

Ten Year PEI Transmission Outlook - 2021

This report is a follow-up to the 10 Year PEI Transmission Outlook (2019) and 2020 Integrated System Plan, and is intended to provide an update on MECL's upcoming transmission system loading and proposed projects to Transmission Customers.

Island Load situation – 2021-2030

The increasing penetration of electric heat is leading to higher Island loads and energy usage. Most new electric heat is supplied by mini-split heat pumps, supplemented by electric resistance heating, which are used in both retrofit and new installations. Over 90% of new homes are installing electric heat exclusively.

The impact of electric vehicles will likely not be discernable until the 2025 timeframe, and large-scale integration will continue after that time. The Island load forecast over the next decade is shown below:

| Year | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 |
|----------------|------|------|------|------|------|------|------|------|------|------|------|
| Peak Load (MW) | 300 | 309 | 316 | 323 | 331 | 338 | 346 | 353 | 360 | 365 | 369 |

Methodology, Criteria and Development

The following methodology was used to develop the study cases:

- Load forecast from Transmission Customers was received;
- Base cases were developed for each year between 2021-2026, and 2030;
- High-level system studies were performed on each base case to determine if results differed from previous system studies;
- Wind and solar generation were considered over the range from zero to full output; and
- NERC Standard TPL-001-4 (Transmission System Planning Performance Requirements) was followed.

Generation is not planned per se, since generation is not dispatched under base load conditions, however generation to be used in back up or emergency situations was considered. The Island system is typically pushed hardest under peak load, no wind conditions. Solar generation is assumed to be zero at times of system peak, which occurs in winter months after sundown.

Upcoming System Issues

The following system issues were present during the high-level loadflow study and reports of system equipment. All have been seen previously in study work:

- Amount of firm load-serving capability from Sherbrooke substation (present)
- West Royalty 138/69 kV transformer overloads under single contingency (2021)
- Western PEI low voltages (2025)
- Eastern system stability at peak loads after 2026

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In addition, replacement of Y-109 and a rebuild of T-11 are required due to current equipment condition.

Firm Load

When a constraint exists on the system where load has to be curtailed, non-firm load is shed first, followed by firm (and network service, which is treated similar to long-term firm service). There is no differentiation between lengths of firm reservation when it comes to curtailment; short-term is treated the same as long-term firm.

However, firm transmission service can only be procured if there is sufficient system capacity under a single outage scenario (ie. N-1). Long-term firm service can be awarded if capacity is available for the next 10 years based on the most recent load forecast (similar to process used in New Brunswick). Long-term firm is considered to be a Transmission Customer's long-term commitment to the transmission system, and as such if system usage increases and can no longer deliver the long-term firm service, the system is upgraded in order to deliver its long-term commitments.

Short-term firm is available for shorter periods, or seasonally, but is not considered a long-term commitment to the system (based on its contract length). The system is not upgraded to meet the requests for short-term firm service. If overall system usage (ie. network or long-term firm) increases and there is less short-term firm available, then less short-term firm is awarded.

Network service is a long term commitment, and as such system planning and upgrades are done based on the load forecast so as to be able to supply the Network load.

Firm Load Availability in Western PEI

Firm service is available in Western PEI – areas currently supplied via the 138/69 kV transformers at Borden and Sherbrooke – using system resources that are currently in place according to the following:

1. There is no long-term firm available in western PEI due to 138/69 kV transformer thermal limitations at Sherbrooke and Borden.
2. The amount of short-term firm available during the winter period is limited by Sherbrooke substation transformer capacity, as follows:

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| Winter Heating Season | System Peak Load (MW) | Available Short-Term Firm Service ¹ - Existing and Planned ² Facilities (MW) |
|-----------------------|-----------------------|--|
| 2021-22 | 300 | 14 ³ |
| 2022-23 | 309 | 13 |
| 2023-24 | 316 | 11 |
| 2024-25 | 323 | - ⁴ |
| 2025-26 | 331 | - ⁵ |
| 2026-27 | 338 | - |
| 2030-31 | 365 | 18 |

