Q. **Reference: Study, page 9 - Transmission Planning Criteria TP-S-007 NLSO Standard**
www.oasis.oati.com/woa/docs/NLSO/NLSOdocs/TP-S-007_Transmission_Planning_Criteria_UPDATED_05112018.pdf

Please file the presentation of February 11 that explains, among other things, the limits of the Primary Transmission System and the scope of TP-S-007 NLSO Standard – Transmission Planning Criteria.

A. Please refer to IOC-NLH-019, Attachment 1.

Overview: Labrador Interconnected System Expansion

February 2019

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Presentation Overview

- Purpose
- Background Information
  - Transmission System and Planning Criteria
- Study Process
- Baseline Load Forecast
- Eastern and Western Labrador Expansion Plans
  - Baseline Plans
  - Plans for Incremental Expansion
- Additional Considerations and Initiatives for 2019

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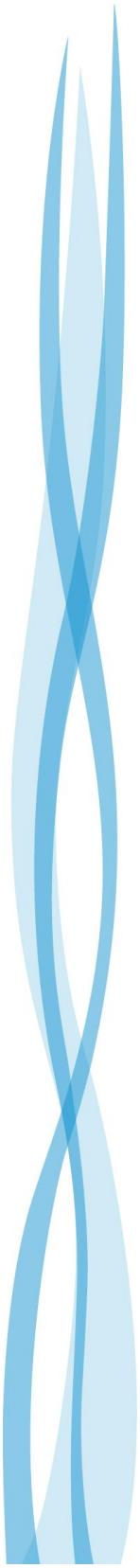

Purpose

Purpose of the Expansion Plan

- The Newfoundland and Labrador Board of Commissioners of Public Utilities (the "Board") requested Newfoundland and Labrador Hydro ("Hydro") file long-term expansion plan for Labrador Interconnected System ("LIS") by October 31, 2018, per Order No. P.U. 9(2018).
- The Plan addresses current and future reliability constraints in light of customer demand forecasts and potential unforeseen additional growth (e.g., data centers, mining, commercial, etc).
- Comprehensive study to determine appropriate approach to ensure safe, reliable, economical system.

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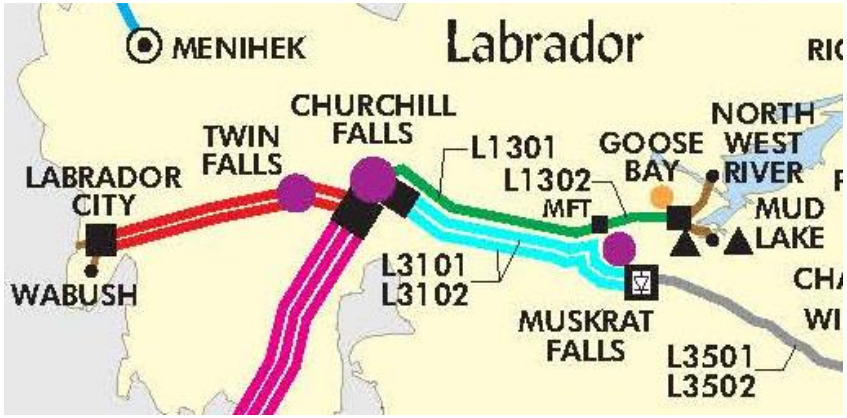
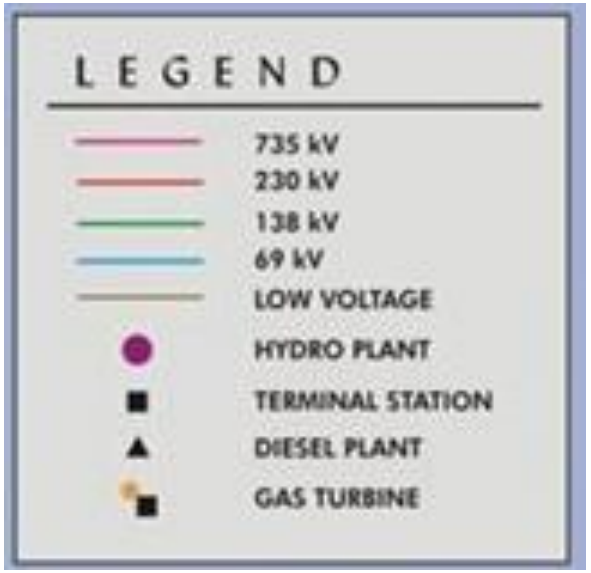
Background

Labrador Interconnected System





- Primary Customers
  - Iron Ore Company of Canada
  - Tacora
  - Hydro Rural

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Labrador Interconnected System

- Challenges:
  - Short construction season
  - Long lead delivery items
  - Cyclical nature of mining industry
  - Environmental permitting
  - Process in neighbouring jurisdictions

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Transmission Planning Criteria

- Planning Criteria only apply to the Primary Transmission System ("PTS")
- The PTS includes the portions of the system that permit the **bulk flow** of electricity
  - Island 230 kV system
  - Labrador Island-Link ("LIL")
  - Labrador 315 kV, 735 kV systems

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Transmission Planning Criteria

- Planning Criteria do not apply to systems not considered part of the PTS. These include:
  - Labrador East: Radial Transmission System
  - Labrador West: Local Network
  - Various Island systems
- These systems distribute power to specific customers.
- Systems are designed to meet customer reliability requirements, taking cost into account.

