# Interconnection Feasibility Study Report
# GIP-IR785-FEAS-R0

## Generator Interconnection Request 785
## 223.2 MW Wind Generating Facility
## Riversdale, Colchester County, NS

November 22, 2024

Control Centre Operations
Nova Scotia Power Inc.

# Executive Summary

The Interconnection Customer (IC) submitted a Network Resource Interconnection Service (NRIS) and Energy Resource Interconnection Service (ERIS) Interconnection Request, referred to as IR785, for a proposed 223.2 MW wind generation facility interconnected to the NSPI Transmission System, with a Commercial Operation Date of 01/12/2026. The Point of Interconnection (POI) requested by the customer was L-7005. Due to the interconnection of higher queued project IR670, L-7005 will be sectionalized into two parts: L-7005 and L-7027, with IR785's POI being L-7027.

There are nineteen transmission Interconnection Requests in the Advanced Stage Transmission and Distribution Queue ahead of IR785 that must be included in the study models for IR785.

In addition, there is a long-term firm Transmission Service Reservation *(TSR)* that must be accounted for: 550 MW from New Brunswick to Nova Scotia *(TSR411)*. TSR411 is a long-term firm point-to-point Transmission Service Reservation and a Facilities Study is currently underway to determine the associated upgrades to the Nova Scotia transmission system. These upgrades are expected to materially alter the configuration of the transmission system in Nova Scotia. As a result, the following notice was posted to the OASIS site at https://www.nspower.ca/oasis/generation-interconnection-procedures:

> *Due to ongoing development discussions and engineering studies, the Transmission System Network Upgrades identified as part of Transmission Service Request #411 will not be included in the System Impact Study (SIS) Analysis for Generator Interconnection Procedures (GIP) Study Groups #32 to #35. GIP Study Group #32 to #35 analysis will be limited to the 2024 Transmission System configuration plus any material Network Upgrades identified in higher queued projects.*

This study assumes that the addition of generation from IR#785 will displace coal-fired generation in eastern Nova Scotia for both NRIS and ERIS.

A few post-contingency thermal loading violations occur due to IR#785 on transmission line L-7027. The following upgrades are proposed if RAS modifications are possible:

- Modifications to Limited Impact RAS (Group 3)
- Modifications to Type 1 RAS (Group 5 & 6)

If RAS modifications are not possible then the following upgrades are proposed:

- Uprate of 6.5 km of L-7005 from 444 MVA (Summer) to 464 MVA (Summer)
  (75° C to 80 ° C Maximum operating temperature)
- Uprate of 3.2 km of L-6515-1 from 157 MVA (Winter) to 166 MVA (Winter).
  (65° C to 70 ° C Maximum operating temperature)

The minimum short circuit level at the Interconnection Facility 34.5kV bus is 888 MVA with all lines in service and IR#785 off-line, resulting in a Short Circuit Ratio (SCR) of 4.0. The minimum short circuit level is 376 MVA with L-7005 (67N substation to IR670 Three Circuit Breaker Ring Bus station) open, resulting in a SCR of 1.7. These conditions must be discussed with the wind turbine manufacturer to determine if the equipment can operate, or if modifications are required.

Data provided by the IC indicates that IR785 will be utilizing the V 162, 6.2 Mk1 Vestas wind turbine generators (WTG). Based on supplied interconnection data and assumptions, IR785 meets the net power factor requirement of +/- 0.95 at the high voltage side of Interconnection Facility. The adequacy of reactive power supply will be further investigated in the System Impact Study as specific details of the collector circuits become available.

NS Power notes that NERC standard PRC-029-1 is currently in development. As proposed, this standard will impose performance requirements for voltage and frequency ride through behaviour on inverter-based generating resources. It is anticipated that this standard will be applicable to the project currently under study. The Interconnection Customer is advised to consider the requirements of PRC-029-1 in their project design to ensure that their project can conform to these requirements. Conformance will be validated at the System Impact Study stage.

To connect IR785 as NRIS with RAS modifications, the preliminary non-binding cost estimate for interconnecting 223.2 MW to NSPI's transmission system is $27,375,000, including a 25% contingency.

In this estimate, $12,375,000 (including 25% contingency) of the amount represents Network Upgrade costs which are funded by the Interconnection Customer, but which are eligible for refund under the terms of section 11.4 of the *Standard Generator Interconnection and Operating Agreement* (*GIA*). The remainder of the costs are fully funded by the Interconnection Customer.

The preliminary cost estimate does not include any supplemental reactive power devices that are potentially required to meet the NSPI power factor and/or inertia requirements. It also does not include costs to address any potential stability issues identified at the SIS stage based on dynamic analysis, or costs related to findings of the electromagnetic transient (EMT) analysis.

It is anticipated that additional equipment, such as a synchronous condenser, will be required to meet the inertia requirements stated in section 7.6.7 of the TSIR and posted on the OASIS site. Any costs associated with such equipment are the responsibility of the Interconnection Customer. The Interconnection Customer must indicate as part of their design submitted at the SIS stage how they intend to meet the inertia requirement.

The estimated time to construct the Transmission Providers Interconnection Facilities and Network Upgrades is 24-36 months after receipt of funds and cleared right of way from the customer. These estimates will be further refined in the System Impact Study and the Facilities Study.

# 1 Introduction

The Interconnection Customer (IC) submitted a Network Resource Interconnection Service (NRIS) and Energy Resource Interconnection Service (ERIS) Interconnection Request for a proposed 223.2 MW wind generation facility interconnected to the NSPI transmission system, with a Commercial Operation Date of 01/12/2026. The Point of Interconnection (POI) requested by the customer was at L-7005, approximately 34.6 km from the 67N substation. Due to IR670, L-7005 will be sectionalized making IR785's POI L-7027.

The IC signed a Feasibility Study Agreement to study the connection of their proposed generating facility to the NSPI transmission system dated 07/15/2024, and this report is the result of that Study Agreement. This project is listed as Interconnection Request 785 in the NSPI Interconnection Request Queue and will be referred to as IR785 throughout this report.

Figure 1 shows the proposed geographic location of IR785 in relation to the NSPI transmission system.

