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July 31, 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 June 30, 2023

Please find enclosed Newfoundland and Labrador Hydro's Quarterly Report on Performance of Generating Units for the Twelve Months Ended June 30, 2023.

Should you have any questions, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Shirley A. Walsh
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, 2023

July 31, 2023

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") provide 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 for the current 12-month reporting period of July 1, 2022 to June 30, 2023 ("current period").

This report contains forced outage rates for the current period for individual generating units at regulated hydraulic facilities[1] as well as the Holyrood Thermal Generating Station ("Holyrood TGS") and Hydro's gas turbines. In addition, this report now contains forced outage rates for the non-regulated hydraulic facility at Muskrat Falls Generating Station ("Muskrat Falls"). This report also provides, for comparison purposes, the individual generating unit data on forced outage rates for the 12-month reporting period of July 1, 2021 to June 30, 2022 ("previous period"). Further, total asset class data is presented based on the calendar year for the 10 most recent years, 2013 to 2022, with the exception of Muskrat Falls.[2]

The forced outage rates of Hydro's generating units are calculated using two measures:

1) Derated adjusted forced outage rate ("DAFOR") for the continuous (base-loaded) units; and

2) Derated adjusted utilization forced outage probability ("DAUFOP") for the stand-by units.

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 units and, historically, was used for the thermal units; however, it is not applicable to gas turbines because of their operation as standby units and their relatively low operating hours.

[1] Regulated hydraulic facilities include the Bay d'Espoir Hydroelectric Generating Facility ("Bay d'Espoir Facility" or "BDE"), the Cat Arm Hydroelectric Generating Station ("Cat Arm Station" or "CAT"), the Hinds Lake Hydroelectric Generating Station ("Hinds Lake Station" or "HLK"), the Upper Salmon Hydroelectric Generating Station ("Upper Salmon Station" or "USL"), the Granite Canal Hydroelectric Generating Station ("Granite Canal Station" or "GCL"), and the Paradise River Hydroelectric Generating Station ("Paradise River Station" or "PRV").

[2] The final generating unit at the Muskrat Falls Generating Station was released for commercial operation on November 25, 2021. Annual DAFOR performance data is available beginning in 2022.

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. DAUFOP is a measure primarily used for gas turbines; however, this measure will be applicable to the thermal units as their operation moves towards standby operation in the future. 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[3] guidelines. These guidelines require that derated levels of a generating unit be 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.

2.0 Assumptions Used in Hydro's Assessment of System Reliability and Resource Adequacy

Hydro continually assesses the reliability of its system and its ability to meet customer requirements, filing both long-term and near-term assessments with the Board of Commissioners of Public Utilities ("Board").[4]

As part of the ongoing *Reliability and Resource Adequacy Study Review* ("*RRA Study Review*") proceeding, 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 1 summarizes the most recent forced outage rate assumptions, as calculated using the forced outage rate methodology.[5] Forced outage rate assumptions will be re-evaluated on an annual basis to incorporate the most recent data available.

[3] Formerly the Canadian Electricity Association.
[4] Hydro currently files an assessment of near-term system reliability and resource adequacy semi-annually in May and November of each year. Hydro also files an assessment of longer-term system reliability and resource adequacy. The most recent filing was the "Reliability and Resource Adequacy Study – 2022 Update," Newfoundland and Labrador Hydro, October 3, 2022 ("RRA Study 2022 Update").
[5] Values indicated for Hydro's near-term analysis reflect those used in the "Reliability and Resource Adequacy Study – 2023 Update: Volume II: Near-Term Reliability Report – May Report," Newfoundland and Labrador Hydro, June 2, 2023 ("May 2023 Near-Term Report").

Table 1: Hydro's Reliability and Resource Adequacy Study Analysis Values (%)

Unit Type	Measure	Near-Term Analysis Value	Resource Planning Analysis Value
Hydraulic: Regulated and Muskrat Falls	DAFOR	2.4	2.3
Thermal	DAUFOP	20.0[6]	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 Facility, Cat Arm Station, Hinds Lake Station, Granite Canal Station, Upper Salmon Station, and Paradise River Station) for the near-term analysis, resulting in a DAFOR of 2.4%,[7] 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.

