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Request IR-1:

The application notes that this project is for the re-insulation of 42 out of 44 rotor poles on Big Falls Unit 6's generator. The remaining two rotor poles were refurbished in 2023 and do not require additional work. The project scope also includes refurbishment of slip rings, brushes and brush boxes, all disassembly work required to remove the rotor poles as well as re-assembly and balancing of the unit when the poles are re-installed.

(a) Please provide the total cost of refurbishing two poles in 2023.

(b) Please provide the dates when the 42 Rotor insulation was re-insulated.

(i) What is the estimated lifespan of a rotor insulation replacement?

(ii) Please provide the most recent cost and corresponding dates for the re-insulation of rotor poles.

(iii) If the date of the last re-insulation is earlier than the estimated lifespan, please list the possible reasons.

(c) Please provide the dates when the slip rings, brushes and brush boxes were last refurbished.

(i) Please provide the estimated lifespan for each refurbished component.

(ii) Please provide the most recent refurbishment cost for each component along the dates.

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1 **(iii) If the date of the last replacement is earlier than the estimated lifespan, please**
2 **list the possible reasons.**

3
4 Response IR-1:

5
6 (a) The cost of refurbishing the two poles in 2023 was \$14,336 each, for a total of \$28,672.

7
8 (b) There are no records of the current 42 rotor poles being re-insulated since the hydro unit
9 was commissioned in 1929 (96 years ago). As it would be unreasonable to assume a
10 lifespan of 96 years, the application assumes a service life of 40 years in calculating the
11 original cost. This suggests a refurbishment may have been completed around 1985.

12
13 (i) The estimated lifespan of rotor pole insulation is 40 years.

14
15 (ii) The most recent cost for the re-insulation of rotor poles was included in the project
16 application: 42 poles at a cost of [REDACTED] each for a total of [REDACTED] Poles were
17 sent off for refurbishment in September 2025 and are expected to be returned in
18 January 2026.

19
20 (iii) It is unknown when the poles were last re-insulated but NS Power estimates they
21 would have undergone some form of refurbishment since commissioned in 1929.
22 Visual assessment of poles shows that they have multiple coats of paint, suggesting
23 that in previous overhauls they were likely cleaned and repainted, not re-insulated.

24
25 (c) Brushes are checked regularly during maintenance and replaced if required due to wear.
26 Brush holder/slip ring history is not known.

27
28 (i) The estimated lifespans for each refurbished component are as follows:
29

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- Slip Rings should last the life of the unit with regular refurbishment. The slip rings are not at end of life, but do require such refurbishment in the form of a refinished surface and insulator replacement at this time. This refinish work will improve brush contact. Replacing the insulators will ensure adequate insulation between the slip rings and the rotor shaft.

- Brushes: Brushes are a consumable item with a lifespan that varies based on the run time and the condition of the slip rings and brush holder. They are replaced on an as-needed basis following quarterly checks. Units that run more often will wear through brushes faster. An uneven surface on the slip rings or an overtightened brush holder will result in faster deterioration of brushes.

- Brush Boxes/Holders: Brush boxes should last the life of the unit with regular maintenance. At Big Falls 6, they were found to be holding the brushes at a low tension, likely providing a poor connection to the slip rings. The overheating observed in the brush holders likely contributed to their deterioration.

- (ii) The most recent replacement costs for slip ring brushes are not specifically tracked, as they are completed on an ongoing, as-needed basis over the life of the unit at a cost of approximately \$100 each. As noted in (i) above, slip rings typically last the life of the unit. This is the first time on record that these are being refinished, therefore no recent costs to compare to in this case. With respect to slip ring brush boxes/holders for Big Falls 6, this is also a first for this unit. For comparison, exciter brush boxes on this unit were replaced in 2024 at a cost of \$626 each. Slip ring brush holders are significantly larger/carry more current than exciter slip ring and brush holders, therefore costs would be expected to be higher to accommodate these

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1 design differences. The costs for replacement/refurbishment of these items
2 represent approximately 2 percent of total project costs.

3
4 (iii) N/A

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Request IR-2:

(a) What is the estimated remaining life of the generator?

(b) Please provide the power produced by each unit for the past five years.

Response IR-2:

(a) The estimated remaining life of the generator based on the asset condition after this project is completed is 2032. There is potential to increase the remaining life in 2032 with additional investment if required.