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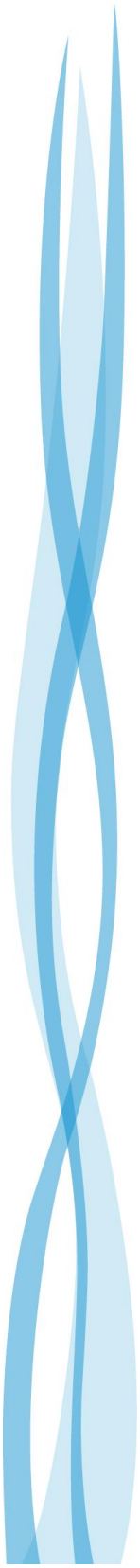

Study Process

Study Process

1. Establish a Baseline Load Forecast
   - Provides a basis for system planning in eastern and western Labrador
2. Establish a Transmission Expansion Plan to meet the baseline load forecast
3. Perform preliminary assessment of transmission upgrades to meet incremental loads beyond the baseline plan

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Baseline Load Forecast

- Includes existing customers:
  - Iron Ore Company of Canada ("IOC")
  - Tacora
  - Expected Hydro Rural retail growth
    - without expanded mining
    - with existing data centres

Does not include:

- Full data centres interest
- New large loads
- Alderon
- Department of National Defence ("DND") fuel conversion

- Covers a study period of 25 years
- Eastern Labrador : 95 MW in 2043 (existing capacity is 77 MW)
- Western Labrador: 383 MW in 2043 (existing capacity is 350 MW)

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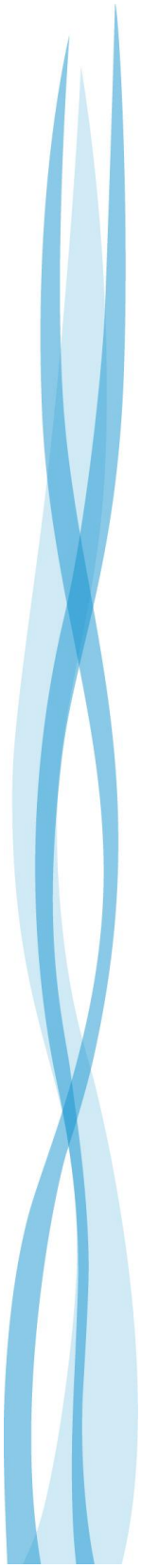

Labrador East Plan

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Eastern Labrador: Baseline Plan

- The least cost, more reliable solution is the proposed 138 kV interconnection between the Happy Valley Terminal Station and the Muskrat Falls Terminal Station
- System capacity will be increased to 104 MW, meeting baseline forecast requirements
- The estimated project cost is $20 million and is currently before the Board
- This is less expensive and more reliable than the alternative of paying for customer interruption and gas turbine operation to meet peak

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Eastern Labrador: Incremental Load

There is a potential for increased load growth above the baseline forecast (new DND load, data centres)

- Labrador East Load Exceeds 104 MW
  - Transformation Upgrade at the Happy Valley Terminal Station ($5 million)
- Labrador East Load Exceeds 125 MW
  - Transformation Upgrade at Happy Valley and Muskrat Falls Terminal Station #2 ($15 million)
- Labrador East Load Exceeds 162 MW
  - Construction of a second 138 kV Line from Muskrat Falls to Happy Valley ($50 million)

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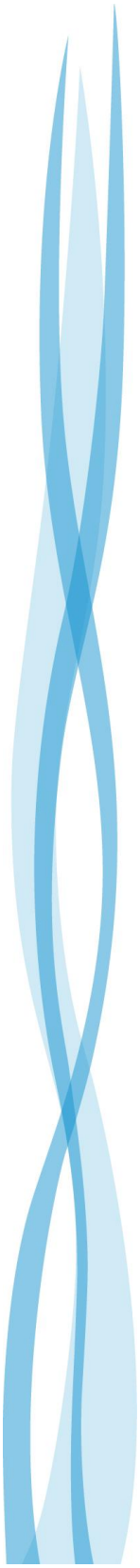

