Q. **Reference: Reliability and Resource Adequacy Study, Technical Conference #3 Presentation, June 2021, slide 58.**

> During Repairs LIL remained available during much of the work outage during the day time with LIL operational at night. Some repairs delayed to enable LIL to remain online. Some commissioning activities occurred at night.

Please provide a detailed overview and explanation of maintenance or repair work that can and cannot be completed on the Labrador Island Link ("LIL") while it is in service. For example, what repairs can be made to a broken pole conductor, electrode line, Optical Ground Wire ("OPGW"), cross-arm, tower, et cetera, while the LIL is in operation and supplying load?

A. There are multiple failure scenarios that can be remedied with the Labrador-Island Link ("LIL") remaining in service through use of energized line techniques. Training is ongoing to develop the capabilities to conduct repairs using energized line techniques within Power Supply. In addition, it is anticipated that Power Supply will establish a contract with an external organization capable of performing various energized line repairs. With any outages or reductions in LIL power transfer capabilities, especially in the event of multiple failures, the first step is to understand what has failed and the estimated repair time of that failure in order to maximize LIL power transfer capabilities. For any repair affecting the system, Power Supply would plan the repairs to minimize the impact to its customers while maintaining sufficient system reliability. The below provides a listing of some of the failures that can occur on the LIL and the power transfer capabilities while these repairs are being conducted.

- Single Electrode Conductor Break – In the event of a single electrode conductor break, the LIL can continue to operate in bipole mode by using the healthy electrode conductor as the ground source. In this scenario, the LIL remains capable of full power transfer capabilities at 900 MW. Based on system conditions, Power Supply would plan to repair the broken electrode cable when possible while minimizing the impact to customers. The repair would require securing the broken electrode conductor in place adjacent to the energized pole conductor. It is anticipated that this would require a monopole outage, resulting in a LIL transfer capability ranging from 446 MW to 674 MW depending on ambient temperatures, while operating in a monopole earth return with single electrode configuration until the repairs are completed.

- Single Electrode Cross Arm Failure – In the event of a single electrode cross arm failure, the LIL can continue to operate in bipole mode. In this scenario, the LIL remains capable of full power transfer capabilities at 900 MW. To complete the repairs, crews would have to work above the energized pole conductor. Assuming the electrode conductor is still in the air, as observed during the January icing event, the LIL can continue to operate in bipole mode full capability throughout the duration of the repair.
- Single Pole Conductor Break – In the event of a single pole conductor break, the LIL can operate in monopole mode with earth return. In this scenario, power transfer capabilities are reduced to 675 MW. To repair a broken pole conductor, the damaged pole conductor would need to be isolated and out of service. During this repair the LIL can continue to operate in monopole mode using earth return with a power transfer capability of 675 MW.
- Double Electrode Conductor Break (EL1 & EL2 Breaks) - In the event of a double electrode conductor break, the LIL can operate in bipole mode with station ground return. In this scenario, the LIL remains capable of full power transfer capabilities at 900 MW. Similar to the repair of a single electrode conductor, this would require securing the first broken electrode conductor in to place adjacent to the energized pole conductor. Based on system conditions, Power Supply would plan to repair one of the broken electrode cables when possible while minimizing the impact to customers. The repair would require a bipole outage of the LIL while the repairs are made to the first broken electrode conductor. The LIL could then be returned to service in bipole mode with single electrode and would be capable of full power transfer (900 MW). Based on system conditions, Power Supply would then plan for the repair of the second electrode conductor. This repair would use the same approach as the Single Electrode Conductor break above. Note that at least one electrode must be connected at each end of the LIL in order to achieve a valid configuration to permit the LIL to be deblocked. Once deblocked, the electrode conductors can be isolated on the Muskrat Falls side. The Soldier’s Pond converter station side, which is connected by a

separate wood pole line connection to the Dowdens Point Electrode Site, must have at least one electrode connected at all times since it is the only available ground reference. If Soldier's Pond does not have one electrode connected it will result in a bipole outage.

- Single Pole Conductor and Single Electrode Conductor Break – In the event of a single pole conductor and single electrode conductor break, the LIL can operate in monopole mode with monopole earth return. In this scenario, power transfer capabilities are reduced to 446 MW to 675 MW, depending on ambient temperatures due to the thermal rating of the single electrode conductor. There are a number of potential repair approaches which consider if failures experienced are on the same or opposite side of the tower, and if failures are located in the same or different spans. The repair approaches are detailed as follows:
  - If both failures are on the same side of the tower(i.e. Pole 1 and Electrode Line 1 or Pole 2 and Electrode Line 2):
    - Repairs would first be conducted on the electrode conductor with the LIL operating in monopole mode using earth return with single electrode, resulting in power transfer capabilities between 446 MW and 674 MW depending on ambient temperatures. Once repairs are completed on the electrode conductor, the LIL can then operate in monopole earth return with both electrode conductors in service, allowing power transfer at a continuous 675 MW, while repairs are completed on the pole conductor. It is important to note, that this repair strategy prioritizes repair and not power transfer capabilities. If system conditions require maximization of power transfer capabilities, the pole conductor would be replaced first allowing bipole operation at a continuous 900 MW as detailed in the next repair strategy.
  - If failures are on opposite sides of the tower (i.e. Pole 1 and Electrode Line 2 or Pole 2 and Electrode Line 1)
    - Repairs would first be conducted on the pole conductor with the LIL operating in monopole mode using earth return with single electrode, resulting in power transfer capabilities between 446 MW and 674 MW depending on ambient temperatures. Once repairs are made to the pole conductor the LIL is capable of bipole operation with single electrode, allowing power transfer at a continuous 900 MW. Based on

system conditions, Power Supply would plan to repair the broken electrode conductor when possible while minimizing the impact to customers. The repair would require securing the broken electrode conductor in place adjacent to the energized pole conductor. It is anticipated that this would require a monopole outage, resulting in a LIL transfer capability ranging from 446 MW to 674 MW depending on ambient temperatures, while operating in a monopole earth return with single electrode configuration until the repairs are completed.

