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July 29, 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

Re: Quarterly Report on Performance of Generating Units for the Twelve Months Ended June 30, 2022

Please find enclosed Newfoundland and Labrador Hydro's Quarterly Report on Performance of Generating Units for the Twelve Months Ended June 30, 2022.

If you have any questions or comments, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

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Senior Legal Counsel, Regulatory
SAW/sk

Encl.

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Quarterly Report on Performance of Generating Units for the Twelve Months Ended June 30, 2022

July 29, 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 June 30, 2022.

This report contains forced outage rates for the current 12-month reporting period of July 1, 2021 to June 30, 2022 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 July 1, 2020 to June 30, 2021. 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 (formerly Canadian Electricity Association) 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 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 June 30, 2022

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

Class of Units	1-Jul-2020 to 30-Jun-2021	1-Jul-2021 to 30-Jun-2022	Base Planning Assumption	Near-Term Planning Assumption[1]
Hydraulic (DAFOR)	1.21	2.71	0.90	2.60
Thermal (DAFOR)	5.92	34.66	9.64	14.00
Combined Gas Turbine (UFOP)	3.79	0.09	10.62	20.00
Holyrood Gas Turbine (UFOP)	1.94	0.00	5.00	5.00
Hardwoods/Stephenville Gas Turbine (DAUFOP)	3.10	1.16	-	30.00
Happy Valley Gas Turbine (DAUFOP)	9.79	0.00	-	15.00
Holyrood Gas Turbine (DAUFOP)	1.94	0.00	-	5.00

As shown in Table 1, hydraulic and thermal DAFOR performance declined for the current 12-month period ending June 30, 2022 compared to the 12 months ending June 30, 2021. The UFOP and DAUFOP[2]

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

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

performance for all gas turbines improved in the current period compared to the 12 months ending June 30, 2021.

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 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,"[3] 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."[4]

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.[5]

[3] "Near-Term Generation Adequacy Report," Newfoundland and Labrador Hydro, rev. May 30, 2018 (originally filed May 22, 2018).
[4] "Labrador-Island Link In-Service Update," Newfoundland and Labrador Hydro, October 1, 2018.
[5] 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[6] 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 June 30, 2022 and the 12 months ending June 30, 2021 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.

[6] 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 June 2021 (%)	12 Months Ending June 2022 (%)	Historical Base Planning Assumption (%)	Historical Near-Term Planning Assumption (%)
All Hydraulic Units – Weighted	**954.4**	**1.21**	**2.71**	**0.90**	**2.60**
Hydraulic Units					
Bay d'Espoir 1	76.5	5.30	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	2.59	0.06	0.90	3.90
Bay d'Espoir 4	76.5	5.21	0.12	0.90	3.90
Bay d'Espoir 5	76.5	0.00	2.25	0.90	3.90
Bay d'Espoir 6	76.5	0.09	0.75	0.90	3.90
Bay d'Espoir 7	154.4	0.47	0.00	0.90	3.90
Cat Arm 1	67	0.58	1.02	0.90	0.70
Cat Arm 2	67	0.59	0.79	0.90	0.70
Hinds Lake	75	0.55	0.19	0.90	0.70
Upper Salmon	84	0.06	23.19	0.90	0.70
Granite Canal	40	1.77	3.11	0.90	0.70
Paradise River	8	1.78	1.02	0.90	0.70