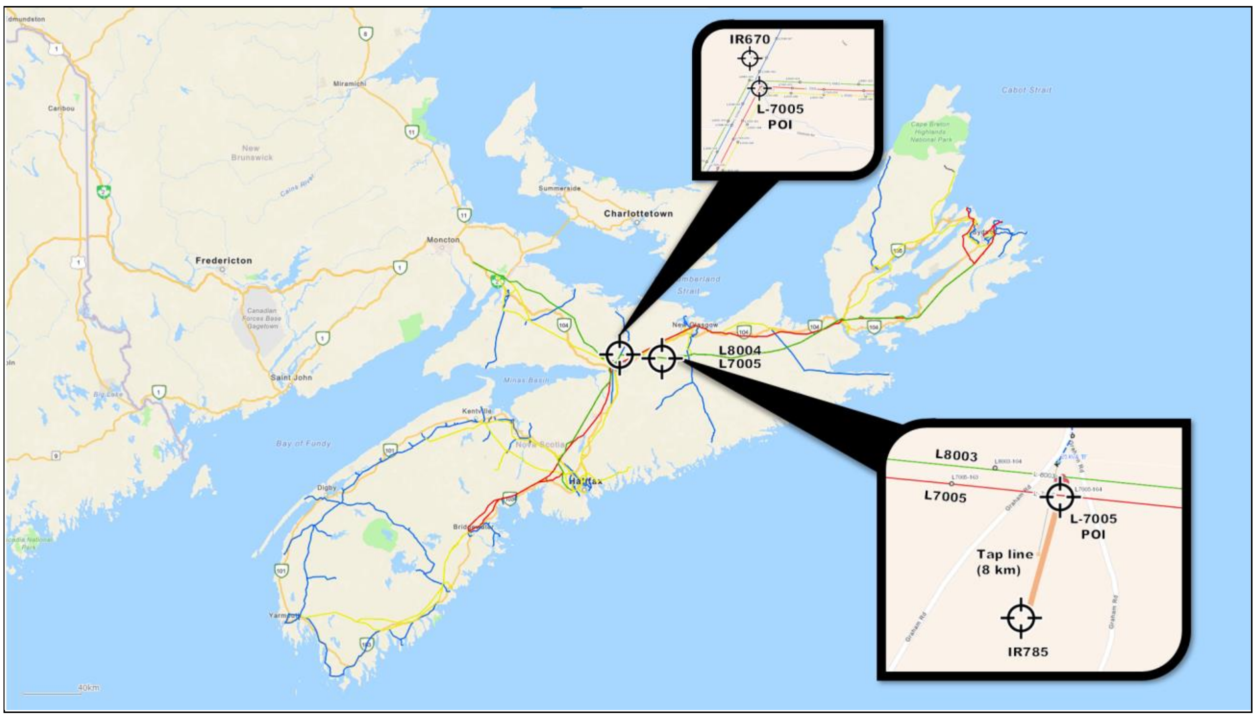



*Figure 1: IR785 Site Location*

Figure 2 shows a not to scale simplified one-line diagram of the transmission system configuration in NS.

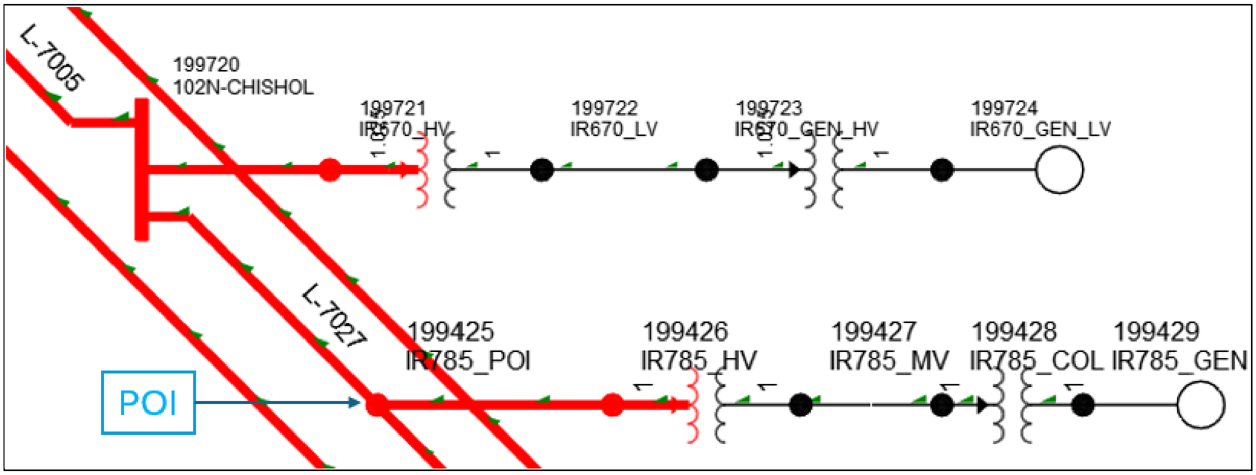



*Figure 2: IR785 POI*

# 2 Scope

The objective of this Interconnection Feasibility Study (FEAS) is to provide a preliminary evaluation of system impacts from interconnecting the proposed generation facility to the NSPI transmission system at the requested location. The assessment will identify potential impacts on transmission element loading, which must remain within their thermal limits. Any potential violations of voltage criteria will be identified and addressed. If the proposed generation increases the short-circuit duty of any existing circuit breakers beyond their rated capacity, the circuit breakers must be upgraded. Single contingency criteria are applied.

The scope of the FEAS includes the modelling of the power system in normal state (*with all transmission elements in service*) under anticipated load and generation dispatch conditions. A power flow and short circuit analysis will be performed to provide the following information:

- Preliminary identification of any circuit breaker short circuit capability limits exceeded as a result of the interconnection, and any network upgrades necessary to address identified short circuit issues associated with IR785. Expected minimum short circuit capability will also be identified for the purpose of Short Circuit Ratio analysis.

- Preliminary identification of any thermal overload or voltage limit violations resulting from the interconnection and identification of the necessary network upgrades to allow full output of the proposed facility. Thermal limits are applied to the seasonal (*summer/winter*) emergency ratings of the transmission elements. Voltage violations occur when the post-contingency transmission bus voltage is outside the range of +/-10% of the nominal voltage.

- Preliminary analysis of the ability of the proposed Interconnection Facility to meet the reactive power, power quality and cold-weather capability requirements of the NSPI *Transmission System Interconnection Requirements* (TSIR)

- Preliminary description and high-level non-binding estimated cost and time to construct the facilities required to interconnect the generating facility to the transmission system.

- For comparative purposes, the impact of IR785 on incremental system losses under standardized operating conditions is examined.

This FEAS is based on a power flow and short circuit analysis and does not include a complete determination of facility changes/additions required to increase the system transfer capabilities that may be required to meet the design and operating criteria established by NSPI, the Northeast Power Coordinating Council (NPCC), and the North American Electric Reliability Corporation (NERC). These requirements will be determined by a more detailed analysis in the subsequent interconnection System Impact Study (SIS). An Interconnection Facilities Study (FAC) follows the SIS to ascertain the final cost estimate to the interconnect the generating facility.

# 3 Assumptions

This FEAS is based on the technical information provided by the Interconnection Customer. The Point of Interconnection (*POI*) and configuration are studied as follows:

1. NRIS and ERIS per section 3.2 of the Generation Interconnection Procedure (GIP).

2. Commercial operation date: 01/12/2026.

3. The Interconnection Customer Interconnection Facility (*ICIF*) consists of 36 x V162, 6.2 Mk1 Vestas WTG each rated at 6.2 MW for a total of 223.2 MW connected to 4 collector circuits operating at a voltage of 34.5 kV.

4. The POI at L-7027 is categorized as a Bulk Power System (BPS) and Bulk Electric System (BES) and will therefore require interconnection via a three-breaker ring bus with protection and full compliance with NPCC/NERC criteria and standards, in accordance with Table 8 of the TSIR.

5. The ICIF will require the construction of an approximately 8 km, 230 kV transmission spur line from the POI to the IC 230 kV/34.5 kV transformers. The IC will be responsible for providing the Right-of-Way for the lines.

