Q. **Reference: Response to the Request for Information NP-NLH-068.**

"The results of that analysis conclude that the estimate of 50-year return period loads developed in Exhibit 85 of the Muskrat Falls Review (which was the basis for the statement in the Basis of Design) shows a much longer return period according to the most recently available CSA reference loads."

Is Hydro indicating that the 1:50 year return period loads referenced in Exhibit 85 of the Muskrat Falls review could in effect be adjusted upwards as a result of Hydro's application of the current CAN/CSA-C22.3 No. 60826-10 standard? If so, please explain in detail how Hydro reached this conclusion.

A. Hydro reiterates its statement as quoted above, but does not accept the premise suggested by Newfoundland Power that loads from one study can be "adjusted" by the results of another, or in this case, through application of the most recent CSA standard.

Exhibit 85 stated that 50-year loads on the Avalon Peninsula are estimated to be 75 mm, but the most recent edition of the applicable CSA standards estimates 50-year loads in the same area to be 60 mm.

The CSA standard was issued 15 years after the study undertaken in Exhibit 85, and also stated its methodology as follows:

> Estimates of 50-year return period glaze ice radial thickness are presented in Figures CA.10 and CA.11. Since there is no national ice accretion observation network, values of ice accretion have been obtained by Environment Canada using the Chaîné model, which provides estimates of ice accretion due to freezing rain or drizzle at locations where standard hourly meteorological

observations are available. The modelled values represent equivalent radial ice thickness of density 900 kg/m3 on a 25 mm diameter conductor 10 m above ground.

The Chaîné model was run for about 200 locations for the period 1953 to 2006. An individual icing event was assumed to begin with the first occurrence of freezing precipitation, and ice was assumed to accrete until either the temperature rose to above 1 °C or 7 days (168 h) passed without further freezing precipitation. The 50-year return period radial ice thickness was then calculated from the total set of icing events over the period of record from each location.

To the extent that the CSA standard was released 15 years after Exhibit 85 and includes at least ten years of additional data (1996 to 2006), Hydro has no basis to discard the most recent applicable standard and rely on that previous work.

Referring to Table 4.2 in Exhibit 85, 50-year glaze ice thicknesses for various locations in southeastern Newfoundland are as follows:

TABLE 4.2
GLAZE ICE THICKNESSES (in mm) FOR SELECTED RETURN PERIOD VALUES

		Return Periods				
Stations	Elevation(s)	10-yr (mm)	25-yr (mm)	50 yr (mm)	99.9 Confidence Limit on 50-Yr Rtn Values (mm)	Max Glaze Ice Thickness Period (mm)
St. John's-Torbay	140	28	35	41	±21	59
Bonavista	25	18	22	25	±12	28
Gander	151	16	21	24	±13	27
Argentia	14	15	19	22	±14	21
St. Lawrence	49	13	16	19	±14	18
St. Alban's	13	6	7	8	±9	7

The 50-year glaze ice thicknesses for various locations in Newfoundland and Labrador from the CSA standard are as follows:

Location	Elevation (m)	Latitude	Longitude	Minimum temperature (°C)*	Reference wind speed† (km/h)	Reference ice thickness‡ (mm)	Wet snow thickness§ (mm)
Newfoundland and Labrador							
Argentia	15	47.30	–53.98	–14	130	35	—
Bonavista	15	48.65	–53.12	–16	140	40	—
Buchans	255	48.82	–56.87	–27	115	24	—
Cape Harrison	5	54.78	–57.95	–31	130	35	—
Cape Race	5	46.65	–53.07	–13	154	45	—
Channel–Port aux Basques	5	47.57	–59.15	–15	133	32	—
Corner Brook	35	48.95	–57.95	–18	111	24	—
Gander	125	48.98	–54.59	–20	117	30	—
Grand Bank	5	47.10	–55.77	–15	130	35	—
Grand Falls	60	48.93	–55.67	–29	100	28	—
Happy Valley–Goose Bay	15	53.32	–60.37	–32	98	20	—
Labrador City	550	52.95	–66.92	–38	95	15	—
St. Anthony	10	51.37	–55.58	–27	138	30	—
St. John's	65	47.57	–52.72	–16	138	42	—
Stephenville	25	48.55	–58.58	–18	114	24	—
Twin Falls	425	53.50	–64.53	–37	95	17	—
Wabana	75	47.63	–52.95	–17	130	40	—
Wabush	550	52.92	–66.87	–38	95	15	—

Some reference ice thicknesses are very similar, while others have increased in the 2010 CSA standard over the 1995 results.

The challenge of extrapolating ice loads from meteorological stations was discussed in Section 4.3 of Exhibit 85:

> The problem of extrapolating ice load estimates from those determined objectively at first-order AES Airport Stations using a specific <u>model</u> to remote transmission line sites with different elevations and topographic exposures to the storm wind is still in the research stage. WECAN (Weather Engineering Corporation of Canada, 1985) has used Cooling Power Equation and the gradient wind/surface roughness method to predict ice loads at a remote site. This method permits adjustment factors based on the

> elevations of the remote site above the airport base elevation to be derived for fully exposed conditions. Independently, Haldar, et al (1988) has also extrapolated both SI. John's and Bonavista data to remote site near Sunnyside Station after adjusting elevations for the remote site and by accounting for the higher and/or lower wind using a gradient wind model. Both these results are presented here in terms of elevation above the Torbay Station. Elevation of the Torbay Airport is 450 feet above the Mean Sea Level.

Recognizing this question is one where considerable research was ongoing, no justification could be found to substitute the most current available edition of the CSA standard issued in 2010 with research undertaken decades earlier.

Hydro did take care to ensure, however, that design loads were no less than those presented in Exhibit 85.