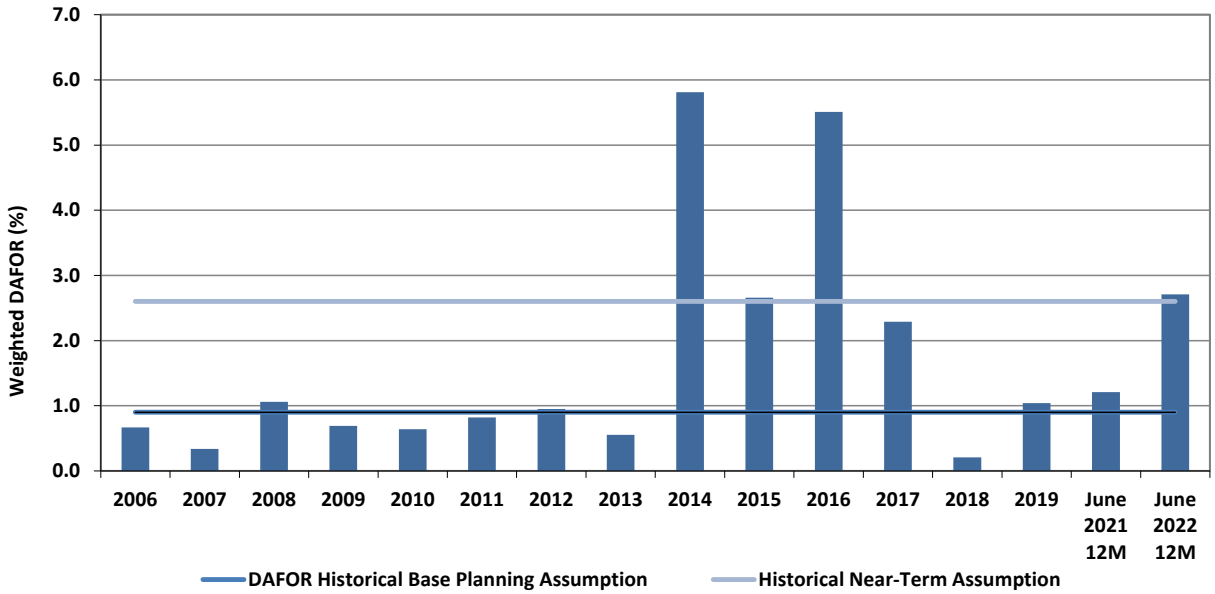

Chart 1: Hydraulic Weighted DAFOR

4.1.1 Bay d'Espoir Hydroelectric Generating Facility

Considering individual hydraulic unit performance, the Bay d'Espoir Unit 5 DAFOR of 2.25% 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. This increase in DAFOR was the result of two forced outages experienced in March 2022, as previously reported. The first, on March 13, 2022, was caused by the failure of a governor pump motor. Maintenance crews replaced the failed motor with an inventory spare and the unit was returned to service. The second outage, on March 30, 2022, was required to address a hot connection on Phase-A of the unit manual disconnect switch, 29-5. On March 29, 2022, it was reported that the Phase-A connection was showing 40 degrees higher than Phases B and C. At that time, the unit was derated to 20 MW until it could be removed from service to investigate and complete necessary corrective actions. The investigation revealed misalignment and poor surface contact on the affected phase. Components were replaced and the unit returned to service. Temperatures remain acceptable on the affected Phase.

4.1.2 Cat Arm Hydroelectric Generating Station

The Cat Arm Unit 1 DAFOR of 1.02% 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 the previously reported deratings experienced through September and October 2021 that were the result of increased generator surface air cooler temperatures, as well as one forced outage, experienced on February 17, 2022, while operating in synchronous condenser mode, which was caused by a low auxiliary cooling water supply to the unit, experienced when one unit is offline and the other is operating in sync condense. A capital project is planned for 2022 to upgrade the cooling water system in Cat Arm, which will include the replacement of cooling water valves.

4.1.3 Granite Canal Hydroelectric Generating Station

The Granite Canal Unit DAFOR of 3.11% 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 three forced outages that occurred in the current period. The first, from April 13 to 17, 2022, was the result of a leaking generator bearing oil 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.

4.1.4 Upper Salmon Hydroelectric Generating Station

The Upper Salmon Unit DAFOR of 23.19% 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 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 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 resulting in a forced extension to the outage that 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. 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.

NDT inspections completed in November 2021, February 2022, May 2022, and July 2022 revealed no material concerns with newly installed blocks; however, cracks were found on rim keys similar to those previously seen. Following further consultation with the OEM, it was advised to increase the frequency of scheduled inspections from every 2,000 hours to every 1,000 hours for the next two inspections. As inspections are completed, the OEM will be consulted to determine when Hydro can return to the prior frequency of every 2,000 hours.

