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April 28, 2023

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

Attention: Cheryl Blundon
Director of Corporate Services and Board Secretary

Re: Quarterly Report on Performance of Generating Units for the Twelve Months Ended March 31, 2023

Please find enclosed Newfoundland and Labrador Hydro's Quarterly Report on Performance of Generating Units for the Twelve Months Ended March 31, 2023.

Should you have any questions, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

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

Encl.

ecc:

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Quarterly Report on Performance of Generating Units

For the Twelve Months Ended March 31, 2023

April 28, 2023

A report to the Board of Commissioners of Public Utilities

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 Hydro uses in its assessments of resource adequacy. This report covers the performance of Hydro's generating units for the 12 months ended March 31, 2023.

This report contains forced outage rates for the current 12-month reporting period of April 1, 2022 to March 31, 2023 for individual generating units at hydraulic facilities, the Holyrood Thermal Generating Station ("Holyrood TGS"), and Hydro's gas turbines. This report also provides, for comparison purposes, the individual generating unit data on forced outage rates for the period of April 1, 2021 to March 31, 2022. Further, total asset class data is presented based on the calendar year for the years 2006 to 2020.

The forced outage rates of Hydro's generating units are calculated using three measures: 1) Derated Adjusted Forced Outage Rate ("DAFOR") for the hydraulic and thermal units, 2) Utilization Forced Outage Probability ("UFOP"), and 3) Derated Adjusted Utilization Forced Outage Probability ("DAUFOP") for the gas turbines.

DAFOR is a metric that measures the percentage of time that a unit or group of units is unable to generate at its maximum continuous rating due to forced outages or unit deratings. 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; 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. 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 Electricity Canada[1] guidelines. These guidelines require that derated levels of a generating unit are calculated 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.

The assumptions referred to throughout this report are the same as those reported in the 2018 quarterly reports except for the assumptions identified in Table 12. As part of its Reliability and Resource Adequacy Study, 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 values have been updated to reflect the most current outage data, and the revised forced outage rates that resulted from this process are included in Sections 8.0 and 9.0 of this report. The potential impacts of these revised forced outage rates on future performance reporting are also discussed. While these assumptions form the basis of Hydro's current planning processes, this report also includes the historical assumptions and style to maintain similarity to previous reports.

2.0 Overview for Period Ending March 31, 2023

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

Class of Units	1-Apr-2021 to 31-Mar-2022	1-Apr-2022 to 31-Mar-2023	Base Planning Assumption	Near-Term Planning Assumption[2]
Hydraulic (DAFOR)	3.00	2.60	0.90	2.60
Thermal (DAFOR)	33.84	12.67	9.64	14.00
Combined Gas Turbine (UFOP)	0.16	3.70	10.62	20.00
Holyrood Gas Turbine (UFOP)	0.00	0.00	5.00	5.00
Hardwoods/Stephenville Gas Turbine (DAUFOP)	1.40	6.12	-	30.00
Happy Valley Gas Turbine (DAUFOP)	0.00	0.00	-	15.00
Holyrood Gas Turbine (DAUFOP)	0.00	0.00	-	5.00

As shown in Table 1, hydraulic and thermal DAFOR performance improved for the current 12-month period ending March 31, 2023 compared to the 12 months ending March 31, 2022. The UFOP

[1] Formerly Canadian Electricity Association.
[2] Please refer to the "Near-Term Generation Adequacy Report," Newfoundland and Labrador Hydro, November 15, 2017, s. 5.0 for further details.

performance for the combined gas turbines has declined over the previous period, while the UFOP performance for the Holyrood Gas Turbine remains unchanged. The DAUFOP[3] performance for Hardwoods and Stephenville has declined, the DAUFOP performance for Happy Valley Gas Turbine and the Holyrood Gas Turbine remains unchanged in the current period compared to the 12 months ending March 31, 2022.

3.0 Generation Planning Assumptions

The Reliability and Resource Adequacy Study introduced new generation planning assumptions; however, the assumptions used throughout this report are the same as reported in previous quarterly reports. The potential impacts of the revised assumptions on reporting of generation unit performance are discussed in Section 9.0 of this report. While the revised assumptions form the basis of Hydro's current planning processes, this report also includes the historical assumptions and style to maintain similarity to previous reports while the regulatory process surrounding the *Reliability and Resource Adequacy Study Review* proceeding remains underway.

Hydro produces reports based on comprehensive reviews of the energy supply for the Island Interconnected System. This is part of Hydro's analysis of energy supply up to the Muskrat Falls interconnection. The May 2018 "Near-Term Generation Adequacy Report,"[4] contains an analysis based on the near-term DAFOR and DAUFOP and the resulting implications 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 with respect to the in-service of the Labrador-Island Link. The results of this analysis were presented to the Board of Commissioners of Public Utilities as part of the "Labrador-Island Link In-Service Update."[5]

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%) as the unit is newer and can be expected to have better availability than the older units.[6]

[3] Hydro began reporting DAUFOP performance in January 2018 for its gas turbines.
[4] "Near-Term Generation Adequacy Report," Newfoundland and Labrador Hydro, rev. May 30, 2018 (originally filed May 22, 2018).
[5] "Labrador-Island Link In-Service Update," Newfoundland and Labrador Hydro, October 1, 2018.
[6] Hydro selected a 5% UFOP for the new Holyrood Gas Turbine following commentary on forced outage rates contained in the "Independent Supply Decision Review," Navigant Consulting Ltd., September 14, 2011, filed as Attachment 1 to Hydro's response to PUB-NLH-010 from the *Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System* proceeding.

Table 2: 2017[7] 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 the 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 TGS	14.0	-
Hardwoods and 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 months ending March 31, 2023 and the 12 months ending March 31, 2022 are presented in Table 4 and Chart 1. 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.

[7] Please refer to "Near-Term Generation Adequacy Report," Newfoundland and Labrador Hydro, November 15, 2017, s. 5.0 for further details.