6. The generation technology used must meet NSPI requirements for reactive power capability of at least 0.95 capacitive to 0.95 inductive at the HV terminals of the IC substation step up transformer. It is also required to have high-speed Automatic Voltage Regulation to maintain

constant voltage at the designated voltage control point during and following system disturbances as determined in the subsequent System Impact Study. The designated voltage control point will either be the low voltage terminals of the wind farm transformer, or if the high voltage terminals are used, equipped with droop compensation controls. It is assumed that the generating units are not de-rated in their MW capability when delivering the required reactive power to the system.

7. Preliminary data was provided by the IC for the substation transformer. The substation transformer is rated at 180/240/300 MVA and modeled with a positive-sequence impedance of 10% on 180 MVA, Wye-Delta-Wye Ground winding configuration with +/-10% on-load tap changer. The transformer was modeled with an assumed X/R ratio of 42.

8. Preliminary data was provided by the IC for the generator step-up (GSU) transformers. Each GSU transformer is rated at 7.5 MVA with an impedance of 7.75%, Delta-Wye Ground winding configuration.

9. Detailed collector circuit data was not provided, so typical data (R+jX = 0.01+j0.04 pu, with B = 0.099 pu charging susceptance on system base 100 MVA) was assumed with the understanding that the net real and reactive power output of the plant will be impacted by losses through transformers and collector circuits.

10. Generation Interconnection Queue and OATT Transmission Service Queue requests that have completed a System Impact Study, or that have a System Impact Study in progress, are assumed to proceed as listed in Section 4 below.

11. It is required that the wind turbines are equipped with a "cold weather option" suitable for delivering full power under expected Nova Scotia winter environmental conditions according to section 7.6.9 of the TSIR.

12. Planning criteria meeting NERC Standard TPL-001-5 Transmission System Planning Performance Requirements and NPCC Directory 1 Design and Operation of the Bulk Power System as approved for use in Nova Scotia by the Utility and Review Board, are used in evaluation of the impact of any facility on the Bulk Electric System.

13. Transmission line ratings used in this study are listed in Appendix A: Transmission line ratings.

# 4 Projects with Higher Queue Positions

All in-service generation is included in the FEAS, except for Lingan Unit 2, which is assumed to be retired.

As of September 18th, 2024, the following projects are higher queued in the Advanced Stage Interconnection Request Queue and are committed to the study base cases:

- IR516: GIA Executed
- IR542: GIA Executed
- IR574: GIA Executed
- IR598: GIA Executed
- IR597: GIA Executed
- IR664: GIA Executed
- IR662: GIA Executed
- IR670: FAC Complete
- IR671: FAC in Progress
- IR669: GIA Executed
- IR668: GIA Executed
- IR618: GIA Executed
- IR673: GIA Executed
- IR675: FAC Complete
- IR677: FAC Complete
- IR697: SIS in Progress
- IR686: SIS in Progress
- IR739: SIS in Progress
- IR742: SIS in Progress

The power system base cases for the feasibility study includes all transmission connected IRs in the GIP queue up to IR742 with the exceptions of IR697, IR686 and IR739 as their SIS were not sufficiently advanced when IR785 was initiated.

In addition, TSR-411 is included in the queue, which reflects the study of long-term firm Transmission Service Reservation (TSR) from New Brunswick to Nova Scotia. If approved by the NSUARB, the TSR is expected to be in service in 2028 and a system study is currently underway to determine the required upgrades to the Nova Scotia transmission system. This has not been included in the feasibility study and the following notice is posted to the OASIS site:

> *Due to ongoing development discussions and engineering studies, the Transmission System Network Upgrades identified as part of Transmission Service Request #411 will not be included in the System Impact Study (SIS) Analysis for Generator Interconnection Procedures (GIP) Study Groups #32 to #35. GIP Study Group #32 to #35 analysis will be limited to the 2024 Transmission System configuration plus any material Network Upgrades identified in higher queued projects.*

# 5 Short-Circuit Duty / Short Circuit Ratio

The NS Power design criteria for maximum system fault capability (3-phase, symmetrical) is 5,000 MVA (21 kA) on 138 kV systems and 10,000 MVA (25 kA) on 230 kV systems.

The fault current characteristic for this V162, 6.2 Mk1 Vestas WTG is given as 1.07 times rated current, or X'd = 0.935 per unit on machine base MVA.

Short circuit analysis was performed using PSS®E for a classical fault study, 3LG and flat voltage profile at 1.0 p.u. The short-circuit levels in the area before and after this development are provided below in Table 1.

*Table 1: Short-Circuit Levels (Classical fault study, flat voltage profile)*

| Location | IR785 not in service | IR785 in service | Post MVA increase | Post % Increase | Short Circuit Ratio (SCR) Without IR785 |
|---|---|---|---|---|---|
| **Max generation, all facilities in service (MVA)** | | | | | |
| IR785_POI (230kV) | 4,309 | 4,507 | 198 | 5% | 19.3 |
| IR785_MV (34.5 kV) | 1269 | 1,492 | 223 | 18% | 5.7 |
| **Min generation, all facilities in service (MVA)** | | | | | |
| IR785_POI (230kV) | 1,784 | 1982 | 198 | 11% | 8.0 |
| IR785_MV (34.5 kV) | 888 | 1111 | 223 | 25% | 4.0 |
| **Min generation, L-7005 Out of Service (MVA)** | | | | | |
| IR785_POI (230kV) | 478 | 676 | 198 | 41% | 2.1 |
| IR785_MV (34.5 kV) | 376 | 599 | 223 | 59% | 1.7 |

Inverter-based generation installations often have a minimum Short Circuit Ratio (SCR) for proper operation of converters and control circuits. The technical data received from the Interconnection Customer requires a SCR of at least 5.0 at the high voltage terminals of the WECS (wind energy conversion systems) transformer. The available SCR ranges from 5.7 at the 34.5kV substation bus at maximum generation with all elements in service, down to 4.0 at the 34.5kV substation bus at minimum generation with all elements in service MV. This further falls to 1.7 with L-7005 (67N-Onslow to IR670 POI) out of service under minimum generation conditions. More detailed EMT analysis is required if IR785 proceeds to the SIS stage.

The IC should consult the wind turbine manufacturers to determine if the equipment can operate or if any modifications for lower SCR conditions are required. The impact of the low SCR will be further examined when detailed data for the machine is made available for the SIS.

Note that Section 7.4.15 of NSPI's TSIR states:

*System short circuit level may decline over time with changes to transmission configuration and generation mix. The Generating Facility shall be able to accommodate these changes.*

# 6 Voltage Flicker and Harmonics

Voltage flicker will be examined when data is made available for the SIS.
NSPI’s voltage flicker requirements are:

- (Short term flicker severity) $P_{st} \leq 0.35$
- (Long-term flicker severity) $P_{lt} \leq 0.25$

The generator must meet *IEEE Standard 519-2014 Voltage distortion limits* for all frequencies or Total Harmonic Distortion (THD) to no higher than 1.5% with no individual harmonic exceeding 1.0% on 230 kV.