(b) Please refer to the table below for the power produced by each Big Falls unit over the past five years:

Year	Big Falls 5 (MWh)	Big Falls 6 (MWh)
2021	25,848	16,660
2022	25,249	27,884
2023	37,011	2,366
2024	24,150	619
2025 (Jan to Aug)	21,341	5,618

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Request IR-3:

The application notes that Big Falls Unit 6 was taken offline in May 2025 to investigate a potential oil leak:

(a) What is the frequency of maintenance performed on the generator/rotor?

(b) When was the last maintenance performed prior to the unit being taken offline in May 2025?

(i) Please provide the supporting documents.

Response IR-3:

(a) Preventative maintenance on the generator rotor and stator is typically performed on a bi-annual basis. Slip ring and brush maintenance is also completed multiple times per year. However, as this generator has been offline for various operational issues and projects over the last several years, maintenance was not required at the usual interval due to ongoing project work and limited / reduced run time on this unit.

(b) The last maintenance performed prior to the unit being taken offline in May 2025 was Slip Ring and Brush Maintenance in March 2025.

(i) Supporting documentation is provided in the form of work order records below:

W/O#	Type	Priority	Work Description	Hrs Labour	Date	Eqp Display Description
167166	PM	1	SLIP RING & BRUSH MAINTENANCE - BF #6	2.00	2025-03-26	BF6 EXCITATION

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Request IR-4:

The application notes that comprehensive electrical testing, including AC/DC drop tests, thermal imaging, and visual inspection, confirmed internal issues within the pole windings, suggesting degradation of both insulation and conductor leads. Additional hot spots were identified on the slip rings and brush boxes, further indicating compromised electrical performance.

(a) What are the possible reasons for the degradation of both insulation and conductor leads?

(b) What are the possible causes for hot spots identified on the slip rings and brush boxes?

(c) Does the utility have an aging management program in place for these electrical components? If so, please provide the relevant documentation.

Response IR-4:

(a) Possible contributors to the deterioration of the insulation and poles include age and operating conditions. Additional factors such as thermal stress from repeated thermal cycles associated with timed runs could also contribute to deterioration of the coils. Expansion and contraction during these cycles can cause cracks or delamination in the insulation. Environmental factors such as moisture and contaminants like carbon dust can degrade insulation as well. As insulating material ages, it will naturally become more brittle, increasing the likelihood of damage and deterioration.

Damage to conductors within the leads is likely due to mechanical stress on the copper. Deterioration of the collars allows for movement of the coils during unit operation, causing stress on copper.

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1
2 During pole disassembly the vendor found that the lead connections within the coil itself
3 are rivetted and not braised resulting in a poor connection to the coil. This manufacturing
4 method likely contributed to the internal failures shown in electrical drop test results. The
5 refurbishment process will replace these leads with brazed leads to resolve this issue.

6
7 (b) Improper brush pressure could result in uneven wear on the surface of the slip rings,
8 creating hot spots and worsening contact over time. The brush pressure was found to be
9 low on these brushes, meaning a higher contact resistance and increased heat generated.
10 Similar to the pole insulation, environmental factors such as moisture and carbon dust
11 contaminate the brushes and lead to deterioration of both the brush holders and their
12 insulators.

13
14 There could be another unknown operating condition that has not yet been identified that
15 is contributing to the unit overheating. Heating issues were noted in the excitation circuit
16 prior to the rotor pole damage discovery. Monitoring of the unit once it returns to service
17 will continue to determine if the heating issue has been resolved or if further
18 troubleshooting is required.

19
20 (c) Risk to the overall health of the generator is managed based on Asset Management
21 principles, using information received through routine inspections, targeted assessments
22 and feedback from Operations. Due to these principles, the utility does not require a formal
23 aging management program for these electrical components (insulation/conductor
24 leads/slip rings/brush boxes).

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Request IR-5:

Regarding the detailed cost estimate sheet provided on page 5 of the application:

(a) What is the estimated time of completion for this project?

(b) Hydro River Staff – construction estimate cost \$140,000, please provide the breakdown hours associated with this estimate along with the tasks.

Response IR-5:

(a) The estimated completion date for this project is October 2026.

(b) Hours are estimated based on an average daily rate of \$417 or hourly rate of \$59.57 across all unionized positions. This includes all travel and safety requirements to complete the work. Labour is summarized below:

Task	Total Estimate	Total hours	Comment
Maintenance Shop for disassembly and reassembly	\$93,000	1,561	Assuming a crew of 4, this would represent approximately 55 days of work for disassembly and reassembly.
Electrical operations staff for electrical reassembly and testing	\$47,000	789	Assuming a crew of 2, this would represent approximately 56 days of work for electrical disassembly and reassembly. It also includes time for testing and electrical commissioning.