During shoulder season months, there is additional short-term firm service available⁶. For example:

- a. In winter months with a 260 MW projected peak, there is 26 MW of short-term firm service available.
 - b. In summer months with a 230 MW project peak, there is 21 MW of short-term firm service available.
3. The proposed system upgrades as detailed below, in particular the O’Leary 138/69 kV transformer, will increase the amount of firm – both long- and short-term firm – available in western PEI.
 4. Generation may be available to alleviate transmission congestion. Entities may consider entering a contractual agreement with Maritime Electric for Maritime Electric to operate their generation to alleviate transmission constraints, enabling these Entities to procure additional short-term non-firm service.
 5. Additional system infrastructure will be needed post-2026 to support eastern voltages. This may include a third west to east line, a 138 kV connection from the Scotchfort area to Lorne Valley, or a synchronous condenser likely located in Charlottetown. Additional studies are required to determine the most economic solution.

¹ Indicative figures. Allows 10% overload on autotransformers at winter peaking conditions. Assumes Summerside import is at 90% power factor; firm limit will be lower if 90% power factor cannot be maintained.

² East Royalty substation project, located in Marshfield, is planned to be online by December 31, 2022, which may be after winter peak. O’Leary stepdown station planned in 2027.

³ T-1 open between Kensington and Cavendish Farms leads to West Royalty transformers over 110%, so open point on T-1 between Kensington and Cavendish Farms is not an option.

⁴ The T-1 open point has to be left between Rattenbury and Kensington to prevent eastern PEI voltage collapse for loss of Y-111, even though West Royalty X5 50 MVA transformer has been replaced with a 75 MVA transformer.

⁵ T-1 open point now between Bagnall Road and Hunter River to avoid a system collapse for loss of Y-111.

⁶ Lower off-season monthly peaks may allow the T-1 open point to be moved west, enabling additional load-serving capability through the remaining Sherbrooke transformer.

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List of Proposed Projects

The transmission system projects proposed in this document generally align with those presented in the 2020 Integrated System Plan ('ISP'), although the timing on some has changed to reflect load growth patterns:

- Line Y-119 build
- East Royalty substation (located in Marshfield)
- Line T-11 rebuild
- West Royalty Transformer replacement
- Replacement of Bedeque reactors
- West Royalty and Sherbrooke bus tie breakers
- Lines Y-101 and Y-103 rebuilds
- O'Leary 138/69 kV transformer

Discussion of Proposed Projects

Y-119 Line Build (2021)

Line Y-109 was originally scheduled to be rebuilt in 2019-2021 due to the condition of the line. It is 41 years old, and both crossarms and poles are reaching end of life. To rebuild Y-109, the Company initially considered two options:

- a) Take the line out for three months for three consecutive summers, and rebuild a portion each summer. This would mean there would be one 138 kV line feeding roughly 60 % of the Island load for three consecutive summers, which raised reliability concerns.
- b) Rebuild the line in sections over three consecutive summer construction periods using live line techniques. This would avoid the reliability issues, however the cost would be roughly 30% higher.

The proposed longer term plan in terms of west to east 138 kV transfer was as follows:

- a) Y-109 rebuild (originally planned in the 2019-2021 timeframe)
- b) Y-111 rebuild (2027-2029 timeframe, when Y-111 is 40 years old)
- c) Y-119 build (350 MW Island load; assumed synchronous condenser in place)

In looking at these options, the Company realized that building a new line along a new roadside route would cost roughly the same as Option A with fewer reliability exposures. In addition, the Company will build Y-119 in one year (2021) instead of over a three year period, primarily based upon the deteriorated condition of Y-109. The resulting west to east transfer plan is thus now as follows:

- a) Y-119 build (2021, replaces Y-109 rebuild; Y-109 taken out of service when Y-119 is complete)
- b) Y-109 rebuild (tentatively 2027-2029, complete in time for when Y-111 is taken out of service due to an expected need to be rebuilt (Y-111 was installed in 1987))

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- c) Y-111 rebuild (tentatively 350 MW Island load; sooner if no synchronous condenser in place)

East Royalty Substation (2022)

The East Royalty substation project is started and will be commissioned in 2022 to meet the growing load in northeastern Charlottetown. It will be located close to Y-104, minimizing the transmission tap length required. The East Royalty substation will not be an OATT facility.