The planned life extension is expected to be carried out to address the out-of-round stator and loose rotor rim, as per the approved supplemental capital expenditure application.[7]

As previously reported, the Upper Salmon Unit experienced two additional forced outages that 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 and includes a review of the preventive maintenance program. The failed jumper was replaced and the unit returned to service on November 10, 2021. A short time after returning to service, on November 10, 2021, the unit experienced a field ground and was once again taken offline. An investigation discovered a ground on rotor pole #9, this pole was replaced with a spare and a thorough inspection and cleaning of the unit were completed. The unit was returned to service on November 17, 2021.

4.1.5 Paradise River Hydroelectric Generating Station

The Paradise River Unit DAFOR of 1.02% 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 Paradise River Unit was unavailable due to a forced outage from October 17 to 19, 2021. This outage was the result of a failed servomotor seal. This seal was original and has been in service since the unit was first commissioned. The seal was replaced and the unit returned to service.

5.0 Thermal Unit DAFOR Performance

Detailed results for the 12 months ending June 30, 2022 and the 12 months ending June 30, 2021 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.

[7] "Application for Approval for Rotor Rim Shrinking and Stator Recentering at the Upper Salmon Hydroelectric Generating Station," Newfoundland and Labrador Hydro, April 26, 2022.

Table 5: Thermal DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 Months Ending June 2021 (%)	12 Months Ending June 2022 (%)	Historical Base Planning Assumption (%)	Historical Near-Term Planning Assumption (%)
All Thermal Units – Weighted	**490**	**5.92**	**34.66**	**9.64**	**14.00**
Thermal Units					
Holyrood 1	170	4.69	36.70	9.64	15.00
Holyrood 2	170	6.07	30.50	9.64	10.00
Holyrood 3	150	7.82	37.15	9.64	18.00

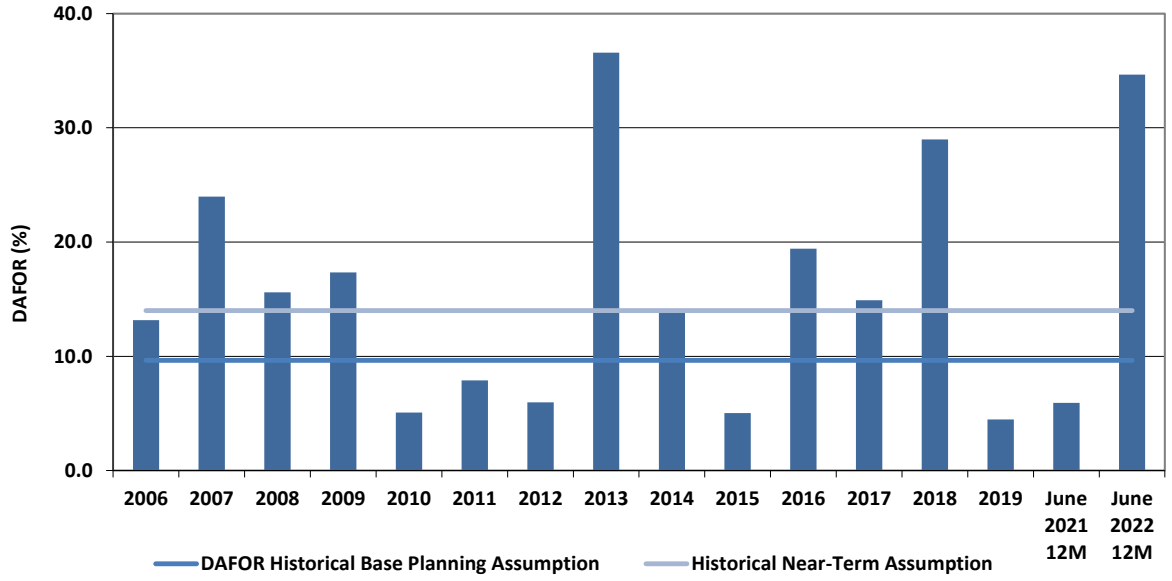

Chart 2: Thermal DAFOR

For the 12 months ending June 30, 2022, the weighted DAFOR for all thermal units of 34.66% is above the historical base planning assumption DAFOR value of 9.64% and the historical near-term planning assumption of 14.00%.