Table 4: Hydraulic Weighted DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 Months Ending Mar 2022 (%)	12 Months Ending Mar 2023 (%)	Historical Base Planning Assumption (%)	Historical Near-Term Planning Assumption (%)
All Hydraulic Units – Weighted	**954.4**	**3.00**	**2.60**	**0.90**	**2.60**
Hydraulic Units					
Bay d'Espoir 1	76.5	3.31	0.00	0.90	3.90
Bay d'Espoir 2	76.5	0.00	0.00	0.90	3.90
Bay d'Espoir 3	76.5	0.00	0.06	0.90	3.90
Bay d'Espoir 4	76.5	0.00	0.20	0.90	3.90
Bay d'Espoir 5	76.5	1.97	26.04	0.90	3.90
Bay d'Espoir 6	76.5	0.12	0.59	0.90	3.90
Bay d'Espoir 7	154.4	0.00	0.00	0.90	3.90
Cat Arm 1	67	1.44	0.00	0.90	0.70
Cat Arm 2	67	1.06	0.24	0.90	0.70
Hinds Lake	75	0.46	0.37	0.90	0.70
Upper Salmon	84	22.62	7.05	0.90	0.70
Granite Canal	40	0.57	3.10	0.90	0.70
Paradise River	8	1.15	0.00	0.90	0.70

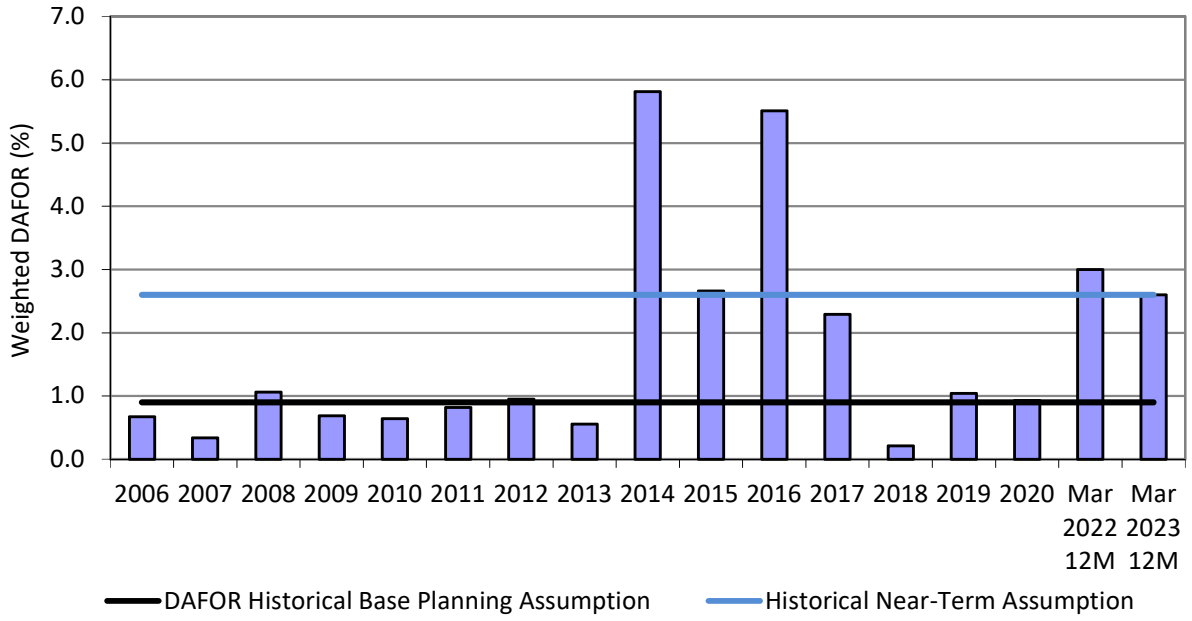

Chart 1: Hydraulic Weighted DAFOR

4.1 Bay d'Espoir Hydroelectric Generating Facility

Considering individual hydraulic unit performance, the Bay d'Espoir Unit 5 DAFOR of 26.04% did not meet the historical base planning assumption of 0.9% and is above the historical near-term planning assumption of 3.90% for an individual Bay d'Espoir unit. This increase in DAFOR was the result of a forced outage on July 3, 2022 as a result of the failure of transformer, BDE T5. This transformer was removed, a suitable spare transformer was installed in its place and the unit successfully synchronized to the system on September 1, 2022 for testing and released for normal service on September 4, 2022. The investigation into the cause of the transformer failure is ongoing.

4.2 Upper Salmon Hydroelectric Generating Station

The Upper Salmon Unit DAFOR of 7.05% did not meet the historical base planning assumption of 0.9% and is above the historical near-term planning assumption of 0.7%. This increase in DAFOR was the result of a forced extension of a planned outage which occurred on March 10, 2023. Hydro has previously reported in its 2022 Near-Term Reliability Report[8] that it has experienced ongoing issues with the rotor rim keys and guidance blocks; during the planned annual preventative maintenance checks in August 2021, a significant crack on 1 of 16 rotor rim guidance blocks was discovered. The discovery of this crack prompted Hydro to expand its inspection scope to include the use of non-destructive testing ("NDT") methods to assess the remaining rim guidance blocks. This expanded inspection revealed that over 35% (6 of 16) of the rim guidance blocks exhibited cracking.

In consultation with the original equipment manufacturer ("OEM") for the equipment, it was determined that the cracking was beyond repair and block replacement was immediately required before the unit could be placed back into reliable service. As recommended by the OEM, all 16 blocks were replaced during a forced extension to the planned outage. The Upper Salmon Unit was returned to service on October 22, 2021.

Following the replacement of all 16 complete guidance block assemblies in 2021, regularly scheduled inspections were completed at 2,000 hour intervals. The intent of these inspections was to address any additional guide block fretting corrosion and weld cracks, as the guide block replacement completed in 2021 was a near-term life extension action until the more permanent long-term solution to address

[8] "*Reliability and Resource Adequacy Study Review* – Near-Term Reliability Report," Newfoundland and Labrador Hydro, November 15, 2022.

rotor/stator alignment issues could be planned and implemented. However, following the discovery of worsening conditions during inspections, the interval between inspections was reduced to 1,000 hours in 2022.

During inspections in November 2022 and January 2023, dislodged fragments of the rotor rim laminations and welds from the guide block assemblies were discovered inside the rotor spider. These findings were non-congruent with historical inspection findings. At the time of this initial discovery, the limited quantity of rim laminations found to be broken did not result in immediate concerns for the continued reliable operation of the unit because there was still sufficient material in the rim dovetail slots to maintain contact with the guidance rim assemblies.

During the most recent inspection in March 2023, significant quantities of broken rim laminations were found in various locations around the unit, being discovered in 8 of 16 guidance block assemblies. The extent of the damage was shown to vary; however, there are two guidance block assemblies with less than 25% of remaining contact surface area between the key and remaining laminations.

