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January 31, 2022

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 of Corporate Services & Board Secretary

Dear Ms. Blundon:

Re: Quarterly Report on Performance of Generating Units for the Twelve Months Ended December 31, 2021

Please find enclosed Newfoundland and Labrador Hydro's "Quarterly Report on Performance of Generating Units for the Twelve Months Ended December 31, 2021."

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

Encl.

ecc:

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Quarterly Report on Performance of Generating Units for the Twelve Months Ended December 31, 2021

January 31, 2022

A report to the Board of Commissioners of Public Utilities

newfoundland labrador hydro

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 December 31, 2021.

This report contains forced outage rates for the current 12-month reporting period of January 1, 2021 to December 31, 2021 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 January 1, 2020 to December 31, 2020. 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 Canadian Electricity Association ("CEA") guidelines. CEA 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 new 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 the new assumptions form the basis of Hydro's current planning processes, this report includes the historical assumptions and style to maintain similarity to previous reports.

2.0 Overview for Period Ending December 31, 2021

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

Class of Units	1-Jan-2020 to 31-Dec-2020	1-Jan-2021 to 31-Dec-2021	Base Planning Assumption	Near-Term Planning Assumption[1]
Hydraulic (DAFOR)	0.93	3.09	0.90	2.60
Thermal (DAFOR)	4.76	33.72	9.64	14.00
Combined Gas Turbine (UFOP)	6.40	0.55	10.62	20.00
Holyrood Gas Turbine (UFOP)	7.95	0.00	5.00	5.00
Hardwoods/Stephenville Gas Turbine (DAUFOP)	14.53	1.73	-	30.00
Happy Valley Gas Turbine (DAUFOP)	6.82	2.13	-	15.00
Holyrood Gas Turbine (DAUFOP)	7.95	0.00	-	5.00

As shown in Table 1, hydraulic and thermal DAFOR performance declined for the current 12-month period ending December 31, 2021 compared to the 12-month period ending December 31, 2020. The

[1] Refer to "Near-Term Generation Adequacy Report," Newfoundland and Labrador Hydro, November 15, 2017, sec. 5.0 for further details.

UFOP and DAUFOP performance for all gas turbines improved in the current period compared to the 12-month period ending December 30, 2020.

Hydro began reporting DAUFOP performance in January 2018 for its gas turbines.

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 these revised assumptions on reporting of generation unit performance are discussed in Section 9.0 of this report. While the new assumptions form the basis of Hydro's current planning processes, this report 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 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,"[2] 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 ("Board") as part of the "Labrador-Island Link In-Service Update."[3]

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 new and can be expected to have better availability than the older units.[4]

[2] "Near-Term Generation Adequacy Report," Newfoundland and Labrador Hydro, rev. May 30, 2018 (originally filed May 22, 2018).
[3] Labrador-Island Link In-Service Update," Newfoundland and Labrador Hydro, October 1, 2018.
[4] 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* proceeding.

Table 2: 2017[5] 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-month period ending December 31, 2021 are presented in Table 4, as well as the data for the 12-month period ending December 31, 2020. 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.

[5] Refer to "Near-Term Generation Adequacy Report," Newfoundland and Labrador Hydro, November 15, 2017, sec. 5.0 for further details.

Table 4: Hydraulic Weighted DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 Months Ending December 2020 (%)	12 Months Ending December 2021 (%)	Historical Base Planning Assumption (%)	Historical Near-Term Planning Assumption (%)
All Hydraulic Units - weighted	954.4	0.93	3.09	0.90	2.60
Hydraulic Units					
Bay D'Espoir 1	76.5	1.44	3.31	0.90	3.90
Bay D'Espoir 2	76.5	0.00	0.00	0.90	3.90
Bay D'Espoir 3	76.5	2.46	0.00	0.90	3.90
Bay D'Espoir 4	76.5	5.44	0.21	0.90	3.90
Bay D'Espoir 5	76.5	1.15	0.00	0.90	3.90
Bay D'Espoir 6	76.5	0.72	0.16	0.90	3.90
Bay D'Espoir 7	154.4	0.46	0.00	0.90	3.90
Cat Arm 1	67	0.15	1.30	0.90	0.70
Cat Arm 2	67	0.27	1.06	0.90	0.70
Hinds Lake	75	2.13	0.46	0.90	0.70
Upper Salmon	84	0.00	22.69	0.90	0.70
Granite Canal	40	0.90	1.88	0.90	0.70
Paradise River	8	1.32	1.45	0.90	0.70