Labrador West Plan

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Western Labrador: Current Situation

- **Capacity:**
  - 350 MW (non-firm, all equipment in service)
  - 290 MW (loss of a synchronous condenser)
  - 244 MW (firm, loss of 230 kV transmission line)

- **Load Forecast:**
  - 358 MW by the winter of 2019/2020
  - 383 MW by the winter of 2042/2043

- **Capacity Shortfall:**
  - Power on Order limitations for Industrial Customers
  - No capacity for development (over 60 MW requests to date)
  - Reliability concerns from customers

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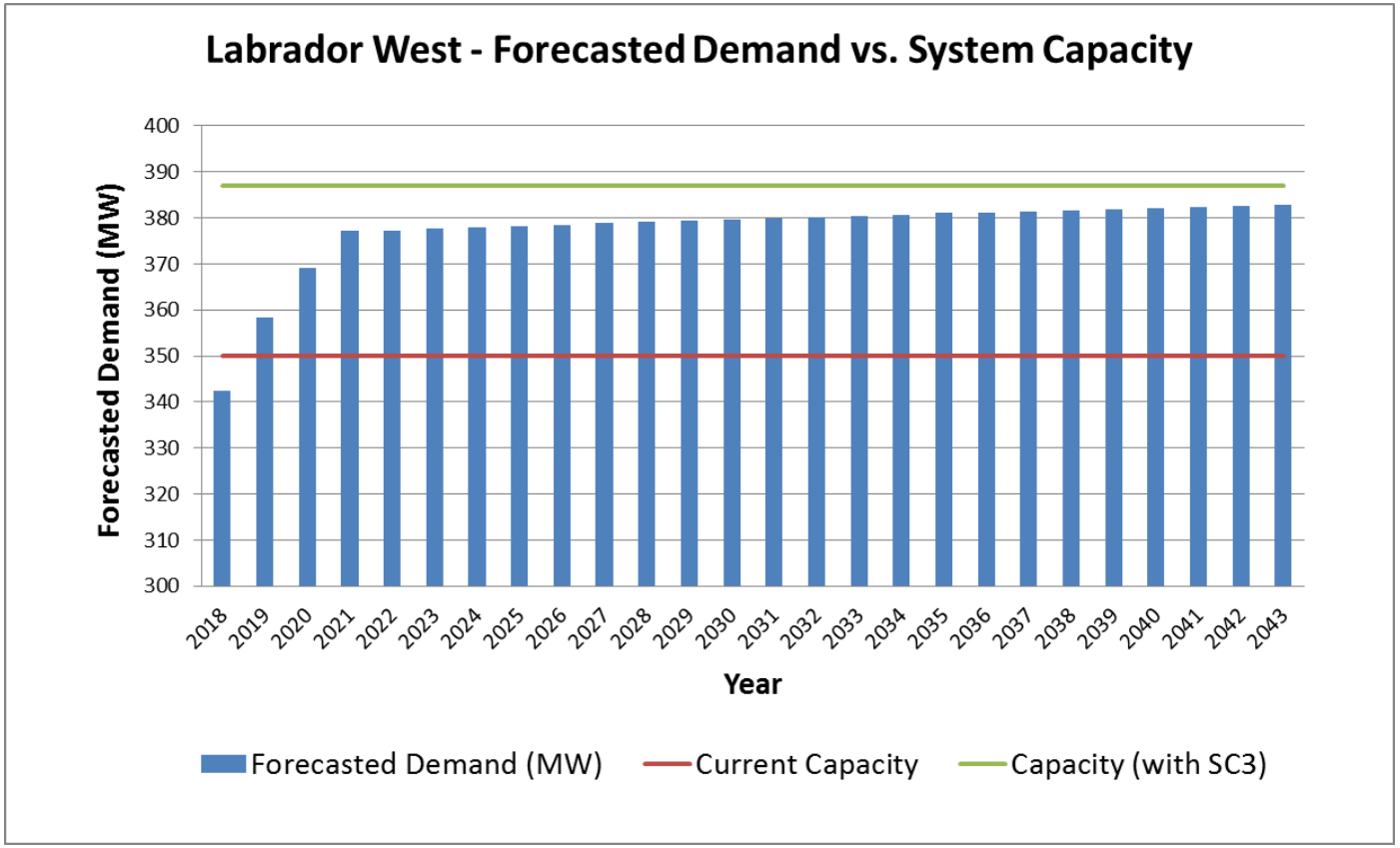
Western Labrador: Baseline Forecast



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Western Labrador: Near-Term Opportunity