For the Muskrat Falls Hydroelectric Generating Facility "(Muskrat Falls Facility"), the same analysis values for near term and resource planning were used, as it is assumed that these assets will be maintained to the same standards as the remainder of the hydraulic fleet. Once historical operational data from the Muskrat Falls Facility is available, the DAFOR applied will be re-evaluated.

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 RRA Study 2022 Update, 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 appropriate measure of forced outage rates; instead, UFOP[8] and DAUFOP should be considered. Given the frequency of deratings historically experienced by these units, DAUFOP is a more appropriate measure.

[6] The Holyrood TGS base assumption is 20.0%. The sensitivity assumption is 34%.
[7] In the May 2023 Near-Term Report, 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 used the ten-year, capacity weighted, average DAFOR, which is higher than the three-year DAFOR, increasing the forced outage rates to more appropriately represent the risk of failure in the near term.
[8] Utilization forced outage probability ("UFOP").

Analyses performed for a range of Holyrood TGS DAUFOP assumptions indicate the sensitivity of supply adequacy to changes in the availability of the Holyrood TGS. From this analysis, a DAUFOP of 20% was recommended in the near term, with a sensitivity value of 34%.[9] Hydro will continue to analyze the operational data to ensure that forced outage rate assumptions for the Holyrood TGS are appropriate. At present time, the operation of the units at the Holyrood TGS remains base loaded to ensure the availability of capacity for the power system, as the Labrador-Island Link ("LIL") is recently commissioned and in the early operational stages. This will remain the case as Hydro continues to monitor LIL performance and reliability. If the LIL is found to perform well for an extended period and system conditions permit, Hydro will have the opportunity to incrementally remove the Holyrood TGS units from service. To ensure alignment with the assumptions used in the resource planning model (PLEXOS)[10] while appropriately reporting on current period performance versus historical, Hydro will continue to use the DAFOR performance measure and the 20% forced outage rate for the units at Holyrood TGS.

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 ("HWD")and Stephenville ("SVL") Gas Turbines, a DAUFOP of 30% was used for the near-term analysis, consistent with the metrics that were considered in the May 2023 Near-Term Report. As the Hardwoods and Stephenville Gas Turbines are approaching end-of-life, 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. As of the most recent update, the Hardwoods Gas Turbine is proposed for retirement in 2030 and the Stephenville Gas Turbine, originally proposed for retirement in 2024, is now being considered for operation beyond 2024 in light of anticipated load growth and recent positive

[9] A sensitivity value of 34% was chosen to reflect actual performance at the Holyrood TGS for the 2021–2022 winter operating period.

[10] The resource planning model does not differentiate between DAFOR and DAUFOP metrics; rather, it applies a forced outage rate only.

performance, should the analysis for the 2024 update for the *RRA Study Review* determine it is necessary.

3.0 Overview for Current Period

Table 2: DAFOR and DAUFOP Overview (%)

Unit Type	Measure	1-Jul-2021 to 30-Jun-2022	1-Jul-2022 to 30-Jun-2023	Near-Term Planning Analysis Value	Resource Planning Analysis Value
Hydraulic: Regulated	DAFOR	2.71	5.25	2.40	2.30
Hydraulic: Muskrat Falls	DAFOR	8.53	3.74	2.40	2.30
Thermal	DAFOR/DAUFOP[11]	34.66	11.78	20.00	20.00
Gas Turbines					
Hardwoods/Stephenville	DAUFOP	1.16	7.12	30.00	N/A
Happy Valley	DAUFOP	0.00	10.97	6.70	7.60
Holyrood	DAUFOP	0.00	2.54	4.90	4.90

As shown in Table 2, regulated hydraulic DAFOR performance declined for the current period, while Muskrat Falls DAFOR and thermal DAFOR performance improved for the current period when compared to the previous period. The DAUFOP[12] performance for the Hardwoods and Stephenville Gas Turbines, the Happy Valley Gas Turbine, and the Holyrood Gas Turbine has declined in the current period compared to the previous period.

