjacent leaking tubes were found in the lower front wall. Through investigation and laboratory failure analysis it was determined that the original failure occurred at a butt welded joint in the tube, and that this weld was part of the original construction, and of relatively poor quality. Other welds in the area were inspected with no damage found. The leak had been present for

an unknown period of time underneath the boiler casing and impinged upon the adjacent tube, which also failed as a result. Several other tubes in the immediate area were corroded due to the presence of the leak, but had not failed. A total of seven tube sections were replaced.

- Also during the planned overhaul, work was completed to correct the air flow and furnace pressure issues in the boiler. A chemical wash of the economizer was completed and the hot end air heater baskets were replaced. The unit was returned to service on September 15, 2018 with the fuel additive system in service and it was immediately noted that the furnace pressure and air flow conditions had been greatly improved. Equipment issues related to start up caused a number of short forced outages and de-rates during the first few days of operation. On September 21, 2018, the unit was load tested to 140 MW, limited because the on-line safety valve testing had not been completed. However, it was clear from the boiler performance that full load should be achievable. This was later confirmed on October 11 when the unit was tested to 171 MW and was capable of more.
- On September 26, 2018 there was a boiler trip related to starting a boiler feed pump. It was demonstrated that this would not occur in VFD air flow control and the fans were switched to VFD. Investigation into the reason for this trip is ongoing.

Unit 2 has now been returned to service following annual maintenance and upgrades. Load test has confirmed 175 MW capability. The work completed during the 2018 outage is expected to address the previous air flow issues which were the prime contributor to 12 month DAFOR performance. Similar outcomes are expected on Units 1 and 3 when they return from their 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, 2017. 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, 2108 the available load was determined to be 120 MW, and on February 10, 2018, this had further reduced to 100 MW. An air heater wash outage was completed from February 10, 2018 to February 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 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 started on April 2, 2018.

- 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 because of 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.
- The annual outage was from April 2, 2018 until June 1, 2018. Air flow issues could not be corrected during the annual outage because of the long lead times for replacement air heater materials. The remainder of the planned work was completed, and a two week outage is planned for October 2018 to complete the air heater work required to restore load capability.

- The Unit 3 generator was put in service in synchronous condenser mode on June 1, 2018 and ran until September 24, 2018, when it was taken off line for a maintenance outage to replace some generator brushes. There was a problem with the drive controller that prevented re-start of the synchronous condenser. On September 28, 2018 the unit was placed on a maintenance outage to prepare for conversion to generation mode.

6.0 Gas Turbine UFOP Performance

The combined UFOP for the Hardwoods, Happy Valley and Stephenville gas turbines was 7.03% for the 12-month period ending September 30, 2018 (see Table 6 and Figure 3). This is below the base planning assumption of 10.62%, and the near-term assumption of 20.00%. The current period UFOP was essentially the same as the previous period UFOP of 7.06%. The Hardwoods UFOP for the current period is 3.19%, which is better than the base planning assumption of 10.62%. The Stephenville UFOP for the current period is 4.95%, which is better than the base planning assumption of 10.62%. Happy Valley's UFOP is 15.39% for the current period, which is above the base planning assumption of 10.62%.

The UFOP for the Happy Valley, Stephenville and Hardwoods gas turbines for the period was impacted by a number of forced outages and deratings. These outages and deratings are detailed in the following section, Gas Turbine DAUFOP Performance.

Table 6: Gas Turbine UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending September 2017 (%)	12 months ending September 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Combined Gas Turbines	125	7.06	7.03	10.62	20.00
Stephenville	50	8.02	4.95	10.62	20.00
Hardwoods	50	6.47	3.19	10.62	20.00
Happy Valley	25	6.81	15.39	10.62	20.00

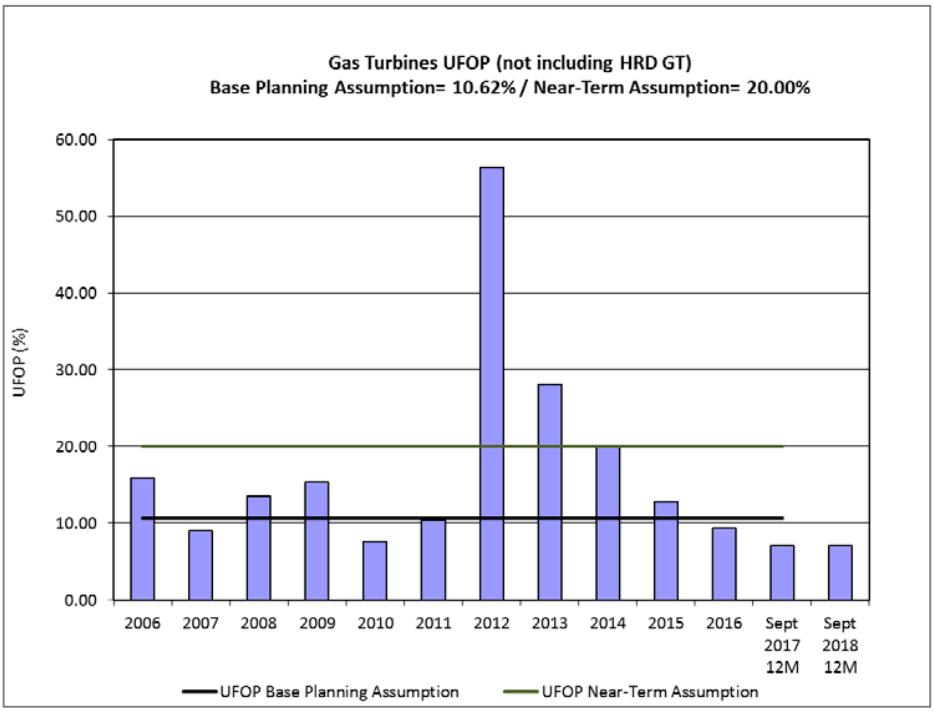

Figure 3: Gas Turbine UFOP – Hardwoods/Happy Valley/Stephenville Units

The Holyrood (HRD) GT UFOP of 0.08% for the current period is better than the base and near-term planning assumptions of 5.00% (see Table 7 and Figure 4).

Table 7: Holyrood GT UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending September 2017 (%)	12 months ending September 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Holyrood GT	123.5	2.10	0.08	5.00	5.00

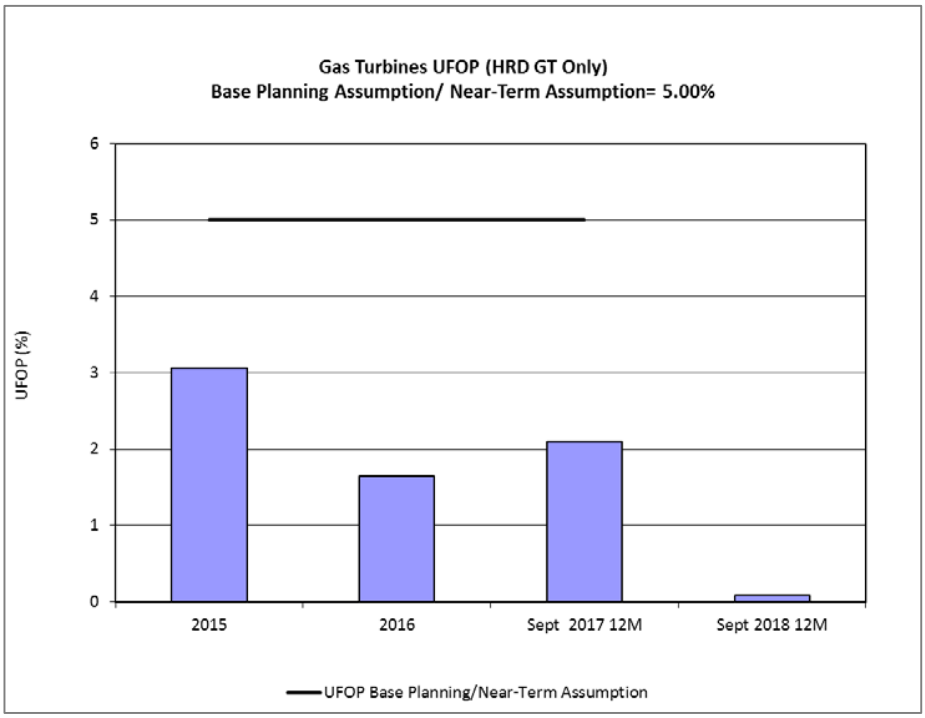

Figure 4: Gas Turbine UFOP – Holyrood Unit

7.0 Gas Turbine DAUFOP Performance

The combined DAUFOP for the Hardwoods and Stephenville gas turbines was 24.83% for the 12-month period ending September 30, 2018 (refer to Table 8 and Figure 5). This is below the near-term planning assumption of 30.00%. The Hardwoods DAUFOP for the current period is 14.47%, which is better than the near-term planning assumption of 30.00%. The Stephenville UFOP for the current period is 51.20%, which is above the near-term planning assumption of 30.00%.

