DECISION **2023 NSUARB 223**
M10632

NOVA SCOTIA UTILITY AND REVIEW BOARD

IN THE MATTER OF THE *PUBLIC UTILITIES ACT*

- and -

IN THE MATTER OF AN APPLICATION by **NOVA SCOTIA POWER INCORPORATED** for approval to Proceed in Advance of Work Order Approval for the Wreck Cove (WRC) Tunnel T-2 Remediation Project

BEFORE:	Richard J. Melanson, LL.B., Panel Chair Steven M. Murphy, MBA, P.Eng., Member Bruce H. Fisher, MPA, CPA, CMA, Member
APPLICANT:	**NOVA SCOTIA POWER INCORPORATED** Rachel Petcoff, Counsel
RESPONDENT:	**CONSUMER ADVOCATE** David J. Roberts, Counsel
	INDUSTRIAL GROUP Nancy G. Rubin, K.C.
	SMALL BUSINESS ADVOCATE E.A. Nelson Blackburn, K.C.
BOARD COUNSEL:	William L. Mahody, K.C.
FINAL SUBMISSIONS:	September 27, 2023
DECISION DATE:	**December 18, 2023**
DECISION:	**The application is approved, with directives.**

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1.0 INTRODUCTION

[1] Nova Scotia Power Incorporated (NS Power) applied to the Board for approval of capital expenditures associated with the remediation of the Wreck Cove Hydro System's Tunnel T-2. The remediation was required after a rockfall from the roof of the tunnel created an imminent risk of a complete tunnel collapse. If Tunnel T-2 collapses, the Wreck Cove Generating Station will eventually be unable to produce power. The Wreck Cove Generating Station produces a significant amount of clean power that is required to meet legislated limits on carbon emissions in the electricity sector. The total amount requested for approval by NS Power in this application is $22,780,580.

[2] The Wreck Cove Hydro System was commissioned in 1978. It is located on Cape Breton Island. It is the largest of NS Power's hydro systems. There are two generating stations: the Wreck Cove Generating Station with an installed capacity of 212 MW and the Gisborne Generating Station with an installed capacity of 3.5 MW. The Wreck Cove Hydro System includes six reservoirs, and a head pond called the Surge Lake Reservoir.

[3] A series of canals, dams and tunnels connect the reservoirs and head pond. Tunnel T-2 is one of these tunnels. This tunnel is the only way to convey water from the Wreck Cove Reservoir to the Surge Lake Reservoir head pond. The water is then used to generate power in the Wreck Cove Generating Station. Therefore, if water cannot move from the Wreck Cove Reservoir to the Surge Lake Reservoir, the Wreck Cove Generating Station will eventually be unable to produce power.

[4] When Tunnel T-2 was built, an adit was used to assist construction. An adit is a passage from the surface connecting to Tunnel T-2. It was used to help with excavation and muck removal. When construction was completed, the adit end was plugged with concrete. As the adit was connected to the low point of Tunnel T-2, a drain was installed to provide a convenient way of dewatering this tunnel. Tunnel T-2 must be dewatered to conduct on-foot inspections. The Operation and Maintenance Manual (O&M Manual) for the Wreck Cove Hydro System recommended a regular schedule of on-foot inspections. The adit collapsed in the early 1990s and attempts to repair it were unsuccessful. After the adit collapsed, NS Power did not conduct any on-foot inspections, or any other form of visual inspection, in Tunnel T-2 until 2019.

[5] An inspection of remotely operated vehicle (ROV) identified a rockfall in Tunnel T-2 in October 2019. The rockfall blocked approximately 65% of Tunnel T-2. Another ROV inspection in 2021 showed the tunnel had continued to deteriorate. A March 2022 assessment showed Tunnel T-2 was in danger of collapse within six months. As such, NS Power prioritized remediation of the tunnel.

[6] The remediation work was done during a planned outage of the Wreck Cove facility, as part of a previously approved major refurbishment of this facility. NS Power requested the Board's permission to proceed without prior approval, at shareholder risk, so the work could be accomplished on schedule. As of April 30, 2023, NS Power had spent $22,263,453 of the $22,780,580 sought in this application. The portion of the capital work for which approval is sought is substantially complete.

[7] We must decide if the amount requested in the approval application is necessary and justified, in the sense that the expenditure is reasonable and prudent. We must note at the outset that the Board has the authority to disallow costs under specific circumstances that we will outline. Other than a disallowance, the Board can only penalize NS Power in specific circumstances, none of which apply to this Matter. There are two main questions we must answer:

- Has NS Power provided enough information to justify the cost figures?
- Should any part of the capital costs included in the application be disallowed?

[8] The answer to these questions raises issues about whether NS Power was prudent in monitoring the condition of Tunnel T-2 over the years, whether NS Power was prudent in conducting the remediation, and whether the company used the least-cost remediation alternative.

[9] We find that NS Power should have conducted visual inspections of Tunnel T-2 more often. We find that failure to undertake regular inspections was imprudent. We cannot conclude, however, that this triggered additional costs. The evidence does not establish that the significant rockfall discovered in 2019 could have been prevented, or that the cost of remediation in 2022 would have been less if regular inspections had been done. As well, we find that NS Power chose a reasonable remediation alternative in 2022. We are, therefore, satisfied that this application should be approved. We will explain why.

2.0 SHOULD THE BOARD DISALLOW ANY COSTS BECAUSE OF HOW NS POWER INSPECTED THE CONDITION OF TUNNEL T-2 OVER THE YEARS?

[10] We start our analysis on this point by emphasizing that the disallowance mechanism is not used as a form of administrative penalty. The *Public Utilities Act* establishes a traditional cost of service methodology as the lens through which most utility

transactions are analyzed. The Board includes NS Power's necessary capital costs in rate base, pursuant to s. 42(2) of the *Act,* based on their "prudent original cost." Sections 42(2)(b) and (c) of the *Act* use the phrase "reasonably and prudently expended" for capital organization expenses and construction overhead.

[11] The Board has defined prudence in past decisions [see: 2016 NSUARB 216]:

> [12] In 2005 NSUARB 27, the Board adopted the definition of prudence as set out in a decision of the Illinois Commerce Commission as a reasonable test to be applied in Nova Scotia.
>
> [13] That test was set out at paragraph 84 of the Board's Decision:
>
> > The standard for determining prudency of a utility's fuel procurement practices is well established. As stated by the Illinois Commerce Commission, "prudence is that standard of care which a reasonable person would be expected to exercise under the same circumstances encountered by utility management at the time decisions had to be made….Hindsight is not applied in assessing prudence….A utility's decision is prudent if it was within the range of decisions reasonable persons might have made. … The prudence standard recognizes that reasonable persons can have honest differences of opinion without one or the other necessarily being imprudent.
> >
> > [2005 NSUARB 27, para. 84]
>
> [14] The Board went on to say:
>
> > [89] While the Board recognizes that the definition of imprudence varies somewhat among the jurisdictions cited, there are several fundamental principles which are common. These include:
> >
> > - Were the utility's decisions reasonable in the context of information which was known (or should have been known) at the time?
> > - Did the utility act in a reasonable manner and use a reasonable standard of care in its decision-making process?
> > - The imprudency test should relate to the circumstances at the time in question and not to hindsight.
> >
> > [2005 NSUARB 27, para. 89]

[12] Board Counsel retained Midgard Consulting Inc. (Midgard) to review this application and provide an opinion on the economic and technical merits of the Tunnel

T-2 remediation project. As part of this review, Midgard raised serious concerns about the way NS Power had inspected the Tunnel T-2 over many years. Midgard's conclusions are summarized at p. 12 of its report:

> • NS Power ignored the directions of its own operating manual (namely, that Tunnel T-2 should be inspected every two years) and has not provided any evidence that this fundamental change in operating procedure is supported by any analysis or was approved by an engineer.
>
> • NS Power received advice to continue inspections and was aware of the need to dewater the tunnel and resume inspections.
>
> • Contrary to its claims in this proceeding, NS Power's alternative to tunnel inspections (i.e., "condition-based operational monitoring") is not a sufficient means of operating or maintaining a critical tunnel.
>
> • Had NS Power properly inspected Tunnel T-2, the fall-of-ground discovered in a known fault zone in 2019 may have been identified at an earlier stage of deterioration and could have been either prevented entirely or remediated at an earlier stage for less cost.
>
> [Exhibit N-6, p. 12]

[13] Midgard says the Board should seriously consider a disallowance based on the foregoing. Midgard suggests that at the high end, we could disallow all the project costs because the need for the project arose because of NS Power's poor operational practices. Midgard says that at the low end, we could compare the remediation costs set out in this application to the costs for 30 years of regular inspections and any smaller scale remediations that would likely have been required because of a regular tunnel inspection program.

[14] The Consumer Advocate (CA), the Small Business Advocate (SBA) and the Industrial Group (IG) all participated in this proceeding. Based on Midgard's findings, the CA submitted that we should consider disallowing a substantial portion of the requested approval amount. While acknowledging this could be a speculative exercise, the CA said it would send the appropriate message to both NS Power and ratepayers. The IG supported Midgard's low-end disallowance methodology as a balanced approach. The

IG acknowledged this would involve a detailed estimation exercise. The SBA said NS Power had not adequately addressed or justified not finding alternative dewatering methods or inspection processes for Tunnel T-2 before 2019. According to the SBA, we should therefore follow Midgard's recommendations about cost disallowances.

