Q. Further to the response to PUB-NLH-232, state the direct current rating of each of the electrode line conductors, the overload capability of a single conductor for 10 minutes, 20 minutes and continuously for ambient temperature of 0, 20 and 30 degrees and the maximum continuous power delivery at Soldiers Pond for operation in monopole operation with a single electrode conductor from the Muskrat Falls converter station to the electrode.

A. For the purposes of this analysis, the following design parameters were utilized:

1. The electrode line in Labrador consists of 1590 kcmil 54/19 ACSR Falcon and 1192.5 kcmil 54/19 ACSR Grackle conductors.
2. The electrode line thermal design temperature is 62°C for the Falcon conductor and 72°C for the Grackle.
3. Electrode current during bipole operation is 12 A.
4. Electrode current during continuous 1.5 pu monopole overload is 1929 A.
5. Electrode current in short term 10 minute 2.0 pu monopole overload is 2571 A.
6. 312 km of Grackle conductor has a total dc resistance of 17.78 Ω.
7. 100 km of Falcon electrode conductor has a total dc resistance of 4.16 Ω.
8. 1068 km of HVdc overhead line conductor has a total dc resistance of 20.29 Ω.
9. Two submarine cables in parallel during monopole operation have a total dc resistance of 0.2535 Ω assuming maximum dc resistance values.

Table 1 outlines the electrode conductor current limits given that the lines are built with a thermal design of 62°C for the Falcon and 72°C for the Grackle. It is clear from the table that the limiting conductor is the smaller 1192.5 kcmil 54/19 ACSR Grackle conductor.

Table 1: Electrode Conductor Current Limits

Electrode Conductor	Ambient Temperature °C	Overload Time (min)	Current (A)	Power Transfer (MW)
Single Falcon	0	10	1850	647.50
		20	1645	575.75
		30	1610	563.50
		Infinite	1609	563.15
	20	10	1650	577.50
		20	1320	462.00
		30	1300	455.00
		Infinite	1281	448.35
	30	10	1600	560.00
		20	1250	437.50
		30	1130	395.50
		Infinite	1075	376.25
Single Grackle	0	10	1750	612.50
		20	1490	521.50
		30	1450	507.50
		Infinite	1442	504.70
	20	10	1590	556.50
		20	1310	458.50
		30	1240	434.00
		Infinite	1204	434.00
	30	10	1480	518.00
		20	1205	421.75
		30	1120	392.00
		Infinite	1062	371.70

Taking the single Grackle electrode conductor maximum current ratings, the I^2R power losses were calculated for each power transfer limit. The difference between

the electrode power limit and the overall monopole conductor heating losses will determine the power delivered at Soldiers Pond. Table 2 outlines the maximum power delivered to Soldiers Pond for each of the operating conditions specified.

Table 2: Maximum Power Delivered to Soldiers Pond with Single Electrode Conductor out of Service

Ambient Temperature °C	Overload Time (min)	Current (A)	Power (MW)	I^2R Power Losses	Power Delivered to SOP (MW)
0	10	1750	612.50	130.12	482.38
	20	1490	521.50	94.33	427.17
	30	1450	507.50	89.33	418.17
	Infinite	1442	504.70	88.35	**416.35**
20	10	1590	556.50	107.42	449.08
	20	1310	458.50	72.92	385.58
	30	1240	434.00	65.33	368.67
	Infinite	1204	421.40	61.59	**359.81**
30	10	1480	518.00	93.07	424.93
	20	1205	421.75	61.70	360.05
	30	1120	392.00	53.30	338.70
	Infinite	1062	371.70	47.92	**323.78**