Following this discovery, the OEM was consulted and has advised that given the known condition of the unit and the worsening results from recent inspections, that continued operation of the unit in this state should not continue. Although Hydro had mitigated the risk of failure to the extent possible in the near term, there was a residual risk that a failure could occur before the execution of the required life extension work scope, and this risk was realized. Following the advice of the OEM, Engineering and Long-Term Asset Planning staff completed the necessary risk review and provided formal recommendation to not return the Upper Salmon Unit to service until the approved capital program can be successfully executed later in 2023. An application was approved to undertake additional work to address the required life extension activities, and work is scheduled to begin in May 2023.[9]

4.3 Granite Canal Hydroelectric Generating Station

The Granite Canal Unit DAFOR of 3.10% for the current period did not meet either the historical near-term planning assumption of 0.7% or the historical base planning assumption of 0.9%. This increase in DAFOR was the result of seven forced outages as previously reported. From April 13, 2022 to April 17, 2022, the Granite Canal unit forced outage was the result of a leaking generator bearing oil

[9] *Public Utilities Act,* RSNL 1990, c P-47, Board Order No. P.U. 18(2022), Board of Commissioners of Public Utilities, May 20, 2022.

cooler. The leaking cooler was replaced with a spare and the unit returned to service. On May 3, 2022, following a distribution line trip, the Granite Canal essential service breaker tripped resulting in a subsequent trip of the generating unit. Following the investigation, it was determined that the trip settings on the essential service breaker were not suitable for the operation and the breaker was replaced with one equipped with appropriate trip settings. On May 6, 2022, while attempting to return the unit to service, a generator surface air cooler developed a leak and required replacement. This work was completed and the Granite Canal Unit was returned to service on May 7, 2022.

In addition, the Granite Canal Unit experienced two outages caused by vibration trips, which occurred on July 22, 2022 and July 31, 2022. The cause of the vibration in both events was determined to be excessive operation in the unit's rough zone. Both outages were short in duration and resulted in no damage to the unit. It is not unexpected to see increased vibration levels when the unit is operated in its defined rough zone, therefore care must be taken to avoid prolonged operation in its rough zone. To mitigate the likelihood of future occurrences, changes were made to automatic generation control parameters to maintain operation above the rough zone where possible. The sixth outage occurred on August 26, 2022 and appeared to be caused by high turbine bearing temperatures; however, upon further investigation it was determined that the device setting was too low, thus false alarming. This setting was adjusted to the correct value and the unit returned to service the same day. The final outage impacting the DAFOR for the current period occurred on September 8, 2022. This outage resulted from loss of signal to the unit's governor controller. Investigation at site revealed no obvious concerns, communication to the controller was re-established and the unit returned to service the same day. Further investigation into the cause of this outage did not yield conclusive results; however, it has been four months since the event and the governor controller has performed normally since being returned to service.

5.0 Thermal Unit DAFOR Performance

Detailed results for the 12 months ending March 31, 2023 and the 12 months ending Mach 31, 2022 are presented in Table 5 and Chart 2. These results 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 Mar 2022 (%)	12 Months Ending Mar 2023 (%)	Historical Base Planning Assumption (%)	Historical Near-Term Planning Assumption (%)
All Thermal Units – Weighted	**490**	**33.84**	**12.67**	**9.64**	**14.00**
Thermal Units					
Holyrood 1	170	33.40	23.78	9.64	15.00
Holyrood 2	170	31.67	0.67	9.64	10.00
Holyrood 3	150	37.15	17.35	9.64	18.00

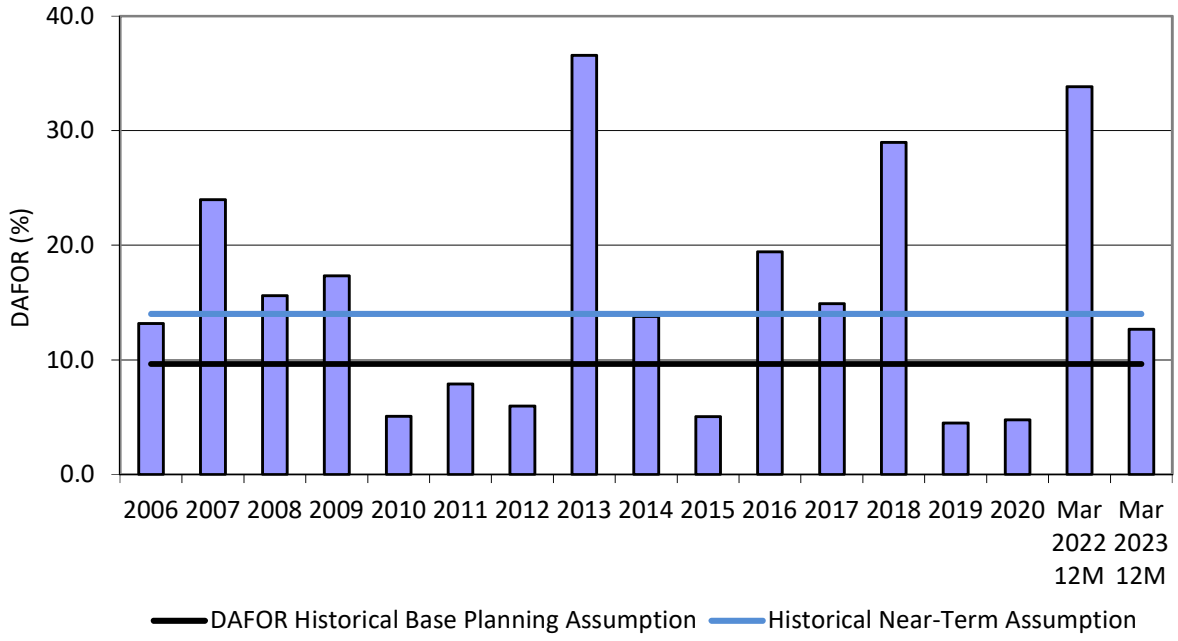

Chart 2: Thermal DAFOR

For the 12 months ending March 31, 2023, the weighted DAFOR for all thermal units of 12.67% is above the historical base planning assumption DAFOR value of 9.64% and below the historical near-term planning assumption of 14.00%. Individual unit DAFOR outcome of 0.67% for Unit 2 for the current period is below the historical base and near-term planning assumptions. Unit 1 and Unit 3 are discussed below.