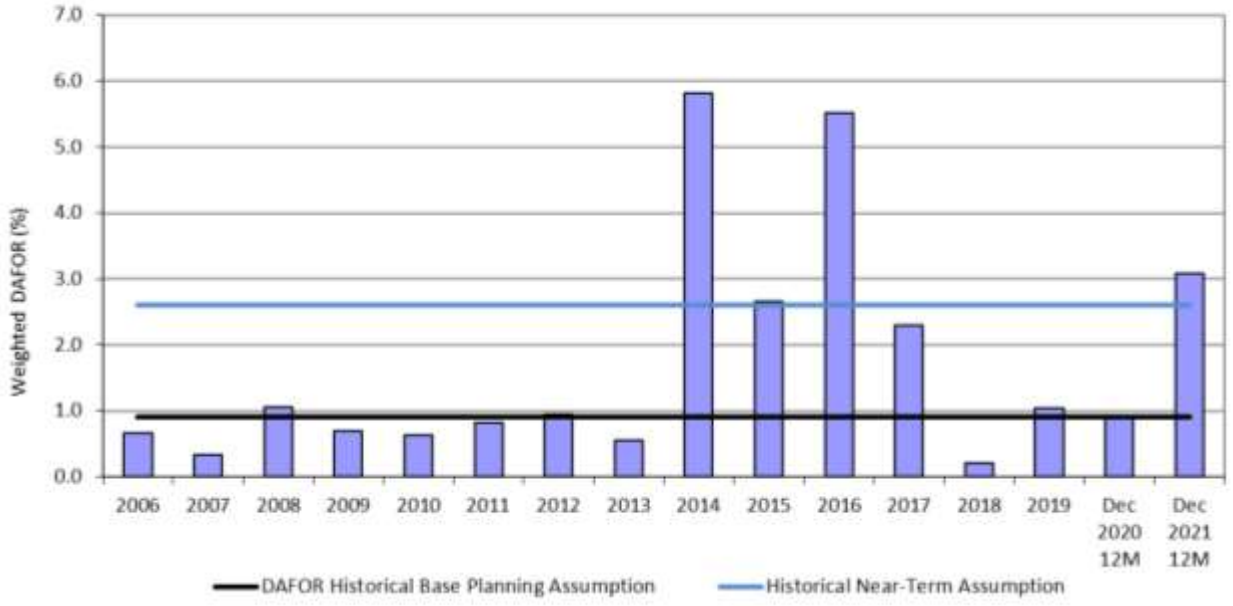

Figure 1: Hydraulic Weighted DAFOR

Considering individual hydraulic unit performance, the Bay d'Espoir Unit 1 DAFOR of 3.31% did not meet the historical base planning assumption of 0.9% but is below the historical near-term planning assumption of 3.90% for an individual Bay d'Espoir unit.

As previously reported, Bay d'Espoir Unit 1 has experienced two forced outages which impacted the DAFOR performance for the current period. The first, from May 14 to 20, 2021, was a forced extension of the planned outage, as a result of findings in the scheduled inspection of Penstock 1. During the inspection, a number of distinct indications of weld deterioration were identified in 16 longitudinal weld seams. The indications were similar in condition to those discovered in recent years and were shallow in depth. Weld refurbishment and final inspection were completed and the penstock was returned to service. This discovery was not unexpected given the known condition of the Bay d'Espoir penstocks. Hydro will use the information obtained through the inspection and refurbishment process to inform its long-term plan for the penstocks; the details of Hydro's long-term plan are expected to be filed with the Board in 2022. The final outage that impacted Bay d'Espoir Unit 1 DAFOR performance occurred May 29 to June 3, 2021 when the unit was removed from service to investigate elevated governor oil temperatures. The investigation discovered misalignment of the permanent magnet generator ("PMG") coupling which caused excessive strain and subsequent shearing of the drive pins which then contributed to the failure of a piston seal ring in the servomotor. The necessary repairs were completed and the unit returned to service. Work orders were entered to inspect other units with similar PMG couplings during the next planned outage and preventative maintenance programs were updated to include the verification of alignment of the PMG coupling. To date, inspections have been completed on Bay d'Espoir Units 4, 5 and 6 as well as the Hinds Lake Unit with no findings of concern. Remaining inspections will be completed during the 2022 annual outages.

The Cat Arm Unit 1 DAFOR of 1.30% 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 was the result of deratings experienced through the months of September and October. These de-ratings were the result of increased generator surface air cooler temperatures due to reduced cooling capacity. The reduced cooling capacity occurred from a buildup of water contaminants in the cooler tubing, commonly referred to as fouling. Surface air coolers are cleaned annually at a set frequency during unit outages however this frequency was disrupted in 2021, with annual outages in Cat Arm scheduled later in the year, increasing the duration between cleaning cycles and allowing cooler fouling to progress further than normal. The coolers have since been thoroughly cleaned and the unit returned to full capacity.

The Cat Arm Unit 2 DAFOR of 1.06% 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 was the result of four forced outages experienced in the current period. As previously reported, the first (May 25, 2021) and second (July 24, 2021) both were the result of failed solenoid coils on the shutdown valve assembly. The failed components were replaced and the entire valve assembly is to be replaced at the next opportunity. The third outage (August 28, 2021) was caused by a leaking governor sump cooler. A replacement cooler was installed on the unit and then the unit was returned to service. Since the previous filing, an additional outage occurred on December 27, 2021 resulting from low governor accumulator oil level. Investigation determined there to be excess air in the accumulator. This issue was addressed and the unit returned to service. It is noted that all components of this system were tested during annual maintenance activities in November 2021 with no deficiencies found. To mitigate the potential for a future forced outage, remedial actions to further inspect, test and verify components of the accumulator system are planned for the 2022 annual maintenance outage.

The Upper Salmon unit DAFOR of 22.69% 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%. As filed previously, during the 2021 planned annual preventative maintenance inspection in August 2021, a significant crack on rim guidance block #10 was discovered. Further inspection of all rim guidance blocks revealed that over 35% (6 of 16 total blocks) of the rim guidance blocks exhibited cracking. Metallurgy analysis determined the failure mode was due to fatigue cracking. The cracking was beyond repair and the blocks were replaced. In addition, after consultation with the original equipment manufacturer ("OEM"), it was determined that adjacent blocks to the cracked blocks were subjected to higher than normal forces due to the reduced strength of the cracked blocks and would likely also suffer damage and failure. To ensure continued reliable operation of the Upper Salmon unit, all 16 blocks were replaced. This work was not included in the scope of the planned outage, thus resulted in a forced extension to the outage which lasted from August 21 to October 21, 2021. The OEM attributes the cause of this issue to be a combination of an out-of-round stator and a loose rotor rim; addressing this life extension work was not possible prior to the 2021–2022 winter season; however, replacement of the blocks before the winter operating season is considered a suitable approach by the OEM to reduce the residual risk to an acceptable level. The planned life extension is expected to be carried out in 2022 to address the out-of-round stator and loose rotor rim, subject to submission of a supplemental Capital Budget Application and approval of the same by the Board. In addition to the block replacement, the OEM has recommended implementing a non-destructive testing ("NDT") inspection program of the

blocks at 12-week intervals until life extension work is completed. This inspection program is now included in Hydro's work plan. The first NDT inspection of the blocks was completed in November 2021 when the opportunity was presented during an unplanned outage to the unit. This inspection revealed no material concerns. Since the previous filing, the Upper Salmon unit experienced two additional forced outages which contributed to this increase in DAFOR. The first, on November 5, 2021 was the result of a failed low voltage jumper on the generator step-up transformer, USL T1. The investigation into the cause of the failure is ongoing, which includes a review of the preventative maintenance program. The failed jumper was replaced and the unit returned to service on November 10, 2021. However, a short time after return to service on November 10, 2021, the unit experienced a field ground and was once again taken offline. Investigation discovered a ground on rotor pole #9, this pole was replaced with a spare and a thorough inspection and cleaning of the unit was completed. The unit was returned to service on November 17, 2021.