Table 8: Hardwoods/Stephenville Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending September 2017 (%)	12 months ending September 2018 (%)	Near-Term Planning Assumption (%)
Gas Turbines (HWD/SVL)	100	22.30	24.83	30.00
Stephenville	50	88.79	51.20	30.00
Hardwoods	50	18.32	14.47	30.00

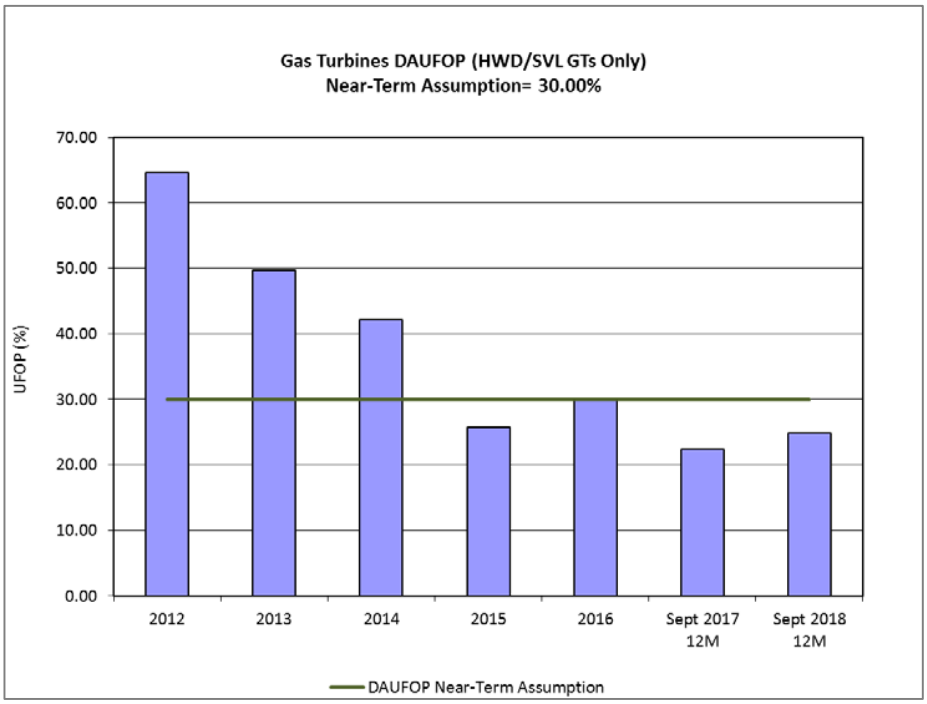

Figure 5: Gas Turbine DAUFOP – Hardwoods/Stephenville Units

The DAUFOP for the Happy Valley gas turbine was 15.39% for the 12-month period ending September 30, 2018 (refer to Table 9 and Figure 6). This is above the near-term planning assumption of 15.00%.

Table 9: Happy Valley Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending September 2017 (%)	12 months ending September 2018 (%)	Near-Term Planning Assumption (%)
Happy Valley	25	12.25	15.39	15.00

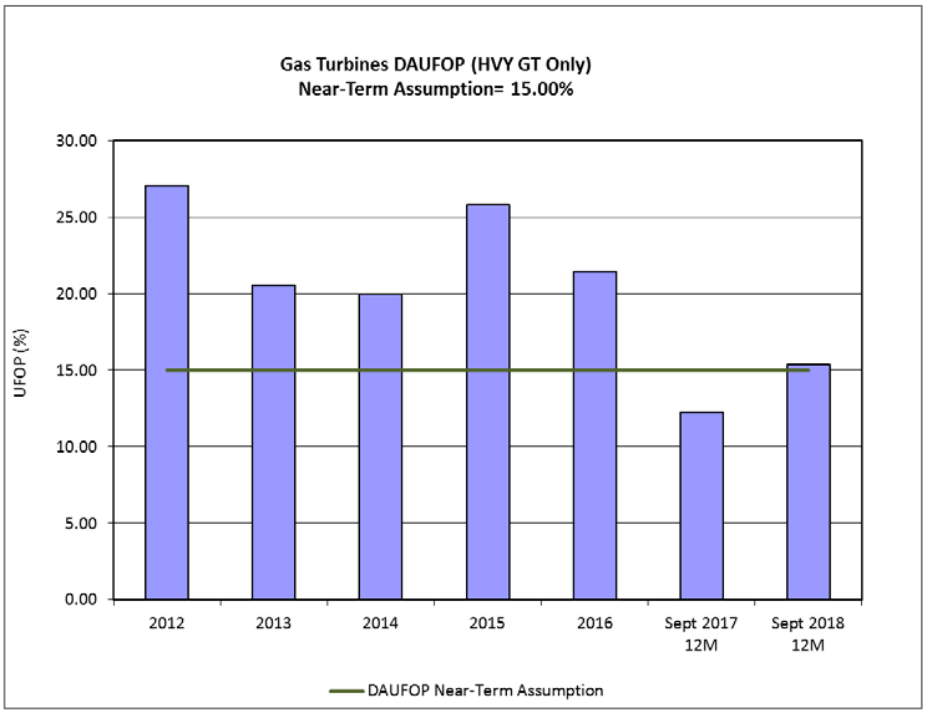

Figure 6: Gas Turbine DAUFOP – Happy Valley Unit

The Holyrood gas turbine DAUFOP of 0.08% for the current period is better than the near-term planning assumption of 5.00% (see Table 10 and Figure 7).

Table 10: Holyrood GT DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending September 2017 (%)	12 months ending September 2018 (%)	Near-Term Planning Assumption (%)
Holyrood GT	123.5	2.10	0.08	5.00

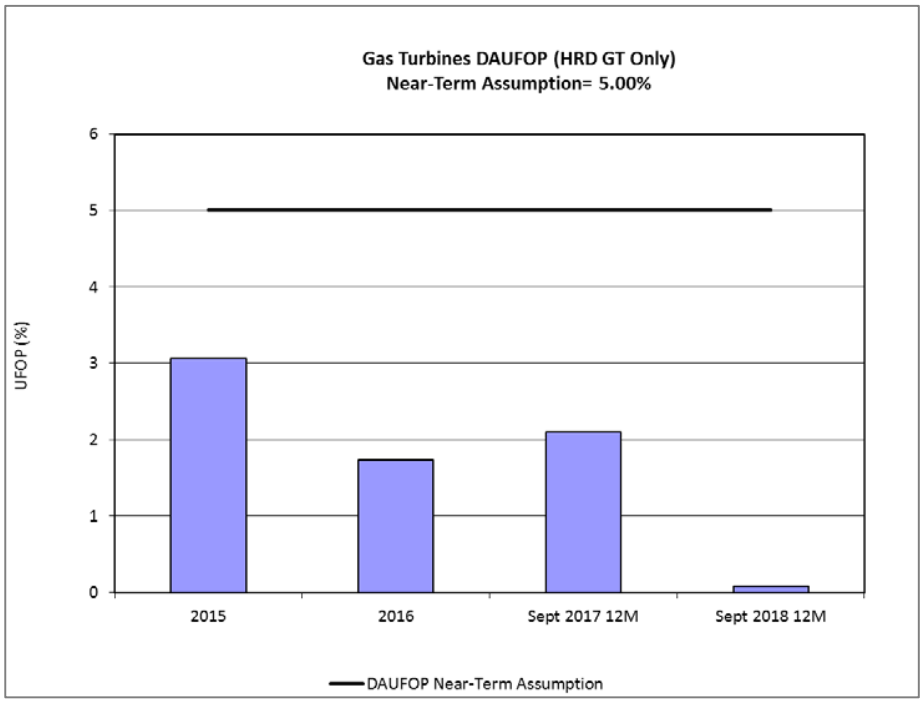

Figure 7: Gas Turbine DAUFOP – Holyrood Unit

The performance for the Stephenville, Hardwoods, and Happy Valley gas turbines was primarily affected by the following events:

- The Stephenville gas turbine DAUFOP for the period is 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 required 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.
- The Hardwoods gas turbine DAUFOP for the period is impacted by the unavailability of the unit due to a number of issues. The Hardwoods gas turbine End A became unavailable on May 28, 2018 due to an exhaust bellows failure. The bellows was removed and sent for repair and End A was returned to service on July 25, 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 the 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.

