Q. **Reference: Application, Schedule 1: Upgrade Report – Penstock 1 Life Extension – Bay d'Espoir, Page 16, lines 15-17.**

> The risk assessment workshop demonstrated that Option 1 is the highest risk option due to its probability of multiple failures and associated significant costs over the next 30 years if a solution is deferred in the short term.

a) Provide a detailed estimate of the significant costs identified in the reference.

b) Has Hydro completed a full lifecycle cost estimate for each of the options assessed? If yes, provide the lifecycle cost estimate, with detailed calculations. If not, why not?

A. **a)** The significant costs identified for Option 1 are variable and depend on a multitude of factors including the size of the failure, the time of year the failure occurs, and available generation. Hydro provided estimated costs for various scenarios:

> Dependent upon the nature of the failure and the time of year, various consequences may be realized. A minor failure in the summer months may be repaired promptly at a cost of approximately $100,000 to $200,000[1] with minimal lost energy costs. If a minor failure were to occur during peak winter demand, this would likely take longer to repair and remove 153 MW from the system when it is needed. Hydro estimated the cost to replace 153 MW with generation from the Holyrood Thermal Generating Station ("Holyrood TGS"), at a high level, would be approximately $120/MWh.[2] Assuming the repair could be completed in four weeks, this could potentially cost $12.5 million for replacement energy and repairs. Impacts to downstream assets, outage durations, repair costs, and the impact to customers by not meeting Hydro's mandate to provide safe, least-cost, reliable power could be much larger.[3]

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[1] Hydro has completed repairs on average in approximately two to three weeks in good weather. Mitigation measures to reduce the repair time have been implemented.

[2] Analysis based on Bay d'Espoir Units 1 and 2 production data from the previous five years, January to March. Economic offsets via the Maritime Link and Labrador-Island Link were not considered. Assumed a Holyrood TGS Derated Adjusted Forced Outage Rate of 15%. Assumed Holyrood TGS full production during these months. Cost of bunker C is based on June 2022 rate ($147/bbl).

[3] "Application for Approval of Capital Expenditures for Section Replacement and Weld Refurbishment for Bay d'Espoir Hydroelectric Generating Facility Penstock 1," Newfoundland and Labrador Hydro, December 7, 2022, sch. 1, p. 13/3–11.

If a major rupture were to occur on the penstock, there is potential for catastrophic damage to critical downstream assets. The outage durations and repair costs for a major rupture have not been estimated.

b) Hydro completed a 30-year cost-benefit analysis for Options 2, 3, and 4 that considers in-service capital costs, operation and maintenance costs, repair costs, recoating costs, and net book value. This duration was used as it represented the estimated lifespan of the penstock if no work was completed. Option 1 was excluded from the cost-benefit analysis, as there is no associated up-front capital cost and this option does not provide acceptable risk mitigation to be considered viable. The details of the cost-benefit analysis can be found in Table 1.

Table 1: Cost-Benefit Analysis

Alternatives	Cumulative Net Present Value ("CPW")	CPW Difference between Alternative and the Least-Cost Alternative
Option 2: Refurbishment and Coating	38,294,804	-
Option 4: Refurbishment, Plates on 17-foot diameter Section, and Coating	45,947,774	7,652,970
Option 3: Replace 17-foot diameter Section, Refurbish Remaining, and Coating	54,388,336	16,093,532

During the front-end engineering and design risk analysis for Penstock 1, it was concluded that Options 2 and 4 were not technically viable options, as they did not sufficiently remedy the penstock's risk of cracking/rupture to achieve Hydro's mandate to provide safe, least-cost, reliable power. As such, Hydro did not include this cost-benefit analysis in the application.

The cost-benefit analysis assumptions are as follows:

- Net present value ("NPV") in 2021 dollars.
- Rates used, such as escalation factors and discount rates, are based on Hydro's Corporate Planning Assumptions.

- In-service project cost based on capital costs from Kleinschmidt's AACE[4] class 4 estimate for Options 2, 3, and 4 as included in Appendices K and L.[5] In-service cost at the time of the analysis was assumed to be 2024.
- The benefit of lifting the rough zone restrictions could not be economically quantified for Option 3 and was omitted from the analysis.
- Based on Kleinschmidt's recommendations, Options 2 and 4 would require weld repairs on a 3- to 5-year basis, as the issues in the 17-foot section would not be resolved. For analysis purposes, Hydro assumed that the repair cost of $200,000 would be required every 4 years, however, it is difficult to predict the frequency, severity, and timing of a repair, particularly as the penstock reaches the end of the 30-year study. This cost did not account for replacement energy costs based on system load requirements, as discussed in part a) of this response, as this is highly dependent on a number of variables.
- Options 2 and 4 assumed the penstock would have reached end-of-life at the end of the 30-year analysis resulting in zero net book value.
- Option 3 was assumed to have a non-escalated net book value for the remaining life at the end of the 30-year analysis for the new penstock section and the remaining life on the coating system.

[4] Association for the Advancement of Cost Engineering ("AACE").
[5] "Application for Approval of Capital Expenditures for Section Replacement and Weld Refurbishment for Bay d'Espoir Hydroelectric Generating Facility Penstock 1," Newfoundland and Labrador Hydro, December 7, 2022, sch. 1, apps. K and L.