# 7 Load Flow Analysis

The load flow analysis was completed for Spring Minimum Load (SML), Summer Shoulder Load (SSH), Summer Peak Load (SUM) and Winter Peak Load (WIN) Scenarios with varying dispatch cases intended to cover a broad range of operating conditions. Two scenarios were examined for each case:

- Pre-IR785 cases ending with "-A": IR785 off.
- Post-IR785 cases ending with "-B": IR785 dispatched at 223.2 MW under NRIS designation.

Table 2 includes the list of cases considered, along with a brief description.

*Table 2: Case Scenario Details*

| Case Name | Description |
|---|---|
| SML_00 | Case under normal conditions |
| SML_01 | Case with nearby generation on max output |
| SSH_00 | Case under normal conditions |
| SSH_01 | Case with nearby generation on max output |
| SUM_00 | Case under normal conditions |
| SUM_01 | Case with nearby generation on max output |
| WIN_00 | Case under normal conditions |
| WIN_01 | Case with nearby generation on max output |

Figure 3 shows the relevant corridors on the NSPI transmission system. The arrow by each corridor shows the power flow direction of positive values.

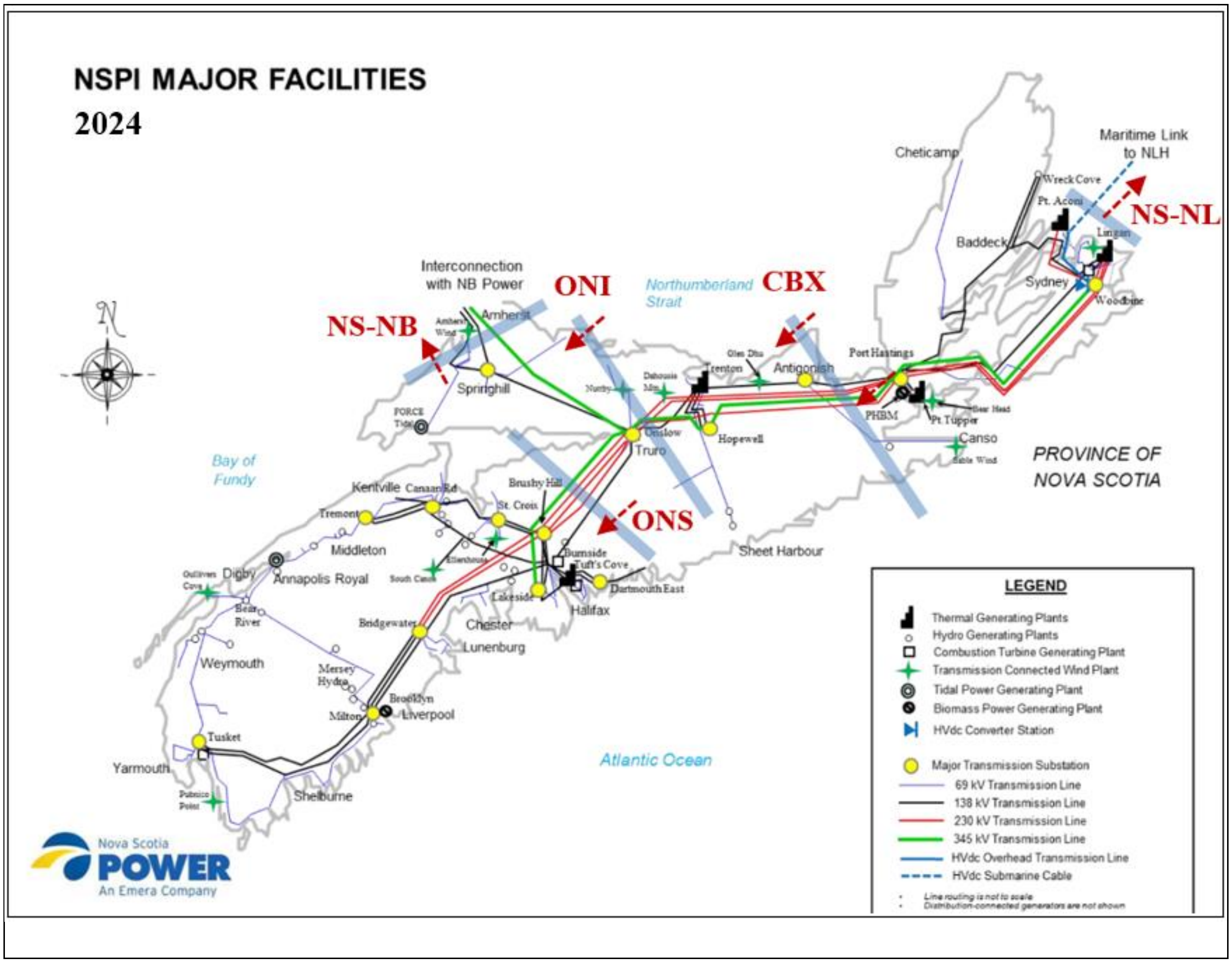



*Figure 3: Relevant Transmission Interface*

*Table 3: Dispatch Cases for IR785*

| Case | IR785 Output (MW) | System Load (MW) | NL→NS (MW) | NS→NB (MW) | ONI (MW) | CBX (MW) | ONS (MW) |
|---|---|---|---|---|---|---|---|
| SML_00-A | 0 | 722 | 170 | 152 | 68.6 | 40 | -95 |
| SML_00-B | 223.2 | 716 | 170 | 152 | -197 | -52 | 34 |
| SML_01-A | 0 | 1060 | 170 | 470 | 391 | 40 | -95 |
| SML_01-B | 223.2 | 1053 | 170 | 470 | 520 | -52 | 35 |
| SSH_00-A | 0 | 1195 | 330 | 152 | 370 | 292 | 164 |
| SSH_00-B | 223.2 | 1170 | 330 | 152 | 370 | 116 | 164 |
| SSH_01-A | 0 | 1534 | 330 | 469 | 689 | 292 | 164 |
| SSH_01-B | 223.2 | 1507 | 330 | 469 | 690 | 117 | 164 |
| SUM_00-A | 0 | 1528 | 330 | 150 | 616 | 509 | 383 |
| SUM_00-B | 223.2 | 1497 | 330 | 150 | 616 | 282 | 383 |
| SUM_01-A | 0 | 1866 | 330 | 463 | 933 | 510 | 383 |
| SUM_01-B | 223.2 | 1833 | 330 | 463 | 933 | 281 | 383 |
| WIN_00-A | 0 | 2296 | 170 | 0 | 930 | 738 | 763 |
| WIN_00-B | 223.2 | 2282 | 170 | 0 | 930 | 661 | 763 |
| WIN_01-A | 0 | 2634 | 170 | 311 | 1243 | 739 | 764 |
| WIN_01-B | 223.2 | 2619 | 170 | 311 | 1243 | 661 | 764 |

Single contingencies were applied at the 345 kV, 230 kV, 138 kV, and 69 kV voltage levels for the above system conditions with and without IR785. Automated analysis searched for violations of emergency thermal ratings and emergency voltage limit for each contingency. Contingencies studied are listed in Table 4.