4.0 Hydraulic Unit DAFOR Performance – Regulated Hydro

Detailed results for the current period and the previous period are presented in Table 3 and Chart 1. These results are compared to Hydro's near-term and resource planning analysis values for forced outage rates, as used in the May 2023 Near-Term Report and the RRA Study 2022 Update. Any individual unit with performance that does not meet the established resource planning and/or near-term analysis values is discussed herein.

[11] The resource planning model does not differentiate between DAFOR and DAUFOP; rather, it requires the selection of a forced outage rate percentage.

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

Table 3: Hydraulic Weighted DAFOR – Regulated Hydro

Generating Unit	Maximum Continuous Unit Rating (MW)	12 Months Ended June 2022 (%)	12 Months Ended June 2023 (%)	Near-Term Analysis Value (%)	Resource Planning Analysis Value (%)
All Hydraulic Units – Weighted	**954.4**	**2.71**	**5.25**	**2.40**	**2.30**
Hydraulic Units					
BDE Unit 1	76.5	0.00	0.00	2.40	2.30
BDE Unit 2	76.5	0.00	0.15	2.40	2.30
BDE Unit 3	76.5	0.06	0.00	2.40	2.30
BDE Unit 4	76.5	0.12	0.18	2.40	2.30
BDE Unit 5	76.5	2.25	28.33	2.40	2.30
BDE Unit 6	76.5	0.75	0.00	2.40	2.30
BDE Unit 7	154.4	0.00	0.00	2.40	2.30
CAT Unit 1	67	1.02	0.00	2.40	2.30
CAT Unit 2	67	0.79	0.19	2.40	2.30
HLK Unit	75	0.19	0.17	2.40	2.30
USL Unit	84	23.19	35.55	2.40	2.30
GCL Unit	40	3.11	0.65	2.40	2.30
PRV Unit	8	1.02	0.00	2.40	2.30