5.1.1 Holyrood TGS Unit 1

Unit 1 DAFOR was 36.70%, 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 as reported in the previous filing; a forced extension of the planned 2021 annual

maintenance outage 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 2021 annual outage.

The annual maintenance outage was planned for completion on September 10, 2021, but Unit 1 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. Also significant was damage found on the rotor and diaphragms, which had to be corrected on site by GE experts, as well as the alignment issues, which required correction. The COVID-19 pandemic protocols associated with bringing experts to the site further contributed to the schedule delay.

On October 25, 2021, Unit 1 experienced a water hammer event in the cold reheat pipe while restarting following successful completion of the overspeed testing required to verify turbine operation after completion of the overhaul work. The unit was offline until December 1, 2021 to allow an investigation of the cause of the event, assessment of the damage, and completion of all remedial work. The investigating team determined that water had been leaking into the cold reheat pipe through a spray station designed to control reheat steam temperature when online. The presence of this water during start up led to a water hammer event, which caused damage to the piping and supports. As recommended from the investigation, spray station valves are being refurbished or replaced as appropriate during the 2022 annual outage season.

5.1.2 Holyrood TGS Unit 2

Unit 2 DAFOR was 30.50 %, 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 a failure of power transformer T2, which was discussed in the previous filing. The failure occurred on November 12, 2021, and the unit was returned to service utilizing a spare transformer on January 13, 2022. With the spare transformer installed, Unit 2 has been proven to have an output capacity of 150 MW, which was the capacity of the unit through 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. An investigation into the cause of the T2 power transformer failure is ongoing, Hydro has engaged outside technical support through both Hitachi Energy (ABB) and Doble Engineering to assist with this investigation.

5.1.3 Holyrood TGS Unit 3

Unit 3 DAFOR was 37.15%, 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, which was discussed in the previous filing. The leak occurred on September 11, 2021, during the return to service after the completion of the planned annual outage. Unit 3 remained on forced outage until November 19, 2021, to allow for a complete investigation of the failure, an assessment of the condition of the remaining boiler tubes, and replacement of all damaged tubes.

The current period DAFOR performance for all three Holyrood units has declined over the 12 months ending June 30, 2021.

6.0 Gas Turbine UFOP Performance

The combined UFOP for the Hardwoods, Happy Valley, and Stephenville Gas Turbines was 0.09% for the 12 months ending June 30, 2022 (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% and is improved over performance during the 12 months ending June 30, 2021. The Stephenville Gas Turbine UFOP for the current period is 0.34%, as compared to the historical base planning assumption of 10.62%. The Hardwoods Gas Turbine UFOP for the current period is 0.04%, as compared to the 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 improved for the Hardwoods, Stephenville, and Happy Valley units over the 12 months ending June 30, 2021.

Table 6: Gas Turbine UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ending June 2021 (%)	12 Months Ending June 2022 (%)	Historical Base Planning Assumption (%)	Historical Near-Term Planning Assumption (%)
Combined Gas Turbines	**125**	**3.79**	**0.09**	**10.62**	**20.00**
Stephenville	50	1.95	0.34	10.62	20.00
Hardwoods	50	0.66	0.04	10.62	20.00
Happy Valley	25	9.79	0.00	10.62	20.00