*Table 4: Contingencies List*

| Contingencies Studied | | | | |
|---|---|---|---|---|
| 88S_L-7014 | 67N-705 | 103H_L-6038 | 20V-T1 | 5S_L-6549 |
| 88S_L-7021 | 67N-706 | 103H-T81 | 20V-503 | 3S_L-6539 |
| 88S_L-7022 | 67N-710 | 103H-T61 | 20V-504 | 3S_bus |
| 88S-710 | 67N-712 | 103H-T63 | 20V-401 | 5S_L-6537 |
| 88S-711 | 67N-713 | 103H-B61 | 102V-L5060 | 2S_L-6516 |
| 88S-712 | 1N_L-6613 | 103H-B62 | 102V-T51 | 5S-606 |
| 88S-713 | 1N_L-6503 | 103H-881 | 102V-GT1 | 5S-607 |
| 88S-714 | 1N_L-6001 | 103H-600 | 17V-L6051 | 2S-513 |
| 88S-715 | 1N-T1 | 103H-608 | 17V-L6011 | 1C-G2 |
| 88S-720 | 1N-T4 | 103H-681 | 17V-L5014 | 48C-G1 |
| 88S-721 | 1N-T65 | 89S-G1 | 17V-L4046 | 50N-G5 |

| | | | | |
|---|---|---|---|---|
| 88S-722 | 1N-C61 | 91H_L-5049 | 17V-L4045 | 50N-G6 |
| 88S-723_G0 | 1N-B61 | 91H_L-5012 | 17V-SHUNT | 50N-L-6511 |
| 88S-723_G8 | 1N-B62 | 91H_L-5041 | 17V-T2 | 91H-G3 |
| 88S-T71 | 1N-600 | 91H-T62 | 17V-T63 | 91H-G4 |
| 88S-T72 | 1N-601 | 91H-T11 | 17V-T1 | 91H-G5 |
| 88S-G2 | 1N-613 | 91H-511 | 17V-612 | 91H-G6 |
| 88S-G3 | 50N-l5500 | 91H-516 | 17V-611 | 104W-G1 |
| 88S-G4 | 50N-l5501 | 91H-521 | 17V-563 | 110W-T62 |
| 101S_ML-POLE1 | 50N-l5502 | 91H-523 | 17V-512 | 104H-600 |
| 101S_ML-POLE2 | 50N-l6503 | 91H-621 | 17V-519 | 50W, 50W-B3_OL |
| 101S_ML-BIPOLE | 50N-l6511 | 91H_L-6042 | 17V-505 | 50W, 50W-615_OL |
| 101S-T81 | 50N-l6507 | 91H-613 | 101V-L6004-a | 9W, 9W-T2_OL |
| 101S-T82 | 50N-l6508 | 91H-604 | 101V-L6053 | 50W, 50W-B3 |
| 101S_L-7011 | 50N-GT6 | 91H_L-6007 | 101V-601 | 50W, 50W-615 |
| 101S_L-7011_G1 | 50N-GT5 | 91H-605 | 101V-602 | 9W, 9W-T2 |
| 101S_L-7012 | 50N-T12 | 91H-606 | 101V-603 | 67N-811_G0 |
| 101S_L-7012_G2 | 50N-T8 | 91H-607 | IR379-GT | 79N_L-8003_G0 |
| 101S_L-7015 | 50N-LOAD1 | 91H_L-6014 | IR372-GT | 67N-811_G5 |
| 101S-701 | 50N-LOAD2 | 91H-608 | IR379-TX | 79N_L-8003_G5 |
| 101S-702 | 50N-614 | 91H-609 | IR372-TX | 79N_L-8003_G6 |
| 101S-703 | 50N-607 | 91H-611 | 110W-661 | 67N-811_G6 |
| 101S-704 | 50N-604 | 91N-701 | 13V L-5531 | 67N_L-8001_NSX1 |
| 101S-705 | 50N-513 | 91N-702 | 13V L-5532 | 67N-814_NSX1 |
| 101S-706 | 50N-508 | 91N-703 | 13V 13V-B51 | 67N_L-8001_NSX2 |
| 101S-711 | 50N-500 | 91N-B71 | 13V L-5533 | 67N-814_NSX2 |
| 101S-712 | 120H_L-7008 | 99W-708 | 51V 51V-B61 | 67N_L-8001_NSI |
| 101S-713 | 120H_L-7009 | 99W-709 | 51V-601 | 67N-814_NSI |
| 101S-811 | 120H_L-6005 | 99W-T71 | 51V-T62 | 67N_L-8001_G0 |
| 101S-814 | 120H_L-6010 | 99W-T72 | 51V 51V-B52 | 67N-814_G0 |
| 101S-816 | 120H_L-6011 | 99W-L5545-a | 51V 51V-T61 | DCT_L-7003][L-7004_G3 |
| 3C_L-7003 | 120H Open L-6051 | 99W-L5546 | 51V 51V-T61_OL | 67N-711_G3 |
| 3C_L-7004 | 120H L-6051 | 99W-L6531 | 51V-L5053 | 3C_L-7005_G3 |
| 3C-T71 | 120H_L-6016 | 99W-L6006 | 9W, L-5535 | 3C-710_G3 |
| 3C-T72 | 120H-T71 | 99W-L6025 | 9W 9W-B53 | 3C-720_G3 |
| 3C-711 | 120H-T72 | 99W-L6002 | 9W 9W-B52 | DCT_L-7003][L-7004_G0 |
| 3C-712 | 120H-SVC | 99W-L7009 | 9W L-5027 | 67N-711_G0 |
| 3C-713 | 120H_L-7018 | 99W-L7008 | 30W 30W-T62 | 3C_L-7005_G0 |
| 3C-714 | 120H-710 | 99W-601 | 30W 30W-B51 | 3C-710_G0 |
| 3C-715 | 120H-711 | 99W-601-IR664 | 50W L-6020 | 3C-720_G0 |