[15] We have summarized NS Power's position on this issue:

- There is no industry standard for the inspection of tunnels like Tunnel T-2.
- NS Power used its internal engineering expertise to determine that the biennial on-foot inspections recommended by the tunnel builders in 1978 was not the best way to monitor the tunnel's condition.
- Biennial inspections would result in significant replacement energy costs because the Wreck Cove Generating Station can't operate while the tunnel is dewatered and inspected.
- When the Wreck Cove Hydro System was built, an adit had been constructed to allow for drainage at a low point in Tunnel T-2. Once the rockfall occurred in the adit in the early 1990s, dewatering could no longer be done according to the original plan.
- NS Power made the conscious decision to use its Supervisory Control and Data Acquisition (SCADA) system to monitor the condition of Tunnel T-2. This essentially involved monitoring the water levels in the Surge Lake Reservoir to look for any anomalies that might be caused by rockfalls or blockages.
- Dewatering itself can increase the risk of tunnel damage. While this risk can be mitigated it cannot be eliminated.
- Since 2019, NS Power has used underwater ROV technology to monitor the condition of the Tunnel T-2. This inspection method discovered the rockfall in 2019.
- Underwater ROV inspections are an acceptable method at this time, given the risks of tunnel damage from dewatering, and the safety precautions required to do on-foot inspections.
- Tunnel T-2 rockfalls have not caused any unplanned outages since Wreck Cove was commissioned in 1978.
- There is no evidence NS Power's historical inspection methods were a cause of the rockfall. Tunnel T-2 is in a fault line, so some type of rockfall was likely inevitable.

- There is no evidence NS Power's inspection methods increased the cost of repairing Tunnel T-2.

- There is, therefore, no basis for a disallowance, of any kind, based on alleged imprudence in the company's inspections.

[16] We are faced with an analytical challenge because there are many unknowns which likely cannot be resolved at this stage. SNC, the tunnel builder, had recommended on-foot inspections every year for the first five years, and every two years after that. This was incorporated in the Wreck Cove Hydro System's O&M Manual prepared by SNC. The precise number of on-foot inspections of Tunnel T-2 NS Power carried out is not known. NS Power confirmed the accuracy of information contained in a Stantec report that at least three on-foot inspections were carried out prior to the adit rockfall. Even the precise date of the adit collapse is not specified, with the "early 1990s" appearing to be the best available information.

[17] It, therefore, appears that even before the adit rockfall, the recommended tunnel inspection regime was not followed. That said, we infer from the absence of any reports, and confirmation by NS Power, that no maintenance or remedial work was carried out on the tunnel, and that the on-foot inspections that were carried out revealed no significant issues with Tunnel T-2.

[18] While the frequency of on-foot inspections may not have followed the SNC O&M Manual's recommendations, we have no evidence establishing that NS Power's inspection practices, prior to the adit collapse, led to undetected tunnel issues which could have been remediated earlier to prevent a larger tunnel rockfall, such as occurred prior to 2019. Therefore, we have no basis for any disallowance for the period before the adit collapse from 1978 to the "early 1990s."

[19] NS Power says it attempted to repair the adit in 1995. This remediation work was unsuccessful. The remediation work was deemed unsafe. The adit was later deemed unsafe for any access and the entrance was gated. With a failed and unsafe adit, it was no longer possible to dewater Tunnel T-2 via the adit. Further, the introduction of more stringent legislative requirements and internal work practices for working in confined places, made it more onerous and difficult to complete on foot tunnel inspections. Therefore, we agree with NS Power that it was prudent to reevaluate Tunnel T-2 inspection practices after the failed attempt to repair the adit.

[20] We have significant difficulty with what happened after that. NS Power consciously decided to rely exclusively on SCADA data to monitor the condition of Tunnel T-2 for a period of approximately 24 years from the mid-1990s until 2019, when an underwater ROV with a camera was used for inspections. The evidence in this proceeding establishes that SCADA monitoring alone is not an adequate way of inspecting Tunnel T-2. The opinions of various consultants retained by NS Power, such as Stantec and KGS, envisioned resuming inspections beyond SCADA monitoring. Midgard is also clear on this point. Visual tunnel inspections are prudent utility practice and SCADA data analysis on its own is not an acceptable substitute.

[21] Beyond the opinions of Midgard and the various consultants, we find the evidence establishes that the SCADA monitoring did not capture the significant rockfall which was discovered by the 2019 ROV inspection. NS Power says this could indicate that the rockfall took place prior to its SCADA monitoring program, since no anomalies were discovered in the recharge rate of Surge Lake right up to the time of remediation. Stantec also suggested that the rockfall could have happened many years ago.

[22] We find it is unlikely that a significant rockfall occurred in Tunnel T-2 many years ago. This is because Stantec also says localized partial blockages increase flow velocities, which can lead to further erosion degradation and tunnel collapse. This appears to be what happened, given the rockfalls discovered in 2019 caused relatively rapid tunnel degradation so that by 2021 tunnel collapse was imminent. Based on expert opinion and observation, the significant tunnel rockfalls most likely happened no more than a few years before they were discovered in 2019, and SCADA monitoring did not uncover the issue.

[23] We appreciate that we can't use hindsight to judge whether NS Power's decision to rely solely on SCADA data was imprudent. We agree with Midgard that what was observed about the rockfall discovered in 2019 only confirms what NS Power should have known about the limitations of the SCADA data. While one might have expected that the NS Power SCADA data would have detected a significant rockfall, it is essentially a reactive form of monitoring. As Midgard suggests, only significant events would be captured. More minor stability issues, which do not appreciably impede water flow, would not be detected unless a proactive form of visual monitoring was used.

[24] While this is not a new concept, the 1978 SNC operating manual gives two reasons why tunnel inspections should be done:

> The main purpose for inspection of the diversion tunnels at Wreck Cove is to confirm that these water conduits are free of any restrictions to flow. Any signs of weakness or instability will also be noted during inspection tours and efforts made to stabilize these zones, where required.
>
> [Exhibit N-4, RIR to Midgard IR-11, Attachment 1, p. 99 of 321]

[25] There is an element of hindsight associated with the assessment that the SCADA monitoring program would not be sufficient to detect a significant blockage. One would have expected such a significant blockage would have caused restrictions on water

flow observable through SCADA, or by looking at water levels in Surge Lake, for that matter. This is not the case for the second main purpose of inspections described by SNC: namely, to discover signs of weakness and instability. NS Power was aware of this purpose and should have been aware that SCADA monitoring could not provide meaningful insights into this aspect of the condition of Tunnel T-2.

[26] With any major component of NS Power's system, the purpose of regular inspections is not just to avoid catastrophic situations involving major failures, but to understand the condition of an asset, and whether repair and maintenance is required to keep the asset in service. The goal is to avoid major repairs through earlier, more minor interventions, where possible. We agree with Midgard that using a monitoring system, which is not useful for this second major purpose of inspections, for approximately 24 years, was not prudent utility practice.

[27] We understand NS Power's legitimate concerns about the costs of doing visual on-foot inspections. There would have been some 12 Wreck Cove planned outages over the 24 years we are considering if NS Power had followed SNC's operating manual. The costs would have been significant. We further understand that following the adit collapse, a period of assessment was required. Those factors do not excuse NS Power from essentially taking no steps at all to resume visual inspections of any kind. Although NS Power opted not to repair the adit after its collapse, dewatering still could have been done in another manner and on-foot inspections could have resumed, even if NS Power chose, for legitimate reasons, to conduct them less frequently than recommended in the SNC operating manual. Also, underwater ROV technology was available well before 2019.

[28] For all these reasons, we find NS Power's inspection program for Tunnel T-2 was not prudent. The more difficult issue is whether there is a basis in evidence to establish a disallowance based on this imprudence. We have given this issue serious consideration, as recommended by Midgard, but conclude there is no basis grounded in public utility law for such a disallowance.

[29] The Board has no general power to issue an administrative penalty to provide a financial consequence for a utility's imprudent conduct. A disallowance should be premised on costs incurred through imprudence which could otherwise have been avoided. We would have to find that regular visual inspections would have uncovered something allowing for an earlier and cheaper form of remediation and prevented the Tunnel T-2 collapse discovered in 2019.

[30] Midgard says "…it is possible, if not likely, …" that the rockfalls leading to the 2022 remediation work could have been detected much earlier and avoided altogether. However, Midgard goes on to say that "…it is not possible to know whether a proactive regime would have identified and prevented…" the rockfall earlier. There is no evidence in any of the consultant's reports filed with the application, or any other materials, establishing that the rockfall could have been prevented through regular visual inspections. Coupled with the known fact that Tunnel T-2 is located on a fault line, and that a rockfall may well have occurred even with regular inspections, we find no cause-and-effect relationship has been established between the imprudent conduct and the amount of the costs associated with the remediation of the rockfall in 2022.

[31] We appreciate Midgard's efforts to provide some guidance on how we might proceed to quantify a disallowance. We agree that if a cause-and-effect relationship

between NS Power's imprudence and the occurrence of the rockfall discovered in 2019, had been established, Midgard's suggested low bookend method would have been appropriate in principle. The exercise would involve comparing the costs of regular inspections over the 24-year period we have established as the period of imprudence with the ultimate project costs.

[32] Midgard acknowledges this would be a difficult exercise. The degree of hindcast estimations required would render this exercise highly speculative. The unknowns include: what regular inspections would have uncovered, if anything; what remediation work would have resulted; and what costs would have been incurred in the process. These are unlikely to be revealed with any degree of accuracy through any future process. In any event, as it has not been established, on a balance of probabilities, that regular visual inspections would have ultimately avoided the rockfall discovered in 2019, there is no basis for proceeding with this analysis.

3.0 SHOULD THE BOARD DISALLOW ANY COSTS BECAUSE NS POWER FAILED TO CONSIDER A POTENTIALLY LOWER COST ALTERNATIVE?

3.1 Background

[33] In the fall of 2019, NS Power procured the services of an ROV inspection company to carry out an underwater inspection of Tunnel T-2. The inspection results indicated that the tunnel had experienced several rockfalls and numerous block fallouts. Most of the observed failures were small to mid-size failures, but some large failures were also noted, causing tunnel opening restrictions of up to approximately 20%. In addition to these failures, one significant collapse of the tunnel crown was identified near the downstream side of the tunnel low point, approximately 1.3 km from the Tunnel T-2 outlet. The collapse resulted in a Fall of Ground (FoG) and an accumulation of rockfall debris

over an approximately 35m long tunnel section that caused an approximate 65% blockage of the tunnel opening. Falling debris also caused the local loss of the tunnel crown with cavities of up to a height of approximately 4m to 5m above the original tunnel crown elevation. The tunnel condition assessment completed at that time concluded that the probability of a future localized tunnel collapse within the FoG area and the associated risk to the operation of the generating station was high.