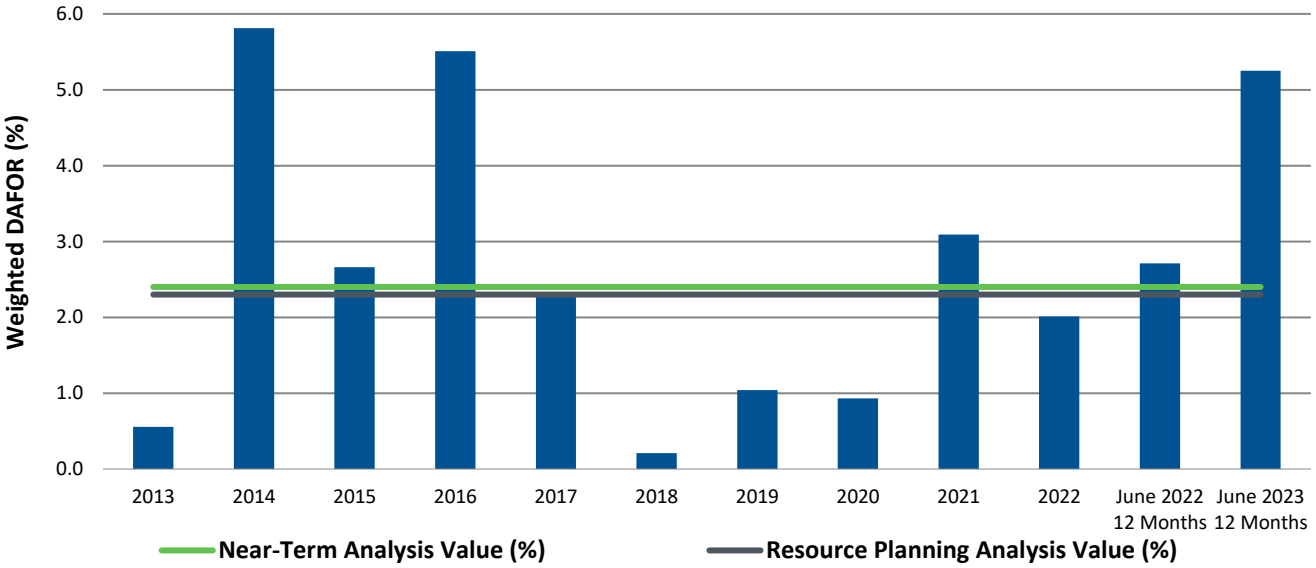

Chart 1: Hydraulic Weighted DAFOR – Regulated Hydro

4.1 Bay d'Espoir Facility

Considering individual hydraulic unit performance, the BDE Unit 5 DAFOR of 28.33% did not meet the resource planning analysis value of 2.30% and is above the near-term planning analysis value of 2.40% for an individual hydraulic 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 and a suitable spare transformer was installed in its place. The unit was successfully synchronized to the system for testing on September 1, 2022 and was released for normal service on September 4, 2022. The investigation into the cause of the transformer failure is ongoing.

4.2 Upper Salmon Station

The Upper Salmon Station unit's DAFOR of 35.55% did not meet the resource planning analysis value of 2.30% and is above the near-term planning analysis value of 2.40% for an individual hydraulic unit. This increase in DAFOR was the result of a forced extension of a planned outage that occurred on March 10, 2023. Hydro has previously reported in the November 2022 Near-Term Report[13] and the May 2023 Near-Term Report that this unit has experienced ongoing issues with the rotor rim keys and guidance blocks.

During the most recent inspection of the rotor rim guidance blocks in March 2023, significant quantities of broken rim laminations were found in 8 of 16 guidance block assemblies. The extent of the damage varied; however, there are two guidance block assemblies with less than 25% of the remaining contact surface area between the key and remaining laminations. Following this discovery, the original equipment manufacturer was consulted and advised that given the known condition of the unit and the worsening results from recent inspections, 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 original equipment manufacturer, Engineering and Long-Term Asset Planning staff completed the necessary risk review and provided a formal recommendation not to return the unit at the Upper Salmon Station to service until the approved capital program can be successfully executed,

[13] "Reliability and Resource Adequacy Study – 2022 Update: Volume II: Near-Term Reliability Report – November Report," Newfoundland and Labrador Hydro, November 15, 2022 ("November 2022 Near-Term Report").

later in 2023. An application was approved to undertake additional work to address the required life extension activities;[14] this work commenced in May 2023. The unit at the Upper Salmon Station is anticipated to be returned to service in the fall of 2023.

5.0 Thermal Unit DAFOR Performance

Detailed results for the current period and the previous period are presented in Table 4 and Chart 2. These results are compared to Hydro's near-term and resource planning analysis values for forced outage rates, as used in the May 2023 Near-Term Report and the RRA Study 2022 Update.

For current period, the weighted DAFOR for all thermal units of 11.78% is below the 20% near-term and resource planning analysis values. Individual unit DAFOR outcome of 0.97% for Holyrood TGS Unit 2 and 15.52 % for Holyrood TGS Unit 3 for the current period is below the 20% analysis value. Holyrood TGS Unit 1 performance is discussed herein.

Table 4: Thermal DAFOR

Generating Unit	Maximum Continuous Unit Rating (MW)	12 Months Ended June 2022 (%)	12 Months Ended June 2023 (%)	Near-Term Analysis Value (%)	Resource Planning Analysis Value (%)
All Thermal Units – Weighted	**490**	**34.66**	**11.78**	**20.00**	**20.00**
Thermal Units					
Holyrood TGS Unit 1	170	36.70	20.90	20.00	20.00
Holyrood TGS Unit 2	170	30.50	0.97	20.00	20.00
Holyrood TGS Unit 3	150	37.15	15.52	20.00	20.00

[14] The "Application for Approval for Rotor Rim Shrinking and Stator Recentering at the Upper Salmon Hydroelectric Generating Station, Newfoundland and Labrador Hydro, April 26, 2022 was approved as per *Public Utilities Act,* RSNL 1990, c P-47, Board Order No. P.U. 18(2022), Board of Commissioners of Public Utilities, May 20, 2022.