| | | | | |
|---|---|---|---|---|
| 3C-716 | 120H-712 | 99W-T62 | 50W L-6024 | 79N-T81_G0 |
| 2C_L-6515 | 120H-713 | 99W-602 | 50W L-6048 | 101S_L-8004_G0 |
| 2C_L-6516 | 120H-714 | 99W-602-IR664 | 50W 50W-B4 | 101S-812_G0 |
| 2C_L-6517 | 120H-715 | 99W-T61 | 50W L-5541 | 101S-813_G0 |
| 2C_L-6518 | 120H-716 | 99W-T61-IR664 | 50W L-5530 | 79N-T81_G5 |
| 2C_L-6523 | 120H-720 | 99W-T62-IR664 | 50W L-5539 | 101S_L-8004_G5 |
| 2C_L-6537 | 120H-621 | 99W-SHUNT | 50W 50W-B2 | 101S-812_G5 |
| 2C_B61 | 120H-622 | 99W-545 | 50W IR597 | 101S-813_G5 |
| 2C_B61_SPS | 120H-623 | 99W-501 | 50W 50W-T53 | 79N-T81_G6 |
| 2C_B62 | 120H-624 | 99W-562 | 50W L-5540 | 101S_L-8004_G6 |
| 2C_L-6537_SPS | 120H-625 | 3W-B53 | 113H-601 | 101S-812_G6 |
| 2C_B62_SPS | 120H-626 | 3V-L4049 | 113H-L6043 | 101S-813_G6 |
| 47C_B1 | 120H-627 | 3V-L5035 | 132H-602 | DCT_L-7003][L-7004_G3 |
| 47C_B2 | 120H-628 | 3V-G1 | 132H-603 | 67N-711_G3 |
| 47C_B3 | 120H-629 | 3V-G2 | 132H-605 | 3C_L-7005_G3 |
| 47C_B4 | 90H-L6002-1 | 22V-L5033 | 132H-606 | 3C-710_G3 |
| 47C_B5 | 90H-L6009-2 | 43V-L6012 | 132H-L6044 | 3C-720_G3 |
| 47C_B6 | 90H-L-6008 | 43V-L6013 | 132H-L6040 | DCT_L-7003][L-7004_G0 |
| 47C_B7 | 90H-L6003 | 43V-L6054 | 132H-L6055 | 67N-711_G0 |
| 4C_L-6552 | 90H-L5003-2 | 43V-L6015 | 1H-603 | 3C_L-7005_G0 |
| 4C_T63 | 90H-L5004-1 | 43V-50VLoad | 1H-L-6035 | 3C-710_G0 |
| 4C_T2 | 90H-T1 | 43V-L6052 | 74N-600 | 3C-720_G0 |
| 4C_620 | 90H-C61 | 43V-L5017 | 74N-L6536 | 51V, L-5025_SPS |
| 4C_621 | 90H-C51 | 43V-L5022 | 74N-L6514 | 13V, L-5026_SPS |
| 4C_622 | 90H-611 | 43V-L5021 | 74N-L5029 | 11V, 11V-B51_SPS |
| 4C_623 | 90H-608 | 43V-T62 | 74N-L5058 | 51V, 51V-B51_SPS |
| 79N_L-6507 | 90H-605 | 43V-604 | 15V-B51 | 51V, L-5025 |
| 79N_L-6508 | 90H-602 | 43V-T61 | 15V-L5050 | 13V, L-5026 |
| 67N_L-8002 | 90H-612 | 43V-B61 | 15V-L5538 | 11V, 11V-B51 |
| 67N_L-7019 | 90H-609 | 43V-B62 | 92V-B51 | 51V, 51V-B51 |
| 67N_L-7001 | 90H-606 | 43V-SHUNT | DCT_L-5039][L-6033 | |
| 67N_L-7002 | 90H-603 | 43V-B51 | DCT_L-7009][L-8002 | |
| 67N-T81 | 90H-610 | 43V-505 | DCT_L-6011][L-6010 | |
| 67N-T82 | 90H-607 | 43V-562 | DCT_L-6010][L-6005 | |
| 67N-T71 | 90H-604 | 43V-503 | DCT_L-6005][L-6016 | |
| 67N-812 | 90H-601 | 43V-506 | DCT_L-7008][L-7009 | |
| 67N-813 | 90H-503 | 41V-L4048 | DCT_L-6507][L-6508 | |
| 67N-701 | 90H-506 | 41V-L4047 | DCT_L-7021][L-6534 | |
| 67N-702 | 90H-501 | 41V-407 | DCT_L-6033][L-6035 | |

| | | | |
|---|---|---|---|
| 67N-703 | 103H_L-6008 | 79V-L5015 | 85S_L-6545 |
| 67N-704 | 103H_L-6033 | 79V-L5016 | 5S_L-6538 |
| IR785-B | IR670-B | IR618-B | IR668-B |

# 8 Overload Results

## 8.1 NRIS

Table 5 below shows the contingencies that cause overloads due to IR785. Note that Rate 2 is the 15-minute emergency rating of a transmission line and is equal to 110% of the line MVA rating.

*Table 5: Results*

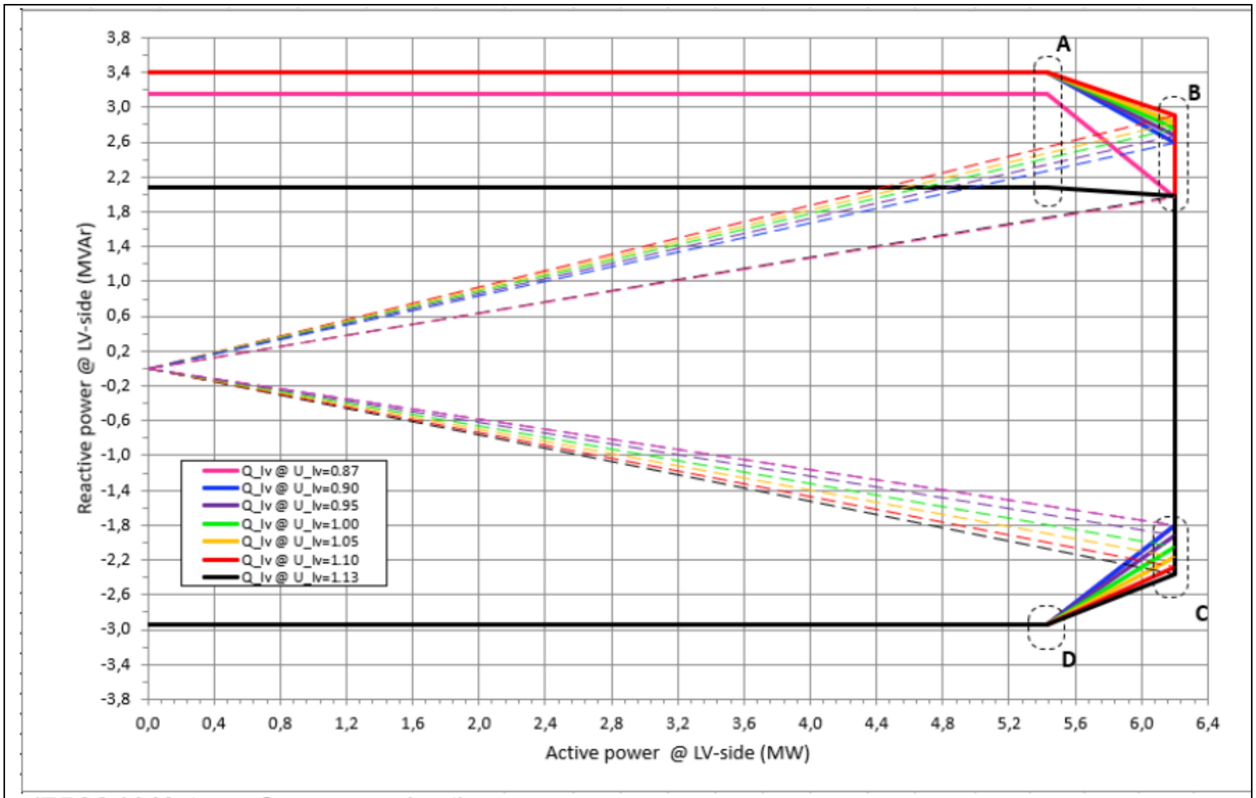
| ID | Item | Highest Overload (% of Rate 2) | Case | Contingency |
|---|---|---|---|---|
| 1 | Transmission Line: L-7005 | 103 % | SUM_01-B<br>WIN_01-B | ***79N-T81_G0*** & 101S_L-8004_G0 & 101S-813_G0 |
| 2 | Transmission Line: L-6515-1 | 101 % | WIN_01-B | 101S_L-8004_G0 & ***101S-813_G0*** |

## 8.2 ERIS

In the unlikely event that there is high wind in the area, causing maximum generation output to IR785 and all nearby windfarms. IR785 may be temporary curtailed to an output of 210 MW. Under this condition no network upgrades are required.