[34] Based on the 2019 ROV inspection results, NS Power began preliminary engineering efforts to determine the design and functional requirements for remediating the FoG area, as well as to assess the project's cost and scope. In November 2020, NS Power issued a Request for Expression of Interest and Qualifications (RFEIQ) to potential contractors for the remediation of Tunnel T-2. The general intent of the RFEIQ was for NS Power to gain an understanding of the capabilities, qualifications, relevant experience, availability, and level of interest of potential contractors to submit a formal proposal for the required work. The RFEIQ provided a general description of the work that would likely be required to rehabilitate the tunnel FoG. In addition, the RFEIQ described two potential alternatives to access the FoG area: a) from the Tunnel T-2 outlet at Surge Lake, and b) through the existing Tunnel T-2 adit (described later in this section). The RFEIQ also allowed contractors to suggest other alternative approaches in their respective RFEIQ responses.

[35] In the RFEIQ, NS Power indicated that it planned to remediate and repair the Tunnel T-2 major collapse location in a 16-week outage window during the summer of 2022, tentatively from July to October 2022. NS Power stated that it structured the Request for Proposal (RFP) in this manner to ensure that the selected contractor would

be able to complete specific scopes of work during non-winter conditions. This was done to mitigate the risks associated with construction in winter conditions, which includes potential delays and unsafe work conditions due to winter weather. Nonetheless, NS Power did not preclude potential bidders from proposing an alternative construction window for discussion with the company. The RFEIQ further noted that preliminary design of the remediation measures was scheduled to begin in Q4-2020, followed by issuing an RFP including drawings and specifications in Q1-2021 for procurement and award in Q2-2021.

[36] As the preliminary design for the project advanced beyond the RFEIQ stage, NS Power identified three potential options to access the FoG area to enable FoG remediation and related tunnel repairs. These included:

- Accessing Tunnel T-2 and the FoG area through the tunnel outlet at Surge Lake (this was the option that was ultimately chosen by NS Power);
- Construction of a new vertical access shaft and bypass tunnel to the FoG area; and
- Accessing Tunnel T-2 and the FoG area through the existing Tunnel T-2 adit.

Each of these options also required dewatering of Tunnel T-2.

[37] Following completion of preliminary design, in August 2021, NS Power issued an RFP for the remediation of the Tunnel T-2 FoG. The RFP identified the vertical access shaft and bypass tunnel as the selected option to access the FoG area in Tunnel T-2. Phase 1 of the project was to comprise all work related to the construction of the access shaft, connector tunnel and parts of the bypass tunnel. This phase was to be completed in 2022 prior to the planned Wreck Cove outage in 2023. Phase 2 of the

project was to be completed during the 2023 outage. It was to involve all work related to the construction of the end sections of the bypass tunnel, the bulkheads, and the required FoG remedial work in Tunnel T-2.

[38] NS Power received responses to the RFP on October 12, 2021. While the proposals were being evaluated, NS Power completed a follow-up ROV inspection of Tunnel T-2 in October 2021 to record any changes to the size of the FoG location and any increase of debris or blockage. This ROV inspection noted further rock failure at the FoG and that the FoG had not reached a steady state. This raised concerns that Tunnel T-2 was at risk of failure sooner than may have been expected based on the findings of the 2019 ROV inspection. In addition, NS Power had concerns related to the project cost and timelines associated with the RFP bids. As such, on November 10, 2021, NS Power issued a post-RFP addendum to the RFP respondents. The addendum requested amended proposals for a revised project work scope. The revision included remediation of the FoG area with access from Tunnel T-2's outlet at Surge Lake, complete with installation of ground support in the tunnel to allow safe access. The addendum also specified two to three construction phases to complete the work. These construction phases were to align with planned Wreck Cove outages between (June to November 2022, 2023, and 2024). Phase 1, to be completed in 2022, was to include all work related to remediation and ground support of Tunnel T-2 from the Surge Lake outlet to the FoG area, including shotcreting of the tunnel walls and crown. Phase 2, to be completed in 2023, was to include remediation of the crown collapse area in Tunnel T-2. Phase 3, to be completed in 2024, was to complete any outstanding work if required. There was no reference in either RFP related to the use of the adit as a means of tunnel access.

[39] NS Power received amended proposals from the RFP respondents on December 10, 2021. During the proposal evaluation process, NS Power's consultant, BGC Engineering (BGC) completed a crown pillar assessment of the FoG area based on a review of the 2019 and 2021 ROV inspections. This assessment evaluated the thickness and stability of the rock mass above the FoG area and was completed in March 2022. It revealed that Tunnel T-2 was at significant risk for a full blockage within less than six months. To minimize the risk of an extended unplanned outage at Wreck Cove resulting from a potential full tunnel blockage, NS Power prioritized the remediation of the FoG area work scope component to be completed in 2022, in alignment with the planned outage for the Wreck Cove Life Extension Modernization (LEM) Project. In March of 2022, NS Power asked for amended RFP submissions to adjust the proposed work scope accordingly. Phase 1 work was to now include ground support of Tunnel T-2 from the Surge Lake outlet to the FoG area, excluding shotcreting, and remediation of the crown collapse area in Tunnel T-2. This phase was to be completed in 2022. Phase 2, to be completed in 2023, was to primarily include shotcreting of Tunnel T-2. In response to Midgard IR-4, NS Power stated that proceeding in this fashion was the only alternative that allowed remediation of the FoG area within a six-month window to prevent an unplanned outage of Wreck Cove.

[40] In April 2022, NS Power completed its assessment of proposals, and awarded the project contract to its selected contractor, Cementation Canada Inc. (Cementation). NS Power then began the remediation work in advance of a related capital approval application to the Board. Phase 1 work was completed by the contractor in 2022 during the planned Wreck Cove LEM outage.

3.2 Project Alternatives

3.2.1 Vertical Shaft and Bypass Tunnel Option

[41] The RFP issued by NS Power in August 2021 requested a contractor proposal for the vertical shaft and bypass tunnel alternative to provide a means of access to the FoG area. In response to NSUARB IR-7, NS Power stated that construction of this option would have required one or more additional construction seasons to safely access the FoG area. Specifically, one full construction season was required upfront in 2022 for construction of the vertical shaft and bypass tunnel. The second construction season in 2023 was intended to connect the bypass tunnel with Tunnel T-2, install concrete plugs on either side of the FoG, and complete the FoG remediation. Given the findings of the crown pillar assessment and the resulting urgent need to remediate the FoG area in 2022 to prevent a potential full tunnel blockage and unplanned Wreck Cove outage, NS Power eliminated this option from further consideration.

[42] Midgard challenged NS Power's assertion that this alternative was not feasible and did not require further study, including an economic analysis, saying this position is only partially supported. Midgard noted the contractor RFP submissions did not establish the need for an additional construction season. Instead, it was NS Power's RFP specifications that defined this requirement. Midgard could not determine how the specifications were developed to include this requirement. Midgard also took issue with NS Power's argument that this option could not be completed in advance of the 2022 planned Wreck Cove outage. Midgard noted that NS Power's response to Midgard IR-13 suggests that NS Power was planning to undertake this work as early as November 2020. Midgard concluded NS Power's limited timeframe to complete this option was self-imposed by waiting until 2022 to initiate the work. Midgard said this self-imposed

restriction should not have been used by NS Power to justify no further assessment of this option for least cost and best value for ratepayers. Like Midgard, Ms. Rubin submitted that NS Power was ultimately limited in its possible options, based on its failure to act prudently and promptly.

3.2.2 Adit Option

[43] To facilitate construction of Tunnel T-2 in the late 1970s, an adit was excavated that connects to Tunnel T-2 at its low point. The horseshoe shaped adit is 4m high by 4m wide and was used to facilitate Tunnel T-2 excavation and muck removal. The adit length is roughly 300m. After construction of Tunnel T-2 was completed, the adit was blocked with a 6m long concrete plug at the intersection with Tunnel T-2. In the following years, the adit was used to dewater the tunnel. Dewatering was done by draining the tunnel through a 12-inch diameter dewatering pipe that is installed through the concrete plug and equipped with two twelve-inch drain valves: one at the entrance of the adit and a second one close to the concrete plug. The entrance into the adit is through a corrugated steel pipe (CSP) approximately 2m in diameter, and roughly 30m to 40m long. The area around the pipe has been backfilled, but the makeup and condition of the backfill are unknown.

[44] In the early 1990s, the adit was inspected, and evidence of rockfalls was found for an approximate 180m length. The inspection also revealed a significant crown collapse that blocked the adit and prevented access to the second drain valve. This prevented any further dewatering of Tunnel T-2 via the adit. NS Power attempted to repair the adit in 1995 but was unsuccessful as the repair effort encountered numerous rockfalls associated with structural instability. As a result, the adit was deemed unsafe

for any access and the entrance was gated. Since then, there has been no access or further assessment of the condition of the adit. Nor has there been any additional attempts to repair the adit.

[45] Since the adit collapse prevented dewatering of Tunnel T-2, NS Power developed an alternative dewatering method, which involved dewatering through existing vents in Tunnel T-2. This was the dewatering methodology used during the 2022 Tunnel T-2 remediation work. This method included installing well pumps in the location of Tunnel Vent Three and pulling water upstream of the FoG area.

