Q. Further to the response to PUB-NLH-264, Attachment 1:

1. Figures 268 to 274 shows a growing instability. Explain why.
2. Figure 290 shows that the frequency starts to recover at about 15 seconds. Explain from where the additional power to increase the frequency comes.
3. Figure 297 shows that the frequency starts to recover at about 10 second. Explain from where the additional power to increase the frequency comes.
4. Figure 311 shows that the frequency suddenly starts to recover at about 7 seconds. Explain how this happens.
5. Figure 346 shows that the frequency starts to recover at about 10 seconds. Explain from where the additional power to increase the frequency comes.

A. 1. The analysis of a permanent pole fault on the LIL indicates that under frequency load shedding will occur on the island particularly when the LIL is set to deliver 830 MW at Soldiers Pond. Figure 290 provides the island frequency response for the case where the ML is curtailed following a permanent LIL pole fault for the future peak load base case with the LIL at 830 MW delivered at Soldiers Pond, the ML export set at 158 MW at Bottom Brook and the on-island generation set at 1085 MW. The ML curtailment mitigation strategy for this load scenario indicates that under frequency load shedding can be avoided with the island frequency reaching a minimum of approximately 59.63 Hz prior to recovery. The recovery from 59.63 Hz beginning at the 15 second mark is attributed to the governor action of the on-island hydro units that are not at their maximum output prior to the event, including the Bay d’Espoir units 1 through 6 which increase their output from 74 MW per machine to 75 MW and Cat Arm units 1 and 2 which increase their output from 63.5 MW per machine to 67.9 MW.

2. The analysis of a permanent pole fault on the LIL indicates that under frequency load shedding will occur on the island particularly when the LIL is set to deliver 830 MW at Soldiers Pond. Figure 297 provides the island frequency response for the case where the ML is curtailed following a permanent LIL pole fault for the peak load base case with the LIL at 830 MW delivered at Soldiers Pond, the ML export set at 158 MW at Bottom Brook and the on-island generation set at 915 MW. The ML curtailment mitigation strategy for this load scenario indicates that under frequency load shedding can be avoided with the island frequency reaching a minimum of approximately 59.73 Hz prior to recovery. The recovery from 59.73 Hz beginning at the 10 second mark is attributed to the governor action of the on-island hydro units. The generation dispatch for this case (base case 2) includes approximately 170 MW of spinning reserve on the island hydro-electric generators.[1] The curtailment of the 158 MW of ML export is sufficient to reduce the rate of change of frequency to the point where there is time for governor action from the on-island hydro units to increase output and restore island system frequency.

3. Base Case 4 is a LIL monopolar case with the LIL operating at 396 MW delivered at Soldiers Pond, the ML set at an export level of 182 MW, and the on-island generation at maximum output. The permanent pole fault contingency in this case results in complete loss of the LIL and the 396 MW at Soldiers Pond. Given the lack of reserve in the system, and the fact that the starting point for the analysis is an N-1 condition, one would expect operation of the on-island under frequency load shedding (UFLS) scheme to prevent system collapse for the N-1-1 event. Figure 311 provides the plot of the system frequency for the loss of the

[1] In Base Case 2 Hinds Lake is set at 67 MW with a rating of 75 MW, Upper Salmon is set at 73 MW with a rating of 84 MW, Cat Arm is set at 2 x 35 MW with a rating of 2 x 63.5 MW, Granite Canal is set at 23 MW with a rating of 40 MW, Bay d'Espoir 1 to 6 are set at 65 – 66 MW with a rating of 75 MW and Bay d'Espoir 7 is set at 135 MW with a rating of 154 MW.

only LIL pole in service with the ML being curtailed for the event. The plot shows a frequency decay to approximately 58.15 Hz prior to a sudden increase and recovery in system frequency at about the seven second mark. The recovery in system frequency is attributed to the successful operation of the UFLS scheme and tripping of all load blocks down to, and including, the 58.2 Hz block. As noted in Figure 316, approximately 250 MW of load was shed for the event, with approximately 50 MW of load in the 58.2 Hz block being shed at the seven second mark. This final 58.2 Hz block load shed was sufficient to arrest frequency decay and initiate frequency recovery.

4. Base Case 10 is a LIL monopolar case with the LIL operating at 550 MW delivered at Soldiers Pond, the ML set at an export level of 500 MW, and the on-island generation at 650 MW. The scheduled LIL delivery for island use equals 50 MW. The permanent pole fault contingency in this case results in complete loss of the LIL and the 550 MW at Soldiers Pond. The case is set with approximately 160 MW of spinning reserve on the island hydro-electric generators[2]. Figure 374 provides the plot of the system frequency for the loss of the only LIL pole in service with the ML being curtailed for the event. The plot shows a frequency decay to approximately 59 Hz prior to recovery in system frequency at about the ten second mark. The recovery in system frequency is attributed to curtailment of the ML export reducing the rate of change in frequency decay such that there is sufficient time for governor action of the on-island hydro-electric generators to restore the system frequency.

[2] In Base Case 10 Hinds lake is set at 67 MW and has a rating of 75 MW, Cat Arm is set at 2 x 35 MW with a rating of 2 x 63.5 MW, Granite Canal is set at 23 MW with a rating of 40 MW, Upper Salmon is set at 73 MW with a rating of 84 MW, two units in Bay d'Espoir are set at 50 MW with a rating of 75 MW each and Bay d'Espoir 7 is set at 135 MW with a rating of 154 MW.