# 9 Reactive Power and Voltage Control

In accordance with the *Transmission System Interconnection Requirements* Section 7.6.2, IR785 must be capable of delivering reactive power for a net power factor of at least +/- 0.95 of rated capacity to the high side of the plant interconnection transformer(*s*). IR785 is also required to have an on-load tap changer for the substation interconnection transformer to manage the medium voltage so the WECS stay in their optimal reactive power output range. Reactive power can be provided by the asynchronous generator or by continually acting auxiliary devices such as STATCOM, synchronous condenser and so on. The Interconnection Customer supplied the P-Q diagram that can be shown in Figure 4.




*(7500 kVA transformer variant)*

| | Coordinates | | | | | | | | Power factor | |
|---|---|---|---|---|---|---|---|---|---|---|
| Point: | A | | B | | C | | D | | B (Capacitive) | C (Inductive) |
| Coordinate: | x (P) | y (Q) | x (P) | y (Q) | x (P) | y (Q) | x (P) | y (Q) | | |
| Reactive power [kVAr] @ LV side @ U_lv = 0.87 p.u. voltage | 5,430 | 3,160 | 6,200 | 1,963 | 6,200 | -1,797 | 5,430 | -2,933 | 0,953 | 0,960 |
| Reactive power [kVAr] @ LV side @ U_lv = 0.90 p.u. voltage | 5,430 | 3,400 | 6,200 | 2,586 | 6,200 | -1,797 | 5,430 | -2,933 | 0,923 | 0,960 |
| Reactive power [kVAr] @ LV side @ U_lv = 0.95 p.u. voltage | 5,430 | 3,400 | 6,200 | 2,670 | 6,200 | -1,918 | 5,430 | -2,933 | 0,918 | 0,955 |
| Reactive power [kVAr] @ LV side @ U_lv = 1.00 p.u. voltage | 5,430 | 3,400 | 6,200 | 2,753 | 6,200 | -2,053 | 5,430 | -2,933 | 0,914 | 0,949 |
| Reactive power [kVAr] @ LV side @ U_lv = 1.05 p.u. voltage | 5,430 | 3,400 | 6,200 | 2,827 | 6,200 | -2,163 | 5,430 | -2,933 | 0,910 | 0,944 |
| Reactive power [kVAr] @ LV side @ U_lv = 1.10 p.u. voltage | 5,430 | 3,400 | 6,200 | 2,900 | 6,200 | -2,287 | 5,430 | -2,933 | 0,906 | 0,938 |
| Reactive power [kVAr] @ LV side @ U_lv = 1.13 p.u. voltage | 5,430 | 2,080 | 6,200 | 1,983 | 6,200 | -2,359 | 5,430 | -2,933 | 0,952 | 0,935 |

*Figure 4: P-Q Diagram*

The power factor analysis is conducted using a SMIB (Single Machine Infinite Bus) case for IR785 is shown in Figure 5 and Figure 6.

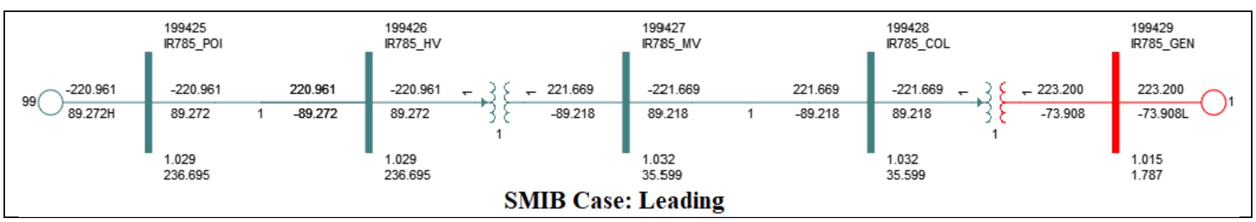



*Figure 5: Leading Power Factor Analysis*

*Table 6: Leading Power Factor Analysis Results*

| IR785 MW | IR785 Mvar | Tx HV MW | Tx HV Mvar | Tx HV MVA | Tx HV PF |
|---|---|---|---|---|---|
| 223.2 | -73.9 | 221 | -89.3 | 238.4 | 0.93 |

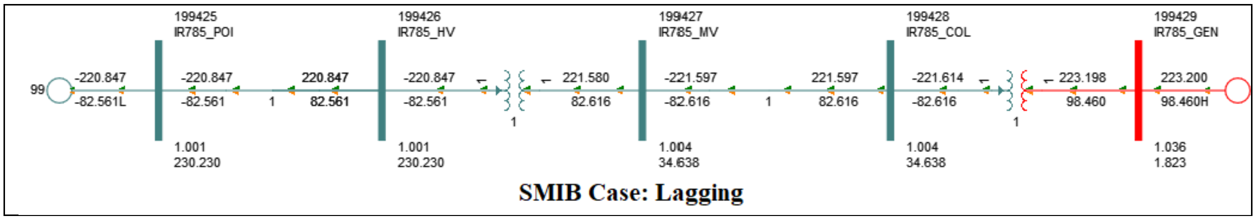



*Figure 6: Lagging Power Factor Analysis*

*Table 7: Lagging Power Factor Results*

| IR785 MW | IR785 Mvar | Tx HV MW | Tx HV Mvar | Tx HV MVA | Tx HV PF |
|---|---|---|---|---|---|
| 223.2 | 98.5 | 220.8 | 82.6 | 235.7 | 0.94 |

This analysis shows that IR785 meets both the leading and lagging power factor requirement of +/- 0.95. Because this analysis is based on preliminary transformer data and assumed collector circuit models, reactive capability will be confirmed in the SIS when detailed design is submitted.

A centralized controller will be required which continuously adjusts individual generator reactive power output within the plant capability limits and regulates the voltage at the 34.5 kV bus voltage. The voltage controls must be responsive to voltage deviations at the terminals of the Interconnection Facility substation; be equipped with a voltage set-point control; and can slowly adjust the set-point over several (*5-10*) minutes to maintain reactive power within the individual generator capabilities. The details of the specific control features, control strategy and settings will be reviewed and addressed in the SIS, as will the dynamic performance of the generator and its excitation. Line drop compensation, voltage droop, control of separate switched capacitor banks must be provided.

The NSPI System Operator must have manual and remote control of the voltage set-point and the reactive set-point of this facility to coordinate reactive power dispatch requirements.

This facility must also have low voltage ride-through capability as per Appendix G of the *Standard Generator Interconnection and Operating Agreement* (*GIA*).

Settings for the ICIF on-load tap-changer must be coordinated with plant voltage controller for long-term reactive power and voltage management at the POI.