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Request IR-6:

On page 7 of Attachment 1, the scope of work includes, among other items, incoming testing and testing of completed coils.

On page 8 of Attachment 1, the total cost summary for the complete refurbishment is listed as [REDACTED]. However, the detailed estimate sheet shows [REDACTED] for materials and [REDACTED] for contracts.

(a) Please provide supporting information explaining the difference between the value shown on page 8 of attachment 1 and the combined dollar value of materials and contracts.

(b) Please explain each of the testing costs under the contracts.

Response IR-6:

(a) The total cost shown on page 8 of Attachment 1 of the application [REDACTED] includes transportation costs of [REDACTED] in addition to the [REDACTED] for material refurbishment. The [REDACTED] for contract work is unrelated to Attachment 1 of the application, but includes items such as electrical connection replacement, rotor balancing, testing, and commissioning as outlined in the Detailed Cost Estimate.

(b) Testing costs included in project contracts includes:

- Rotor Pole Testing - \$13,954: Investigation completed in May 2025. Results of this testing are noted in Attachment 1 of the original application. Tests included insulation testing, AC and DC drop tests to check for interturn failures within the**

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1 pole windings, and thermal testing to check for hot spots to identify possible
2 damage to the copper conductors within the poles.
3

- 4 • Stator Testing - \$15,000: Estimated cost for on-site stator testing planned for 2026.
5 This estimate was based on the rotor pole testing completed in 2025, as similar third
6 party resources will be required to complete testing for a similar amount of time as
7 required for rotor pole testing. The stator cannot be tested accurately until the rotor
8 is removed, as the field coils on the rotor will influence the test results. Testing will
9 include insulation testing to check for insulation faults, windings resistance and
10 impedance testing to check for copper or insulation issues within the windings, as
11 well as core testing to check for problems within the core of the stator.

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Request IR-7:

Page 7 of Attachment 1 notes that the list of 25 poles identified for repair provides a good indication of the overall health of all poles. If only these 25 poles are repaired, there is a high probability that issues will arise with the remaining poles in the coming years.

(a) Besides the vendor's recommendation, what mechanism did the utility follow to determine that all 42 rotar poles require repair and that this is the most cost-effective approach? Please provide any supporting information.

(b) Please explain the basis for the statement indicating a high probability of failure in the coming years.

(i) Please describe the potential consequences.

Response IR-7:

(a) NS Power relied on the judgement and recommendations of internal subject matter experts (Professional Engineers) to determine that rewinding all 42 poles provides the best long-term value for customers. While there is no way to know with certainty how long the remaining poles would remain in service, all 42 poles are presumed to be the same age and operating under the same conditions since they were last refurbished. Therefore, the deterioration is expected to be relatively consistent across all poles.

If most poles have deteriorated to the point of visual or electrical failure, it is a reasonable assumption that some of the remaining poles will begin to show signs of failure in the near future as well. In addition, the outage time to refurbish 42 poles instead of 25 is minimal, but if another outage and rotor removal was required in the future to address the remaining 17 poles it would require another extended outage and labour to disassemble/reassemble.

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1 Including all poles in the current scope also brings the unit price per pole down, reducing
2 the overall cost impact per pole.

- 3
4 (b) The statement in Attachment 1 of the application about a high probability of failure in the
5 coming years is based on several interconnected observations:

6
7 **Extent of Degradation:** 25 poles have already been identified for removal due to electrical
8 or mechanical issues, suggesting systemic degradation rather than isolated failures.

9
10 **Testing Limitations and Variability:** The AC drop test was influenced by rotor magnetic
11 fields and air gap inconsistencies, introducing uncertainty. DC drop test results showed
12 wide variation, with several poles exceeding tolerance limits, suggesting uneven aging or
13 damage.

14
15 **Statistical Likelihood:** If 25 poles are already failing or degraded, the remaining poles—
16 likely of similar age and exposure—are statistically at risk of developing similar issues.

- 17
18 (i) Potential consequences of not addressing remaining poles include but are not
19 limited to:

20
21 **Operational Reliability Risks:** Undetected faults could lead to sudden failures
22 during operation, causing unplanned outages.

23
24 **Escalating Maintenance Costs:** Future failures may require emergency shutdowns
25 and expedited service, increasing costs.

26
27 **Safety Hazards:** Mechanical failures (e.g., loose collar fragments) could cause
28 internal damage or pose safety risks to personnel. Electrical faults may lead to
29 overheating, arcing, or fire hazards.