The Granite Canal unit DAFOR of 1.88% did not meet either the historical near-term planning assumption of 0.7% or the historical base planning assumption of 0.9%. As previously reported, the Granite Canal unit was unavailable due to a forced outage from February 25 to 26, 2021 and another from February 28 to March 3, 2021. These two outages were the result of governor pressure issues caused by the accumulator system. These issues have been resolved and preventative maintenance procedures have been updated to prevent future occurrence of similar issues. Additionally, on September 13, 2021 a faulty bearing temperature probe resulted in an unplanned outage. The faulty equipment was replaced and suitable spare components procured. Since the previous filing an additional outage occurred on December 20, 2021 as a result of a faulty temperature transmitter. This equipment issue was resolved and plans have been developed to replace similar temperature transmitters with a suitable alternative.

5.0 Thermal Unit DAFOR Performance

Detailed results for the 12-month period ending December 31, 2021 and the 12-month period ending December 31, 2020 are presented in Table 5. 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 December 2020 (%)	12 Months Ending December 2021 (%)	Historical Base Planning Assumption (%)	Historical Near-Term Planning Assumption (%)
All Thermal Units - weighted	490	4.76	33.72	9.64	14.00
Thermal Units					
Holyrood 1	170	3.97	34.50	9.64	15.00
Holyrood 2	170	7.78	26.19	9.64	10.00
Holyrood 3	150	0.52	42.12	9.64	18.00

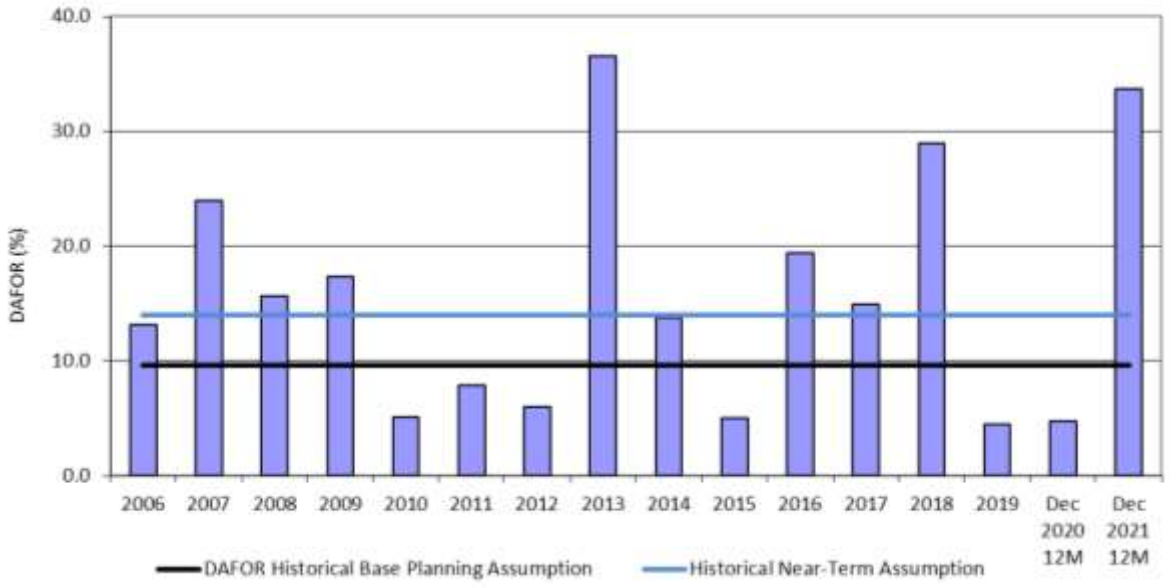

Figure 2: Thermal DAFOR

For the 12-month period ending December 30, 2021, the weighted DAFOR for all thermal units of 33.72% is above the historical base planning assumption DAFOR value of 9.64% and the historical near-term planning assumption of 14.00%.

Unit 1 DAFOR was 34.50%, which is above both the historical base planning assumption of 9.64% and the historical near-term planning assumption of 15.00%. The increase in Unit 1 DAFOR is a result of two significant events; a forced extension of the planned annual maintenance outage that was discussed in the previous filing, and a water hammer event that caused damage to the cold reheat line between the turbine and the boiler during start-up of the unit upon completion of the annual outage.

The annual maintenance outage was planned to be completed on September 10, 2021 but the unit remained on maintenance outage until October 20, 2021. This forced extension was caused by a number of significant findings during the execution of the planned major turbine overhaul. Most significant was the additional time required to replace the high temperature studs that connect the upper half of the turbine to the lower half at the horizontal joint. These studs, ranging in size up to 4.5 inches in diameter, were at the end of acceptable service life and required replacement as recommended by the turbine OEM, General Electric ("GE"). Failure to replace the studs could have resulted in the inability to seal the horizontal joint during turbine reassembly, or subsequent high pressure steam leaks from the horizontal joint as a result of excessive stretch of the studs. While Hydro had planned for replacement of the studs, removal of the original studs required materially more time than had originally been allocated for this aspect of the project; 29 of the 116 studs required removal using specialized equipment and machinists that had to travel to site and self-isolate for two weeks due to COVID-19 restrictions.