- Capacity issues during the winter peak are due to voltage limitations
- Additional voltage support would increase capacity
- Solution: Synchronous Condenser #3 ("SC3")
  - Owned by IOC
  - Technical and commercial discussions underway
  - Capacity increase ~35 MW:
    - 387 MW (non-firm, all equipment in service)
    - 350 MW (loss of a synchronous condenser)
    - 277 MW (firm, loss of 230 kV transmission line)

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Western Labrador: Baseline Plan

Premise:

- Develop least-cost, reliable plan
- Target - No loss of load for either of the following:
  - Loss of a synchronous condenser
  - Loss of a capacitor bank
  - Loss of a power transformer
  - Loss of a 46 kV transmission line
- Loss of load would occur for:
  - Loss of a 230 kV transmission line

Western Labrador: Baseline Plan

The Solution - Three components:

- Wabush 230 kV terminal station upgrades
- 46 kV transmission line upgrades
- Wabush Substation upgrades

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Western Labrador: Baseline Plan

Wabush 230 kV Terminal Station Upgrades:

- IOC's SC3
- Capacitor banks
- Transformer, circuit breaker replacements

Project Details:

- Estimated project cost: $12.6 million (Excludes SC3)
- Seeking approval in 2019
- Completion by end of 2022
- Equipment brought online in stages (2020, 2021, 2022)
- Capacity Increase:
  - 421 MW (non-firm, all equipment in service)
  - 383 MW (for loss of synchronous condenser)
  - 290 MW (firm, for loss of line)

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Western Labrador: Baseline Plan

46 kV System Upgrades

- 46kV transmission line upgrades ($1.4 million)
- Wabush Substation upgrades ($8.4 million)

- Required for reliable supply to town load

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Western Labrador: Incremental Load

- There is a potential for increased load growth above the baseline forecast (data centres, Alderon)
- For incremental loads up to 50 MW above baseline:
  - Further Wabush Terminal Station upgrades
  - Thermal uprating of existing 230 kV lines
  - Project cost of $ 17 million
- For incremental loads > 50 MW above the baseline:
  - 315 kV interconnection to the Hydro-Québec network
  - Currently in discussions with Hydro-Québec
  - Project cost of $ 153 million

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Western Labrador: Other Considerations

- Interruptible agreements
  - Under investigation
  - Possible opportunities with IOC, Tacora, data centres
  - Cost to be compared against baseline plan
- Demand side management
  - Time of use rates
  - Seasonal rates

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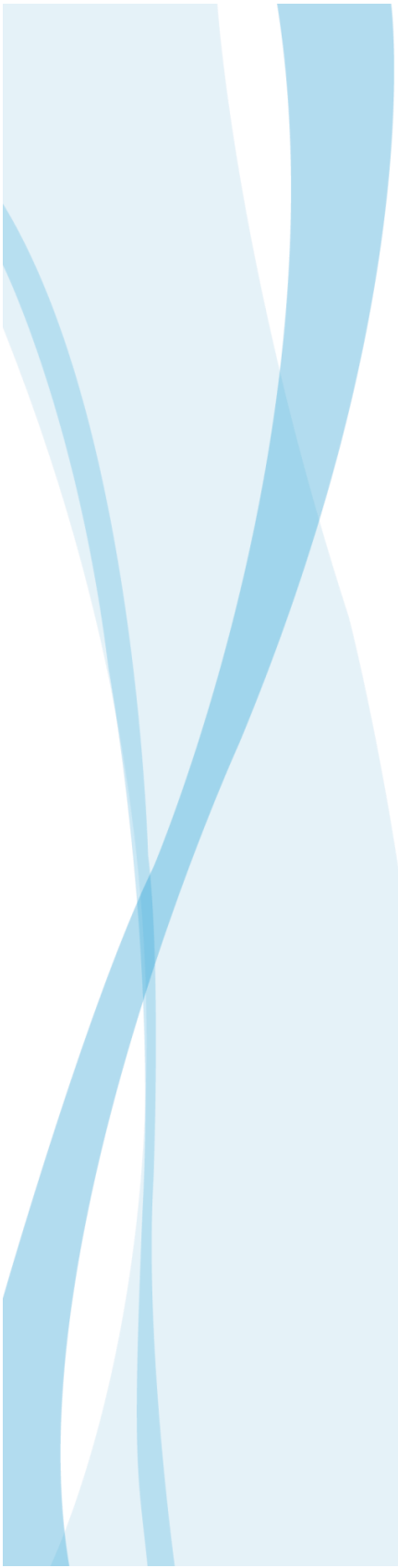
Additional Reliability Initiatives

- Under study in 2019:
  - Reconfiguration of Churchill Falls Terminal Station
    - Minimize system-wide outages due to maintenance
  - Lightning arresters on 230 kV transmission lines
  - Second 46 kV line to Wabush Substation
  - Progress interconnection discussions with Hydro-Québec



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