5.1 Holyrood Unit 1

Considering individual thermal unit performance, the Holyrood Unit 1 DAFOR of 23.78% did not meet the historical base planning assumption of 9.64% and is above the historical near-term planning assumption of 14% for this unit. This increase in DAFOR was primarily the result of electrical issues that continued from February 1, 2023 to March 12, 2023, and two extended periods of derating due to pump motor failures.

From November 15, 2022 to December 8, 2022, the unit was derated to 80 MW due to a failure of the east boiler feed pump motor, which went to ground during startup. Investigation found that the lead wire had failed. This had to be replaced and the motor windings had to be cleaned of soot and debris buildup that resulted from the failure. The motor was reassembled, tested and balanced. This work was completed in the motor service contractor's shop. The motor was returned to site for installation and commissioning, which was completed on December 8, 2023.

The primary event impacting DAFOR was the electrical issues that caused several forced outages and deratings during February and March, 2023. The unit was offline for six related forced outages between February 1, 2023 when the unit first tripped due to a potential transformer failure, and March 15, 2023 when the unit was released for service by Engineering following completion of their investigation. Through the investigation, two problems were identified. The first finding was an 180Ω resistor in series with the primary of the potential transformer which had a crack in the porcelain, causing the resistance to fluctuate. The purpose of this resistor is to mitigate the effect of ferroresonance, which can lead to voltage fluctuations and subsequently the failure of the potential transformer.[10] A direct replacement for the resistor was not available, and due to the age of the equipment, it is no longer being manufactured. A temporary resistor was put in place on the secondary side of the potential transformers to mitigate the effect of ferroresonance. Further testing showed a voltage signal that followed a pattern typical of a floating ground reference, and upon investigation there was a failed resistor found in the secondary of the generator grounding transformer. The resistor was replaced with a temporary resistor, as a direct replacement could not be sourced with a reasonable lead time. Unit 1 was then brought online on March 12, 2023 and released for full service on March 15, 2023 and has remained online and reliable since. Several corrective actions were identified, including:

[10] Ferroresonance refers to a non-linear phenomenon in electrical circuits which causes harmonics and fluctuations in voltage and current.

- Replacement of the temporary resistors with industrial resistors on the secondary of the potential transformer and the grounding transformer. This work is planned to be completed during the 2023 annual outage.
- Maintenance procedures will also be reviewed, including the frequency of preventative maintenance activities on the grounding resistors and transformers.
- Instrument transformer testing methods will be investigated to develop an in-depth testing plan for the potential transformers to better assess their condition.
- Investigation into the cause of the failure, as well as identified spare parts issues, will be completed.

Unit 1 was derated to 90 MW from March 27, 2023 until April 1, 2023 due to a failure in the electrical supply feeding the west cooling water pump. The plant electricians corrected the problem and returned the pump to service on April 1, 2023.

5.2 Holyrood Unit 3

The Holyrood Unit 3 DAFOR of 17.35% did not meet the historical base planning assumption of 9.64% but is slightly below the historical near-term planning assumption of 18% for this unit. This increase in DAFOR was primarily the result of three forced outages, two of which were related to the boiler and one related to the turbine.

In December 2022, there was a forced outage caused by a leak in the fire protection (sprinkler) system in the front standard of the turbine. The leak occurred on December 15, 2022 and caused a trip of the unit when components related to the control of the turbine became wet and failed in-service causing the trip. The control components were dried-out and the unit was successfully returned to service on December 18, 2022. The cause of the leak was identified and corrective measures implemented.

The primary driver of DAFOR during the period was a boiler tube leak that forced the unit offline from February 6, 2023 to February 18, 2023. The leak was discovered inside the furnace in a lower water wall tube where the tube attached to the side wall tubes and the lower water wall header. The failed section of tube was replaced by the boiler service contractor using new tube material drawn from inventory. Boiler tube leaks are a common issue in thermal plants due to the inherent design of the tubes, which requires relatively thin walls for heat transfer subjected to high temperatures and stresses. Hydro

conducts annual tube thickness surveys and visual inspections, and maintains a thorough selection of spare tube material and a contract with an experienced boiler contractor for the provision of emergency repairs in the event of tube failures. The failed tube section was sent to a metallurgical lab for failure analysis to determine if there are any specific remedial actions that should be taken. Results from this investigation are pending.

In addition, a combustion air leak developed on the Unit 3 boiler which resulted in a forced derating to 70 and 100 MW from February 20, 2023 to February 21, 2023 and subsequently a forced outage from February 21, 2023 to February 22, 2023. An expansion joint on the east hot air duct, which supplies air to the burners for combustion of fuel, failed in service. The boiler contractor completed a repair of this expansion joint during the outage, which proved reliable for the remainder of the operating season. The joint will be re-evaluated during the annual maintenance outage this summer and further remedial work may be required.

6.0 Gas Turbine UFOP Performance

The combined UFOP for the Hardwoods, Happy Valley, and Stephenville Gas Turbines was 3.70% for the 12 months ending March 31, 2023 (Table 6 and Chart 3). This performance is better than the base planning assumption of 10.62% and the near-term assumption of 20.00% but has declined in comparison to performance during the 12 months ending March 31, 2022. The Stephenville Gas Turbine UFOP for the current period is 9.04%, as compared to the historical base planning assumption of 10.62%. The Hardwoods Gas Turbine UFOP for the current period is 0.64%, as compared to the historical base planning assumption of 10.62%. The Happy Valley Gas Turbine UFOP is 0.00% for the current period, as compared to the base planning assumption of 10.62%. On an individual unit basis, gas turbine UFOP performance for the current period has declined for the Hardwoods and Stephenville units, and remained consistent for the Happy Valley unit over the 12 months ending March 31, 2022.