- 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 shutoff valve solenoid. The failure of the solenoid caused the 3-way valve to divert some fuel away from the engine as is its design. The reduced fuel flow to the engine caused the engine to be unable to sustain the required load and this resulted in the unit shutting down. A replacement solenoid was sourced, and when received the valve was repaired and the engine was released for service on November 9, 2017.

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January 31, 2019

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

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

Dear Ms. Blundon:

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

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

On November 16, 2018 Hydro filed the Reliability and Resource Adequacy Study with the Board of Commissioners of Public Utilities ("Board"). The Reliability and Resource Adequacy Study included Hydro's proposed planning assumptions for consultation and discussion with the Board and other stakeholders. For the enclosed report, which covers the performance of Hydro's generating units for the quarter ending December 31, 2018, the assumptions that were reported in the previous 2018 quarterly reports have been maintained for clarity prior to the transition to the new assumptions. Future quarterly reports will utilize the planning assumptions included within the Reliability and Resource Adequacy Study.

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

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Shirley A. Walsh
Senior Legal Counsel – Regulatory
SAW/kd

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 December 31, 2018

January 31, 2019

A Report to the Board of Commissioners of Public Utilities

newfoundland labrador hydro
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Table of Contents

1.0 Introduction

In this report, Newfoundland and Labrador Hydro ("Hydro") provides data on forced outage rates of its generating facilities. The data provided pertains to historical forced outage rates, and assumptions used by Hydro in its assessments of resource adequacy. On November 16, 2018 Hydro filed its Reliability and Resource Adequacy Study with the Board of Commissioners of Public Utilities ("Board"). The Study included Hydro's proposed planning assumptions for further discussion with the Board and intervenors. This quarterly report covers the performance of Hydro's generating units for the quarter ending December 31, 2018. The assumptions used throughout are the same as reported in the previous 2018 quarterly reports except where new assumptions are included and identified in Table 12. The continued use of the assumptions and style used in previous reports is to ensure clarity prior to the transition to the new assumptions. Future quarterly reports will utilize the planning assumptions included within the Reliability and Resource Adequacy Study.

The report contains forced outage rates for the current 12-month reporting period of January 1, 2018 to December 31, 2018 for individual generating units at hydraulic facilities, the Holyrood Thermal Generating Station, and Hydro's gas turbines. The report also provides, for comparison purposes, the individual generating unit data on forced outage rates for the previous period January 1, 2017 to December 31, 2017. Further, total asset class data is presented based on a calendar year for the years 2006-2016.

The forced outage rates of Hydro's generating units are calculated using three measures: Derated Adjusted Forced Outage Rate ("DAFOR") for the hydraulic and thermal units; and Utilization Forced Outage Probability ("UFOP") and 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 in order to provide a company total and reflect the relative impact a unit's performance has on overall generating

performance. This measure is applied to hydraulic and thermal units; however, it is not applicable to gas turbines because of their operation as standby units, and their relatively low operating hours.

UFOP and DAUFOP are measures used for gas turbines. UFOP measures the percentage of time that a unit or group of units will encounter a forced outage and not be available when required. DAUFOP 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, but this metric includes the impact of unit deratings.

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 under Canadian Electricity Association ("CEA") guidelines. CEA guidelines state to calculate derated levels of a generating unit a by converting the operating time at the derated level into an equivalent outage time.

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

Note that the data for 2006 to 2016 in Figures 1 through 7 are annual numbers (January 1 to December 31), while the data for 2017 and 2018 are 12-month rolling numbers (January 1 to December 31 for each year).

As part of its Reliability and Resource Adequacy Study, filed with the Board on November 16, 2018, Hydro detailed the process undertaken to determine the forced outage rates most appropriate for use in its near-term reliability assessments and long-term resource adequacy analysis. The revised forced outage rates, which were the outcome of this process, are included in Sections 8 and 9 of this report. The potential impacts of these revised forced outage rates on future performance reporting is also discussed.

2.0 Overview for Period Ending December 31, 2018

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

Class of Units	Jan 1, 2017 to Dec 31, 2017	Jan 1, 2018 to Dec 31, 2018	Base Planning Assumption	Near-term Planning Assumption[1]
Hydraulic (DAFOR)	2.29	0.21	0.90	2.60
Thermal (DAFOR)	14.91	28.97[2]	9.64	14.00
Gas Turbine (Combined) (UFOP)	6.93	3.62	10.62	20.00
Gas Turbine (Holyrood) (UFOP)	2.02	0.00	5.00	5.00
Gas Turbine (Hardwoods/ Stephenville) (DAUFOP)	19.72	21.67	-	30.00
Gas Turbine (Happy Valley) (DAUFOP)	22.18	2.11	-	15.00
Gas Turbine (Holyrood) (DAUFOP)	2.02	0.00	-	5.00

There was an improvement in hydraulic DAFOR and a decline in thermal DAFOR performance for the current 12-month period ending December 2018, compared to the previous 12-month period ending December 2017 (see 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 slight decline in performance.

[1] Near-term Generation Adequacy Report, November 15, 2017, see section 5.0 for further details.
[2] The thermal DAFOR is 12.74% with the air flow derating removed.
[3] Combined Gas Turbines include the Hardwoods, Happy Valley, and Stephenville units. The performance of the Holyrood unit was not included in the combined base planning or sensitivity numbers as these numbers were set prior to its 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 Bay d'Espoir Units 1 and 2 in 2016 and 2017.

For the Holyrood thermal units, the forced outage rate of the current period ending December 2018 is 28.97%[4], which is above the base planning assumption of 9.64%, the sensitivity of 11.64% (refer to Section 3), and above the near-term planning assumption of 14.00%.[5] This is primarily caused by an air flow 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 2018-2019 winter season due to the work that was completed to improve the unit's performance for air flow limitations. Unit 2 has been successfully tested to 175 MW,[6] and Unit 3 has been successfully tested to 150 MW. Unit 1 has been load tested to 162 MW. Following the load test in the fall of 2018, further investigation was completed on efforts required to reinstate the 8 MW. At this time, Hydro has not approved the project to proceed with reinstating the additional 8 MW. The time, cost, and potential risk to other parts of the generating system associated with suggested work are drivers for the decision not to proceed at this time.

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.

Hydro began reporting DAUFOP performance in January 2018, for which the first full 12-month period ending December 31, 2018 is included. For the current 12-month period, the combined

[4] The thermal DAFOR is 12.74% with the air flow derating removed.
[5] 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 of the other assets contributed to this outcome. Further, the near-term planning assumption is a probabilistic view of system performance under various criteria.
[6] The unit has normally been considered capable of sustained running at 170 MW. Under the right conditions and with the boiler in very clean condition, it is able to go to 175 MW. However, at this maximum limit, the unit is unable to respond to load increases and as normal fouling from operation progresses, it might not be available. Therefore, this 5 MW is not part of the continuous rating and is not used for planning purposes, but would be used if available and required by the system.

gas turbines DAUFOP (Hardwoods and Stephenville units only) performance is primarily impacted by a lengthy forced outage to the Stephenville unit.

3.0 Generation Planning Assumptions

The Reliability and Resource Adequacy Study submitted to the Board in November 2018 introduced new generation planning assumptions; however, the assumptions used throughout this report are the same as reported in the previous 2018 quarterly reports. The potential impacts of these revised assumptions on reporting of generation unit performance are discussed in Section 9 of this report. The continued use of the assumptions and style used in previous reports is to ensure clarity prior to the transition to the new assumptions.

Hydro produced reports based on comprehensive reviews of energy supply for the Island Interconnected System ("IIS"). This is part of Hydro's analysis of energy supply up to the Muskrat Falls interconnection. The most recent Near-Term Generation Adequacy report, filed on May 22, 2018 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. The near-term analysis has been updated since that time to reflect changes in assumptions around the in-service of the Labrador-Island Link ("LIL"). The results of this analysis were presented to the Board as part of the LIL In-Service Update submitted October 1, 2018. This analysis will be updated accordingly if asset assumptions change materially.

