

1 Q. **References: Volume II, Tab 1, Hydraulic Generation Asset Management Overview,**
2 **page 16, lines 7 - 9.**

3 *A penstock is a large pipe, most commonly constructed of welded*
4 *steel, which conveys water from a reservoir to turbine. Hydro has*
5 *eight steel and one wood stave penstock serving the hydraulic units*
6 *and three arrangements with penstock/power tunnel combinations.*

7
8 Does Hydro have a specific asset management program for penstocks? If so, please
9 describe the program.

10
11 A. Yes, Hydro has an Asset Management Program for penstocks. Hydro's preventive
12 maintenance schedule currently has a five-year frequency for Comprehensive
13 Internal Inspections of all its major generating unit penstocks. At times, penstocks
14 can be inspected more frequently as a result of assessments by Hydro personnel or
15 a consultant's recommendation. It is Hydro's intention to move the inspections to a
16 six-year cycle to coincide with the penstocks associated generating unit's six-year¹
17 major overhaul.

18
19 Hydro's normal penstock asset management program consists of the following:

- 20 • Comprehensive Internal Inspections: Consists of non-destructive testing to
21 check weld condition and metal wall thickness, laser survey to check
22 roundness, chipper hammer tests and visual walkthroughs. The inspections
23 are tendered and carried out by external technical consultants.

¹ The ASCE 79 Steel Penstocks Chapter 17 Section 17.1.2 Inspection Types and Content Standard provides a broad range of frequency for penstock owners to complete inspections. This range is between 5 and 10 years for the comprehensive internal inspections of steel penstocks.

- 1 • Monthly Inspection: External inspection consisting of a complete walk down
2 of the penstock to check for items such as vegetation growth, sloughing,
3 drain flow and drain blockages and abnormal ground leakage. These
4 inspections are carried out by trained internal personnel.

5

6 To supplement the normal preventive maintenance activities within the Penstock
7 Asset Management Program, Hydro has implemented other tasks specific to Bay
8 d’Espoir Penstocks 1 - 3 to maintain reliability. These include:

- 9 • Daily Checks: Checks comparable to the monthly inspections noted prior due
10 to the recent penstock issues experienced at Bay d’Espoir.
- 11 • Level II Condition Assessment: This condition assessment is focused on
12 identifying the work required for reliable service life of these penstocks. The
13 details of this plan will modify, if necessary, the preventive maintenance
14 program, as well as inform the five-year and 20-year capital plans. Further,
15 Hydro is undertaking a testing program in 2018 to apply test applications of
16 coatings inside Bay d’Espoir Penstock 2 to assess the best coating
17 application for longevity.
- 18 • Annual Comprehensive Internal Inspection: In addition to the tasks
19 contained within the Comprehensive Internal Inspection, Hydro will inspect
20 and review the condition of the coating test application on Penstock 2.

21

22 Table 1 contains the schedule for Comprehensive Internal Inspections over the next
23 five years.

Table 1: Penstock Comprehensive Internal Inspection Schedule

Penstock	Year
Cat Arm (Rock Trap and Steel Liner)	2018
Upper Salmon	2018
Granite Canal	2019
Cat Arm (Rock Tunnel)	2020
Hinds Lake	2020
Paradise River	2021
Bay d’Espoir P4	2022
Star Lake	2022
Bay d’Espoir Penstock 1, 2, 3	Scheduled annually. This annual schedule will remain until formal recommendations are received and evaluated for appropriateness from the consultant on the required program for penstock reliability (expected at year end 2018).

1 Cat Arm is listed twice since it is of a different design than Hydro’s other penstocks. Cat
 2 Arm consists of a 3 km rock tunnel with rock traps and a steel liner for transition instead of
 3 a continuous steel penstock. The inspection for Cat Arm is divided into two components,
 4 inspection of the rock trap and steel liner coupled with a tunnel inspection. A remote
 5 operated vehicle will be utilized for an internal inspection of the full tunnel length using
 6 point cloud technology to determine rock falls and areas of concern.