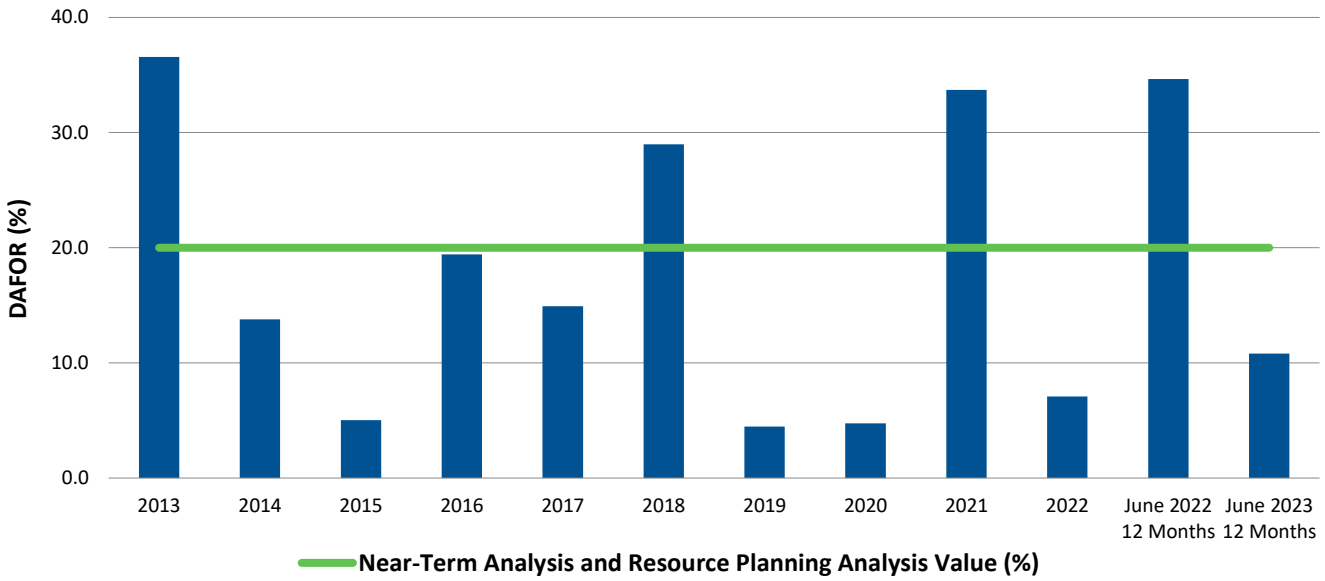

Chart 2: Thermal DAFOR

5.1 Holyrood TGS Unit 1

Considering individual thermal unit performance, the Holyrood TGS Unit 1 DAFOR of 20.90% did not meet the near-term and resource planning analysis value of 20.0% for a unit at the Holyrood TGS. This increase in DAFOR was primarily the result of electrical issues that continued from February 1 to March 12, 2023 as well as two extended periods of derating due to pump motor failures.

From November 15 to December 8, 2022, the unit was derated to 80 MW due to a failure of the east boiler feed pump motor, which experienced a ground fault during start-up. The 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 the 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 the completion of the investigation. The unit remained online and reliable for the remainder of the operating season.

