

1 **Q. Please comment on the type of penstock leaks that can be plugged or patched**
2 **without necessarily de-watering the penstock and please provide an estimate as to**
3 **the number of man hours and anticipated cost of attending to the leaks along the**
4 **penstock that are amenable to such plugging or patching in this manner?**
5

6 A. The size of leaks that can be plugged without de-watering the penstock varies with the
7 water pressures at different points along the penstock. For leaks that are small enough to
8 plug, a wooden plug slightly larger than the hole is forced or driven into the opening.
9 Once the flow of water has been stopped, the excess wood is usually trimmed off.

10
11 For the smallest leaks, a wooden shim or shingle may suffice. For larger holes, a piece of
12 lumber as large as a two-by-four could be required.

13
14 In the low pressure end of the Rattling Brook penstock, leaks of less than 75 mm
15 (approximately 3 inches) in diameter can sometimes be plugged without having to de-
16 water the penstock. In the high pressure end, it may be possible to plug leaks under 38
17 mm (approximately 1.5 inches) in diameter.

18
19 The low pressure end is the top 1,250 metres of penstock starting at the forebay dam.
20 The water pressure in this section varies from 12 pounds per square inch (psi) to 64 psi.
21 The high pressure end is the lower 450 metres of the penstock, where the pressure varies
22 from 64 to 110 psi under normal operating conditions. With only one unit operating,
23 which is normal from August to November, these pressures will be higher.

24
25 The pressure at the location of the repair completed on May 9, 2006, when the upper
26 section of the penstock was de-watered to below the Trans-Canada Highway bridge, was
27 approximately 25 psi. The hole measured approximately 75 mm x 25 mm. Attempts to
28 plug the hole without de-watering were unsuccessful.

29
30 For leaks that are too large to plug, it is sometimes possible to patch the leak by
31 loosening one of the steel bands, or hoop bars, encircling the penstock and inserting a
32 steel plate before tightening the band again. In the case of the Rattling Brook penstock,
33 the wood has deteriorated beyond the point where this is possible. Because of the poor
34 structural strength of the wood, loosening one of the steel bands on the Rattling Brook
35 penstock while the penstock is full could significantly worsen the leak.

36
37 Worker safety is a consideration when performing penstock repairs. Because of the
38 advanced deterioration of the wood in the Rattling Brook penstock, care must be taken to
39 ensure that patching efforts do not cause a hole to suddenly grow in size while workers
40 are close by. Workers must therefore always be conscious of the location of the leak and
41 the condition of the wood.

42
43 The best method for repairing larger leaks is to install a steel plate over the area. To do
44 this, the steel bands must be removed and the steel plate installed under the bands. Due to
45 the poor condition of the wood in the Rattling Brook penstock, this can only be done with
46 the penstock de-watered.

1 Sometimes, a leak may be too large to plug, but small enough so that the escaping water
2 is not a hazard to safety or to the penstock infrastructure. In these cases, attempts are
3 made to cover the leak or deflect the water away from the penstock until such time as the
4 penstock must be de-watered for other reasons.

5
6 For details on the number of man hours and cost of plugging penstock leaks, please see the
7 response to CA-30.0 NP.