Hydro's DAFOR and UFOP planning assumptions are provided in Table 2. The Holyrood gas turbine has a lower expected rate of unavailability than the older gas turbines, (5% compared to 10.62%), due to the fact that the unit is new and can be expected to have better availability than the older units.[7]

[7] 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[8] 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	20.00
Gas Turbines - New			5.0	10.0

The DAFOR and DAUFOP assumptions used in developing Hydro's May 2018 Near-Term Generation Adequacy report are noted in Table 3.

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

	DAFOR (%) Near-Term Generation Adequacy Assumption	DAUFOP (%) 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	
Hardwoods & Stephenville Gas Turbines		30.0
Happy Valley Gas Turbine		15.0
Holyrood Gas Turbine		5.0

4.0 Hydraulic Unit DAFOR Performance

Detailed results for the 12-month period ending December 31, 2018, are presented in Table 4, as well as the data for the 12-month period ending December 31, 2017. These are compared to Hydro's short term generation adequacy assumptions, as used in the May 2018 Near-Term Generation Adequacy report, and Hydro's long-term generation planning assumptions for the forced outage rate.

[8] Near-term Generation Adequacy Report, November 15, 2017, see section 5.0 for further details.

Table 4: Hydraulic Weighted DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending December 2017 (%)	12 months ending December 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Hydraulic Units - weighted	954.4	2.29	0.21	0.90	2.60
Hydraulic Units					
Bay D'Espoir 1	76.5	9.33	0.07	0.90	3.90
Bay D'Espoir 2	76.5	14.11	0.64	0.90	3.90
Bay D'Espoir 3	76.5	0.03	0.00	0.90	3.90
Bay D'Espoir 4	76.5	0.27	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	1.48	0.54	0.90	3.90
Bay D'Espoir 7	154.4	1.80	0.00	0.90	3.90
Cat Arm 1	67	0.22	0.94	0.90	0.70
Cat Arm 2	67	0.09	0.00	0.90	0.70
Hinds Lake	75	0.89	0.07	0.90	0.70
Upper Salmon	84	0.81	0.15	0.90	0.70
Granite Canal	40	0.11	0.45	0.90	0.70
Paradise River	8	1.70	0.00	0.90	0.70

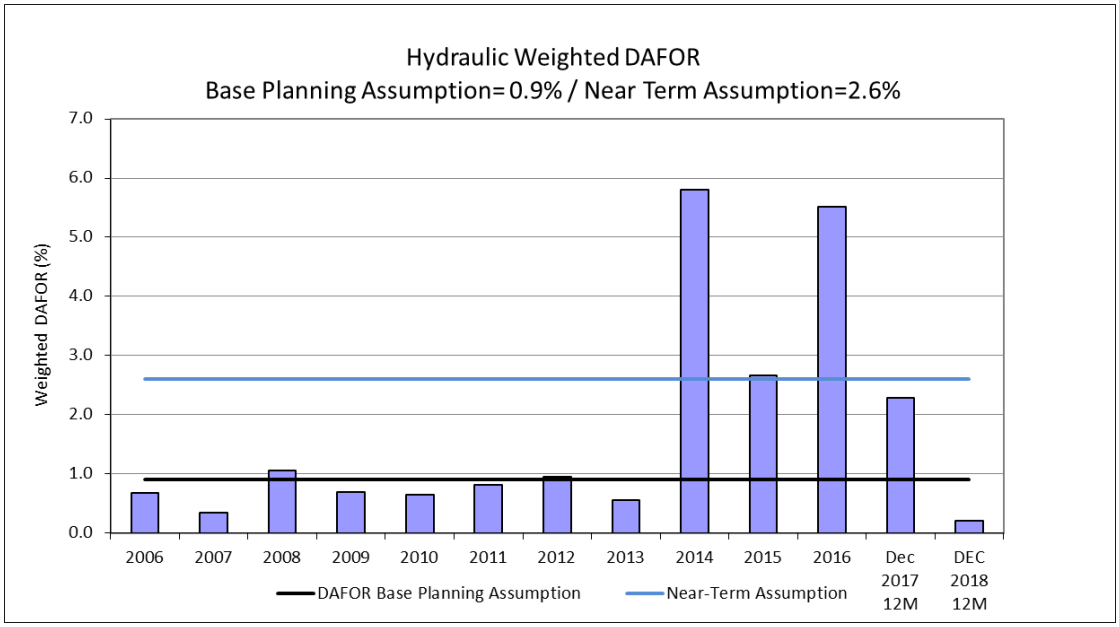

Figure 1: Hydraulic Weighted DAFOR

1 Considering the individual unit performance, the Hydro generation base planning DAFOR was
2 exceeded for Cat Arm Unit 1 for the current period.

The Cat Arm Unit 1 DAFOR of 0.94% exceeded the base planning assumption of 0.9% and the near-term assumption of 0.7% for an individual Cat Arm unit. This was due to a forced derating of Cat Arm Unit 1 from 67 MW to 57 MW for the period of July 5, 2018 to August 6, 2018 as a result of an issue with Needle #1 transducer feedback. This issue has since been resolved by replacement of the needle feedback transducer during the annual maintenance outage for the unit.

5.0 Thermal Unit DAFOR Performance

Detailed results for the 12-month period ending December 31, 2018, are presented in Table 5, as well as the data for the 12-month period ending December 31, 2017. These are compared to Hydro's short term generation adequacy assumptions, as used in the May 2018 Near-Term Generation Adequacy report, and Hydro's long-term generation planning assumptions for the forced outage rate.

Table 5: Thermal DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending December 2017 (%)	12 months ending December 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
All Thermal Units - weighted	490	14.91	28.97	9.64	14.00
Thermal Units					
Holyrood 1	170	19.35	36.66	9.64	15.00
Holyrood 2	170	19.14	24.03	9.64	10.00
Holyrood 3	150	5.84	22.80	9.64	18.00

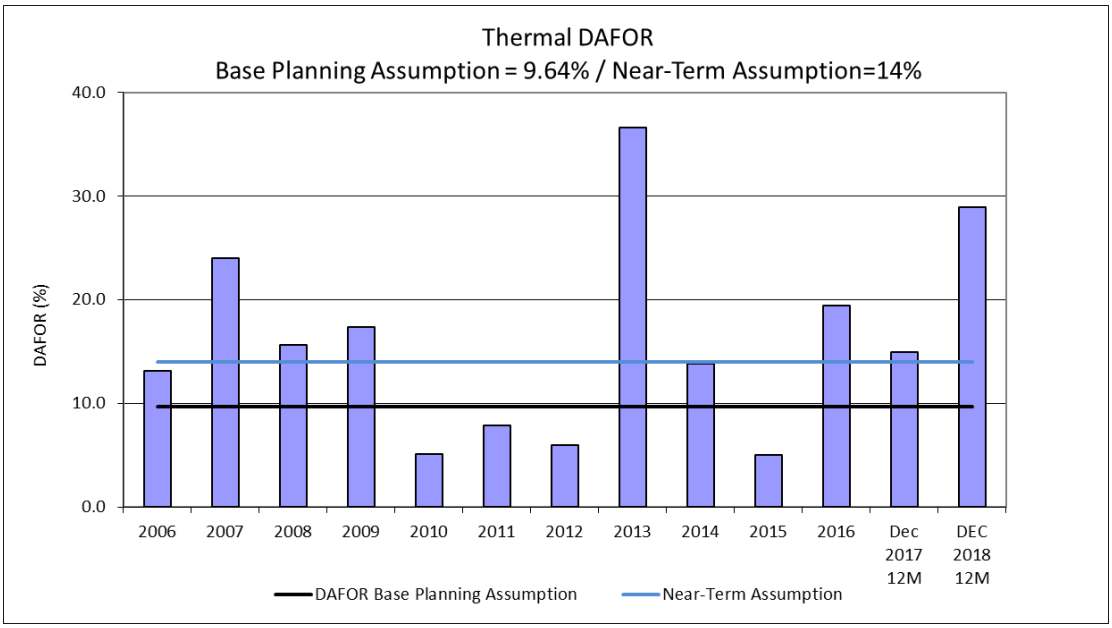

Figure 2: Thermal DAFOR

For the 12-month period ending December 31, 2018, the weighted DAFOR for all thermal units of 28.97%[9] is above the assumed Hydro generation base planning DAFOR value of 9.64%, and the near-term assumption of 14.00%. Unit 1 DAFOR was 36.66% and Unit 2 DAFOR was 24.03%. 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 22.80%, which is above the base planning assumption of 9.64% and 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 capability of the unit declined during the winter operating season due to ongoing fouling during operation. The capability was 150 MW at the beginning of the year. 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, 2018 to address the issue. 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

[9] The thermal DAFOR is 12.74% with the air flow derating removed.