In addition to the above issue, alignment checks demonstrated the need to adjust the position of the turbine bearings and the position of the generator relative to the turbine shaft. Also, a defect was found on the turbine rotor which required weld repair on site by GE experts, and significant damage was found on several stages of the diaphragms that required specialized on-site repair by GE experts. Correction of these issues was necessary to ensure a reliable unit going forward. COVID-19 protocols again contributed to the schedule delay.

On October 25, 2021 the unit was placed on line briefly to 40 MW to allow completion of the overspeed testing, which was successful. During re-start after the testing there was a sudden and significant movement of the cold reheat pipe that supplies steam from the turbine to the boiler reheater. Damage to the supports and insulation on this line was evident and start-up efforts ceased to allow an investigation of the cause of the event and assessment of the associated damage.

The investigating team determined that water had been leaking into the cold reheat pipe through a spray station that is designed to control reheat steam temperature when online. The presence of this water during start-up led to a water hammer event, which caused the observed damage.

Expert consultation was provided by GE, the boiler and turbine OEM and service provider for the plant, and third party experts from Hatch. The extent of damage was determined through inspection as recommended by the experts. Scaffolding was erected and insulation removed from areas of concern to

allow non-destructive evaluation and visual inspection. The boiler reheater section was also inspected and leak checks performed.

After completion of all remedial work including replacement of damaged pipe hangers and re-welding of failures at the reheat header to tube welds and at the condensate drain, the unit was returned to service on December 1, 2021. A root cause investigation report on this event is complete and under final internal review and will be made available to the Board in February, 2022.

Unit 2 DAFOR was 26.19 %, which is above the historical base planning assumption of 9.64% and the historical near-term assumption of 10.00%. This increase in DAFOR is the result of failure of power transformer T2, which occurred on November 12, 2021. The failed transformer has since been replaced with a spare. The unit was returned to service for commissioning of the spare transformer on January 12, 2022 and was released for service to the Newfoundland and Labrador System Operator on January 13, 2022. With the spare transformer installed, Unit 2 has been proven to an output capacity of 150 MW which will be the capacity of the unit thorough the remainder of the 2021–2022 winter operating season. Efforts are ongoing to increase the unit output in advance of the 2022–2023 winter operating season, if these efforts are successful the capacity will be adjusted to reflect. Investigation into the cause of the T2 power transformer failure is ongoing, although transformer monitoring showed no indication of concerns leading up to the failure.

Unit 3 DAFOR was 42.12%, which is above the historical base planning assumption of 9.64% and the historical near-term planning assumption of 18.00%. This increase in DAFOR is the result of a forced outage caused by a cold-side tube leak on the east side of the Unit 3 boiler. This occurred on September 11, 2021 during return to service after completion of the planned annual outage. The unit remained on forced outage until November 19, 2021 to allow for a complete investigation of the failure and an assessment of the condition of the remaining boiler tubes.

Hydro followed the recommendations from the boiler OEM (B&W), the boiler service provider (GE) and an independent metallurgical engineering company. Hydro also engaged a specialized boiler tube inspection company (TesTex) to complete the tube inspections.

Investigation determined that the failure was related to large structural attachments to tubes that are found in eight locations on this particular boiler. All of these locations were thoroughly inspected. Inspection required information from the inside of the tubes, obtained using specialized probes

designed to detect damage in the tube. As such, a section of each tube spanning the areas of concern had to be removed to provide access for the specialized probes to pass through the tube. All tubes that were found to have surface indications of depth beyond the fit for service criteria established by the experts in accordance with applicable codes were replaced. The areas of concern were expanded until there were, at minimum, three consecutive tubes that did not show any sign of defect. Upon completion of the inspection, a total of 71 tube sections had been removed to facilitate the inspections and eight tube sections were identified that did not meet fit for service criteria and had been removed. All removed tube sections were replaced with new tube material.

The unit was returned to service on November 19, 2021 after completion of all work including replacement of boiler insulation and cladding that was removed for access.

The current period DAFOR for all three Holyrood units has declined over the 12-month period ending December 31, 2020.

6.0 Gas Turbine UFOP Performance

The combined UFOP for the Hardwoods, Happy Valley, and Stephenville Gas Turbines was 0.55% for the 12-month period ending December 31, 2021 (Table 6 and Figure 3). This performance is better than the base planning assumption of 10.62% and the near-term assumption of 20.00% and is improved over performance during the 12-month period ending December 30, 2020. The Stephenville Gas Turbine UFOP for the current period is 0.38%, as compared to the historical base planning assumption of 10.62%. The Hardwoods Gas Turbine UFOP for the current period is 0.12%, as compared to the base planning assumption of 10.62%. The Happy Valley Gas Turbine UFOP is 2.13% 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 improved for the Hardwoods, Stephenville, and Happy Valley units over the 12-month period ending December 31, 2020.

Table 6: Gas Turbine UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ending December 2020 (%)	12 Months Ending December 2021 (%)	Historical Base Planning Assumption (%)	Historical Near-Term Planning Assumption (%)
Combined Gas Turbines	125	6.40	0.55	10.62	20.00
Stephenville	50	8.13	0.38	10.62	20.00
Hardwoods	50	4.64	0.12	10.62	20.00
Happy Valley	25	6.82	2.13	10.62	20.00