Table 6: Gas Turbine UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending Mar 2022 (%)	12 months ending Mar 2023 (%)	Historical Base Planning Assumption (%)	Historical Near-Term Planning Assumption (%)
Combined Gas Turbines	**125**	**0.16**	**3.70**	**10.62**	**20.00**
Stephenville	50	0.45	9.04	10.62	20.00
Hardwoods	50	0.12	0.64	10.62	20.00
Happy Valley	25	0.00	0.00	10.62	20.00

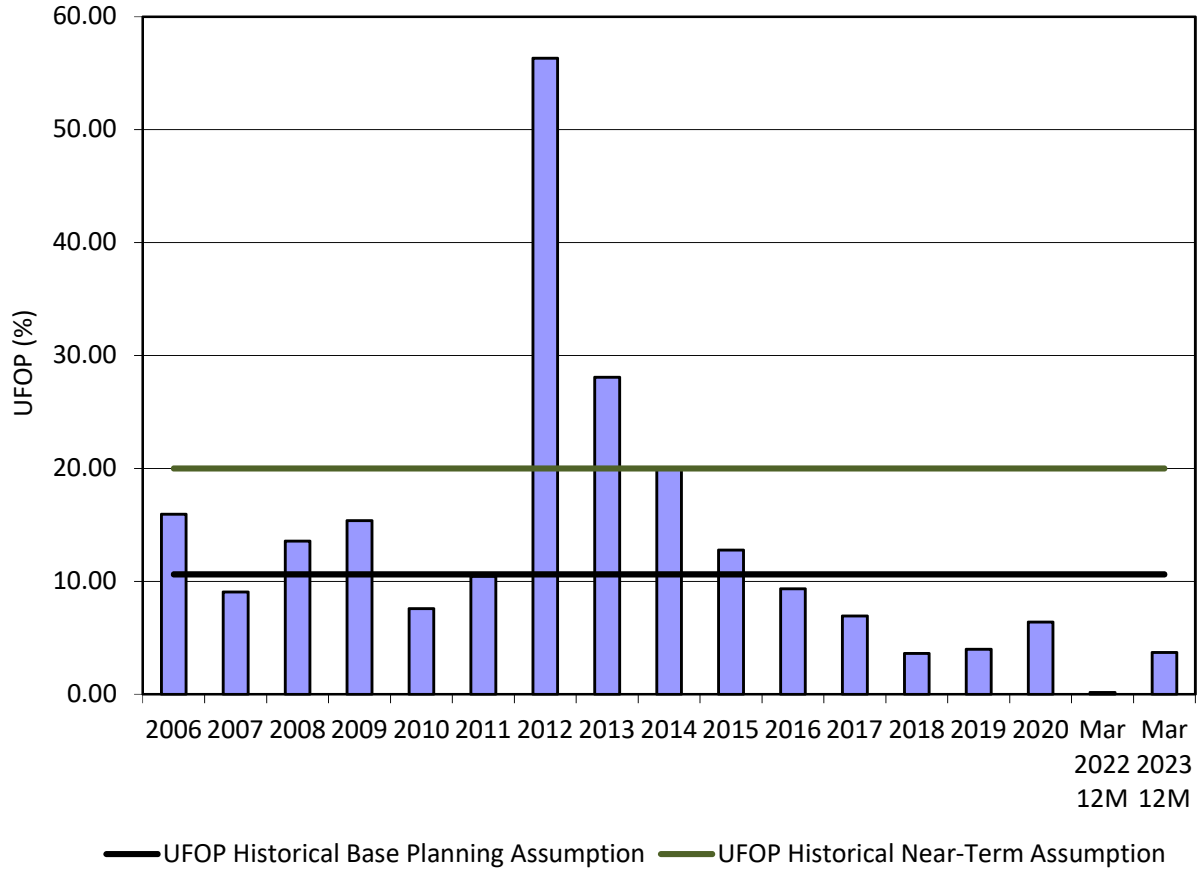

Chart 3: Gas Turbine UFOP: Hardwoods/Happy Valley/Stephenville Units

The Holyrood Gas Turbine UFOP for the current period is 0.00%, which is below the historical base and near-term planning assumptions of 5.00% (Table 7 and Chart 4) and is consistent over the 12 months ending March 31, 2022.

Table 7: Holyrood Gas Turbine UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending Mar 2022 (%)	12 months ending Mar 2023 (%)	Historical Base Planning Assumption (%)	Historical Near-Term Planning Assumption (%)
Holyrood	123.5	0.00	0.00	5.00	5.00

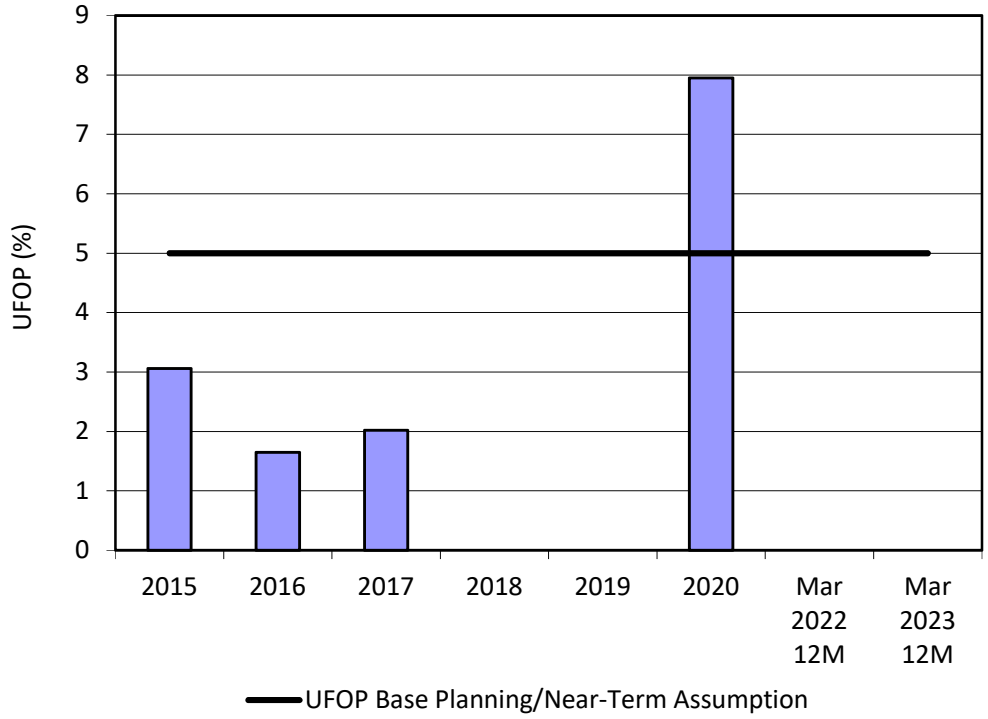

Chart 4: Gas Turbine UFOP: Holyrood Unit

7.0 Gas Turbine DAUFOP Performance

The combined DAUFOP for the Hardwoods and Stephenville Gas Turbines was 6.12% for the 12 months ending March 31, 2023 (Table 8 and Chart 5). This is below the near-term planning assumption of 30.00%. The Stephenville Gas Turbine DAUFOP for the current period is 10.40%, which is below the near-term planning assumption of 30.00%. The Hardwoods Gas Turbine DAUFOP for the current period

is 1.99%, which is below the near-term planning assumption of 30.00%. On a per unit basis, this indicates a decline in performance over the 12 months ending March 31, 2022 for both units.