Through the investigation, two problems were identified, as detailed in the May 2023 Near-Term Report, these included:

- A crack in the porcelain of the primary potential transformer in series with a 180-ohm resistor; and
- A failed resistor in the secondary of the generator grounding transformer. In addition, several corrective actions were identified, including:
  - The replacement of the temporary resistors on the secondary of the potential transformer and the grounding transformer, which is planned for completion in August 2023 during the planned annual outage;[15]
  - A review of maintenance procedures has been completed, including the frequency of preventive maintenance activities on the grounding resistors and transformers. As a result, the preventive maintenance strategy is being updated to include more detail regarding required measured values. The frequency of preventive maintenance is also being increased;
  - An investigation of instrument transformer testing methods has been completed to develop an in-depth testing plan for the potential transformers to better assess their condition. A review of the preventive maintenance for the potential transformers has been completed and it was found to be appropriate. The failure cause was not related to the potential transformers; and
  - An investigation into the cause of the failure, as well as identified spare parts issues, has been completed. The cause of the failure was due to the failure of a grounding resistor in the grounding transformer cabinet. Spare part deficiencies were identified and these parts have been procured and received at the site.

[15] As a preventive measure, new resistors are also being installed on the secondary of the potential transformers on Holyrood TGS Unit 2; which has the same configuration but has not experienced any failures. Unit 2 work is scheduled for July 2023, during the planned annual outage.

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

6.0 Gas Turbine DAUFOP Performance

The combined DAUFOP for the Hardwoods and Stephenville Gas Turbines was 7.12% for the current period, as shown in Table 5 and Chart 3. This is below the near-term planning analysis value of 30.00%. The Stephenville Gas Turbine DAUFOP for the current period is 10.98%, which is below the near-term planning assumption of 30.00%. The Hardwoods Gas Turbine DAUFOP for the current period is 2.67%, which is below the near-term planning assumption of 30.00%. On a per-unit basis, this indicates a decline in performance over the previous period for both units.

Table 5: Hardwoods/Stephenville Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ended June 2022 (%)	12 Months Ended June 2023 (%)	Near-Term Planning Analysis Value (%)
Gas Turbines (HWD/SVL)	**100**	**1.16**	**7.12**	**30.00**
SVL	50	0.99	10.98	30.00
HWD	50	1.21	2.67	30.00