[46] The option to access Tunnel T-2 through the existing adit was initially included in NS Power's November 2020 RFEIQ. However, as preliminary design advanced for the project, it became apparent that this option would also require an additional construction season to safely access the FoG area. Given the deteriorated state of the adit, NS Power indicated that a full construction season prior to conducting any Tunnel T-2 work would be required to install ground support along the full length of the adit so it could be safely accessed. Remediation of the crown collapse in the adit would be also required. Once the adit was remediated, it may have been possible to dewater Tunnel T-2 through the existing drainage pipe installed in the concrete plug. However, this could only be done if the existing drain valves were fully functional, which could not be confirmed until the adit work was complete. A second and possibly third construction season was then projected for removal of the existing concrete plug separating the adit from Tunnel T-2, installation of ground support in approximately 400m of Tunnel T-2, remediation of the FoG area, and reinstallation of the adit concrete plug to prevent water from exiting the Tunnel through the adit once Tunnel T-2 was re-watered.

As such, given the urgent need to remediate the FoG area in 2022, NS Power eliminated this option from further consideration.

[47] NS Power asserted that the adit access alternative was not feasible and did not require further study, including an economic analysis. Midgard, however, concluded this assertion is not supported. Midgard highlighted a comment by Stantec in the November 2020 RFEIQ. Stantec stated that even though this option would require a substantial amount of work, it would result in a shorter remediation (ground support) section in Tunnel T-2 and could be carried out prior to the planned outage in 2022. As it relates to NS Power's reasons for eliminating the adit option from consideration, including NS Power's stated need to install ground support in 300m of the adit and 400m of Tunnel T-2, Midgard stated:

> …NS Power elected to install ground support on a full 1230 m of tunnel (from the Surge Lake outlet 1 to the FoG area). The cost of installing tunnel support from the Surge Lake outlet to the FoG area was significant and may have been more costly than accessing the site through remediation of the adit – in a 2017 report Golder estimated the cost of such remediation as $1.5M. Notably, the adit repair alternative would have had the added benefit of making the adit available for future dewatering needs at much less cost than pumping and would provide a second method of egress for the tunnel, making future work in the tunnel easier and safer.
>
> [Exhibit N-6, pp. 25-26]

[48] Midgard also noted that if NS Power had prudently addressed the adit issues since they were discovered in the 1990s, the adit would have been in serviceable condition prior to the discovery of the Tunnel T-2 FoG.

[49] Ms. Rubin stated that NS Power should have more seriously considered the alternative of pursuing the repair of the adit and using the adit to access the FoG area. In particular, she concurs with Midgard that the urgent need to repair the Tunnel T-2 FoG was a self-created limitation. Ms. Rubin noted that this was a result of NS Power's failure to act swiftly when issues were originally identified in 2019, or in the many years prior with

respect to the rockfall in the adit in the 1990s. She also submitted that NS Power could have reasonably undertaken the adit repair in 2021. Ms. Rubin agrees with Midgard's conclusion that NS Power's assertion that the adit "…alternative was so patently unattractive as to not require economic analysis is not supported."

3.2.3 Other Option

[50] Midgard suggested that there was another alternative that NS Power could have considered to access the Tunnel T-2 FoG area. This option would have consisted of direct access into the tunnel from above the FoG itself. In this alternative, material would have been excavated from above the FoG through overhead access. Construction access would then have been established from overhead, and installation of the FoG support equipment accomplished from above as well.

[51] In response to Midgard IR-20(b), NS Power stated that this option was not feasible for the following reasons:

> 1. The FoG area was not stable due to the condition of the rock in the fault zone. Drilling a shaft would not have been technically feasible.
>
> 2. Based on contractor RFP submissions for shaft options, drilling a shaft would be higher cost than accessing the FoG area through the outlet. Please refer to NSUARB IR-9 Attachment 6 Page 67-69.
>
> 3. A shaft at this location would require additional consideration for plugging and capping as the surface elevation is below the normal elevations of both Wreck Cove and Surge Lake reservoirs.
>
> [Exhibit N-4, Response to IR-20(b), p. 2]

[52] Midgard acknowledged that there were valid ground stability concerns for this option. However, Appendix I of NS Power's application notes that as the Tunnel T-2 ground support remediation work approached the FoG area, on September 15, 2022, a sinkhole was identified that had broken through to the ground surface above the Tunnel T-2 FoG area. Midgard's review of Appendix I suggests that between September 15,

2022, and October 3, 2022 (a span of 18 days), the contractor had grubbed the surface above the FoG, excavated overburden, and cleared the collapsed area to the tunnel. Midgard, therefore, pointed out that NS Power was ultimately able to execute such a plan in 18 days, while 105 days (June 3, 2022 through September 23, 2022) were needed to accomplish access to the FoG area from the Surge Lake outlet.

[53] Midgard also highlighted that the contractor submission referenced by NS Power in its response to Midgard IR-20(b) was for the vertical shaft and bypass tunnel option. As such, Midgard believes it is not a valid reference for the option to access the FoG from directly overhead. Midgard also pointed out that the "plugging and capping" referenced in NS Power's IR response did ultimately occur and was significantly less costly than accessing the FoG area from the Surge Lake outlet.

[54] Ultimately, while recognizing that there are likely other considerations in evaluating this option, Midgard opined that the disadvantages were not so great as to preclude the prudency of assessing the option's economics.

3.3 Potential Disallowance

[55] Midgard says NS Power failed to consider potentially lower-cost alternatives in planning the Tunnel T-2 project. As a result, Midgard believes that NS Power has imposed additional costs on ratepayers, which the Board could disallow. This disallowance could be based on the cost difference between a reasonable lower-cost alternative and the option selected by NS Power. Midgard suggests that the adit option may represent a lower cost alternative. As such, Midgard indicated that the Board could consider a significant cost disallowance based on the difference in cost between the two options. Midgard further noted that this disallowance amount fails to recognize the

additional value of reinstating the existing adit. Midgard stated that an operational adit would provide a second means of egress for future on-foot tunnel inspections and a low-cost means for dewatering the tunnel, if and when future work is required.

[56] Ms. Rubin agreed with Midgard and noted that a disallowance is warranted in the circumstances. She also submitted that Midgard reasonably calculated a disallowance amount.

3.4 Findings

3.4.1 Timing of the Capital Application

[57] Midgard concluded that restricting the required FoG work to only one option was self-imposed by NS Power. Midgard believes this was due to poor project planning that resulted in NS Power waiting until 2022 to initiate the work. Midgard asserts that the RFEIQ indicates NS Power was planning to undertake the work as early as November 2020, implying that there was no reason for NS Power to wait until 2022. Midgard's opinion is that it is reasonable to assume that some form of filing for the project could have been made in November 2020.

[58] The Industrial Group's IR-3(d) to Midgard asked how long NS Power would have needed to take reasonable consideration of the alternate project options. In response, Midgard stated that it is unable to speculate on how long NS Power would have needed to properly consider these alternatives. However, NS Power's Reply Evidence gives an indication of the required timeline. The company states that it disagrees with Midgard's assertion that the company was "planning to undertake this work as early as November 2020":

> Given that preliminary engineering activities such as the condition assessment, preliminary design, geotechnical assessment, and detailed design were ongoing between 2020 and

> 2021 and RFP bids for the vertical access shaft and bypass were not received until October 2021, it is clear that NS Power was not in a position to undertake this work in 2020 or 2021.
>
> [Exhibit N-8, p. 32]

[59] In addition, NS Power noted:

> Significant preliminary engineering effort is required before an application can be prepared and submitted to the Board in [the] normal course. In the case of more complex projects, preliminary engineering may involve the completion of competitive bidding processes and contracting stages. Given the unique and complex nature of this project, it was necessary to take the project to the competitive bidding/contracting stage to fully understand and mitigate project risks, develop detailed project specifications and select the proposed solution.
>
> [NS Power Reply Submission, pp. 16-17]

[60] We agree with NS Power. The 2019 ROV inspection was completed on October 9 and 10, 2019, and the related report was submitted to NS Power on March 4, 2020. Based on the ROV inspection report, NS Power engaged a consultant to complete a condition assessment of Tunnel T-2. The related report was submitted on October 6, 2020. Given this timeline, it is our opinion that a full application to address Tunnel T-2 concerns, which were discovered only after the 2019 ROV inspection, could not have been filed in November 2020. Further, our review of the evidence confirms that the RFEIQ stated the preliminary design of the remediation measures was scheduled to begin in Q4-2020, followed by issuing the RFP, including drawings and specifications, in Q1-2021 for procurement and award in Q2-2021. As such, it is clear to us that NS Power was not intending to undertake construction of the project in November 2020. Instead, it was planning to undertake initial design and option analysis activities at that time.

[61] We also agree that this was a complicated and complex project, with significant risks and unknowns. As such, we find that the amount of preliminary engineering completed by NS Power, including issuing a revised RFP to address initial RFP cost and schedule concerns, was appropriate. Given the nature of these tasks, we

do not believe it would have been possible for NS Power to submit a complete capital filing to the Board in November 2020. Instead, we find that after the 2019 ROV inspection and the related condition assessment report were completed, NS Power assessed project options and finished the project over an appropriate timeline. As explained in the following section, we also find the timing of this capital application had no impact on the FoG access and remediation option ultimately selected by NS Power.

3.4.2 Project Planning After the Crown Pillar Assessment

[62] NS Power implemented this project by proceeding with Phase 1 work in 2022 to coincide with the planned Wreck Cove LEM outage. This work included ground support of Tunnel T-2 from the Surge Lake outlet to the FoG area, excluding shotcreting, and remediation of the crown collapse area in Tunnel T-2. Phase 2, not part of the current application for Board approval, is to be completed in 2023, and primarily includes shotcreting of Tunnel T-2. One of NS Power's main arguments for proceeding in this manner is that this option was the only one that would address the immediate need to repair the FoG area in 2022 to prevent a potential full Tunnel T-2 blockage. This need was only identified after the crown pillar assessment was completed in March 2022.