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 General Electric 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 (12,500 psi) was completed on the air heater baskets.

- 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 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 up. The contaminated insulation was replaced and close inspection of the bearing confirmed no active leak. The unit was returned to service on February 25, 2018.
- On February 28 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 drive ("VFD") 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 VFD 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 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 determined to be a failure of a turbine control valve stem. The valve stem was replaced during the planned 2018 turbine valve outage.
- 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 2018 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. This 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 had to be replaced. The unit returned to service on June 18, 2018 but the same bearing failed after only a few hours of operation. The bearing was again replaced and the unit was successfully returned to service on June 19, 2018. A field representative from the fan's original equipment manufacturer travelled to site to assist with the failure analysis of these bearings. It was concluded that the bearing liner babbitted surface failed. Additional checks have been added to the Preventive Maintenance work for these bearings to prevent such a failure.
- The planned maintenance outage for Unit 1 started on July 27, 2018. Outage work included a chemical wash of the economizer, and replacement of the hot end air heater baskets to address air flow and furnace pressure load restrictions.
- The unit was returned to service following the annual outage on October 20, 2018, with a load restriction of 140 MW pending completion of on-line safety valve testing. After completion of the valve testing, the available load was confirmed to be 162 MW on December 6, 2018 and continued to year end. Boiler tuning was completed by a boiler tuning expert from December 17, 2018 to December 20, 2018. This improved the operation of the boiler, but did not increase the available load.
- On November 3, 2018, the unit tripped due to contamination in the turbine hydraulic system. A full overhaul was completed and the unit was returned to service on

November 24, 2018. The observations on Unit 1 triggered the same refurbishment of the Unit 2 turbine hydraulic system, which was completed in December 2018.

- On December 9, 2018, the unit tripped due to a failure of a potential transformer ("PT"), which led to the immediate failure of a second PT. The PTs were replaced with available spares. Electrical testing was completed on the remaining four PTs and the generator windings before returning the unit to service on December 14, 2018. No further issues were identified.

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

- The capability of the unit declined during the winter operating season 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 2018 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 capacity. 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 off for a short, planned outage to replace generator brushes. There was a forced extension to this outage when a unit board breaker tripped during re-start 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 servos on these valves. To address this problem, the hydraulic fluid was replaced and the system flushed during the 2018 annual outage. Additional flushing and maintenance of the hydraulic system was completed in a maintenance outage in December 2018 based on observations and issues observed in Unit 1 in November 2018.

- 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 off line 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. TRO replaced the B2T2 breaker during the 2018 annual outage, which resolved this issue.
- 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, not a thinning failure, of a tube in the lower water wall (not in the area of previous boiler tube issues). At the time of the failure, Hydro determined that the unit was no longer required for system reliability reasons prior to the scheduled planned outage and could be placed on planned outage in preparation for the annual overhaul.
- The tube leak was corrected during the overhaul. Two adjacent leaking tubes were found in the lower front wall. Through investigation and laboratory failure analysis it was determined that the original failure occurred at a butt welded joint in the tube, and that this weld was part of the original construction, and of relatively poor quality. Other welds in the area were inspected with no damage found. The leak had been present for an unknown period of time underneath the boiler casing and impinged upon the

adjacent tube, which also failed as a result. Several other tubes in the immediate area were corroded due to the presence of the leak, but had not failed. A total of seven tube sections were replaced.

- Also during the planned overhaul, work was completed to correct the air flow and furnace pressure issues in the boiler. A chemical wash of the economizer was completed and the hot end air heater baskets were replaced. The unit was returned to service on September 15, 2018 with the fuel additive system in service and it was immediately noted that the furnace pressure and air flow conditions had been greatly improved. Equipment issues related to start up caused a number of short forced outages and de-rates during the first few days of operation. On September 21, 2018, the unit was load tested to 140 MW, limited because the on-line safety valve testing had not been completed. However, it was clear from the boiler performance that full load should be achievable. This was later confirmed on October 11, 2018 when the unit was tested to 171 MW and was capable of more.
- On September 26, 2018 there was a boiler trip related to starting a boiler feed pump. The fan was in vane control and it was demonstrated that this trip would not occur in VFD air flow control. The fans were switched to VFD control mode, which ensures that the drives are more reliable, and that the savings on auxiliary power use can be realized.
- On October 16, 2018, there was a bypass of a power cell in one VFD drive, which caused a fan to trip resulting in a short derating to 70 MW until the fan could be restarted.

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

- The capability of the unit declined during the winter operating season due to ongoing fouling during operation. On December 31, 2017, the available load was 131 MW. On January 18, 2108 the available load was determined to be 120 MW, and on February 10, 2018, this had further reduced to 100 MW. An air heater wash outage was completed from February 10, 2018 to February 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 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 started on April 2, 2018.

- 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 because of 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.
- The annual outage was from April 2, 2018 until June 1, 2018. Air flow issues could not be corrected during the annual outage because of the long lead times for replacement air heater materials. The remainder of the planned work was completed, and a two week outage was planned for October 2018 to complete the air heater work required to restore load capability.
- The Unit 3 generator was put in service in synchronous condenser mode on June 1, 2018 and ran until September 24, 2018, when it was taken off line for a maintenance outage to replace some generator brushes. There was a problem with the drive controller that prevented re-start of the synchronous condenser. On September 28, 2018 the unit was placed on a maintenance outage to prepare for conversion to generation mode.
- The hot end air heater baskets were replaced during the outage in October 2018 to address the air flow restrictions on the unit. The unit returned to service on October 30, 2018, limited to 140 MW pending on-line testing of the safety valves, which was

completed on November 6, 2018. Full load capability to 150 MW was confirmed by load test on December 2, 2018, and available at 150 MW for the remainder of 2018.

- On November 13, 2018, the unit tripped due to an issue with the west boiler feed pump discharge valve. The unit was returned to service later that same day after troubleshooting.
- On November 15, 2018 the unit was taken off line on a forced outage to repair a water wall tube leak. The unit was returned to service on November 20, 2018.
- On December 3, 2018 the unit tripped when an operator changed control to a drum level transmitter that had a fault. Unit protection operated properly and the unit was returned to service within an hour.

6.0 Gas Turbine UFOP Performance

The combined UFOP for the Hardwoods, Happy Valley and Stephenville gas turbines was 3.62% for the 12-month period ending December 31, 2018 (see Table 6 and Figure 3). This is below the base planning assumption of 10.62%, and the near-term assumption of 20.00%. The current period UFOP is significantly better than the previous period UFOP of 6.93%. The Hardwoods UFOP for the current period is 4.80%, which is better than the base planning assumption of 10.62%. The Stephenville UFOP for the current period is 1.45%, which is better than the base planning assumption of 10.62%. The Happy Valley UFOP is 2.11% for the current period, which is below the base planning assumption of 10.62%.