Line T-11 (2022)

Line T-11 was originally built in the 1960s, and a short portion was rebuilt in the late 1990s. A rebuild was planned for 2024, but a recent inspection showed crossarms are severely deteriorated, requiring the rebuild to be carried out sooner. Maritime Electric is planning the rebuild with T-11 remaining energized, and required outages will be coordinated with the City of Summerside. The line will be rebuilt with 477 MCM conductor, raising its thermal limit to 80 MVA from the existing 32 MVA.

West Royalty Transformer X5 (2023)

The West Royalty 138/69 kV transformers show overloading (116%) in 2021 when the western end of line T-1 is out of service. In the short term CT3 can be dispatched to relieve the overload.

The West Royalty transformer 'X5' has a tap changer located inside the transformer tank that has been experiencing issues. The Company is proposing to upgrade this transformer to a 75 MVA unit in 2023 to provide additional transformation capacity at West Royalty in response to increasing system load, and replace a 40 year old unit which is becoming a reliability concern.

West Royalty 'X6' is proposed for replacement in 2026 for similar reasons.

Replacement of Bedeque Reactors (2023, 2024)

Reactors 1 and 2 at Bedeque are showing signs of advancing age. Reactor 1 in particular has had significant gassing issues in the past few years and has been out of service several times for emergency inspections. Reliability is an increasing concern. Reactor 1 was installed in 1977 when Cables 1 and 2 were originally installed, and has reached the end of its useful life. Reactor 2 was installed in 1991 and is also having gassing issues. Loss of a reactor may lead to a forced outage on a cable, or limitations in returning cable(s) to service, depending on the season. Reactors 1 and 2 will be replaced in 2023 and 2024 respectively, and the replacement units will likely have similar ratings to the original units.

138 kV Bus Tie Breakers at West Royalty (2024) and Sherbrooke (2025)

Maritime Electric is proposing to add bus tie breakers at both West Royalty and Sherbrooke substations. The purpose of bus tie breakers is to allow sections of the 138 kV bus to be easily taken out of service for maintenance. In addition, a transformer forced outage will not remove the entire 138 kV bus from service, but only that section of bus out which is connected to the transformer. This will improve reliability for all customers connected downstream of the 138 kV buses.

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Rebuild of lines Y-101 and Y-103 (2026+)

Lines Y-101 and Y-103 were constructed in 1977 and are showing signs of advancing age. Rebuilding of these lines is scheduled to begin in 2026, and may be undertaken in a staged approach over several years.

O'Leary Stepdown Transformer (2027)

The O'Leary stepdown transformer is being planned in 2027 to provide additional reliability to western PEI customers. The entire region is currently supplied by a 69 kV line, and a 138/69 kV transformer will be placed near O'Leary, connecting the 69 kV system to Y115 (138 kV). This will allow maintenance to occur on the 69 kV system without the need to disconnect all downstream customers.

A second benefit of this project is that the new transformer will offload the Sherbrooke and Borden 138/69 kV transformers, enabling more firm service in the region beginning in 2027.

Other Transmission Projects

Other transmission facility rebuilds may be necessary in the upcoming decade, depending on results of field inspections, including:

- Lines T-15 and T-1, which may need partial or complete refurbishment
- Charlottetown Substation, which will reach end of life around 2030 and will require rebuilding

In addition, other projects may be required to meet growing system load, including substations in the Tignish, Mt. Pleasant and Stratford areas. Transmission solutions will be proposed if they are economically and technically superior to distribution solutions.

Future System Studies

The next 10 Year PEI Transmission Outlook will be completed in 2022. The next Integrated System Plan is expected in the 2023-25 timeframe.