Q. **Newfoundland and Labrador Hydro - EFLA Consulting Engineers Report - *Structural Capacity Assessment of the Labrador Island Transmission Link*, April 30, 2020 ("EFLA" Report)**

With respect to the statements set forth in the three bullets beginning near the bottom of page 5 of the April 30, 2020 EFLA report, please:

a. Define methodologically and quantitatively what specifically is meant by the "approach" indicated under the first bullet, associated with design of the LIL.

b. Provide the specific ice values used under the "same approach cited" and provide their source.

c. Define specifically, provide the values, and cite the source for what are termed "CSA recommendations" and explain the basis for concluding that the CSA has opined that such values are "recommended."

d. Provide the best available quantitative measures of how EFLA defined "realistic" and "probable" recognizing, for example that the latter can mean 51 percent.

e. Identify and provide the values set forth in all sources of information considered by EFLA in analyzing ice and wind conditions specific to particular tower and conductor locations.

f. Cite the locations in the EFLA report that show return periods or other structural capacity measures under such localized conditions, and, if EFLA has performed analysis using such conditions, but not included them in the report, provide them.

g. Provide the exceedance utilization level EFLA does consider "critical" and explain in detail if and whether any level less than qualifying as critical is material to assessing tower and conductor structural capacity.

h. Define "should not" as used in the second bullet and provide and support EFLA's" judgment about the likelihood (expressed as quantitatively as possible) of breakage or outage.

i. Provide and quantify what EFLA considers "normal design practice," indicated under the third bullet, with respect to electrode conductor suspension hardware.

j. Define as quantitatively as possible "marginal increase" with respect to failure of such hardware, and identify as particularly and quantitatively as possible the amount of increase EFLA considers as present.

A. a. The methodology is described in Section 3.3.6, page 36 of the report and the quantitative influence is provided in Table 20 on page 39. Note that this change in ice loading pertains only to the ice accumulation on the tower body.

b. Please refer to Section 3.3.6, page 36 of the report where the reduction in the ice accumulation on the tower body is discussed. The source for the basis of this numerical analysis is the CSA 60826 standard, paragraph A.5.8.3.

The following provides an example of specific quantitative values used in this scenario:

In tower 3212 (zone 11-4) the ice weight in the load case "Max. Ice" with full radial ice in CSA-150 is 44 ton, which is a weight ratio of ice to tower of 5.3. The conductor radial ice is 71.8 mm, thus the ratio should be 3.3 when using Figure 21.By lowering the amount of ice used in the design to the amount designated in the Canadian standard, the utilization on the tower reduces.

c. The recommendations in question are referring to Section A.5.8.3 of the CSA Standard.

The effect of icing on structures.

Ice accretion on structures increases their vertical loads on the structure and may control the design of foundations and some support members.

The weight of ice can be calculated using the geometry of the support members and the relevant thickness of ice accretion. Alternatively, an approximation can be derived from the following table, where:

Ice Thickness (mm)	15	25	30	35	40	45	50
Ratio of weight of ice to structure weight	0.57	1.00	1.23	1.48	1.73	2.00	2.28

The suggestions outlined in CSA are recommendations and not mandatory. When alternatives are provided within a standard, the designer should use relevant utility based experience to decide on which selection is more relevant to their own situation. Although completed in the design of the Labrador-Island Link ("LIL"), assuming full radial ice on all tower members is a conservative approach and as a result may not be realistic of actual circumstances, therefore resulting in some additional unused capacity.

d. The words realistic and probable are not used in the document as a quantitative measure. The word realistic on page 5 is used since the amount of accumulation of ice on the tower body using high amount of radial ice is likely higher than can be explained with physical icing models.

e. The reference wind and ice value used in the analysis are provided in Table 17 and Table 18. The values for ice load on the tower body was then modified in line with the explanation provided in Section 3.3.6 of the report, page 36.

f. For the purpose of the study completed by EFLA Consulting Engineers ("EFLA"), no use of local climatological condition values other than those standard values provided in the CSA standards were considered. The intent of the study was to complete an assessment of the LIL as benchmarked against return period loadings provided in CSA 22.3 No. 60826-10 Design criteria of overhead transmission lines only.

g. Generally 100% utilization is used as reference criteria. Three towers (0.09% of all towers) on the line have utilization exceedance of 0.8%, as noted in the summary provided on page 5 of the report. This value is not considered critical as the strength factor of 0.9 was used for the towers in the LIL design and the study. Also, the material strength is defined with the minimum exceedance value. Therefore it will be possible to determine the risk/criticality of the exceedance considering the utilization of all towers in the line.

Information specific to the utilization of the optical ground wire ("OPGW") is provided in Newfoundland and Labrador Hydro's response to NP-NLH-008.

h. The OPGW failure limit is higher than the damage limit used as a reference in the study. The failure limit in Table 16 of the CSA standard is given as the ultimate tensile strength of the cable. The hardware connections may result in a reduction of the OPGW breaking tension to approximately 95% of the rated tensile strength. The exceedance represents a tension corresponding to 87% of the cable rated tensile strength.

i. With respect to this component, a minimum safety factor of 1.6 is considered to be reasonable for utility practice, which is in line with the European standard EN 50431.

j. The safety factor originally specified in the design criteria for this component was 2. As a result of procurement issues for the specified component, an alternative with a lower capacity was accepted by the original designers resulting in a safety factor of 1.88. From a quantitative perspective, this results in a 6% decrease in capacity. In total, five towers are impacted out of 3,223 towers on the line or 0.16%. The term marginal refers to "of secondary or minor importance; not central," which indicates that EFLA does not deem this decrease critical with respect to probability of failure.