Table 6: Gas Turbine UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2017 (%)	12 months ending December 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Combined Gas Turbines	125	6.93	3.62	10.62	20.00
Stephenville	50	5.59	1.45	10.62	20.00
Hardwoods	50	2.91	4.80	10.62	20.00
Happy Valley	25	19.32	2.11	10.62	20.00

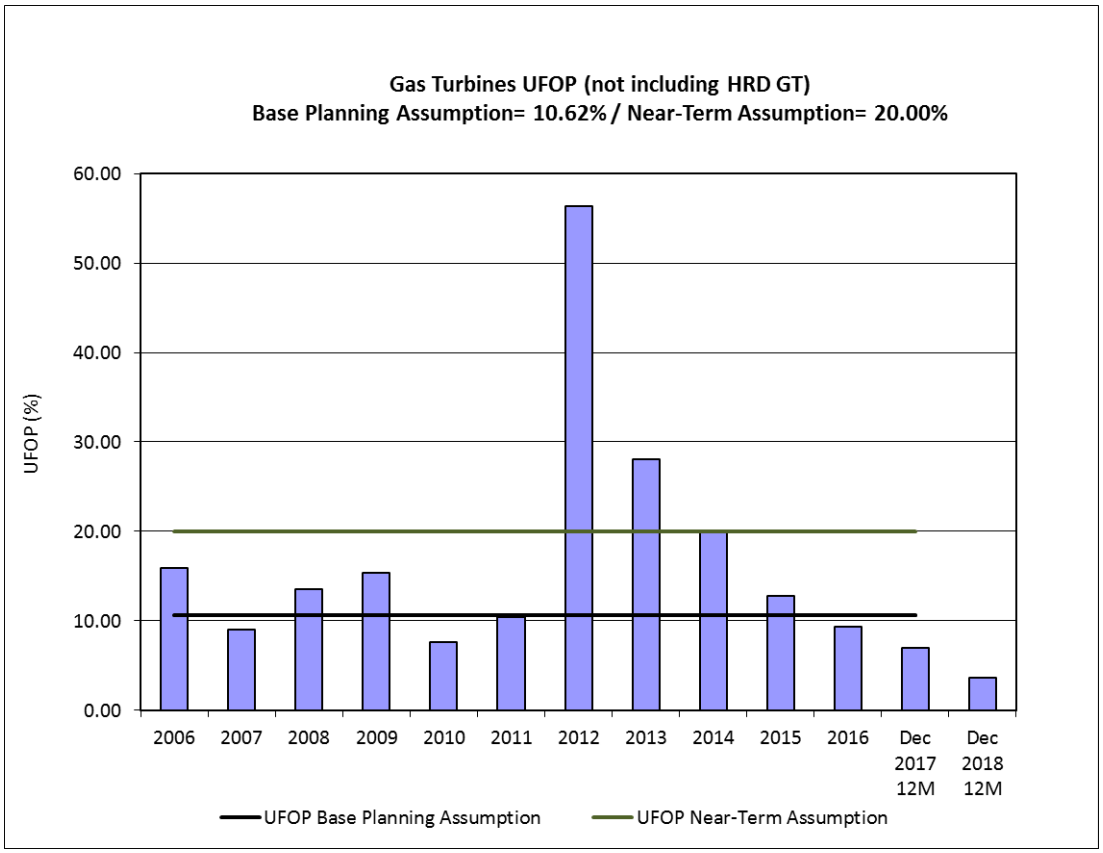

Figure 3: Gas Turbine UFOP – Hardwoods/Happy Valley/Stephenville Units

The Holyrood UFOP of 0.00% for the current period is better than the base and near-term planning assumptions of 5.00% (see Table 7 and Figure 4).

Table 7: Holyrood GT UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2017 (%)	12 months ending December 2018 (%)	Hydro Generation Base Planning Assumption (%)	Near-Term Planning Assumption (%)
Holyrood GT	123.5	2.02	0.00	5.00	5.00

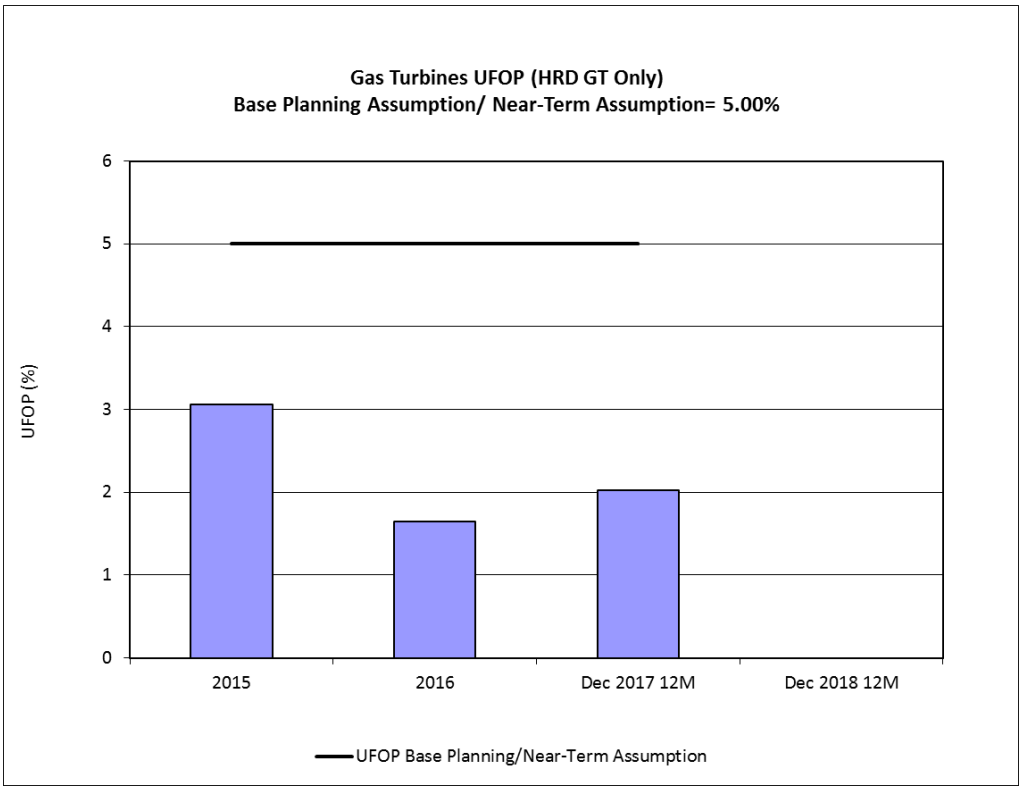

Figure 4: Gas Turbine UFOP – Holyrood Unit

7.0 Gas Turbine DAUFOP Performance

The combined DAUFOP for the Hardwoods and Stephenville gas turbines was 21.67% for the 12-month period ending December 31, 2018 (refer to Table 8 and Figure 5). This is below the near-term planning assumption of 30.00%. The Hardwoods DAUFOP for the current period is 8.28%, which is better than the near-term planning assumption of 30.00%. The Stephenville DAUFOP for the current period is 47.48%, which is above the near-term planning assumption of 30.00%.

Table 8: Hardwoods/Stephenville Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2017 (%)	12 months ending December 2018 (%)	Near-Term Planning Assumption (%)
Gas Turbines (HWD/SVL)	100	19.72	21.67	30.00
Stephenville	50	40.06	47.48	30.00
Hardwoods	50	10.86	8.28	30.00