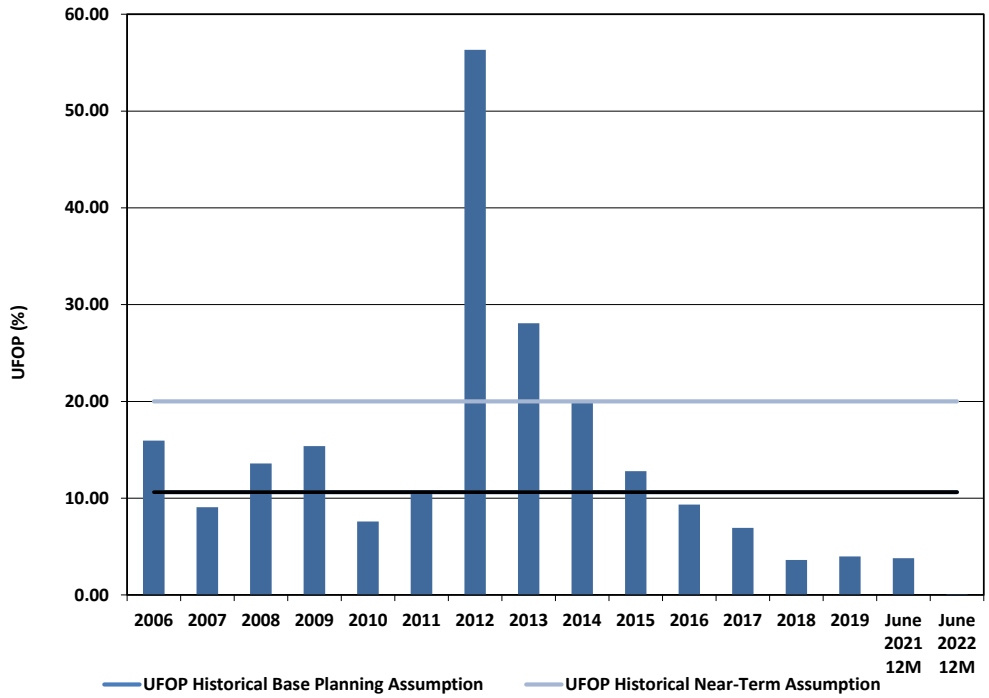

Chart 3: Gas Turbine UFOP: Hardwoods/Happy Valley/Stephenville Units

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 improved over the 12 months ending June 30, 2021.

Table 7: Holyrood Gas Turbine UFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ending June 2021 (%)	12 Months Ending June 2022 (%)	Historical Base Planning Assumption (%)	Historical Near-Term Planning Assumption (%)
Holyrood	123.5	1.94	0.00	5.00	5.00