3.4.2.1 Number of Construction Seasons

[63] NS Power indicated that the vertical shaft/bypass tunnel and adit options would have required additional construction seasons to complete the FoG remediation work. As such, the company stated that these options could not have been completed before the FoG repair in 2022. Midgard stated that it was NS Power itself, not contractors, that set the requirement for the vertical shaft/bypass tunnel and adit options to be constructed over additional construction seasons. Midgard, therefore, does not fully

support NS Power's assertion that an additional construction season would be required for these options.

[64] In reviewing the evidence, we agree that the initial August 2021 RFP specifications for the vertical shaft/bypass tunnel option did, in fact, specify two construction seasons, one in 2022 and one in 2023. However, we note that the RFP did not appear to prevent a bidder from proposing an alternative solution with a compressed construction period over one season. This conclusion is supported by some of the confidential information on the record. As well, it appears that Cementation agreed with the two-season construction timeline identified in the RFP.

[65] We also highlight NS Power's response to NSUARB IR-7. This response stated that the need for multiple construction seasons for the vertical shaft/bypass tunnel and adit options was based on contractor submissions to the initial RFP. However, the initial RFP did not include any references to the adit option. The RFEIQ did, and allowed contractors to suggest other alternative approaches in their respective RFEIQ responses. The contractor's responses to the RFEIQ may have indicated the adit option would require multiple construction seasons. However, the RFEIQ responses are not part of the evidentiary record in this Matter. As such, it is unclear if this may have been the case.

[66] In summary, we find it is very likely that both the vertical access shaft/bypass tunnel and the adit option would have taken multiple construction seasons to complete. After the crown pillar assessment was completed in March 2022, the risks associated with potential tunnel collapse became much more of a concern. As such, we find the issue related to construction seasons was a valid consideration for NS Power to assess in moving forward with the Tunnel T-2 FoG remediation.

3.4.2.2 Evaluation of Alternatives

[67] When the crown pillar report was completed in March 2022, NS Power was in the process of completing an economic analysis of the vertical access shaft/bypass tunnel option and the Surge Lake outlet access options. This review was based on pricing received in October 2021 from the initial RFP submissions and December 2021 from the updated RFP submissions. It was also based on what was understood at the time about the condition of the FoG area. A contractor had not yet been selected for the project, and a construction contract had not been signed.

[68] When the crown pillar assessment confirmed that the FoG area was at risk for collapse in less than six months, NS Power claims it had already determined that the vertical access shaft/bypass tunnel had been eliminated based on cost, duration of execution and complexity. Based on our review of the initial and updated RFP submissions from Cementation, we find no reason to dispute this determination from a cost perspective. The company also claims that the adit alternative had been eliminated due to the level of uncertainty of the condition of the FoG in the adit itself. This particular issue is discussed in more detail in a later section of this Decision.

[69] Further, as we have concluded above, it is likely that both the vertical access shaft/bypass tunnel and the adit alternatives would have required an additional construction season upfront before remediation of the FoG area could take place. Accessing the tunnel from the Surge Lake outlet, however, did not require any upfront construction. This meant that after completion of the crown pillar assessment, it was the only alternative of the three that would allow NS Power to remediate the FoG area prior to a potential full tunnel collapse within six months. Further, as noted by NS Power, the dewatering process for this alternative could be carried out successively in combination

with the inspection and remediation of the T-2-Tunnel. NS Power also considered this alternative as the lowest risk option given no net-new construction was required (as would be required with the vertical shaft/bypass tunnel alternatives), and this alternative did not require the remediation of two FoG areas (as with the adit alternative).

3.4.2.3 The "Other" Option

[70] Midgard has suggested that NS Power could have considered another option to access the Tunnel T-2 FoG area by directly accessing the tunnel from above the FoG itself. Midgard opined that the economics of this option should have been assessed by NS Power to determine if it offered a lower cost alternative to other options being considered. In fact, it appears to us from some of the confidential information on the record that at the time of tendering this option could have been more expensive than the one NS Power chose.

[71] In its Reply Evidence, NS Power also stated:

> …NS Power engaged with qualified external engineering firms, to inform the development and elimination of potential access alternatives. Drilling and blasting in a fault zone above an unsupported and partially failed tunnel could lead to more damage to the tunnel and possibly connect FoG I and FoG II resulting in a collapse of a much larger section of the tunnel than was encountered in September 2022.
>
> Access to the FoG area from above without establishing access from the outlet is not a safe and feasible option as installing a shaft over an unstable tunnel would have been extremely challenging both from a geotechnical and hydrogeological perspective due to instability of the tunnel and the rock mass at the FoG area. Significant engineering assessment would have been required, including civil/mechanical engineering, geotechnical engineering, hydrogeological engineering as well as additional drill holes to cite the proposed access location. Additionally, there would have been several logistical challenges with this access alternative to execute this option as well as permitting and safety requirements to allow both equipment and personnel safe access to the FoG area.
>
> [Exhibit N-8, pp. 39-40]

NS Power further noted that project alternatives were sufficiently considered and evaluated with the assistance and input of qualified geotechnical engineers who have

historical experience with NS Power's hydro facilities and who developed their opinions after having been on site.

[72] While there is some foundation for Midgard's opinion about this option, we do note that Midgard's opinion is provided with the benefit of hindsight. Midgard points out that when the sinkhole over the Tunnel T-2 FoG area was discovered, it only took NS Power 18 days to effectively address the sinkhole by completing a scope of work like that which would have been required for this option. In comparison, it took 105 days to accomplish access to the FoG area from the Surge Lake outlet. However, had the sinkhole not occurred, we would not have known how long it would have actually taken to complete the scope of work for this "other" option.

[73] Our decision whether NS Power's assessment, and ultimate elimination, of this "other" option was prudent cannot be made with the benefit of hindsight. Instead, our decision must be based on the circumstances at the time when NS Power was evaluating project alternatives in advance of construction. At that time, the company found that it would not be safe or feasible to proceed with this option. It was then dropped from further consideration. We find no evidence or reason to dispute this finding. NS Power's geotechnical engineers were sufficiently qualified and experienced and made the decision to eliminate this option from further consideration based on the best available information at the time.

3.4.2.4 Conclusions on Project Planning after the Crown Pillar Assessment

[74] We conclude that it was prudent for NS Power to re-prioritize the project after the findings of the crown pillar assessment were presented. This allowed the company to ensure that the FoG area would be remediated in 2022 to prevent an

unplanned outage of Wreck Cove. Of all the options assessed, we find that, after the results of the crown pillar assessment became apparent, the only viable Tunnel T-2 FoG access alternative was the one NS Power is asking the Board to approve.

3.4.3 The Adit Access Option and Potential Disallowance

[75] We have already found that after the 2019 ROV inspection and related condition assessment report were complete, NS Power assessed project options and finished the project over an appropriate timeline. We have also found that after the results of the crown pillar assessment became apparent, the only viable Tunnel T-2 FoG access alternative was the one ultimately selected by NS Power. As such, we have found that after completion of the 2019 ROV inspection, the Tunnel T-2 access option through the adit was not preferred.

[76] The existing Tunnel T-2 adit experienced a rockfall in the 1990s. NS Power attempted to remediate the rockfall and repair the adit in 1995 but was unsuccessful. Since then, there has been no access to or further assessment of the condition of the adit. Nor have there been any additional attempts to repair the adit. We will now address NS Power's actions, when the adit was effectively taken out of service, and when the 2019 ROV inspection was carried out.

[77] Midgard's IR-22(b) asked NS Power if it had attempted any repairs to the adit since the late 1990s to restore the functionality of the drain valves. NS Power responded:

> No. NS Power continued to monitor the operation of Tunnel T-2 and there were no performance indicators or operational constraints that justified the capital investment. Reinvestment in the adit was considered based on KGS recommendations in their 2013 Generating Station Condition Assessment Report and preliminary engineering was underway when the blockage was discovered in Tunnel T-2.
>
> [Exhibit 4, Response to IR-22(b), p. 2]

The KGS report referenced in this response was submitted in Board Matter M09596, Wreck Cove LEM Capital Approval Application, as Exhibit N-4. The report is dated April 2013.

[78] In response to the KGS report recommendations, NS Power engaged Golder and Associates in 2016 for further review and evaluation of Tunnel T-2 dewatering alternatives. Golder submitted its report in April 2017. The report identified "remediation of the existing adit" as one of the highest rated options. In fact, it was identified as the highest rated option under the assumption that the existing drain valve outside the concrete plug is still functional. The report went on to provide a $1.5 million cost estimate for this option, but also listed some key implementation risks. These risks included the condition of the existing drain valves and pipe, unknown rock conditions behind the adit FoG area, and unknown conditions around the corrugated steel entrance pipe.

[79] In its Reply Evidence, NS Power stated:

> Based on the reports and recommendations developed by Golder, NS Power re-initiated a capital project for the adit remediation in 2017 and resumed additional preliminary engineering; however, once the ROV inspection was scheduled for 2019, the adit submission was placed on hold until after the inspection and condition assessment were complete. Given the capital costs and risks associated with the adit remediation, the outage time required to complete on-foot inspections, and the safety concerns associated with on-foot inspections being completed in an unlined tunnel, NS Power wanted to confirm whether ROV inspections could be a suitable alternative to on-foot inspection; NS Power also wanted to confirm the tunnel condition before submitting the adit remediation works, given the tunnel condition could impact the timing, scope, cost and prioritization of the adit project.
>
> [Exhibit N-8, pp. 20-21]

[80] Based on our review of the evidence, it seems clear that NS Power did nothing to repair the adit and assess its related dewatering capabilities between 1995 and 2013. In fact, it was 22 years after the initial attempted adit repair that NS Power initiated preliminary engineering for an adit remediation capital project. The evidence suggests that NS Power delayed initiating this project for as long as it could because operational

monitoring of Tunnel T-2 after the adit rockfall revealed no performance issues or operational constraints within the tunnel. As such, NS Power believed that the capital expenditure to repair the adit was not warranted. NS Power stated that it acted in the best interest of customers by managing a critical asset through its life cycle with no forced outages.