Table 8: Hardwoods/Stephenville Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending Mar 2022 (%)	12 months ending Mar 2023 (%)	Historical Near-Term Planning Assumption (%)
Gas Turbines (HWD/SVL)	**100**	**1.40**	**6.12**	**30.00**
Stephenville	50	1.31	10.40	30.00
Hardwoods	50	1.42	1.99	30.00

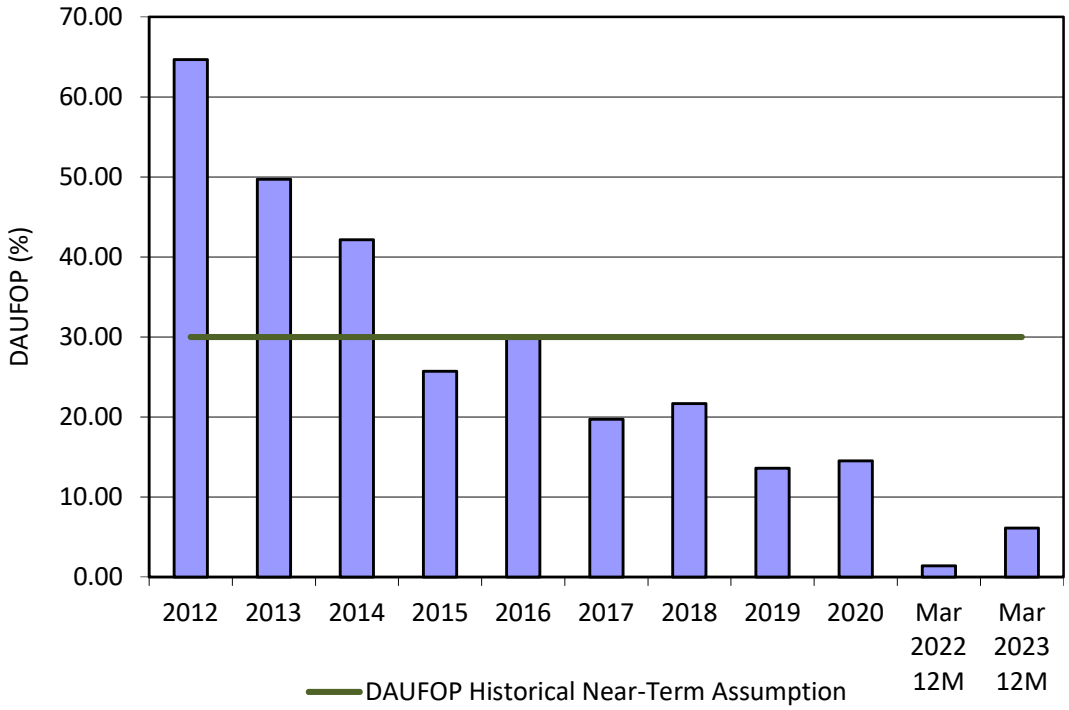

Chart 5: Gas Turbine DAUFOP: Hardwoods/Stephenville Units

The DAUFOP for the Happy Valley Gas Turbine was 0.00% for the 12 months ending March 31, 2023 (Table 9 and Chart 6). This is below the near-term planning assumption of 15.00% and remains consistent in performance over the 12 months ending March 31, 2022.

Table 9: Happy Valley Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending Mar 2022 (%)	12 months ending Mar 2023 (%)	Historical Near-Term Planning Assumption (%)
Happy Valley	25	0.00	0.00	15.00

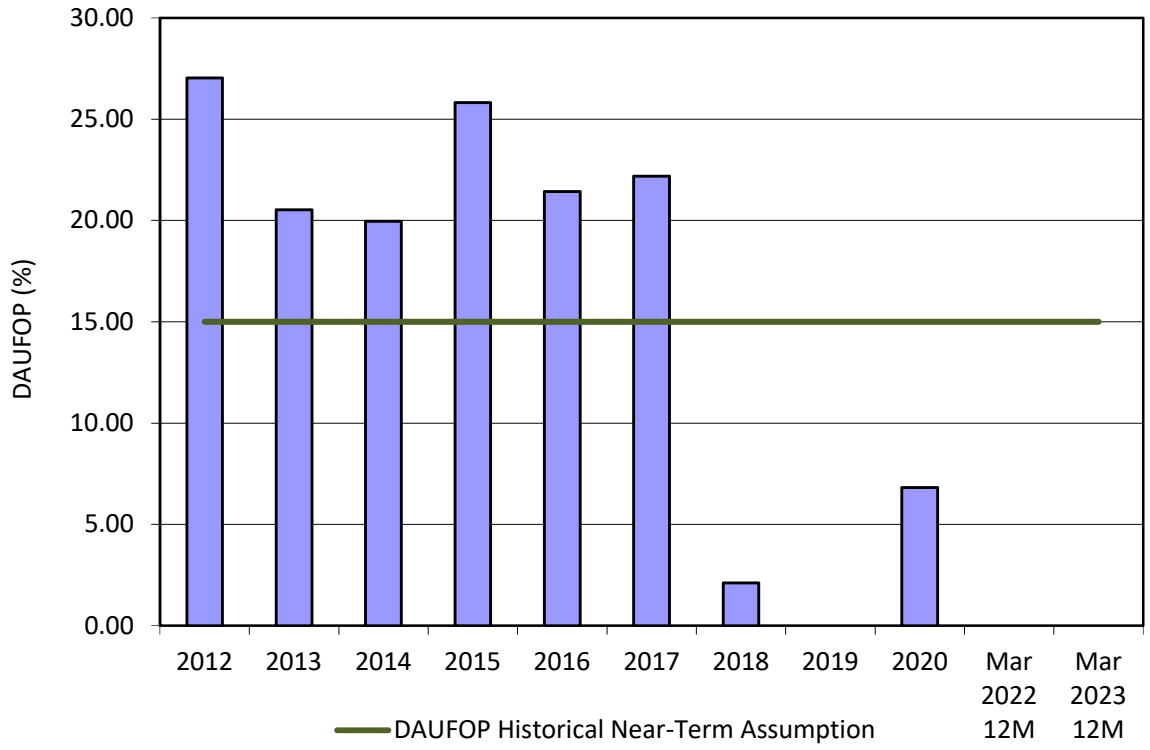

Chart 6: Gas Turbine DAUFOP: Happy Valley Unit

The Holyrood Gas Turbine DAUFOP of 0.00% for the current period is below the near-term planning assumption of 5.00% (Table 10 and Chart 7), and is consistent when compared to the 12 months ending March 31, 2022.