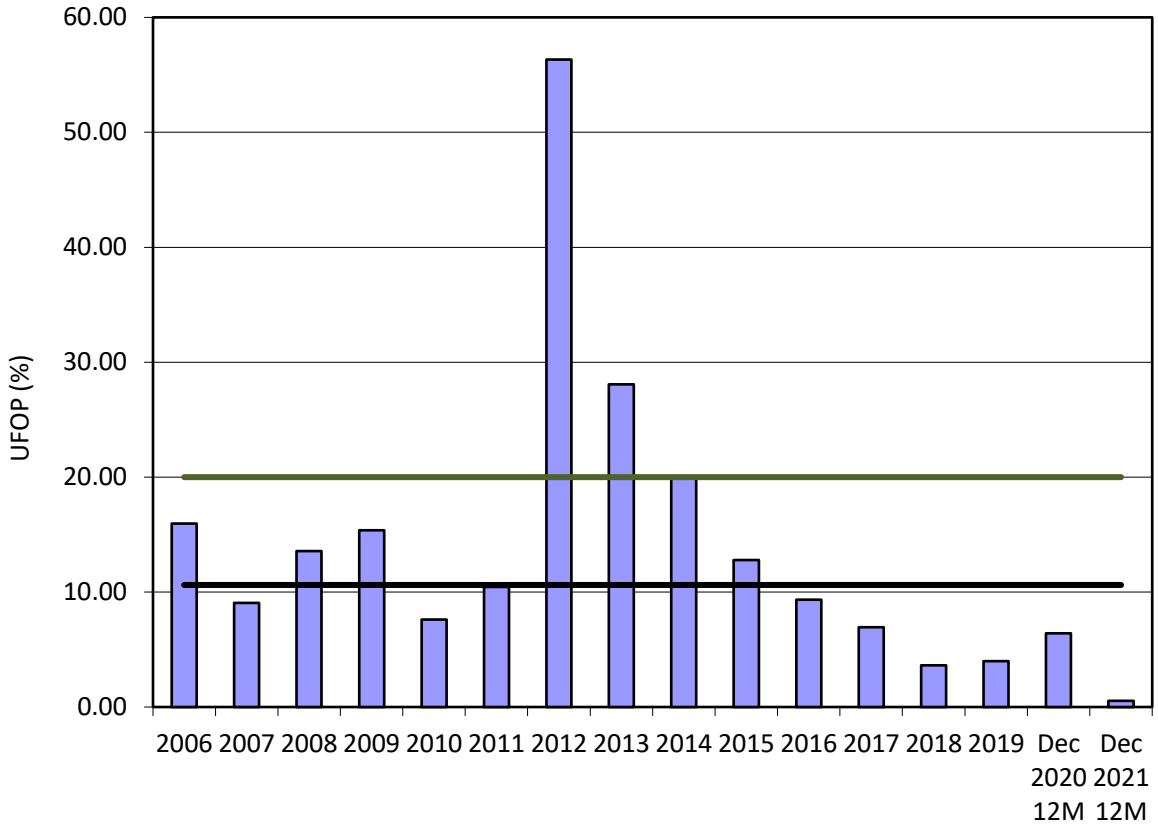

Figure 3: Gas Turbine UFOP: Hardwoods/Happy Valley/Stephenville Units

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 Figure 4) and has improved when compared to the 12-month period ending December 31, 2020.

Table 7: Holyrood Gas Turbine UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ending December 2020 (%)	12 Months Ending December 2021 (%)	Historical Base Planning Assumption (%)	Historical Near-Term Planning Assumption (%)
Holyrood GT	123.5	7.95	0.00	5.00	5.00

