

CI C0051136

**TUC2 - HP/IP Turbine Refurbishment
ATO**

NON-CONFIDENTIAL

May 16, 2025



NSEB APPROVAL SHEET

Project Title: TUC2 - HP/IP Turbine Refurbishment

CI Number: C0051136

Date: May 16, 2025

Expenditure Profile			Type of Filing	
Year	Budget Amount	Project Estimate	☐	Capital Project Authorization
2024	3,760,671	4,916,788	☐	Unforeseen and Unbudgeted (U&U)
2025	504,106	1,048,240	☐	Planned & Advanced (P&A)
2026			☐	Subsequent Approval Item
2027			☒	Authorization to Overspend (ATO)
2028			☐	Scope Change
Total	\$4,264,777	\$5,965,028	☐	Final Cost (FIN)

COMMENTS

Approved	\$4,264,777
Current Submission	\$5,965,028
ATO Request	\$1,700,251

Submitted on behalf of NOVA SCOTIA POWER INCORPORATED



Authorized Signatory
Dave Pickles
Chief Operating Officer

DATE

May 15, 2025

Approved on behalf of NOVA SCOTIA ENERGY BOARD

DATE

CI Number: C0051136**Title: TUC2 HP/IP Turbine Refurbishment**

Start Date: 2024/02
In-Service Date: 2024/11
Final Cost Date: 2025/07
Function: Steam
Forecast Amount: \$5,965,028

DESCRIPTION:

This project is for component inspection, refurbishment, or replacement of the Tufts Cove Unit 2 steam turbine High Pressure (HP) and Intermediate Pressure (IP) Turbine components (such as rotor, casings, steam path, seals, bearings fasteners) to allow for the continued safe and reliable operation of the steam turbine.

The Tufts Cove Unit 2 turbine consists of high pressure (HP) and intermediate pressure (IP) cylinders, which transmit the energy from the high pressure/high temperature steam received from the TUC2 boiler to mechanical energy which rotates the TUC2 generator, resulting in the production of electrical energy. The HP and IP turbine sections are subjected to high temperature and pressure service conditions and are affected over time by solid particle erosion (due to contaminants in the steam) and creep damage (due to continuous operation at high temperature, increased cycling and ramping of the unit).

Summary of Related CIs +/- 2 years:

Pursuant to Section 11.2 of the CEJC, related CIs for Steam projects includes “work completed on the same asset (turbine, boiler, etc.) and on the same unit (Lingan Unit #3, for example).”

- 2023 – CI C0051134 TUC2 – L-0 Blade Replacement - \$4,157,503
- 2023 – CI C0051135 TUC2 – Turbine Valves Refurbishment - \$1,048,924

Depreciation Class: Steam Production Plant – Tufts Cove 2

Estimated Life of the Asset: 30 Years

Retirement Information:

- Categorization of Retirement: Accounting Policy 6420 - Retirement and Disposal of Capital Assets
- Percentage of Asset Pool: 1.0%

JUSTIFICATION:

Justification Criteria: Thermal

Sub Criteria: Equipment Refurbishment/Replacement

Why do this project?

The TUC2 steam turbine is forecast to accumulate over 280,000 operating hours and over 2,780 start/stop cycles at the time of the next TUC2 planned 2024 major outage when this project will be completed. Unit utilization, the number of start/stop cycles and the risk profile of the assets at TUC2 has been used to identify the requirement for a turbine refurbishment. This project provides current condition information to allow appropriate maintenance planning and risk assessment targeted to maintain the near term and long-term safe reliable operation of the TUC2 turbine and mitigate the risk of unplanned outages.