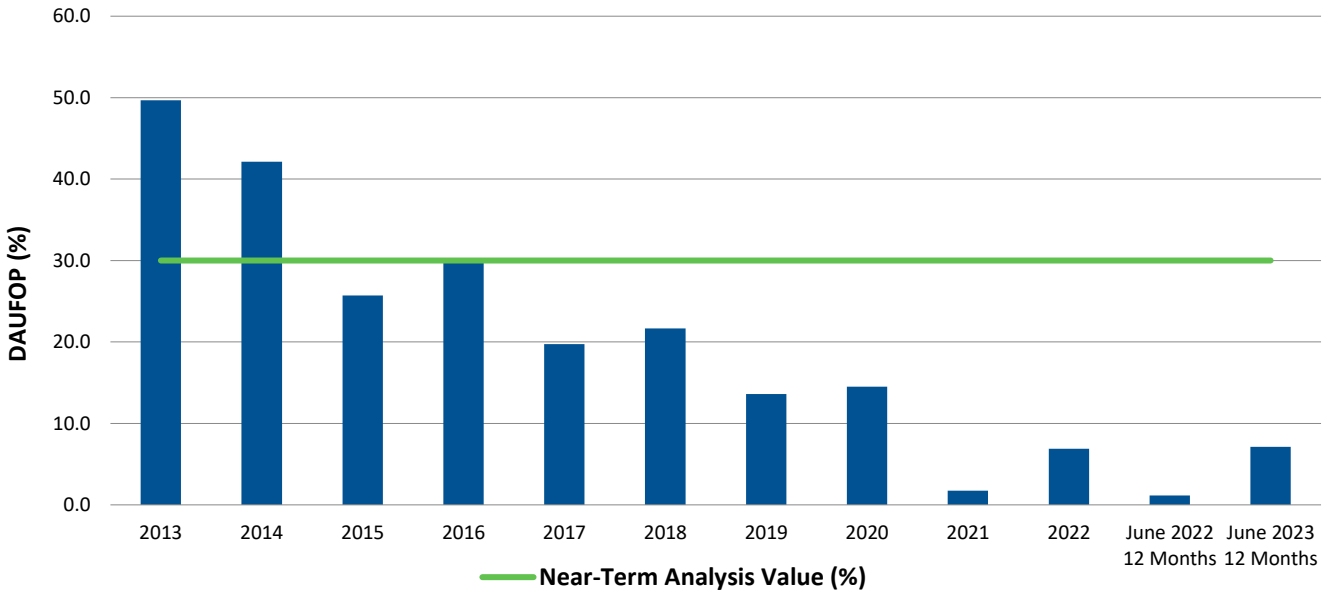

Chart 3: Gas Turbine DAUFOP: Hardwoods/Stephenville Units

The DAUFOP for the Happy Valley Gas Turbine was 10.97% for the current period, as shown in Table 6 and Chart 4. This is above both the near-term analysis value of 6.7% and the resource planning analysis value of 7.6% and indicates a decline in performance over the previous period. The performance of the Happy Valley Gas Turbine is discussed herein.

Table 6: Happy Valley Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ended June 2022 (%)	12 Months Ended June 2023 (%)	Near-Term Analysis Value (%)	Resource Planning Analysis Value (%)
Happy Valley	25	0.00	10.97	6.7	7.6

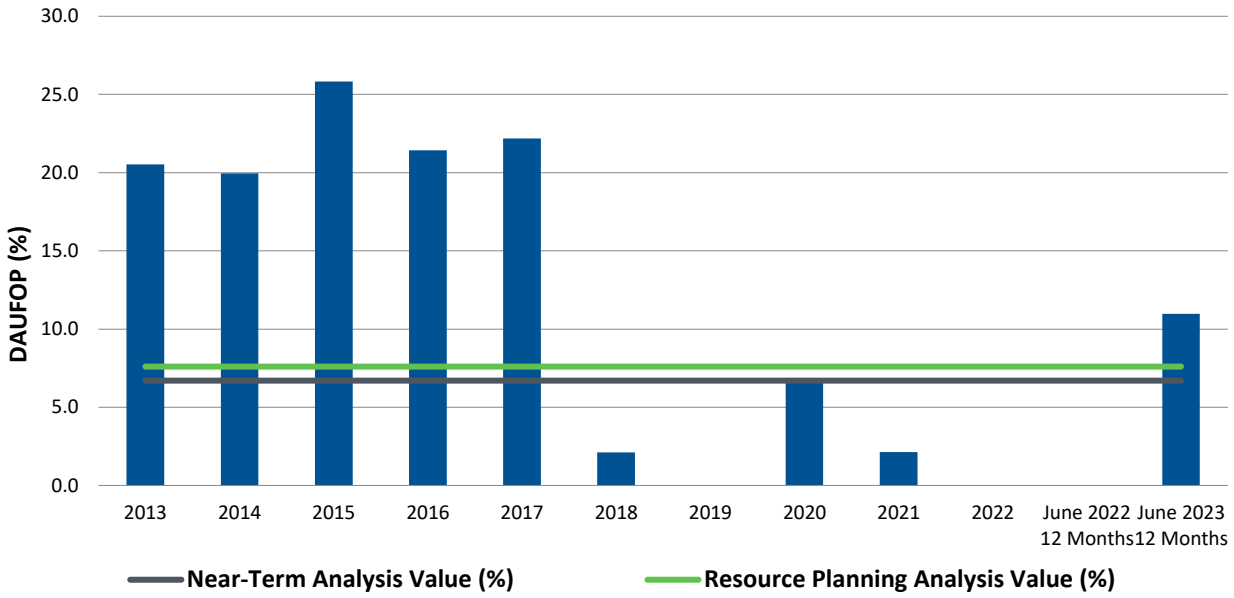

Chart 4: Gas Turbine DAUFOP: Happy Valley Unit

The Holyrood Gas Turbine DAUFOP of 2.54% for the current period is below the near-term and resource planning analysis value of 4.90%, as shown in Table 7 and Chart 5, and indicated a decline in performance when compared to the previous period.