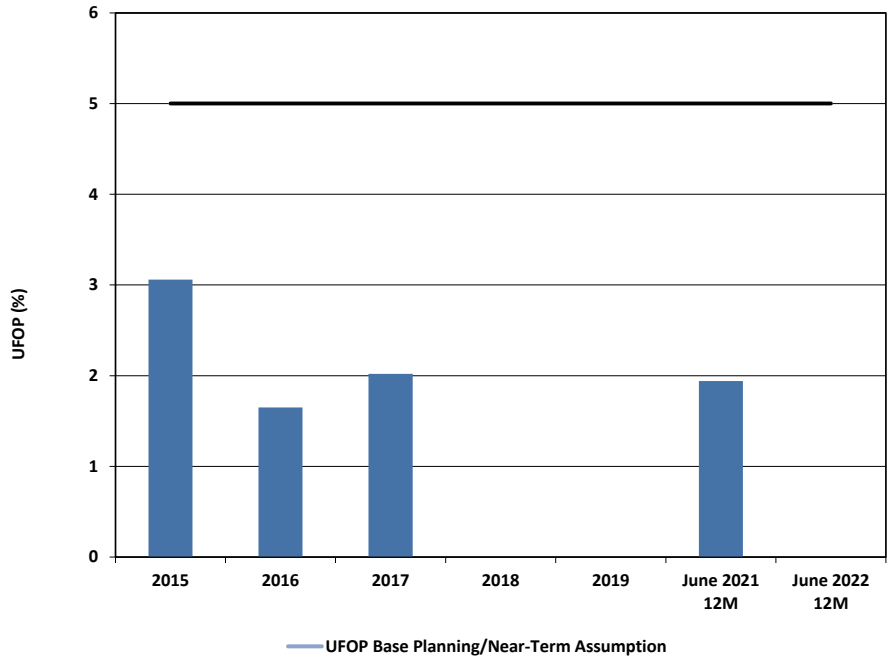

Chart 4: Gas Turbine UFOP: Holyrood Unit

7.0 Gas Turbine DAUFOP Performance

The combined DAUFOP for the Hardwoods and Stephenville Gas Turbines was 1.16% for the 12 months ending June 30, 2022 (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 0.99%, which is below the near-term planning assumption of 30.00%. The Hardwoods Gas Turbine DAUFOP for the current period is 1.21%, 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 months ending June 30, 2021 for both units.

Table 8: Hardwoods/Stephenville Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ending June 2021 (%)	12 Months Ending June 2022 (%)	Historical Near-Term Planning Assumption (%)
Gas Turbines (HWD/SVL)	**100**	**3.10**	**1.16**	**30.00**
Stephenville	50	1.95	0.99	30.00
Hardwoods	50	3.01	1.21	30.00

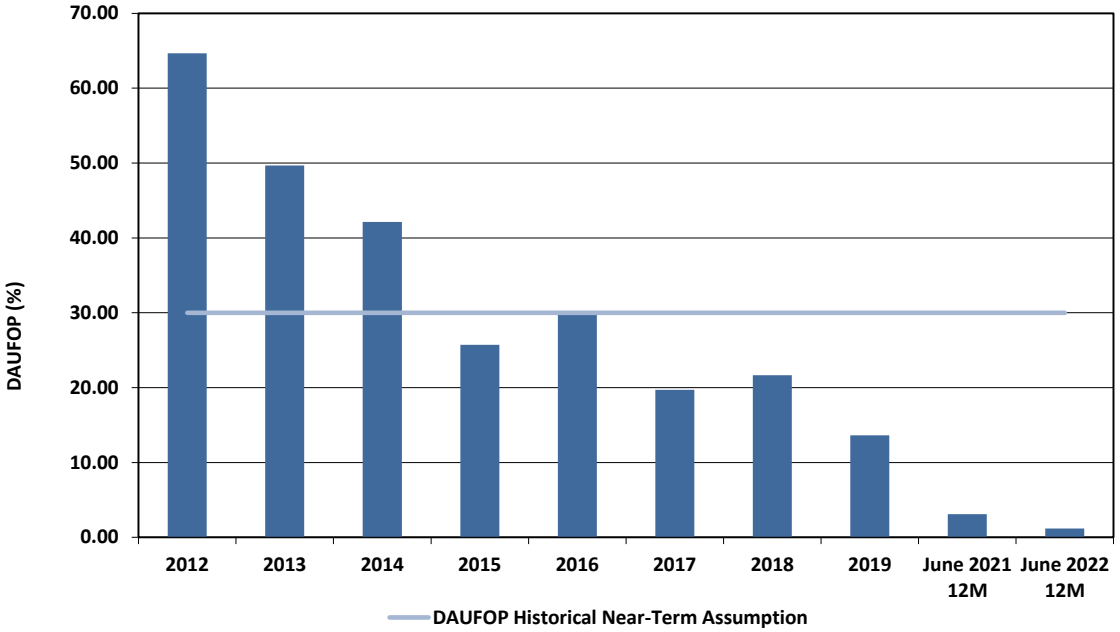

Chart 5: Gas Turbine DAUFOP: Hardwoods/Stephenville Units

The DAUFOP for the Happy Valley Gas Turbine was 0.00% for the 12 months ending June 30, 2022 (Table 9 and Chart 6). This is below the near-term planning assumption of 15.00% and shows an improvement in performance over the 12 months ending June 30, 2021.