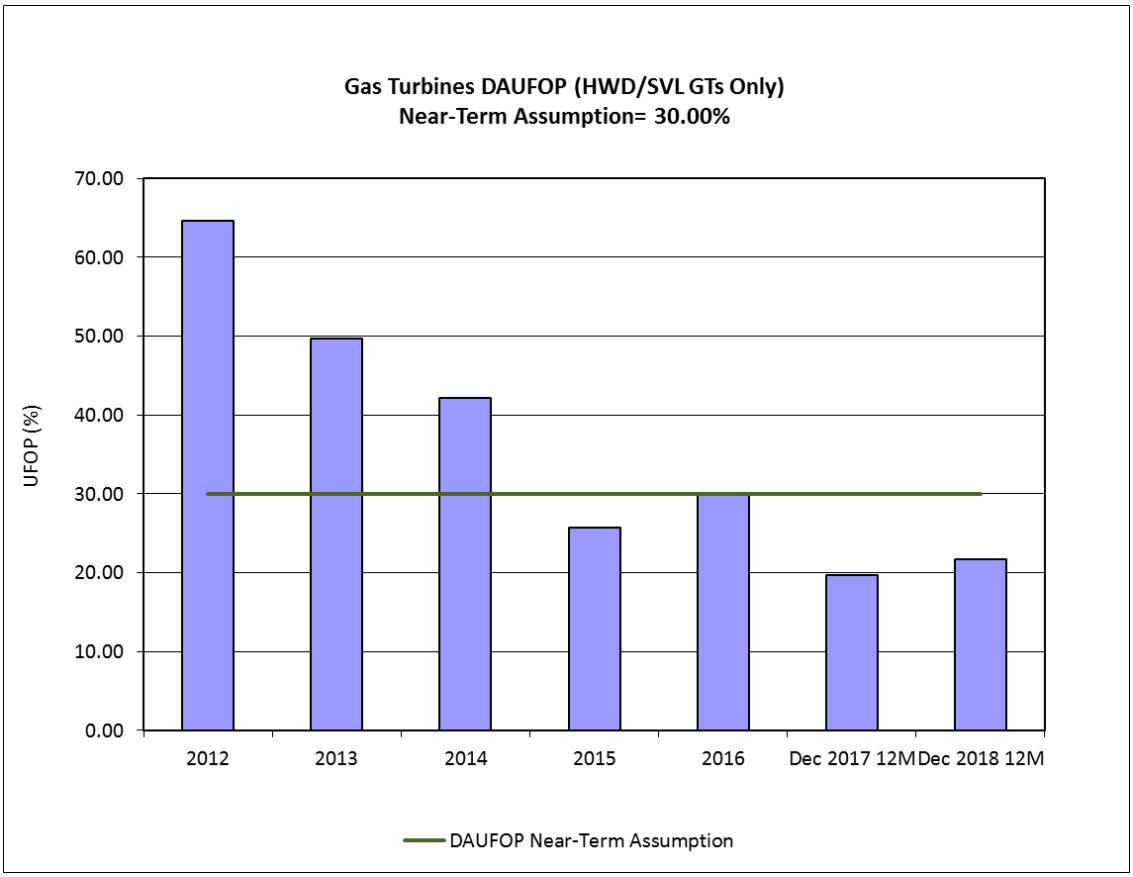

Figure 5: Gas Turbine DAUFOP – Hardwoods/Stephenville Units

The DAUFOP for the Happy Valley gas turbine was 2.11% for the 12-month period ending December 31, 2018 (refer to Table 9 and Figure 6). This is below the near-term planning assumption of 15.00%.

Table 9: Happy Valley Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2017 (%)	12 months ending December 2018 (%)	Near-Term Planning Assumption (%)
Happy Valley	25	22.18	2.11	15.00

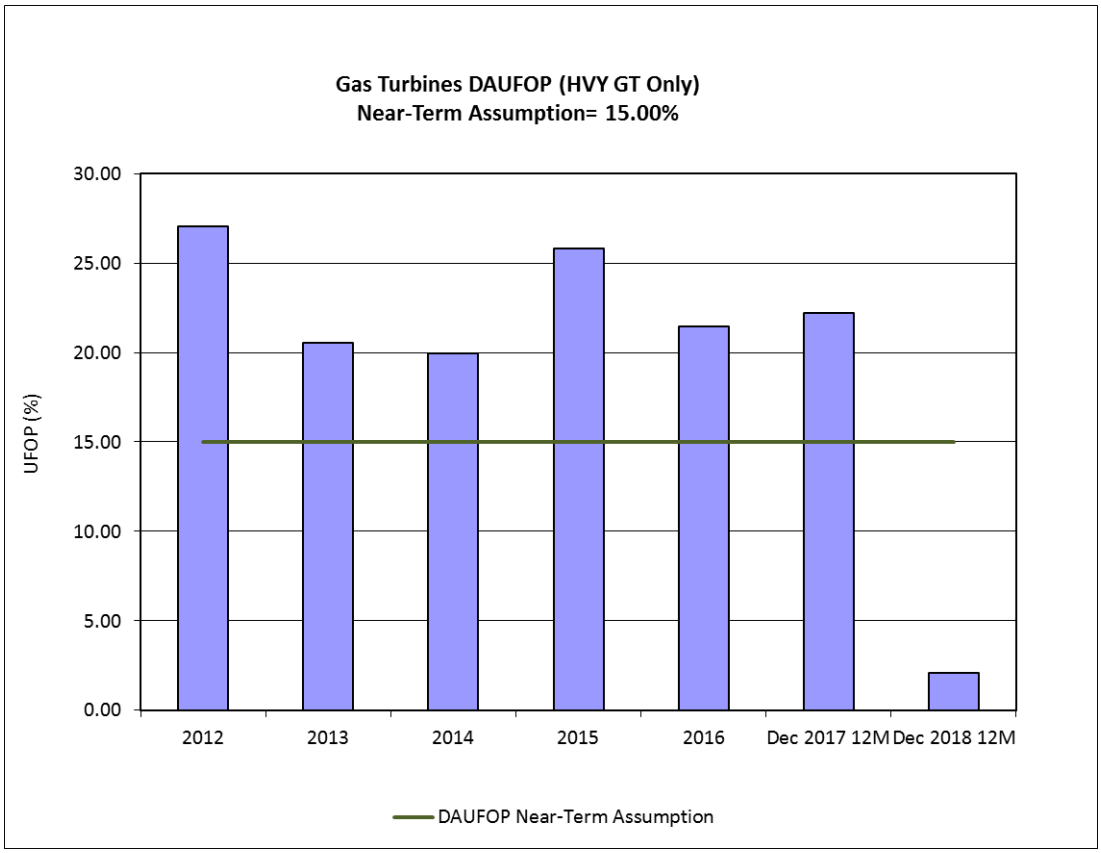

Figure 6: Gas Turbine DAUFOP – Happy Valley Unit

The Holyrood gas turbine DAUFOP of 0.00% for the current period is better than the near-term planning assumption of 5.00% (see Table 10 and Figure 7).

Table 10: Holyrood Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2017 (%)	12 months ending December 2018 (%)	Near-Term Planning Assumption (%)
Holyrood GT	123.5	2.02	0.00	5.00

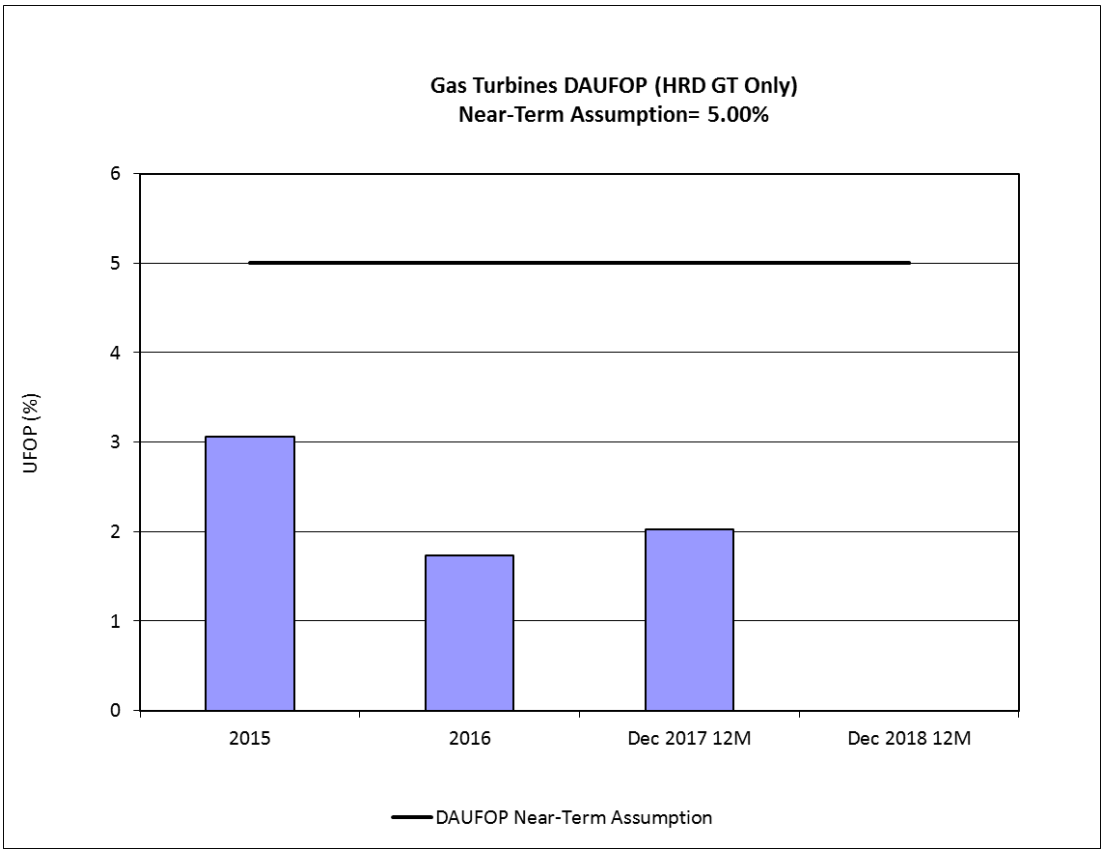

Figure 7: Gas Turbine DAUFOP – Holyrood Unit

The Stephenville gas turbine DAUFOP for the period is 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. Stephenville End A was unavailable at this time due to issues with the power turbine rear bearing, which required 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.