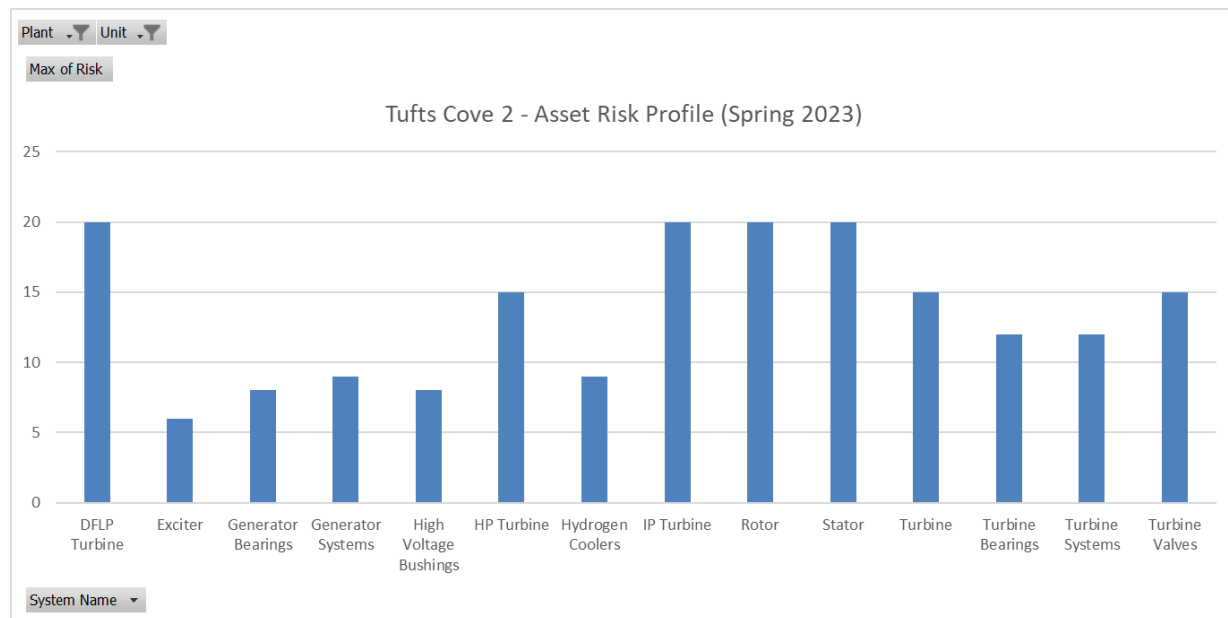
Why do this project now?

The TUC2 steam turbine is forecast to accumulate over 280,000 operating hours and over 2,780 start/stop cycles at the time of the next TUC2 planned 2024 major outage when this project will be completed. The last major inspection of these components occurred in 2012 at 232,040 hours of operation. The HP/IP turbine will have operated in excess

of 40,000 hours since its last major inspection and will be due for overhaul in 2024 based on NS Power's asset management strategy.

Completing this project in a planned manner, assessing current conditions, and mitigating against the risks of unplanned failure is the preferred approach to complete this work.

Steam turbine overhauls are scheduled based on accumulated operating hours and cycles and by known conditions within each unit. Below is a risk profile of Tufts Cove 2 steam turbine High Pressure (HP) and Intermediate Pressure (IP) Turbine components that shows risks associated within each. The risk profile shows that while the machine is due for inspection there are also components that require refurbishment, or replacement in the HP & IP sections to reduce operational risk.



Why do this project this way?

Inspection and refurbishment of the HP/IP turbine components within appropriate time intervals and OEM recommendations versus complete replacement of the turbine is the most cost-effective approach. This approach also ensures the continued safe and reliable operation of the Steam Turbine. In addition to maintaining the safe and reliable operation of the turbine, completing the HP/IP turbine refurbishment during the 2024 planned outage will allow for efficient operation of the unit in alignment with NS Power's asset management strategy.

Reason for Variance

The increase of approximately \$1.7 million over the approved 2024 ACE Plan budget of \$4,264,777 is due to additional scope resulting from inspection findings that the welds have failed in service on the shroud bands of the IP rotor and #4 gland rubbing issues leading to high vibrations on unit run-up. The original project estimate was developed with the support of NS Power's vendor, Siemens. As is the case with all turbine refurbishments, the estimate was developed prior to equipment disassembly and formal inspection work, and was informed by evaluations of unit hours and cycles. The estimate was also informed by anticipated worn and damaged components based on Siemens' and NS Power's experience. Though the estimated amount of component failures, refurbishments and replacements were conservative and informed by unit monitoring, they did not ultimately reflect the full extent of the required refurbishments and replacements determined once the HP/IP Turbine was fully disassembled and assessed.

Non destructive examination (NDE) of the IP rotor periphery was performed using direct visual testing (VT). The periphery areas examined included the rotating blades, shrouds, and rotor shaft. The periphery VT of the IP rotor revealed missing welds and blade shroud steam damage from stages 12-15. The weld refurbishments on the shroud bands of the IP rotor between 12-15 required a specialized blade team to be mobilized to complete this unforeseen scope. The additional cost of approximately \$250K associated with this work includes labour, machine rentals (welders, power rollers, etc.), and non-destructive testing.