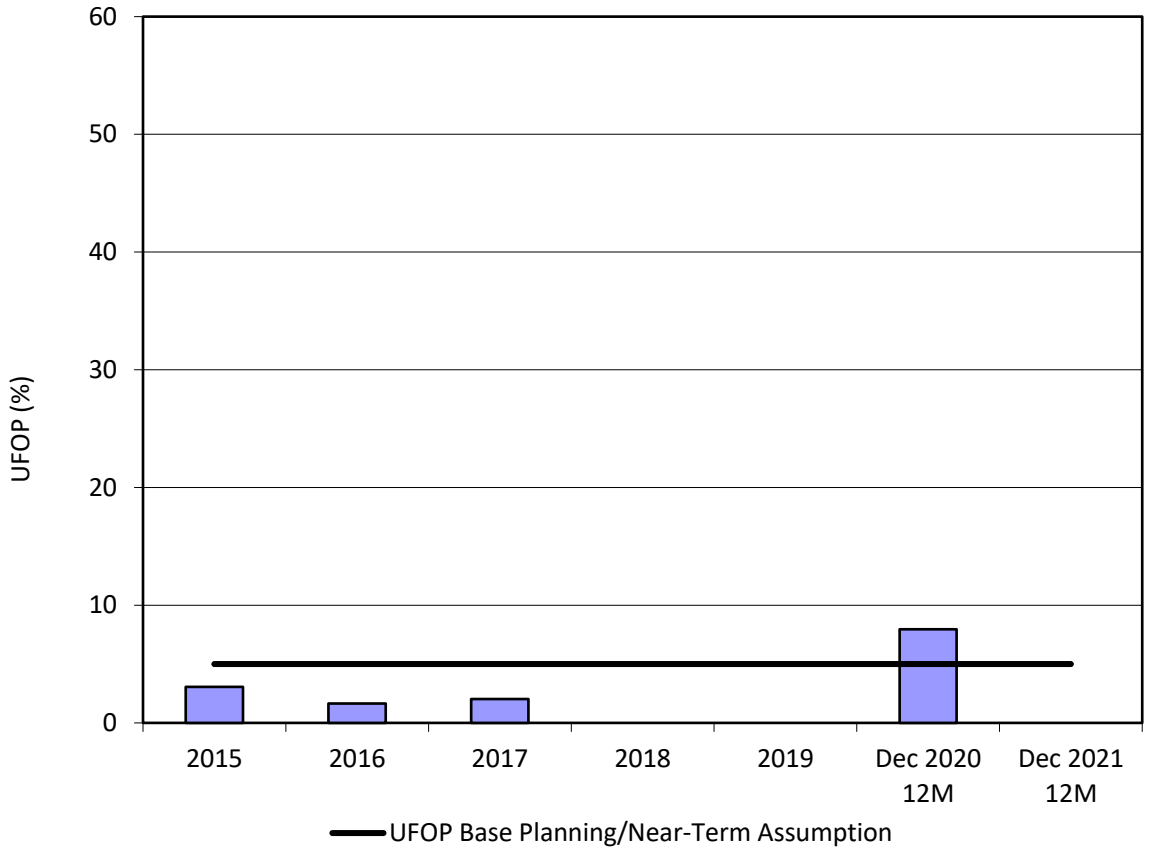

Figure 4: Gas Turbine UFOP: Holyrood Unit

7.0 Gas Turbine DAUFOP Performance

The combined DAUFOP for the Hardwoods and Stephenville Gas Turbines was 1.73% for the 12-month period ending December 31, 2021 (Table 8 and Figure 5). This is below the near-term planning assumption of 30.00%. The Stephenville Gas Turbine DAUFOP for the current period is 1.11%, which is below the near-term planning assumption of 30.00%. The Hardwoods Gas Turbine DAUFOP for the current period is 1.91%, which is below the near-term planning assumption of 30.00%. On a per unit basis, this indicates an improvement in performance over the 12-month period ending December 31, 2020 for both units.

Table 8: Hardwoods/Stephenville Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ending December 2020 (%)	12 Months Ending December 2021 (%)	Historical Near-Term Planning Assumption (%)
Gas Turbines (HWD/SVL)	100	14.53	1.73	30.00
Stephenville	50	8.13	1.11	30.00
Hardwoods	50	16.25	1.91	30.00

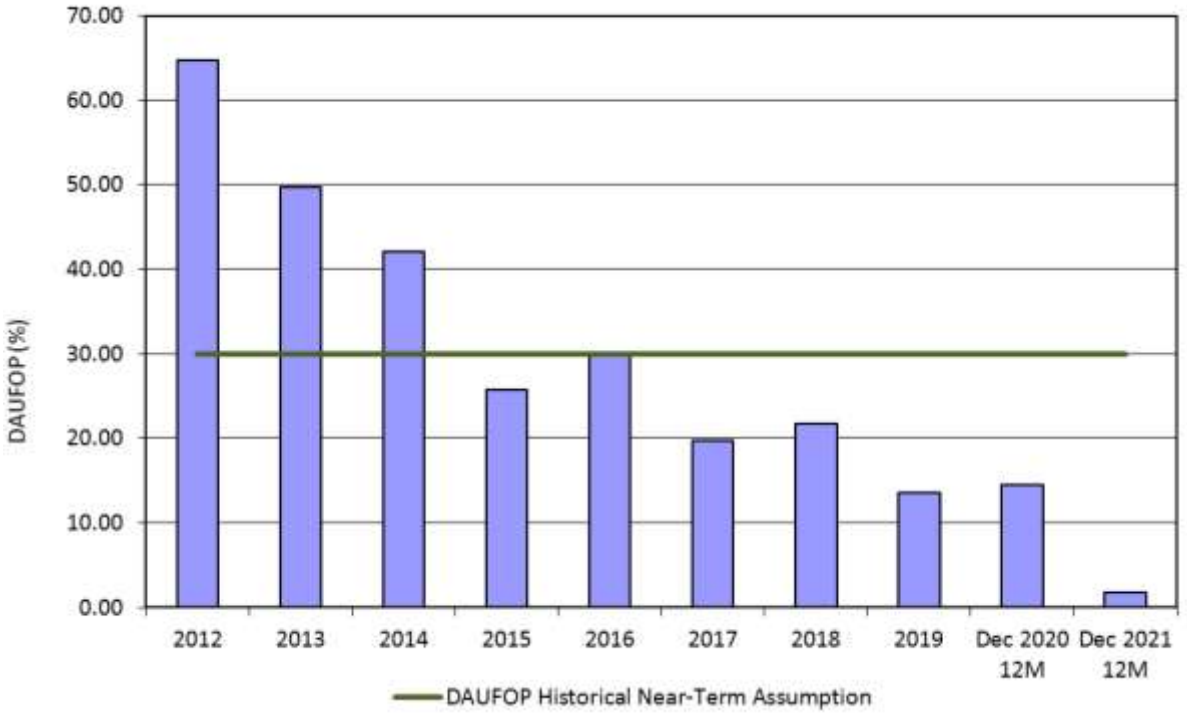

Figure 5: Gas Turbine DAUFOP: Hardwoods/Stephenville Units

The DAUFOP for the Happy Valley Gas Turbine was 2.13% for the 12-month period ending December 31, 2021 (Table 9 and Figure 6). This is below the near-term planning assumption of 15.00%, and shows an improvement in performance over the 12-month period ending December 31, 2020.

Table 9: Happy Valley Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ending December 2020 (%)	12 Months Ending December 2021 (%)	Historical Near-Term Planning Assumption (%)
Happy Valley	25	6.82	2.13	15.00