Table 10: Holyrood Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 months ending Mar 2022 (%)	12 months ending Mar 2023 (%)	Historical Near-Term Planning Assumption (%)
Holyrood	123.5	0.00	0.00	5.00

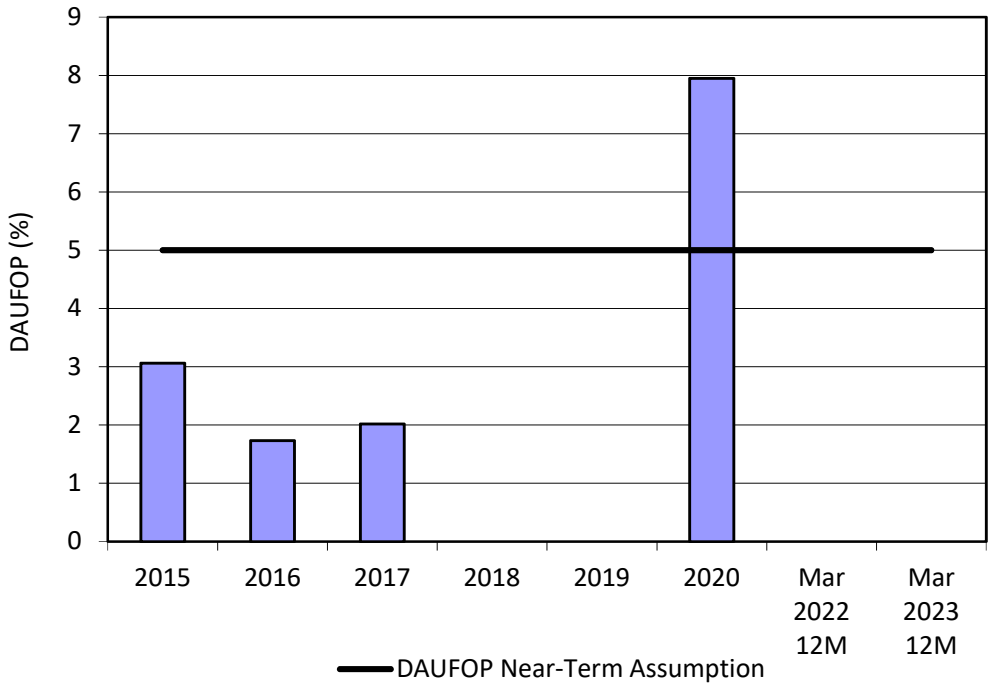

Chart 7: Gas Turbine DAUFOP: Holyrood Unit

8.0 Updated Planning Assumptions/Analysis Values

As part of the Reliability and Resource Adequacy Study, 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. Table 11 summarizes the most recent forced outage rate assumptions as calculated using the forced outage rate methodology.[11]

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

Unit Type	Measure	Near-Term Analysis Value (%)	Resource Planning Analysis Value (%)
Hydraulic	DAFOR	2.3	2.3
Thermal	DAUFOP	20.0[12]	20.0
Gas Turbines	-	-	-
Happy Valley	DAUFOP	6.7	7.6
Hardwoods and Stephenville	DAUFOP	30.0	N/A
Holyrood	DAUFOP	4.9	4.9

A five-year, capacity-weighted average was applied to the hydraulic units (Bay d'Espoir, Cat Arm, Hinds Lake, Granite Canal, Upper Salmon, and Paradise River) for the near-term analysis, resulting in a DAFOR of 2.6%,[13] while a ten-year, capacity-weighted average was applied for use in the resource planning model, resulting in a DAFOR of 2.3%. The DAFOR value was based on historical data reflective of Hydro's maintenance program over the long term.

Historically, forced outage rates for the three units at the Holyrood TGS have been reported using the DAFOR metric, predominately used for units that operate in a continuous (base-load) capacity. As presented in Hydro's Reliability and Resource Adequacy Study – 2022 Update,[14] there are reliability concerns associated with the operation of the units at the Holyrood TGS in a standby capacity. When considering standby or peaking operations of units at the Holyrood TGS, DAFOR is no longer the most

[11] Values indicated for Hydro's near-term analysis reflect those used in the "Reliability and Resource Adequacy Study 2022 Update: Volume II: Near-Term Reliability Report – November Report," Newfoundland and Labrador Hydro, November 15, 2022.
[12] Holyrood TGS Base assumption is 20.0%. The Sensitivity Assumption is 34%.
[13] In the Near-Term Reliability Report, filed May 16, 2022, Hydro deviated from the forced outage rate methodology as described when selecting forced outage rates for its hydraulic units as the result of the prescribed methodology did not accurately represent the risk of unit outage. For the hydraulic units, Hydro maintained the capacity-weight average DAFOR from its Near-Term Reliability Report filed in November 2021, which is higher than the five-year DAFOR, increasing the forced outage rates to more appropriately represent the risk of failure in the near term.
[14] "*Reliability and Resource Adequacy Study Review* – Reliability and Resource Adequacy Study – 2022 Update," Newfoundland and Labrador Hydro, October 3, 2022.

appropriate measure of forced outage rates, and UFOP and DAUFOP should be considered instead. Given the frequency of deratings historically experienced by these units, DAUFOP is a more appropriate measure.

Analyses performed for a range of Holyrood TGS DAUFOP assumptions indicate the sensitivity of supply adequacy to changes in Holyrood TGS availability. From this analysis, a DAUFOP of 20% was recommended in the near term, with a sensitivity value of 34%. Hydro will continue to analyze the operational data to ensure that forced outage rate assumptions for the Holyrood TGS are appropriate.

As the gas turbines in the existing fleet are in varied conditions, 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 6.7%, while a ten-year, capacity-weighted average was applied for use in the resource planning model resulting in a DAUFOP of 7.6%. The DAUFOP values were based on historical data founded upon the unit's past reliable performance. For the Holyrood Gas Turbine, a scenario-based approach was used to estimate an appropriate value for the near-term analysis, resulting in a DAUFOP of 4.9%. For the Hardwoods and Stephenville Gas Turbines, a DAUFOP of 30% was used for the near-term analysis, consistent with the metrics that were considered in Hydro's May 2018 "Near-Term Generation Adequacy Report." As the Stephenville Gas Turbine is proposed for retirement in 2024 and the Hardwoods Gas Turbine in 2030, these units were not included in the long-term analysis; therefore, there is no resource planning analysis value listed for these facilities and the near-term assumption will remain for the remaining life of each facility.

