

1 Q. Preamble: In his report, Dr. Bernander expressed serious concern that there may be
2 gaps and errors in the engineering analysis of the North Spur stability issue as made
3 public by Nalcor and their engineering advisors SNC-Lavalin. In particular, Dr.
4 Bernander is concerned that that there are apparently unresolved safety risks
5 associated with possible “Downhill *Progressive* Landslide formation” at the North
6 Spur. He states on page 1 of his report at III) “ The raised hazard, related to downhill
7 progressive (brittle) failure formation in extensive landslides is not covered by the
8 conventional values of safety factors normally applicable to analyses based on the
9 concept of Plastic Limit Equilibrium Failure”
10 Under the heading Item 1 Use of appropriate safety factors-Progressive Failure vs
11 Plastic Limit Model... he makes the following statement.
12 “It has been stated in this context that uncertainties in landslide modelling are
13 taken into consideration by the application in North Spur stability analyses of
14 safety factors (Fs) that are 30 to 50 % higher than 1. i.e. $1.3 < F_s < 1.5$ ” ...
15 “This is generally a correct approach when the conventional method of analysis,
16 based on the concept of the **Limit Equilibrium Plastic Failure** mode is applied
17 and considered to **be valid**. However, for **Progressive Failure** formation in **long**
18 **slopes** with highly sensitive clay, the Plastic Limit Equilibrium Failure Approach
19 (the PLEFA) is **not applicable**, and for these landslides the safety factors are
20 defined in a different way.”
21 It is therefore important to know whether the appropriate safety factors have been
22 considered in evaluating the risk of failure at the North Spur, and its consequences
23 regarding the reliability of power from the Muskrat Falls generating station.
24 Have any studies been performed including progressive failure analysis in the North
25 Spur? If so, please provide the complete analysis. If not, why not?

1 A. []

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3 Multiple studies and analyses have been undertaken in relation to the North Spur.
4 These have been summarized in a presentation prepared by LCP for the Muskrat
5 Falls Independent Engineer in July 2014.¹
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7 The studies and analyses include:

- 8 a) Multiple site investigation programs to establish the general nature,
9 patterns, and properties of the materials deposited on the North Spur;
10 b) An assessment of the most probable conditions based on the results of
11 the site investigation programs;
12 c) Development of 2D and 3D hydrogeological models for the area;
13 d) Initial (2008) and updated (2014) Seismic Hazard Studies;
14 e) Cyclic Stress Ratio (CSR) and Cyclic Resistance Ratio (CRR) calculations,
15 and
16 f) Dynamic Nonlinear Analysis (FLAC Model).

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18 The approach used to stabilize the North Spur focuses on eliminating triggers to
19 progressive failure to prevent them from disturbing the site and then to undertake
20 specific analyses to address the remaining triggers (such as seismic events) to
21 ensure they will not trigger a slide event.

¹ <http://muskratfalls.nalcorenergy.com/wp-content/uploads/2014/08/North-Spur-Stabilization-Works-Updated-Presentation-Independent-Engineer-July-21-2014.pdf> (previously filed as Hydro's response to PUB-NLH-290 Attachment 1).