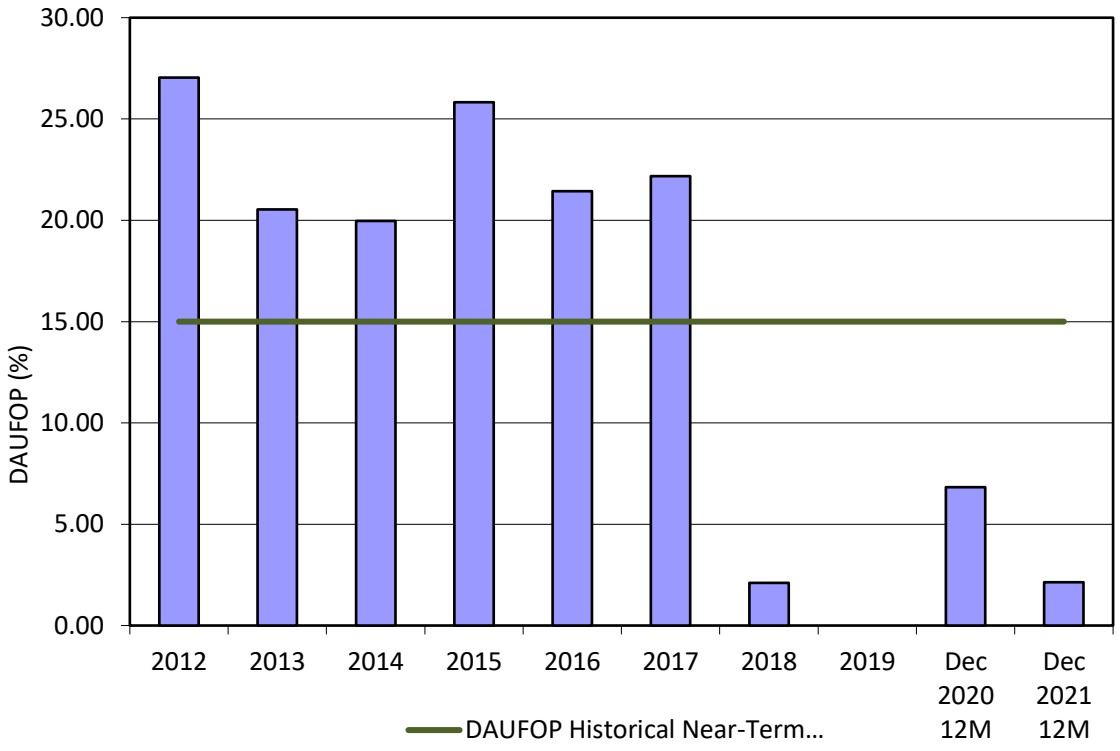

Figure 6: Gas Turbine DAUFOP: Happy Valley Unit

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 Figure 7) and has improved from the 12-month period ending December 31, 2020.

Table 10: Holyrood Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ending December 2020 (%)	12 Months Ending December 2021 (%)	Historical Near-Term Planning Assumption (%)
Holyrood GT	123.5	7.95	0.00	5.00

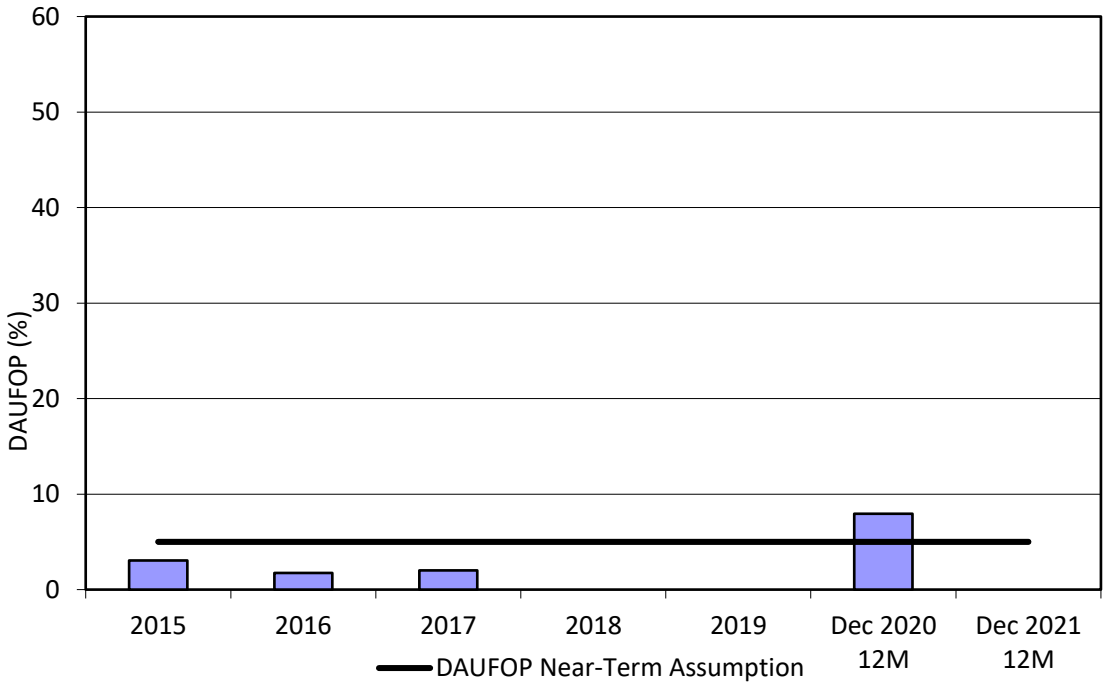

Figure 7: Gas Turbine DAUFOP: Holyrood Unit

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.[6]

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

Unit Type	Measure	Near-Term Analysis Value (%)	Resource Planning Analysis Value (%)
Hydraulic	DAFOR	2.6	2.1
Thermal	DAFOR	15.0	N/A
Gas Turbines			
Happy Valley	DAUFOP	12.0	9.7
Hardwoods and Stephenville	DAUFOP	30.0	N/A
Holyrood	DAUFOP	4.9	1.7

A five-year, capacity-weighted average was applied to the hydroelectric 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%,[7] while a ten-year, capacity-weighted average was applied for use in the resource planning model, resulting in a DAFOR of 2.1%. The DAFOR value was based on historical data reflective of Hydro's maintenance program over the long-term.

DAFORs of 15%, 18%, and 20% were applied to each of the units at the Holyrood TGS to determine the sensitivity of the system to Holyrood TGS availability in the near term. This is consistent with the May 2018 "Near-Term Generation Adequacy Report." As the Holyrood TGS units are being retired from generation mode in the near term, the units were not included in the long-term analysis; therefore,

[6] Values indicated for Hydro's near-term analysis reflect those used in the "Reliability and Resource Adequacy Study 2020 Update: Volume II: Near-Term Reliability Report," Newfoundland and Labrador Hydro, November 18, 2020.