Table 9: Happy Valley Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ending June 2021 (%)	12 Months Ending June 2022 (%)	Historical Near-Term Planning Assumption (%)
Happy Valley	25	9.79	0.00	15.00

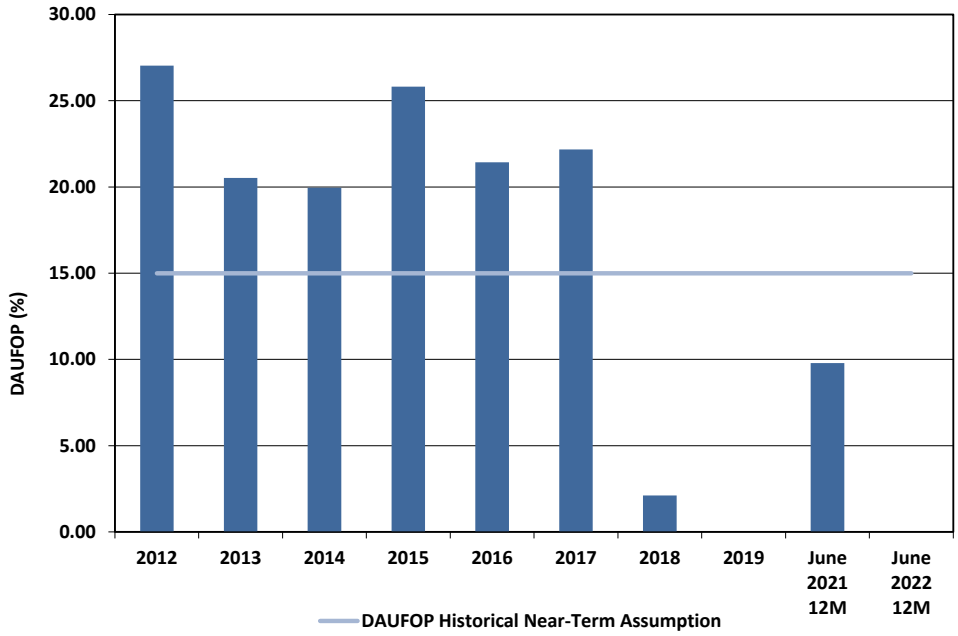

Chart 6: Gas Turbine DAUFOP: Happy Valley Unit

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 an improvement when compared to the 12 months ending June 30, 2021.

Table 10: Holyrood Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ending June 2021 (%)	12 Months Ending June 2022 (%)	Historical Near-Term Planning Assumption (%)
Holyrood	123.5	1.94	0.00	5.00

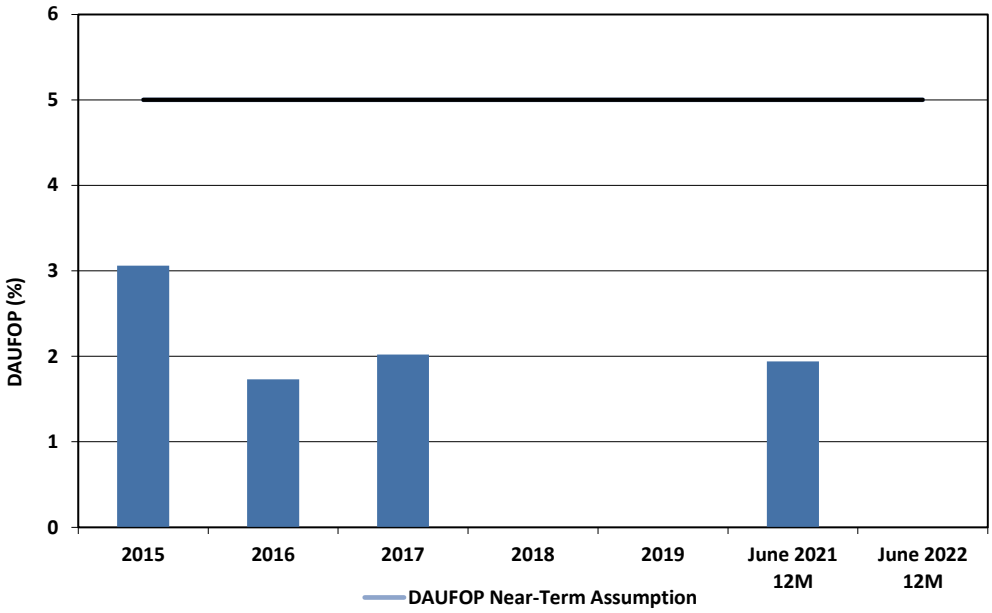

Chart 7: Gas Turbine DAUFOP: Holyrood Unit

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.[8]

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

[8] 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 – May Report," Newfoundland and Labrador Hydro, May 16, 2022.