Additionally, Tufts Cove Unit 2 has been demonstrating higher air ingress levels, directly impacting the unit's heat rate. This issue was identified as a necessary refurbishment for the Fall 2024 Major Outage and it required the removal of the IP turbine rotor in order to access IP glands 3 & 4. Based on Siemens' recommendation, the decision was made to tighten the glands to reduce the air ingress levels to improve the unit's heat rate. The commissioning costs increased due to necessary adjustments that were required to mitigate clearance and vibration issues. These adjustments are expected as part of a major turbine refurbishment, however this project required more adjustments than originally anticipated. These adjustments included the removal of the IP rotor in order to improve the rotor residual balance, which required additional internal labour and contractor resources. This scope was executed using multiple shifts on a 24-hour cycle to minimize unit downtime. Tufts Cove Unit 2 was a priority to return to service to have this unit's capacity support the grid for the remainder of the winter. The total cost to inspect, troubleshoot and remediate the vibration issues, which includes removing the IP rotor for a second time, was approximately \$1.4M.

CI Number : C0051136 - TUC2 - HP/IP Turbine Refurbishment

Project Number C0051136

Parent CI Number : -

Asset Location : -

Budget Version NSEB Submissions

Capital Item Accounts

Exp. Type	Utility Account	Forecast Amount
Additions	1000 - SGP - Turbo Gen.Instal.	5,453,106
Retirements	1000 - SGP - Turbo Gen.Instal.	511,922
Total Cost:		5,965,028
Original Cost:		719,275

CI C0051136 - TUC2 HP IP Refurbishment				
Account	Approved	Current Submission	Variance	Reason for Variance
Regular Labour	199,620	314,828	115,208	During commissioning, it is normal to expect adjustments, as the machine cannot be fully tested until it is run to speed. It was concluded that further weight iterations (adding/removing balance weights on the rotor body in order to dynamically balance the rotor; process requires multiple run ups until the rotor is balanced per ISO specifications) would have a very low probability of resolving the vibration issues. Based on Siemens recommendation and NS Power's internal expertise, a low-speed balance was performed on both the HP and IP rotors which required an additional disassembly and reassembly of the HP/IP turbine.
Term Labour	-	110,220	110,220	
Overtime Labour	127,594	410,777	283,183	The vibration issues were resolved using multiple shifts on a 24-hour cycle to minimize unit down and to efficiently use contractors by minimizing the time they needed to be on site. This work was completed over the holidays in late December/early January which caused additional overtime.
Term Labour - OT	-	83,681	83,681	
Travel	-	114	114	-
Materials	404,053	812,395	408,342	Increased costs were due additional materials and consumables required to the remediate the inspection findings.
Contracts	2,474,442	3,511,434	1,036,992	The Siemens cost for the extra work scopes for Siemens were as follows: EWA#1 - Weld Refurbishment Rotor Blades 12-15 = \$140k EWA#3 - Machine Dynamics = \$44k EWA#8 - #4 Gland Rub = \$705k EWA#9 - Low speed Balance = \$95k The lengthened schedule for the outage due to needing an additional disassembly and reassembly of the HP/IP turbine increased outage support from contractors including additional Siemens support (TFA + the above EWAs), scaffolding, and machining/craft support throughout the outage.
Consulting	155,000	14,391	(140,609)	Less technical advising consultants required than originally estimated. Technical support was covered from on-site technical assistance and therefore was charged under contracts.
Meals	-	809	809	Increased labour lead to increased meals.
Overtime Meals	-	15,751	15,751	Increased overtime lead to increased overtime meals.
Other Goods and Services	504,106	-	(504,106)	Contingency was entirely used for project spend.
Freight	-	1,126	1,126	-
Rentals	-	16,621	16,621	Trailer rentals required to support contractors throughout the outage not considered in the original estimate.
Admin Overheads	75,142	204,569	129,427	Increased labour costs lead to increased admin overhead costs.
Contractor Admin Overhead	304,257	432,406	128,149	Increased contractor costs lead to increased contractor admin overhead costs.
AFUDC Interest	20,563	35,904	15,341	Increased material cost and lengthened schedule lead to increased AFUDC Interest costs.
Total	4,264,777	5,965,028	1,700,251	