Q. **Re: CBA, Rev. 1, vol. II, Labrador City L22 Voltage Conversion, page 1 (p. 609 pdf)**

Citation 1:

> Power delivery on long heavily loaded distribution lines is constrained by the large amount of voltage drop that occurs over the long distance. This voltage drop increases as the load on the line increases. To compensate for this Hydro installs voltage regulators that can boost the line voltage up to an acceptable level and increase the amount of load that can be supplied. As both Sheshatshiu and North West River are located at the end of Line 7 multiple points of voltage regulation are required to maintain acceptable voltage levels. Voltage regulation for Line 7 is provided at the Happy Valley Terminal Station and voltage regulators HV7-VR2, HV7-VR3, and HV7-VR1 located along the feeder as indicated in Figure 1. Figure 2 shows a picture of a typical set of 200 A voltage regulators used by Hydro.
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> Analysis has indicated that due to the recent load growth in Sheshatshiu and North West River, voltage regulators HV7-VR3 and HV7-VR1 are operating above their planning rating. To ensure reliable distribution system operation past 2021, Hydro proposes to replace these voltage regulators to address the situation.

Citation 2 (page 3):

> Historical Peak Load in Sheshatshiu and North West River is not available on an annual basis. Instead, peak load information is collected by installing temporary meters when required. The peak load for the entirety of Line 7 is recorded at the Happy Valley Terminal Station and has shown steady load growth.

Citation 3 (page 4, note 4):

> This forecast estimate was created using the Happy Valley System Forecast and multiplying it by the average load contribution of Line 7 to the system peak.

a. Please provide the analysis that indicates that voltage regulators HV7-VR3 and HV7-VR1 are operating above their planning rating.

A.

a. A load study was performed in February 2017 which recorded the current on each phase at specific locations along the length of L7. These results are included in the Table 1 which show that HVY7-VR3 is above the full regulation range rating of 200 A on phase A and that HV7-VR1 was at the limit of the 200 A rating on Phase A.

Table 1: Load Study Results February 2017

Description	Current (A)			MW
	Φ A	Φ B	Φ C	
HV7-VR3	216	187	188	8.316
HV7-VR1	199	174	172	7.798

These regulators have a load boost feature which allows them to be loaded 10% above their nameplate rating if their regulation range is reduced from ±10% to ±8.75%. Therefore, it was determined that upgrading HV7-VR3 and HV7-VR1 could be deferred until either the boosted planning rating of 220 A was exceeded or the full regulation range was needed.

Since the load study in 2017, the load on L7 has been growing with the majority of this growth attributed to new developments in North West River and Sheshatshiu. These services are at the end of L7 and load growth in this area increases the load on both sets of regulators. This load growth is evident from the Energy Management System ("EMS") readings taken at the Happy Valley Terminal Station with the historic non-coincident peak load on L7 included in Table 2.

Table 2: Yearly Peak Load on HVY L7 Based on EMS Recordings at HVY Terminal Station

Non-Coincident Peaks				
Date	Current (A)			MW
	Φ A	Φ B	Φ C	
21-Feb-2020, 9:30	259	249	225	10.691
20-Jan-2019, 9:00	253	219	216	9.911
15-Jan-2018, 9:15	221	203	202	9.203

Newfoundland and Labrador Hydro ("Hydro") uses Cyme Distribution Analysis Software to perform load flows on a system model which calculates current and voltage for each device on

the system. This software is the industry standard for modelling distribution systems and is used by many utilities across North America to identify when upgrades are required on distribution systems. Hydro allocates load to the model by setting the load at the beginning of each feeder according to the coincident peak load current as recorded at the substation. This load is then scaled according to the system peak load forecast to represent future growth on the system. The load flow analysis results based on the winter 2019 forecast (December 2019 to April 2020) are included in Table 3. These results show that HV7-VR3 is loaded above the boosted rating of 220 A and HV7-VR2 has almost reached the same limit.

Table 3: L7 Load Flow Results Based on the HVY 2019 Forecast

	Description	Current (A)			MW
		Φ A	Φ B	Φ C	
Actual	2019 Coincident Peak Recording on L7	248	205	225	9.735
Load Flow Analysis Results	L7 Start	289	228	252	11.181
	HV7-VR3	234	189	207	8.994
	HV7-VR1	218	180	194	8.278

Hydro has received a number of requests for service in the North West River and Sheshatshiu area which are expected to come online in 2020 and 2021 that will further increase the loading on these regulators. Once all of these services are connected the expected load on these regulators will further exceed their planning rating as per the load flow results in Table 4. For these reasons it is required that the regulators be upgraded to allow Hydro to continue serving both communities with reliable power.

Table 4: HVY L7 2019 Forecast Load Flow with Requests for Service Online

Description	Current (A)			MW
	Φ A	Φ B	Φ C	
HV7-VR3	264	215	234	9.894
HV7-VR1	244	204	216	9.178