- If failures are at different tower span locations
  - Repair strategies and LIL operation would be similar to the scenarios discussed prior, however repair time could be increased due to snow removal and equipment mobilization.

- Single Pole Conductor and Double Electrode Conductor Breaker (EL1 & EL2) – In the event of a single pole conductor and double electrode conductor break, the LIL would be forced offline. The primary focus of the repair would be to the electrode conductor that is on the same side of the tower as the healthy pole. Once the first electrode conductor is repaired, the LIL could operate in monopole mode using earth return with single electrode. The power transfer capabilities would range from 446 MW to 674 MW depending on ambient temperatures. The repairs then would be the same as previously outlined in the event of a single pole conductor and single electrode conductor break.
- Optical Ground Wire ("OPGW") Conductor Break – In the event of an OPGW conductor break, the LIL can continue to operate in bipole mode. In this scenario, the LIL remains capable of full power transfer capabilities at 900 MW. Repairs would be undertaken at an appropriate time considering system conditions and would not impact power transfer.
- Pole, Electrode and OPGW Damper Failure – In the event of a pole, electrode and OPGW damper failure, the LIL can continue to operate in bipole mode. In this scenario, the LIL remains capable of full power transfer capabilities at 900 MW. Repairs would be undertaken at an appropriate time considering system conditions and would not impact power transfer.

- Pole Corona Ring Failure – In the event of a pole corona ring failure the LIL can continue to operate in bipole mode. In this scenario, the LIL remains capable of full power transfer capabilities at 900 MW. Repairs would be undertaken at an appropriate time considering system conditions and would not impact power transfer.
- OPGW Ground Strap Failure – In the event of an OPGW ground strap failure the LIL can continue to operate in bipole mode. In this scenario, the LIL remains capable of full power transfer capabilities at 900 MW. Repairs would be undertaken at an appropriate time considering system conditions and would not impact power transfer.
- Damaged Pole Conductors (fewer than four broken strands) – In the event of a damaged pole conductor with fewer than four broken strands, the LIL can continue to operate in bipole mode. In this scenario, the LIL remains capable of full power transfer capabilities at 900 MW. These repairs can potentially be conducted while the LIL continues to operate in bipole mode with full power transfer capability through the use of energized line techniques.
- Damaged Pole Conductors (four or more broken strands) – Impact and repairs may be similar to those detailed when less than four strands are broken; however, depending on the severity of the damage, this may require an outage to the pole conductor, resulting in the LIL operating in monopole using earth return with power transfer capability limited to 675 MW during the repair.
- Broken HVdc Pole Suspension Insulator(s) – In the event of a broken HVdc pole suspension insulator, the LIL can continue to operate in bipole mode provided there were sufficient insulators remaining to avoid flashover at full voltage of 350 kV. In this scenario, the LIL remains capable of full power transfer capabilities at 900 MW. This would result in the LIL continuing to operate in bipole under energized line repair standards, only a certain number of insulators can be failed to allow energized line techniques to be utilized to safely conduct the repair. The permissible number of failed insulators depends on the number of insulators in the string. If too many insulators are damaged to repair in an energized state, Power Supply would plan the repairs to minimize the potential for impact to customers. During the repair, the LIL can continue to operate in monopole mode using earth return, with a power transfer capability of 675 MW. In addition, if the number of insulators broken resulted in a

flashover at 350 kV, the LIL does have the capability to operate in a reduced voltage mode down to 280 kV, in which case the LIL can continue to operate in bipole mode with power transfer capabilities between 720 MW and 900 MW, dependent on final operating voltage. If flash over still occurs at 280 kV or if energized line techniques cannot be utilized, the pole with the damaged insulators would have to be removed from service. In this case, the LIL can continue to operate in monopole mode using earth return, with power transfer capability of 675 WM until the repairs were completed.

- Broken Electrode Suspension Insulator(s) – This would have no effect on the operation of the LIL. Since the LIL can operate in bipole mode at full power transfer capability with one or two electrode lines in service, the affected electrode line can be isolated and insulators repaired without a reduction in power transfer.
- Single or Multiple Tower Failure – In the event of a single or multiple tower failure, the LIL would be forced offline. Depending on how the tower has failed, Power Supply would evaluate whether to install new tower(s) or erect a bypass around the single or multiple tower failures. The priority would be to return a single pole and electrode conductor to service to allow the LIL to operate in monopole mode using earth return with a single electrode. The power transfer capabilities would range from 446 MW to 674 MW depending on ambient temperatures due of the thermal rating of the single electrode conductor.
- Single Guy Failure – This would have no effect on the operation of the LIL. It is anticipated that repairs can be conducted on the guy while the LIL remains online in bipole mode, capable of full power transfer.