9.0 Comparison of Planning Assumptions and Analysis Values

As Hydro's reliability and adequacy planning assumptions have historically been used in reporting on the performance of Hydro's generating units, a comparison of the historical values to those used in the most recent analysis 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 instead utilized the DAUFOP measure with changes as shown in Table 12.

Table 12: Comparison of Hydro's Planning Assumptions (%)

		Historical Planning Assumptions		Reliability and Resource Planning Assumptions	
Generating Unit Type	**Measure**	**Historical Base Planning Assumption**	**Historical Near-Term Planning Assumption**	**Near-Term Analysis Value**	**Resource Planning Analysis Value**
Hydraulic	DAFOR	0.9	2.6	2.3	2.3
Thermal	DAFOR	9.64	14.0	N/A	N/A
Thermal	DAUFOP	N/A	N/A	20.0	N/A
Gas Turbines					
Happy Valley	DAUFOP	-	15.0	6.7	7.6
Hardwoods and Stephenville	DAUFOP	-	30.0	30.0	N/A
Holyrood	DAUFOP	-	5.0	4.9	4.9

The generating unit performance presented earlier in this report is again presented in Table 13 to Table 17, with comparisons to the previous assumptions, as well as the recently revised values. Hydro notes that on an asset class basis, the 12-month rolling performance of its generating units has not violated Hydro's current planning assumptions pertaining to asset availability for all assets, with the execption of Hydraulic Generating assets.

Table 13: Hydraulic Weighted DAFOR Performance Comparison

				May 2018		November 2022	
Generating Unit	**Maximum Continuous Unit Rating (MW)**	**12 Months Ending March 2022 (%)**	**12 months ending Mar 2023 (%)**	**Historic Base Planning Assumption (%)**	**Historic Near-Term Planning Assumption (%)**	**Near-Term Planning Analysis Value (%)**	**Resource Planning Analysis Value (%)**
All Hydraulic Units - weighted	954.4	3.00	2.60	0.90	2.60	2.30	2.30
Hydraulic Units							
Bay D'Espoir 1	76.5	3.31	0.00	0.90	3.90	2.30	2.30
Bay D'Espoir 2	76.5	0.00	0.00	0.90	3.90	2.30	2.30
Bay D'Espoir 3	76.5	0.00	0.06	0.90	3.90	2.30	2.30
Bay D'Espoir 4	76.5	0.00	0.20	0.90	3.90	2.30	2.30
Bay D'Espoir 5	76.5	1.97	26.04	0.90	3.90	2.30	2.30
Bay D'Espoir 6	76.5	0.12	0.59	0.90	3.90	2.30	2.30
Bay D'Espoir 7	154.4	0.00	0.00	0.90	3.90	2.30	2.30
Cat Arm 1	67	1.44	0.00	0.90	0.70	2.30	2.30
Cat Arm 2	67	1.06	0.24	0.90	0.70	2.30	2.30
Hinds Lake	75	0.46	0.37	0.90	0.70	2.30	2.30
Upper Salmon	84	22.62	7.05	0.90	0.70	2.30	2.30
Granite Canal	40	0.57	3.10	0.90	0.70	2.30	2.30
Paradise River	8	1.15	0.00	0.90	0.70	2.30	2.30

Table 14: Thermal DAFOR[15] Performance Comparison

				May 2018		November 2022	
Generating Unit	**Maximum Continuous Unit Rating (MW)**	**12 Months Ending March 2022 (%)**	**12 months ending Mar 2023 (%)**	**Historic Base Planning Assumption (%)**	**Historic Near-Term Planning Assumption (%)**	**Near-Term Planning Analysis Value (%)**	**Resource Planning Analysis Value (%)**
All Thermal Units - weighted	490	33.84	12.67	9.64	14.00	N/A	N/A
Thermal Units							
Holyrood 1	170	33.40	23.78	9.64	15.00	N/A	-
Holyrood 2	170	31.67	0.67	9.64	10.00	N/A	-
Holyrood 3	150	37.15	17.35	9.64	18.00	N/A	-

Table 15: Hardwoods/Stephenville Gas Turbine DAUFOP Performance Comparison

				May 2018		November 2022	
Gas Turbine Units	**Maximum Continuous Unit Rating (MW)**	**12 Months Ending March 2022 (%)**	**12 months ending Mar 2023 (%)**	**Historic Base Planning Assumption (%)**	**Historic Near-Term Planning Assumption (%)**	**Near-Term Planning Analysis Value (%)**	**Resource Planning Analysis Value (%)**
Gas Turbines (HWD/SVL)	100	1.40	6.12	N/A	30.00	30.00	N/A
Stephenville	50	1.31	10.40	N/A	30.00	30.00	N/A
Hardwoods	50	1.42	1.99	N/A	30.00	30.00	N/A

Table 16: Happy Valley Gas Turbine DAUFOP Performance Comparison

				May 2018		November 2022	
Gas Turbine Units	**Maximum Continuous Unit Rating (MW)**	**12 Months Ending March 2022 (%)**	**12 months ending Mar 2023 (%)**	**Historic Base Planning Assumption (%)**	**Historic Near-Term Planning Assumption (%)**	**Near-Term Planning Analysis Value (%)**	**Resource Planning Analysis Value (%)**
Happy Valley	25	0.00	0.00	N/A	15.00	6.70	7.60

Table 17: Holyrood Gas Turbine DAUFOP Performance Comparison

				May 2018		November 2022	
Gas Turbine Units	**Maximum Continuous Unit Rating (MW)**	**12 Months Ending March 2022 (%)**	**12 months ending Mar 2023 (%)**	**Historic Base Planning Assumption (%)**	**Historic Near-Term Planning Assumption (%)**	**Near-Term Planning Analysis Value (%)**	**Resource Planning Analysis Value (%)**
Holyrood GT	123.5	0.00	0.00	N/A	5.00	4.90	4.90

[15] DAFOR is no longer used for Near-Term and Resource Planning analysis for Thermal Generation; however, calculation of DAFOR performance will continue.