Table 7: Holyrood Gas Turbine DAUFOP

Gas Turbine Units	Maximum Continuous Unit Rating (MW)	12 Months Ended June 2022 (%)	12 Months Ended June 2023 (%)	Near-Term Analysis Value (%)	Resource Planning Analysis Value (%)
Holyrood	123.5	0.00	2.54	4.90	4.90

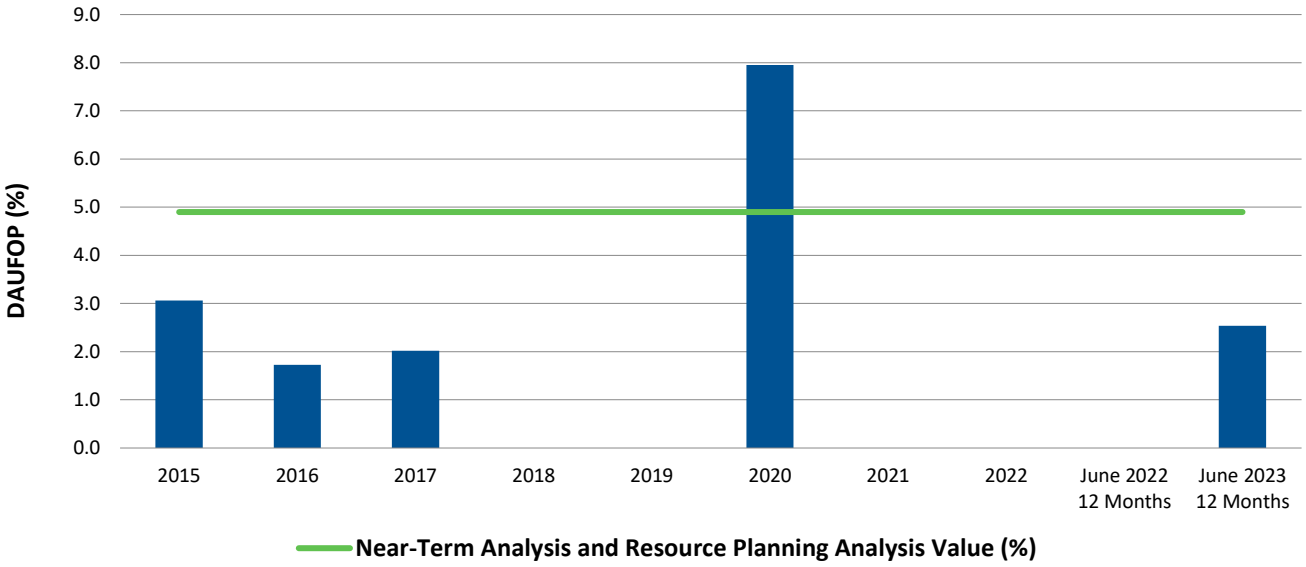

Chart 5: Gas Turbine DAUFOP: Holyrood Unit

6.1 Happy Valley Gas Turbine

The Happy Valley Gas Turbine DAUFOP was 10.97% for the current period, which is above the near-term analysis value of 6.7% and the resource planning analysis value of 7.6%. This decline in performance is a result of three forced outages, which occurred in the second quarter of 2023.

In May 2023, the Happy Valley Gas Turbine experienced two separate, short-duration forced outages. First, the unit tripped during a test run on May 30, 2023, due to a faulty control system card. The card was reset and the unit returned to service. Next, during a period of scheduled operation on May 31, 2023, the unit tripped due to a malfunctioning pressure switch. This pressure switch was replaced with a spare and the unit was made available for service.

In June 2023, the Happy Valley Gas Turbine experienced a third forced outage during a period of unscheduled operation on June 16, 2023. The unit tripped while servicing customers because of a faulty vibration accelerometer cable. The cable was replaced with a spare and the unit was made available for service.