[7] In its most recent Near-term Reliability Report, filed November 15, 2021, Hydro deviated from the FOR methodology as described when selecting FORs for its hydroelectric units as the result of the prescribed methodology did not accurately represent the risk of unit outage. For the hydroelectric units, Hydro maintained the capacity-weight average DAFOR from its Near-term Reliability Report filed in May 2021, which is higher than the 5-year DAFOR, increasing the FOR to more appropriately represent the risk of failure in the near term.

there is no resource planning analysis value listed for these units. For the total plant, an all units weighted value of 15% is used for the near term.

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 12%, while a ten-year, capacity-weighted average was applied for use in the resource planning model resulting in a DAUFOP of 9.7%. 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 Hardwoods and Stephenville Gas Turbines are being considered for retirement in the near term, these units were not included in the long-term analysis; therefore, there is no resource planning analysis value listed for these facilities.

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	2.6	2.1
Thermal	DAFOR	9.64	14.0	15.0	N/A
Gas Turbines					
Happy Valley	DAUFOP	-	15.0	12.0	9.7
Hardwoods and Stephenville	DAUFOP	-	30.0	30.0	N/A
Holyrood	DAUFOP	-	5.0	4.9	1.7

The generating unit performance presented earlier in this report is again presented in Tables 13 to 17 with comparison 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 violations of Hydro's current planning assumptions pertaining to asset availability for both Hydraulic and Thermal units. Details of what contributed to these violations are included in Sections 4.0 and 5.0 of this report.

Table 13: Hydraulic Weighted DAFOR Performance Comparison

				May 2018		November 2020	
Generating Unit	**Maximum Continuous Unit Rating (MW)**	**12 months ending December 2020 (%)**	**12 months ending December 2021 (%)**	**Historic Base Planning Assumption (%)**	**Historic Near-Term Planning Assumption (%)**	**Near-Term Planning Analysis Value (%)**	**Resource Planning Analysis Value (%)**
All Hydraulic Units - weighted	954.4	0.93	3.09	0.90	2.60	2.60	2.10
Hydraulic Units							
Bay D'Espoir 1	76.5	1.44	3.31	0.90	3.90	2.60	2.10
Bay D'Espoir 2	76.5	0.00	0.00	0.90	3.90	2.60	2.10
Bay D'Espoir 3	76.5	2.46	0.00	0.90	3.90	2.60	2.10
Bay D'Espoir 4	76.5	5.44	0.21	0.90	3.90	2.60	2.10
Bay D'Espoir 5	76.5	1.15	0.00	0.90	3.90	2.60	2.10
Bay D'Espoir 6	76.5	0.72	0.16	0.90	3.90	2.60	2.10
Bay D'Espoir 7	154.4	0.46	0.00	0.90	3.90	2.60	2.10
Cat Arm 1	67	0.15	1.30	0.90	0.70	2.60	2.10
Cat Arm 2	67	0.27	1.06	0.90	0.70	2.60	2.10
Hinds Lake	75	2.13	0.46	0.90	0.70	2.60	2.10
Upper Salmon	84	0.00	22.69	0.90	0.70	2.60	2.10
Granite Canal	40	0.90	1.88	0.90	0.70	2.60	2.10
Paradise River	8	1.32	1.45	0.90	0.70	2.60	2.10

Table 14: Thermal DAFOR Performance Comparison

				May 2018		November 2020	
Generating Unit	**Maximum Continuous Unit Rating (MW)**	**12 months ending December 2020 (%)**	**12 months ending December 2021 (%)**	**Historic Base Planning Assumption (%)**	**Historic Near-Term Planning Assumption (%)**	**Near-Term Planning Analysis Value (%)**	**Resource Planning Analysis Value (%)**
All Thermal Units - weighted	490	4.76	33.72	9.64	14.00	15.00	N/A
Thermal Units							
Holyrood 1	170	3.97	34.50	9.64	15.00	15.00	-
Holyrood 2	170	7.78	26.19	9.64	10.00	15.00	-
Holyrood 3	150	0.52	42.12	9.64	18.00	15.00	-

Table 15: Hardwoods/Stephenville Gas Turbine DAUFOP Performance Comparison

				May 2018		November 2020	
Gas Turbine Units	**Maximum Continuous Unit Rating (MW)**	**12 months ending December 2020 (%)**	**12 months ending December 2021 (%)**	**Historic Base Planning Assumption (%)**	**Historic Near-Term Planning Assumption (%)**	**Near-Term Planning Analysis Value (%)**	**Resource Planning Analysis Value (%)**
Gas Turbines (HWD/SVL)	100	14.53	1.73	N/A	30.00	30.00	N/A
Stephenville	50	8.13	1.11	N/A	30.00	30.00	N/A
Hardwoods	50	16.25	1.91	N/A	30.00	30.00	N/A

Table 16: Happy Valley Gas Turbine DAUFOP Performance Comparison

				May 2018		November 2020	
Gas Turbine Units	**Maximum Continuous Unit Rating (MW)**	**12 months ending December 2020 (%)**	**12 months ending December 2021 (%)**	**Historic Base Planning Assumption (%)**	**Historic Near-Term Planning Assumption (%)**	**Near-Term Planning Analysis Value (%)**	**Resource Planning Analysis Value (%)**
Happy Valley	25	6.82	2.13	N/A	15.00	12.00	9.70

Table 17: Holyrood Gas Turbine DAUFOP Performance Comparison

				May 2018		November 2020	
Gas Turbine Units	**Maximum Continuous Unit Rating (MW)**	**12 months ending December 2020 (%)**	**12 months ending December 2021 (%)**	**Historic Base Planning Assumption (%)**	**Historic Near-Term Planning Assumption (%)**	**Near-Term Planning Analysis Value (%)**	**Resource Planning Analysis Value (%)**
Holyrood GT	123.5	7.95	0.00	N/A	5.00	4.90	1.70