8.0 Updated Planning Assumptions/Analysis Values

As part of its Reliability and Resource Adequacy Study filed with the Board in November 2018, Hydro detailed the process undertaken for determining the forced outage rates most appropriate for use in its near-term reliability assessments and long-term resource adequacy analysis. The Table 11 summarizes the analysis values that were utilized in the study.

Table 11: Hydro's Reliability and Resource Adequacy Study Analysis Values

Unit Type	Measure	Near-term Analysis Value (%)	Resource Planning Analysis Value (%)
Hydraulic	DAFOR	3.50	1.93
Thermal	DAFOR	15	N/A
Gas Turbines:			
Happy-Valley	DAUFOP	13.92	12.59
Hardwoods, Stephenville	DAUFOP	30	N/A
Holyrood	DAUFOP	3.06	2.24

For the hydroelectric units (Bay d'Espoir, Cat Arm, Hinds Lake, Granite Canal, Upper Salmon, and Paradise River) a three-year capacity-weighted average was applied to these units for the near-term analysis, resulting in a DAFOR of 3.50%, while a ten-year capacity-weighted average was applied for use in the resource planning model, resulting in a DAFOR of 1.93%. The DAFOR value was based on historical data which is reflective of Hydro's maintenance program over the long term.

DAFORs of 15, 18, and 20% were applied to the Holyrood Thermal Generating Station in order to determine the sensitivity of the system to Holyrood availability in the near term. This is consistent with the May 2018 Near-Term Generation Adequacy Report. As the Holyrood units are being retired from generation mode in 2021, they were not included in the long term analysis and thus there is no resource planning analysis value listed for these units. For the total plant, an all units weighted value of 15.00% is used.

As the gas turbines in the existing fleet are in varied condition, each was considered on an individual basis, rather than applying a weighted average across all units. For the Happy Valley gas turbine, a three-year capacity-weighted average was applied to the unit for the near-term analysis, resulting in a DAUFOP of 13.92%, while a ten-year capacity-weighted average was applied for use in the resource planning model resulting in a DAUFOP of 12.59%. The DAUFOP

values were based on historical data founded upon the unit's past reliable performance. As the Holyrood gas turbine has only been in operation for the past three years, the near-term analysis considered performance in the worst case year of its operational history[10]. For the long term analysis, the average of the three years of operational data was applied for the unit, resulting in a long-term DAUFOP of 2.24%. For the Hardwoods and Stephenville gas turbines, a DAUFOP of 30% was used for the near-term analysis, consistent with what was considered in Hydro's May 2018 Near-Term Generation Adequacy Report. As the Hardwoods and Stephenville gas turbines are being considered for retirement in 2021, they were not included in the longer term analysis and thus there is no resource planning analysis value listed for these units.

9.0 Comparison of Planning Assumptions/Analysis Values

As Hydro's reliability and adequacy planning assumptions have been historically used in reporting on the performance of Hydro's generating units, a comparison of the values used most recently (May 2018 Near Term Generation Adequacy Report) to these new values (November 2018 Reliability and Resource Adequacy Study) is provided in Table 12 for clarity.

Hydro notes that the Reliability and Resource Adequacy Study did not utilize UFOP in its analysis. The analysis utilized instead the DAUFOP measure with changes as shown in the table.

[10] The Holyrood gas turbine had a DAUFOP of 3.06% for 2015.

Table 12: Comparison of Hydro's Planning Assumptions

Generating Unit Type	Measure	Historical Planning Assumptions		Reliability and Resource Planning Assumptions	
		Base Planning Assumption (%)	Near-term Planning Assumption (%)	Near-term Analysis Value (%)	Resource Planning Analysis Value (%)
Hydraulic	DAFOR	0.9	2.60	3.50	1.93
Thermal	DAFOR	9.64	14.00	15.00	N/A
Gas Turbines:					
Happy-Valley	DAUFOP	-	15.00	13.92	12.59
Hardwoods, Stephenville	DAUFOP	-	30.00	30.00	N/A
Holyrood	DAUFOP	-	5.00	3.06	2.24

The generating unit performance presented previously in this report is again presented in Tables 13 to 17 with comparison to the previous assumptions as well as the recently revised values. No table is provided for the UFOP performance, as Hydro does not plan to use this metric in future for reliability assessments.

Table 13: Hydraulic Weighted DAFOR Performance Comparison

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending December 2017 (%)	12 months ending December 2018 (%)	May 2018		November 2018	
				Base Planning Assumption (%)	Near-term Planning Assumption (%)	Near-Term Planning Analysis Value (%)	Resource Planning Analysis Value (%)
All Hydraulic Units - weighted	954.4	2.29	0.21	0.9	2.6	3.50	1.93
Hydraulic Units							
Bay D'Espoir 1	76.5	9.33	0.07	0.90	3.90	3.50	1.93
Bay D'Espoir 2	76.5	14.11	0.64	0.90	3.90	3.50	1.93
Bay D'Espoir 3	76.5	0.03	0.00	0.90	3.90	3.50	1.93
Bay D'Espoir 4	76.5	0.27	0.15	0.90	3.90	3.50	1.93
Bay D'Espoir 5	76.5	0.00	0.00	0.90	3.90	3.50	1.93
Bay D'Espoir 6	76.5	1.48	0.54	0.90	3.90	3.50	1.93
Bay D'Espoir 7	154.4	1.80	0.00	0.90	3.90	3.50	1.93
Cat Arm 1	67	0.22	0.94	0.90	0.70	3.50	1.93
Cat Arm 2	67	0.09	0.00	0.90	0.70	3.50	1.93
Hinds Lake	75	0.89	0.07	0.90	0.70	3.50	1.93
Upper Salmon	84	0.81	0.15	0.90	0.70	3.50	1.93
Granite Canal	40	0.11	0.45	0.90	0.70	3.50	1.93
Paradise River	8	1.70	0.00	0.90	0.70	3.50	1.93

Table 14: Thermal Unit DAFOR Performance Comparison

Generating Unit	Maximum Continuous Unit Rating (MW)	12 months ending December 2017 (%)	12 months ending December 2018 (%)	May 2018		November 2018	
				Base Planning Assumption (%)	Near-term Planning Assumption (%)	Near-Term Planning Analysis Value (%)	Resource Planning Analysis Value (%)
All Thermal Units - weighted	490	14.91	28.97	9.64	14.00	15.00	N/A
Thermal Units							
Holyrood 1	170	19.35	36.66	9.64	15.00	15.00	-
Holyrood 2	170	19.14	24.03	9.64	10.00	15.00	-
Holyrood 3	150	5.84	22.80	9.64	18.00	15.00	-

Table 15: Hardwoods/Stephenville Gas Turbine DAUFOP Performance Comparison

				May 2018		November 2018	
Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2017 (%)	12 months ending December 2018 (%)	Base Planning Assumption (%)	Near-term Planning Assumption (%)	Near-Term Planning Analysis Value (%)	Resource Planning Analysis Value (%)
Gas Turbines (HWD/SVL)	100	19.72	21.67	N/A	30.00	30.00	N/A
Stephenville	50	40.06	47.48	N/A	30.00	30.00	N/A
Hardwoods	50	10.86	8.28	N/A	30.00	30.00	N/A

Table 16: Happy Valley Gas Turbine DAUFOP Performance Comparison

				May 2018		November 2018	
Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2017 (%)	12 months ending December 2018 (%)	Base Planning Assumption (%)	Near-term Planning Assumption (%)	Near-Term Planning Analysis Value (%)	Resource Planning Analysis Value (%)
Happy Valley	25	22.18	2.11	N/A	15.00	13.92	12.59

Table 17: Holyrood Gas Turbine DAUFOP Performance Comparison

				May 2018		November 2018	
Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending December 2017 (%)	12 months ending December 2018 (%)	Base Planning Assumption (%)	Near-term Planning Assumption (%)	Near-Term Planning Analysis Value (%)	Resource Planning Analysis Value (%)
Holyrood	123.5	2.02	0.00	N/A	5.00	3.06	2.24