Q. **Reference: Application, Schedule 1: Upgrade Report – Penstock 1 Life Extension – Bay d'Espoir, Appendix D, Page 34 of 42 and Table 10-1.**

> Table 10-1 is a preliminary list of possible long-term solutions with advantages and disadvantages of each.
>
> The scope of this study and time constraints do not permit an analysis or discussion of these alternatives at this time. The identification of a long-term solution requires further study.

a) Please confirm that Hydro's analyses of alternatives for the refurbishment of Penstock 1 have identified only one technically feasible alternative to return Penstock 1 to safe and reliable operation.

b) Other than the list of advantages and disadvantages included in Table 10-1, did Hydro complete any further analysis on the 15 items listed as long-term solutions for Penstock 1? If yes, please provide the analysis. If not, why not?

c) Does Hydro intend to complete further study as indicated by its consultant? If further study is required why was the further study not completed prior to filing the application?

d) With respect to item 9 in Table 10-1, in addition to traditional fibreglass liners, did Hydro or its consultants also investigate the use of carbon fibre wrapping as described in ASCE Manuals and Report on Engineering Practice, No. 79 – Steel Penstocks, page 188? If yes, please provide the research completed by Hydro or its consultants. If not, why not?

e) Please describe Item 15 in Table 10-1 more fully. In particular, what opportunities exist for incorporating unit 8 into the planning for the refurbishment of penstocks 1, 2 and 3 to address project risks, reduce cost and address operational restrictions associated with Penstock 1?

A. **a)** It is confirmed. Of the four options considered in the final stage of the design review, only Option 3 was deemed technically feasible to return Penstock 1 at the Bay d'Espoir Hydroelectric Generating Facility ("Bay d'Espoir") to safe and reliable operation.

Newfoundland and Labrador Hydro ("Hydro") also eliminated additional alternatives at previous screening stages due to factors such as higher costs or technical feasibility. Summaries of these alternatives can be found in Appendices D[1] and H.[2] Hydro's review of the life extension for Bay d'Espoir Penstock 1 indicates the selected alternative is the lowest cost technically feasible alternative.

b) Hydro completed further analysis on seven possible alternatives as potential long-term solutions for Penstock 1. These alternatives were:

1. Refurbishment of deteriorated weld seams, both longitudinally and circumferentially, and recoating the interior of the penstock.
2. Replacement options for each penstock:
    i. Full penstock replacement
    ii. Replacement of penstock 17-foot ID section
3. Refurbishment of deteriorated weld seams and the installation of a fibre-reinforced plastic liner.
4. Refurbishment of deteriorated weld seams and the installation of reinforcing plates over all longitudinal and circumferential weld seams.
5. Installation of a steel liner inside the existing penstock with grout injection to fill void space to the existing penstock.
6. Encasement of the existing penstock in a concrete ring approximately 2 feet thick.

The results of this analysis determined the alternatives that were considered for the final stages of life extension studies presented in Appendices I through L.[3]

[1] "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, app. D, s. 10, Table 10-1, pp. 35–36.
[2] "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, app. H, p. 24.
[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, app. I to L.

c) As noted in part b) of this response, Hydro completed further analysis on seven possible alternatives as potential long-term solutions for Penstock 1. Hydro does not intend to complete further study beyond that described in part b).

d) The use of various fibre wraps or reinforcements has been reviewed at various stages of the project, as shown in Appendices D[4] and H.[5]. Given the advancing technology with respect to fibre wrap alternatives, Hydro asked Kleinschmidt to review these technology advancements to confirm the previous elimination of this alternative. Kleinschmidt did not find anything to justify a change in that decision. Kleinschmidt is currently finalizing a report to document its findings on the suitability of fibre wrap alternatives and why they are not the preferred alternatives for Bay d'Espoir Penstock 1.

Carbon fibre has been reviewed at a high level; however, it has not been advanced for further study due to its high cost for a penstock of this diameter. Early cost estimates showed a fibre-reinforced polymer wrap alternative would be roughly 1.5 times the cost of the replacement of the 17-foot diameter section/weld refurbishment. A carbon fibre system was anticipated to have an even higher cost than the fibre-reinforced polymer wrap system.

e) Item 15[6] in this study referred to the possibility of constructing Bay d'Espoir Unit 8 adjacent to the existing Unit 7. A bifurcation would allow Penstock 4 to provide flow to both Unit 7 and Unit 8, similar to how Penstock 1 provides flow to Unit 1 and Unit 2. In this alternative, Unit 1 and Unit 2 would be operated intermittently, as required, and repaired as needed.

From 2016 to 2019, Bay d'Espoir Penstock 1 experienced four ruptures within the 17-foot diameter section, resulting in Bay d'Espoir Units 1 and 2 being unavailable for service for extended periods and significant unplanned expenditures. With it being the largest of Hydro's hydroelectric facilities, generation at Bay d'Espoir is very important in maintaining reliable service to the Island Interconnected System. Hydro's reviews of the condition of the

[4] "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, app. D, s. 10, Table 10-1, pp. 35–36.
[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, app. H, p. 28.
[6] "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, app. D, s. 10, Table 10-1, Item 15, p. 36.

penstocks, in particular the review completed by Kleinschmidt in 2021, have identified Penstock 1 as the most critical of the three penstocks.

The regulatory process surrounding the possible construction of Bay d'Espoir Unit 8 cannot begin until Hydro has completed further analysis and examination of that project and its requirements to enable the preparation of the regulatory application. Hydro does not anticipate being able to proceed with an application before the end of 2023. Hydro has not examined the option of combining the construction of Bay d'Espoir Unit 8 with the refurbishment of the penstocks to provide substantive comment on the opportunities referenced above; however, it is clear that proceeding in that manner would introduce further, likely substantial, delay.

The repair of Penstock 1 would return Bay d'Espoir Units 1 and 2 to normal operation and ensure the supply of the 153 MW needed to satisfy reliability criteria on the Island Interconnected System. Due to the high risk of future weld failures and associated significant cost impacts, Hydro believes that the proposed option is the appropriate least-cost solution to provide safe, reliable service.