[81] From a ratepayers' perspective, the deferral of such costs generally makes sense, if the deferral does not result in increased costs to ratepayers or negatively impacts utility operations. However, as noted by Midgard, had the adit issues been addressed in a timely manner after the issues were first discovered in the 1990s, the adit would have already been in serviceable condition prior to the discovery of the Tunnel T-2 FoG. Midgard also stated that repair of the adit would have offered other benefits, including the ability to drain Tunnel T-2 without extensive pumping and provision of a second means of access to Tunnel T-2 (although this would likely require removal and reinstallation of the concrete plug each time the tunnel was accessed). Finally, in response to the Industrial Group's IR-4(d), Midgard stated it would expect that an experienced hydroelectric operator such as NS Power would recognize that the collapsed adit represented a significant maintenance issue for a critical piece of its infrastructure. Indeed, Midgard noted that in the insert to NS Power's Wreck Cove O&M Manual (dated March 2000), NS Power itself notes that the collapse of the adit hinders NS Power's ability to dewater the Tunnel T-2.

[82] Midgard believes that it would have been prudent for NS Power to address the issue presented by the collapsed adit in the 1990s when the issue first occurred. The questions that we must consider when assessing this prudency concern are whether the

delay in repairing the adit resulted in unnecessary increased costs to ratepayers, and whether this warrants a cost disallowance.

[83] Midgard has suggested that NS Power's decision to delay the adit repair resulted in increased costs to ratepayers. The suggested amount was derived from confidential information. Midgard further indicated that a disallowance in this amount may be warranted. Midgard developed this value based on its estimate of the difference in cost between NS Power's chosen Tunnel T-2 FoG access solution and Midgard's estimate for the adit access option. Using quantities and prices from Cementation's RFP submittal as a reference for the actual cost of the works associated with Tunnel T-2 support leading up to but not including the FoG, Midgard estimated the direct cost of bolting and meshing Tunnel T-2 between the FoG area and the Surge Lake outlet. Midgard assumed that all other costs included in Cementation's RFP submittal would be common with the adit access option.

[84] In developing its Tunnel T-2 adit access option estimate, Midgard assumed that the adit option would have been constructed in 2022, as an alternative to the access option ultimately chosen by NS Power. Midgard used Golder's 2017 estimate of $1.5 million for the adit repair as the basis of its adit access option estimate. Midgard added a 50% contingency to the Golder estimate, and then inflated the 2017 estimate to 2022 costs based on the Nova Scotia, all items, not seasonally adjusted Consumer Price Index (CPI). Midgard's estimate to repair the adit in 2022 to facilitate access to the Tunnel T-2 work area is roughly $2.5 million.

[85] This cost estimate is based on the adit access option being constructed in 2022. However, we have already found that after the results of the crown pillar

assessment became apparent in March 2022, the adit access option was not viable. Midgard believes though that it would have been prudent for NS Power to repair the adit well before 2022, closer to the time when the adit collapse actually occurred. Unfortunately, there is no evidence providing a reasonable estimate of the cost to repair the adit at that time. The best estimate on record is the one prepared by Golder in 2017 in the amount of $1.5 million. So, for the purposes of our high-level assessment, we will assume that NS Power could have repaired the adit in 2017.

[86] To develop our base estimate for a 2017 adit repair cost, we start with the Golder 2017 estimate of $1.5 million. The 2017 Golder estimate included cost allowances for rock support for the entire length of the adit, remediation of the adit FoG area, and removal of the CSP pipe at the adit entrance. However, as noted in the Golder report, depending on the rock conditions encountered during repair activities, additional costs may have arisen for rock support. Further, the report notes that the condition of the adit beyond the FoG area is unknown, and that the extent of the failure area may be more than assumed by Golder in its estimate. In addition, Golder assumed that the gap between the CSP pipe at the adit opening had originally been backfilled. If this is not the case, Golder noted that the cost to remove the CSP pipe could be greater than assumed. Golder also assumed that the adit drainpipe and valves are in good working order. Given the presence of rockfalls in the adit, and that the valve near the concrete plug had not been operated for at least 20 years, there is a legitimate risk that this assumption may be invalid. If these components are not in good working order, they would need to be replaced to ensure continued Tunnel T-2 dewatering capabilities through the adit. Finally, as noted by NS Power in its Reply Evidence, the Golder cost estimate was prepared at a

Class 5 level or greater and was developed without a formal condition assessment of the adit, and without additional geotechnical assessments and design work.

[87] Midgard's adit repair cost estimate methodology applied a 50% contingency to the Golder base estimate of $1.5 million. However, taking the above factors and risks into consideration, we believe that it would be more appropriate to apply a 100% contingency to the Golder base estimate. This produces a risk adjusted cost estimate of $3.0 million to repair the adit in 2017. We also note that if the adit drainpipe or valves were not found to be in working order and required replacement, this may have required dewatering of Tunnel T-2 to facilitate the replacement work. At the low end, Golder estimated that 2017 Tunnel T-2 dewatering costs would have been roughly $1.2 million. However, part of this cost was related to remediation of the tunnel to provide safe access during dewatering. This remediation work may have negated the need to do some of the tunnel remediation work that would eventually be required in 2022. So, we have reduced the estimated dewatering cost by 50% to $600,000. Further, Golder notes that dewatering of Tunnel T-2 would have resulted in 2017 power outage costs at the Wreck Cove Generating station of approximately $90,000 per day. Golder estimated that it would take approximately 14 days to dewater Tunnel T-2, which would amount to $1.26 million in power outage costs. We do not know how long it would have taken to replace the drainpipe and valves, so we have left that consideration out of our calculations.

[88] Adding together all the above costs results in our cost estimate to repair the adit in 2017 as $4.86 million. Undoubtedly this value would be lower if the adit had been repaired earlier than 2017, but we have no evidence before us to estimate this cost. In addition, NS Power would have had an opportunity to annually earn its weighted average

cost of capital (WACC) on any adit repair capital investments once the related assets were put into service. This would have increased the overall cost to ratepayers for this option. Nevertheless, for the purpose of our high-level assessment, we have opted to omit these costs to be conservative in our analysis.

[89] We also note the even if the adit had been repaired in 2017, there would still have been additional costs to access the Tunnel T-2 FoG area via the adit in 2022. These costs would have been associated with installation of 400m of ground support in the Tunnel T-2 section between the adit and the tunnel FoG area, and removal and re-installation of the 6m concrete plug (and drainpipe through the plug) that seals the connection between the adit and the tunnel. We have no means to estimate the cost to remove and re-install the concrete plug. However, based on confidential pricing information on the record, Midgard has estimated a cost for Cementation to install the 1,230m of ground support in Tunnel T-2. We can prorate this estimate to estimate the cost to install the 400m of ground support in the adit. Adding this number to our estimate of $4.86 million noted about, we find that, if the adit had been repaired in 2017 and then the Tunnel T-2 FoG area was accessed through the remediated adit, the cost could have been over 20% higher than Midgard's estimate. In addition, there would have been an additional cost to remove and re-install the concrete plug at end of the adit.

[90] Therefore, based on our analysis, repair of the adit in 2017 and access to the Tunnel T-2 FoG in 2022 through the repaired adit could have resulted in a cost of at least 20% more than it cost to address the FoG using the methodology ultimately selected by NS Power. The resulting increase in cost is not overly large relative to the overall $23 million cost of the Tunnel T-2 FoG remediation project. If the adit had been repaired

earlier than 2017, this differential would certainly be less and may have even flipped to favor the adit access option. However, we have no means of determining this differential using an adit repair period earlier than 2017. Regardless, in our opinion the differential would likely be immaterial. In addition, although Midgard pointed out other benefits that would have resulted if the adit had been repaired, NS Power also noted that the Tunnel T-2 work it completed extends the service life of Tunnel T-2 by 30 years.

[91] Therefore, we find that a disallowance related to Midgard's contention that NS Power failed to consider potentially lower-cost project alternatives is not warranted.

4.0 SHOULD THE BOARD DISALLOW ANY COSTS BECAUSE NS POWER FAILED TO CONSIDER A DIFFERENT TUNNEL T-2 SUPPORT DESIGN?

[92] NS Power's FoG remediation methodology involved the installation of Tunnel T-2 ground support to reach the FoG area. In a previous section of this Decision, we have found that after the 2022 crown pillar assessment results were presented, access to the FoG area via the Surge Lake outlet was the only feasible option. We must now decide whether NS Power's approach to this option was prudent and reasonable. Midgard said that NS Power's approach to remediating Tunnel T-2 was conservative and could have been done at a lower cost. Hence, Midgard recommends that half of the funds spent on Tunnel T-2 ground support should be disallowed. Based on the evidence and submissions, there are three questions that we must address.

4.1 Did safety concerns reasonably justify mesh and rock bolts being used in the entire 1,230m section of tunnel from the FoG to the Surge Lake outlet?

[93] Midgard's report discusses what it considers "good industry practice for providing safe access to the FoG area from the tunnel outlet." It supports the use of a geotechnical engineer to assess on a step-by-step basis "which rock category is observed

and therefore which ground support design should be installed for this first section of tunnel" and for subsequent tunnel sections. Midgard believes "safe access" could be provided by "replacing rock anchors and shotcrete installed during the original construction along with scaling and adding rock anchors and/or shotcrete to "limited new areas of localized instability."

[94] NS Power's application emphasized that:

> …for personnel to safely enter Tunnel T-2 and perform the remediation and stabilization of the FoG area, the outlet channel area and segments of the walls and crown of Tunnel T-2 in the approximately 1230m leading up to the FoG were remediated.
>
> [Exhibit N-1, p. 22]

The remediation also allowed for "machinery that would be brought into the tunnel".