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%,[9] 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%, 20%, and 34% 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 a deviation from the May 2018 "Near-Term Generation Adequacy Report," which previously used values of 15%, 18%, and 20%. 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, 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 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 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] In its most recent 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 FOR to more appropriately represent the risk of failure in the near term.

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 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 violated 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 June 2021 (%)**	**12 Months Ending June 2022 (%)**	**Historic Base Planning Assumption (%)**	**Historic Near-Term Planning Assumption (%)**	**Near-Term Planning Analysis Value (%)**	**Resource Planning Analysis Value (%)**
All Hydraulic Units - Weighted	**954.4**	**1.21**	**2.71**	**0.90**	**2.60**	**2.60**	**2.10**
Hydraulic Units							
Bay D'Espoir 1	76.5	5.30	0.00	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	2.59	0.06	0.90	3.90	2.60	2.10
Bay D'Espoir 4	76.5	5.21	0.12	0.90	3.90	2.60	2.10
Bay D'Espoir 5	76.5	0.00	2.25	0.90	3.90	2.60	2.10
Bay D'Espoir 6	76.5	0.09	0.75	0.90	3.90	2.60	2.10
Bay D'Espoir 7	154.4	0.47	0.00	0.90	3.90	2.60	2.10
Cat Arm 1	67	0.58	1.02	0.90	0.70	2.60	2.10
Cat Arm 2	67	0.59	0.79	0.90	0.70	2.60	2.10
Hinds Lake	75	0.55	0.19	0.90	0.70	2.60	2.10
Upper Salmon	84	0.06	23.19	0.90	0.70	2.60	2.10
Granite Canal	40	1.77	3.11	0.90	0.70	2.60	2.10
Paradise River	8	1.78	1.02	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 June 2021 (%)**	**12 Months Ending June 2022 (%)**	**Historic Base Planning Assumption (%)**	**Historic Near-Term Planning Assumption (%)**	**Near-Term Planning Analysis Value (%)**	**Resource Planning Analysis Value (%)**
All Thermal Units - Weighted	**490**	**5.92**	**34.66**	**9.64**	**14.00**	**15.00**	**N/A**
Thermal Units							
Holyrood 1	170	4.69	36.70	9.64	15.00	15.00	-
Holyrood 2	170	6.07	30.50	9.64	10.00	15.00	-
Holyrood 3	150	7.82	37.15	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 June 2021 (%)	12 Months Ending June 2022 (%)	Historic Base Planning Assumption (%)	Historic Near-Term Planning Assumption (%)	Near-Term Planning Analysis Value (%)	Resource Planning Analysis Value (%)
Gas Turbines (HWD/SVL)	**100**	**3.10**	**1.16**	**N/A**	**30**	**30.00**	**N/A**
Stephenville	50	1.95	0.99	N/A	30	30.00	N/A
Hardwoods	50	3.01	1.21	N/A	30	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 June 2021 (%)	12 Months Ending June 2022 (%)	Historic Base Planning Assumption (%)	Historic Near-Term Planning Assumption (%)	Near-Term Planning Analysis Value (%)	Resource Planning Analysis Value (%)
Happy Valley	25	9.79	0.00	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 June 2021 (%)	12 Months Ending June 2022 (%)	Historic Base Planning Assumption (%)	Historic Near-Term Planning Assumption (%)	Near-Term Planning Analysis Value (%)	Resource Planning Analysis Value (%)
Holyrood	123.5	1.94	0.00	N/A	5.00	4.90	1.70