[95] We understand that tunnels at Wreck Cove are subject to the Nova Scotia Underground Mining Regulations (UMR), under the *Occupational Health and Safety Act*. We have no jurisdiction over these regulations but understand that "a person must not work or travel in any underground area of a mine unless that area has been assessed and secured in accordance with the ground control procedure." (Section 106(1))

[96] There is discussion within the evidence over tunnel ventilation and egress requirements under the UMR. However, NS Power did not file any correspondence or details of discussions that it had with the Nova Scotia Department of Labour, Skills and Immigration (Labour), explaining the Department's interpretation of ground control procedures as they applied to the tunnel remediation at Wreck Cove. Rather, NS Power provided some general statements in response to Midgard IR-14 that under UMR and its Department of Labour-approved code of practice it was required to install "ground support." The minimum ground support recommended by BGC, and considered acceptable to the contractor, was rock bolts and mesh. NS Power does not elaborate on

any of these statements or detail what discussions it had with Labour. NS Power also mentioned the *Nova Scotia Confined Space Regulations* but did not explain if and how it might affect costing of the 1,230m tunnel segment.

[97] But, in its answer to a Midgard IR-14(g), NS Power emphasized the importance of safety, stating that:

> … BGC's design for minimum ground support included the installation of rock bolts and mesh to facilitate safe access for personnel. The mesh alleviates the risk of small rocks which dislodge from the tunnel crown and wall from falling into the tunnel, potentially creating a safety hazard for personnel. The additional safety benefits provided to personnel with the installation of wire mesh outweighed the possibility of mesh dislodging over time and being introduced to the penstock. [emphasis added]
>
> [N-4, IR-14(g), p. 4]

[98] NS Power further clarified in its final submission that:

> Safety is at the forefront of all work executed by NS Power and NS Power is of the view that the ground support, which was designed by two qualified geotechnical engineering firms, reviewed and accepted by the contractor, and further reviewed and approved by LSI [Labour] from a safety perspective and which complied with Nova Scotia's Underground Mining Regulations and NS Power's internal Safe Work Practices for confined spaces, was appropriate.
>
> [NS Power Final Submission, p. 19]

[99] We have carefully considered the safety issue. Obviously, the ground control procedures regulated by Labour must be followed. It is not clear whether the different approach suggested by Midgard (step-by-step remediation to replace old ground support and shore up limited new areas of instability) would have been acceptable under the UMR. As a practical matter, it may have been difficult for Labour to fully approve such an approach without a detailed section by section inspection. In turn, the detailed inspection was likely dependent to some degree on safe access to the tunnel.

[100] We recognize that safety is not simply a matter of meeting the minimum regulated standard. Failure to provide a safe working environment can have serious consequences, both to life and health and financially. Considering the high level of

uncertainty and the potential danger to its employees, we understand NS Power's emphasis on safety in the Tunnel T-2 remediation. We conclude that, from a safety perspective, the company's approach to use mesh and rock bolts in the entire 1,230m FoG to Surge Lake tunnel section was reasonable.

4.2 Was it reasonable to install mesh and rock bolts in the entire 1,230m section of tunnel from the FoG to the Surge Lake outlet?

[101] NS Power originally considered a bypass tunnel to access the FoG area. However, it decided instead to approach the FoG from the Tunnel T-2 Surge Lake outlet. To make the tunnel area safe to enter, NS Power had to "secure" the tunnel area through "Ground Support." The related Issued for Construction (IFC) drawings were prepared by BGC. The initial design called for the installation of mesh, rock bolts and shotcrete through the entire 1,230m FoG to Surge Lake tunnel section. However, considering the findings of the crown pillar assessment, this was revised. The installation of shotcrete was deferred and the IFCs were revised to simply install mesh and rock bolts.

[102] The decision to install mesh and rock bolts through the entire 1,230m length of tunnel has been questioned by Midgard. Midgard notes that "it could be inferred that the rock downstream of the FoG area was of reasonably good quality and strength, and therefore may not have required the installation of rock bolts and mesh other than in localized areas to provide safe access for workers." Midgard based this on several observations:

1) the rock conditions encountered during the original construction warranted only localized areas of ground support outside the fault zone;

2) only one small localized rockfall was observed downstream of the FoG area after 44 years of operation;

3) intact rock in outcrops are noted as "strong to very strong"; and

4) boreholes in the fault zone, where rock is generally of lower quality than the rest of the tunnel, show significant sections of rock in the boreholes noted as being of fair or good quality….

[Exhibit N-6, p. 36]

[103] Midgard concluded that a geotechnical engineer should have inspected each section of tunnel, assessed the rock quality, and recommended ground support design on a step-by-step basis as work progressed up the tunnel. Midgard also suggested that existing anchors and shotcrete could have been replaced while "some limited new areas of localized instability" may have required scaling, anchors and/or shotcrete.

[104] Based on confidential information in Cementation's RFP submission, Midgard estimated the actual direct cost of rock bolts and mesh through the entire 1,230m FoG to Surge Lake tunnel section. In Midgard's opinion, a disallowance of 50% would be a reasonable estimate of the unnecessary cost resulting for an overly conservative ground support design.

[105] In reviewing this issue, we are mindful of the prudency test. Results should not be viewed with the benefit of hindsight. And to be prudent, decisions should fall within "the range of decisions reasonable persons might have made."

[106] We note that Midgard's inference about the rock being of good quality is based on several factors. This includes the limited rockfall debris seen in the ROV surveys, "rock conditions encountered during the original construction", and the borehole data within the 1,230m tunnel section. We believe, however, that this evidence is not strong enough to reasonably conclude that the rock is consistently of good quality. We note that:

- Original tunnel construction occurred over 50 years ago.

- While the limited rockfalls may be an indicator of relatively good rock conditions, our understanding from the evidence is that the ROV inspections provided limited visibility, making it difficult to assess the Rock Mass Rating.

- We understand that four boreholes were drilled within the 1,230m section of Tunnel T-2 and one of them showed poor to very poor rock quality at the level of the tunnel.

[107] As such, we are cognizant that the rock condition of the 1,230m FoG to Surge Lake tunnel section was not fully known. Ultimately, we accept BGC's observations that:

> …there is limited geotechnical data for Tunnel T-2, and as such assumptions will be made based on our experience at this site and the available geotechnical data.
>
> [Exhibit N-5, RIR to UARB IR-8, Attachment 2, p. 3]

[108] At the same time, we do not discount Midgard's opinion that a step-by-step inspection and remediation may have provided for a less expensive result. Indeed, there is ample evidence within the documentation on the importance of site inspection, including from BGC.

[109] However, we note that professional advice appeared to support NS Power's decisions in this area. In 2022, Stantec prepared a condition assessment of the T-2 tunnel, based on the 2021 ROV inspection. One of their recommendations was:

> Installation of rock support measures along the remainder of the tunnel alignment is recommended to establish safe access into the tunnel for future inspection and maintenance work and to protect the exposed rock surfaces against the deteriorating impact of the permanent water flow within Tunnel T-2 and thus prevent future failures.
>
> [N-1, p. 14]

[110] NS Power was also supported by BGC, who designed the tunnel remediation measures. In its January 2023 Project Review and Inspection Report, BGC commented:

> To access and remediate the FoG areas in Tunnel T-2, approximately 1230 m of unsupported length, from the outlet portal to the contact with the 60 m wide fault zone, was required to be supported to provide safe access to the FoG areas. BGC carried out a geotechnical assessment of the available rock mass data and developed the ground support design for the Tunnel T-2 segments from the outlet portal up to the fault zone contact (BGC, June 6, 2022). The recommended ground support included one or a combination of rock bolts, mesh screen and shotcrete. CCI completed rock bolts and mesh screen installation for 1230 m length of Tunnel T-2 from June to September 2022.
>
> [N-1, Appendix I, p. 6]

[111] On balance we find that while there is a difference of expert opinion, NS Power's decision to follow BCG's recommendation falls within the range of decisions that a reasonable person might have made.

4.3 Would the cost of mesh, rock bolts and shotcrete for a portion of the tunnel have been less than the cost of mesh and rock bolts for the entire 1,230m?

[112] The cost for mesh, rock bolts and shotcrete for only a portion of the 1,230m is not provided within the application or other evidence in this Matter. Mostly this is due to the difficulties of undertaking a full Tunnel T-2 inspection and determining precisely which sections of the 1,230m FoG to Surge Lake tunnel section would have needed ground support versus being left unlined. Midgard assumed that a selective approach to ground support would have produced a lower cost, but, due to the paucity of information, provides no estimated cost. Midgard also points out that shotcreting the tunnel area has been deferred. Midgard notes that without the shotcrete there is a risk of mesh being torn off the tunnel walls and eventually being swept into the machinery at the Wreck Cove Generating Station. This would result in additional future costs.

[113] In its submission, NS Power explained how the on-site work proceeded:

> BGC completed a desktop design for ground support based on the results of the geotechnical investigations. This design was also modified as needed during construction by BCG engineers who were onsite daily during construction and their revisions were based on actual observed conditions. Because T-2 was an unsupported tunnel, personnel couldn't safely access the FoG without completion of this work. The remediation work completed on 1200m of Tunnel T-2 also extended the expected life cycle of the tunnel by

> 30 years. The installed ground supports are necessary for the safety of personnel, particularly if on foot inspections are to resume as recommended by Midgard and Intervenors. A conservative approach to safety when personnel are expected to be present in an underground tunnel, whether for inspection or construction purposes, is both prudent and necessary.
>
> [NS Power Reply Submission, p. 20]

[114] We have considered all of this. Under the approach suggested by Midgard, presumably a sizeable portion of the tunnel might have remained unlined, saving funds. These savings would have been partially offset by the added cost of the shotcrete to the selected area. We accept that it is plausible that a selective approach would have cost less than the approach taken by NS Power. Nevertheless, there is insufficient evidence on this issue.

[115] Further, the available evidence is insufficient to determine how much could be disallowed, should we determine NS Power was imprudent. Midgard has suggested that a 50% cost disallowance may be appropriate. This disallowance amount is based on Midgard's “high-level” assumption that 50% of the amount of work ultimately carried out was conservative and unnecessary. The exact cost of a selective ground support approach would be driven by the Rock Mass Rating (Q) and the Rock Mass Quality Designation at multiple points within the tunnel. It is likely this information would only be available as the work proceeded. We are of the view there is insufficient evidence to support a disallowance amount.

[116] We also note Midgard’s comments regarding the possible future shotcreting of the full 1,230m of Tunnel T-2. However, that issue is not currently before us, and can only be fully examined when, and if, NS Power brings it forward.

5.0 FUTURE INSPECTIONS

[117] A key concern identified in the Midgard report and agreed upon by all intervenors is the lack of periodic inspections over the life of the Wreck Cove tunnels. NS Power has not provided any documentation for the decision not to follow its own recommendation of biennial visual inspections except an after the fact justification.

[118] Expert reports and information submitted into evidence by NS Power found that no industry guidelines, standards, or recommendations for conducting hydro tunnel inspections currently exist. The reports provide recommendations on future inspections, and these are summarized below.

[119] The Golder Report 2017 recommended:

> … Although there is no industry standard for inspections of tunnels of this nature, and an unmanned, underwater Remotely Operated Vehicle (ROV) inspection with sonar and high-resolution video every 5 to 10 years and a geotechnical inspection on foot inside the tunnel after dewatering every 15 to 20 years would be reasonable in order to monitor deterioration in the ground conditions and/or rock support performance.
>
> [Exhibit N-4, IR-15, Att. 1, p. 7]

[120] The Stantec Report 2020 recommended:

> - Follow-Up Inspections: Tunnels T-1 and T-2 should be inspected by ROV five years following remediation to verify the conditions and assess the performance of the remediation measures in the major failure areas. A shorter timeline is recommended if head losses (including small head losses) are noted which would indicate a failure within the tunnels.
>
> - Regular Inspections: Following the follow-up inspection, subsequent regular ROV inspections should be carried out every ten years under the precondition that no major stability concerns were observed during the follow-up inspection and no head losses were recorded. A shorter inspection timeline would be recommended if stability concerns would be identified (either during a previous inspection or due to head losses) which would require closer monitoring or remediation.
>
> - Monitoring: Regular monitoring of hydraulic heads and flow through the tunnels should be carried out to identify flow reductions that could be indicative of a rockfall constricting the tunnel opening and restricting the flow. Automated monitoring instrumentation should be installed to facilitate the monitoring and introduce alert values that trigger alarms when flow reductions reach a certain threshold.
>
> A detailed monitoring program should be developed for the tunnel inspections, that outlines the execution of the inspections, including items such as timeline, responsibilities,

> inspection procedures, reporting of findings, etc., and defines the course of action to be taken as well as the timeline for required maintenance and/or remedial work based on the findings during the inspections. This will allow planning of and budgeting for the inspections, and will mitigate the risk of emergency shutdowns, including associated efforts and costs.
>
> The tunnel inspections should be carried out as ROV inspections to prevent potential stability issues that could be caused by dewatering of the tunnels. The tunnels should be inspected under completely submerged conditions (entirely filled with water) to prevent air pockets along the crown and allow data collection in the tunnel crown. Based on the findings of the ROV inspections, additional visual inspections might be warranted. ROV inspection data should be reviewed and compared to the previous inspection results by a qualified geotechnical/geological engineer for stability assessment and recommendations for required maintenance and/or remediation. If dewatering is required for inspection, maintenance or remediation purposes, the dewatering process must be done in a slow and controlled fashion to allow drainage of the rock around the tunnel and minimize new rockfalls potentially caused by the dewatering.
>
> [Exhibit N-1, Appendix C, pp. 9-10]

[121] The BCG Report 2022 recommended:

> Conduct periodic inspection of the tunnel. It is suggested an ROV survey or an on-foot inspection to be completed every five years and should be included in the Wreck Cove Ground Control Management Plan. More frequent inspections may be required based on ROV surveys or operational indicators.
>
> [Exhibit N-1, Appendix G, p. 14]

[122] NS Power's reply evidence cited information from literary reviews and state:

> Brox (2020) notes that for a fully submerged tunnel ROV inspections are the preferred type of inspection and that dewatered (on-foot) inspections only be considered for the case where the findings of the ROV inspection identify serious tunnel stability concerns. Brox (2020) provides guidance on a recommended frequency of inspections for new tunnels ranging from 10 to 15 years immediately after construction. For existing tunnels with historical problems, the recommended frequency ranges from 1 to 3 years (Brox (2020)).
>
> [Exhibit N-8, Appendix A, p. 6]

[123] NS Power references a paper produced by Indebir Hundal and Martin Lawrence, 2022, *Tunnelling for the Future*, at page 2 which recommends:

> The focus of this paper is on largely unlined tunnels in the BC Hydro power system, and some recent inspections carried out as part of the regular civil maintenance and dam safety inspection programs. The frequency of inspections is usually on a 6 to 10-year cycle depending on the type of tunnel and according to a priority rating and defect rating classification system. However, for all tunnels that require dewatering (i.e., power, diversion, and low-level outlets) the cycle of inspections is every 10 years.

[124] From the information provided, most tunnel inspection recommendations suggest a five-to-ten-year span between inspections. The reports also vary whether information from ROV inspections is sufficient or visual on-foot inspections are required.

[125] NS Power did not provide a go forward tunnel inspection plan in this application, but stated the following in response to Midgard IR-15:

> NS Power is in the process of developing a detailed monitoring program for T-1 and T-2 with input from BGC Engineering Inc. (BGC). While the program is being developed, operational monitoring is ongoing and annual Remote Operated Vehicle (ROV) inspections are scheduled for both tunnels in Q3 2023.
>
> [Exhibit N-4, p. 2]

[126] The Board notes that the SBA provided the following request in its final submission:

> The SBA further submits that NSPI should provide confirmation to the Board of when their existing O&M manuals for hydro facilities were last updated, whether they require updating, and when this can be expected to happen.
>
> …
>
> … We further request that NS Power be required to report to the Board and stakeholders on how it plans to review its operations and maintenance manual and make sure that the protocols and processes included in them - including inspections at the required intervals -- are followed for the Wreck Cove Hydro System assets, including the continued work on both Tunnel 1 and Tunnel 2.

5.1 Findings

[127] For NS Power to make informed investment decisions for capital projects or maintenance and repair, it must obtain data on the condition and operation of the tunnels. The data obtained through routine and thorough inspections of the tunnels will provide information necessary to maintain safe and reliable operation and prevent structural, geotechnical, and functional failures. Routine inspections record the changes to the tunnel over time and can be used to identify and predict future life expectancy and identify safety critical deficiencies. Establishing written policies and procedures on how and why

inspections will be conducted will provide a framework and documentation for future decisions.

[128] Wreck Cove is a critical asset and critical assets should be maintained based on sound risk management principles. The Board understands that there are no generally accepted industry standards for tunnel inspections, but it is reasonable to expect NS Power to develop and provide a documented process and plan that details how tunnels will be monitored and inspected by qualified individuals, as well as the schedule for those inspections. If there are deviations to what experts or industry recommend, then NS Power needs to explain why the company proposes deviating from such recommendations. Once the inspection procedure is finalized, any justifications for deviating from it must be documented beforehand, and not after the deviation has already occurred.

[129] The Board directs NS Power to do the following:

1. Update the O&M Manuals for the Wreck Cove tunnels including inspection procedures. NS Power must provide justification if the company proposes deviating from expert or industry recommendations on inspection methods and frequency.
2. Provide the updated O&M Manuals to the Board and stakeholders complete with redline version.
3. Provide an update on the results of the Q3 2023 ROV inspections on Tunnel T-1 and Tunnel T-2.

[130] The Board directs NS Power to provide this information by March 31, 2024.

6.0 CONCLUSION

[131] The Wreck Cove Hydro System is a critical asset in NS Power's generation fleet. A significant rockfall was discovered in Tunnel T-2 in 2019. This area deteriorated quickly. It had to be repaired in 2022 when a full tunnel collapse became imminent. There was a planned Wreck Cove outage scheduled in 2022. This outage had previously been planned to work on the Wreck Cove LEM. Therefore, no additional downtime at Wreck Cove was needed to repair Tunnel T-2.

[132] We are satisfied that the process followed by NS power to remediate Tunnel T-2 was reasonable. We are satisfied that, based on the available information at the time, NS Power used the least-cost option. The chosen option both accomplished the stabilization goal and provided safety for the workers who did the task.

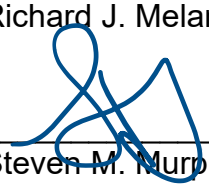
[133] In our view, NS Power's failure to conduct regular visual inspections, whether on-foot or by ROV technology, was imprudent. The evidence does not show any additional costs were incurred to remediate Tunnel T-2 because of this imprudence.

[134] In our view, NS Power was lucky that there were no major issues with Tunnel T-2 prior to 2019. NS Power was also lucky that the discovery of the major rockfall coincided with a planned Wreck Cove outage. Management of a critical asset should not depend on luck. We have therefore directed NS Power to update its tunnel inspection procedures.

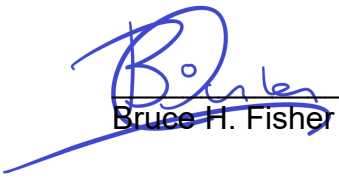
[135] An Order will issue accordingly.

DATED at Halifax, Nova Scotia, this 18th day of December, 2023.

Richard J. Melanson



Steven M. Murphy



Bruce H. Fisher