# 10 System Security / Bulk Power Analysis

The interconnection with L-7027 is part of the NPCC Bulk Power System (BPS). As such, all protection systems associated with IR785 must comply with NPCC Directory 4 System Protection Criteria. BPS testing following NPCC's A-10 classification of bulk power system elements will be performed in the SIS to confirm if IR785 will be BPS categorized. It should also be noted that IR785's maximum capacity is larger than Nova Scotia's standard source loss contingency of 168MW (Pt Aconi). This may require the purchase of additional reserve by the IC over the amount required by NS Power during periods when IR785 output is above 168MW. The requirement for additional reserve would be eliminated by use two 230kV spur lines from IR785 to the POI and use of a 4-breaker ring bus so that the largest source loss would be reduced to 112MW. Reserve will be further explored in the SIS..

Since L-7027 is currently classified as part of the NERC Bulk Electric System (BES), it is also subject to the applicable NERC Reliability Criteria.

As IR785 has dispersed generation totaling more than 75 MVA, Inclusion I4 of the NERC BES Definition applies; each generator and systems designed for delivering that aggregate capacity to the POI classified are categorized as BES elements.

# 11 Expected Facilities Required for Interconnection

## 11.1 NRIS With RAS Modifications

The following facility changes will be required to connect IR785 to the NSPI transmission system at the POI at L-7027.

**Required Network Upgrades:**

1. Three Circuit Breaker Ring Bus station
2. Protection and control equipment & modifications at 3C and IR670 substation.
3. Modifications to Limited Impact RAS (Group 3)
4. Modifications to Type 1 RAS (Group 5 & 6)

**Required Transmission Provider's Interconnection Facilities *(TPIF)*:**

1. Construct a total of 8 km transmission spur line between the L-7027 POI and the Interconnection Customer's Interconnection Facility.
2. Supervisory, control, and communications between the wind farm and NSPI SCADA system (to be specified).

**Required Interconnection Customer's Interconnection Facilities *(ICIF)*:**

1. Facilities to provide 0.95 leading and lagging power factor when delivering rated output at the HV terminals of the IC Substation Step Up Transformer when the voltage at that point is operating between 95 and 105% of nominal. Rated reactive power shall be available through the full range of real power output, from zero to full power.
2. Centralized controls for voltage setpoint control for the low side of the ICIF transformer. Fast acting control is required and will include a curtailment scheme, which will limit/reduce total output from the facility, upon receipt of a telemetered signal from NSPI's SCADA system.
3. NSPI to have supervisory and control of this facility, via the centralized controller. This will permit the NSPI System Operator to raise/lower the voltage setpoint, change the status of reactive power controls, change the real/reactive power remotely.
4. When curtailed, the facility shall offer over-frequency and under-frequency control with ±0.2 Hz deadband and 4% droop characteristic. The active power controls shall also react to continuous control signals from the NSPI SCADA system's Automatic Generation Control (AGC) system to control tie-line fluctuations as required.

5. The facility shall support short-duration frequency deviations by providing inertia response equivalent to a Synchronous Generator with an inertia factor (H) of at least 3.0 MW-s/MVA for a period of at least 10 seconds.
6. Voltage ride-through capability as described in the NS Power TSIR.
7. Frequency ride-through capability in accordance with the NS Power TSIR. The facility shall have the capability of riding through a rate of change of frequency of 4 Hz/s.
8. Facilities for NSPI to execute high speed generation rejection (transfer trip), if determined in the SIS. The plant may be incorporated in RAS runback or load reject schemes.
9. Operation at ambient temperatures as low as -30ºC. The IC shall also provide icing models and conduct icing studies for their facility.
10. NS Power notes that NERC standard PRC-029-1 is currently in development. As proposed, this standard will impose performance requirements for voltage and frequency ride through behaviour on inverter-based generating resources. It is anticipated that this standard will be applicable to the project currently under study. The Interconnection Customer is advised to consider the requirements of PRC-029-1 in their project design to ensure that their project can conform to these requirements. Conformance will be validated at the System Impact Study stage.

## 11.2 NRIS Without RAS Modifications

**Required Network Upgrades:**

5. Three Circuit Breaker Ring Bus station
6. Protection and control equipment & modifications at 3C and IR670 substation.
7. Uprate of 6.5 km of L-7005 from 444 MVA (Summer) to 464 MVA (Summer).
8. Uprate of 3.2 km of L-6515-1 from 157 MVA (Winter) to 166 MVA (Winter).

**Required Transmission Provider's Interconnection Facilities *(TPIF)*:**

3. Construct a total of 8 km transmission spur line between the L-7027 POI and the Interconnection Customer's Interconnection Facility.
4. Supervisory, control, and communications between the wind farm and NSPI SCADA system (to be specified).

**Required Interconnection Customer's Interconnection Facilities *(ICIF)*:**

11. Facilities to provide 0.95 leading and lagging power factor when delivering rated output at the HV terminals of the IC Substation Step Up Transformer when the voltage at that point is operating between 95 and 105% of nominal. Rated reactive power shall be available through the full range of real power output, from zero to full power.
12. Centralized controls for voltage setpoint control for the low side of the ICIF transformer. Fast acting control is required and will include a curtailment scheme, which will limit/reduce total output from the facility, upon receipt of a telemetered signal from NSPI's SCADA system.
13. NSPI to have supervisory and control of this facility, via the centralized controller. This will permit the NSPI System Operator to raise/lower the voltage setpoint, change the status of reactive power controls, change the real/reactive power remotely.
14. When curtailed, the facility shall offer over-frequency and under-frequency control with ±0.2 Hz deadband and 4% droop characteristic. The active power controls shall also react to continuous

control signals from the NSPI SCADA system's Automatic Generation Control (AGC) system to control tie-line fluctuations as required.

15. The facility shall support short-duration frequency deviations by providing inertia response equivalent to a Synchronous Generator with an inertia factor (H) of at least 3.0 MW-s/MVA for a period of at least 10 seconds.
16. Voltage ride-through capability as described in the NS Power TSIR.
17. Frequency ride-through capability in accordance with the NS Power TSIR. The facility shall have the capability of riding through a rate of change of frequency of 4 Hz/s.
18. Facilities for NSPI to execute high speed generation rejection (transfer trip), if determined in the SIS. The plant may be incorporated in RAS runback or load reject schemes.
19. Operation at ambient temperatures as low as -30ºC. The IC shall also provide icing models and conduct icing studies for their facility.
20. NS Power notes that NERC standard PRC-029-1 is currently in development. As proposed, this standard will impose performance requirements for voltage and frequency ride through behaviour on inverter-based generating resources. It is anticipated that this standard will be applicable to the project currently under study. The Interconnection Customer is advised to consider the requirements of PRC-029-1 in their project design to ensure that their project can conform to these requirements. Conformance will be validated at the System Impact Study stage.

## 11.3 ERIS

**Required Network Upgrades:**

1. Three Circuit Breaker Ring Bus station
2. Protection and control equipment & modifications at 3C and IR670 substation.

**Required Transmission Provider's Interconnection Facilities *(TPIF)*:**

1. Construct a total of 8 km transmission spur line between the L-7027 POI and the Interconnection Customer's Interconnection Facility.
2. Supervisory, control, and communications between the wind farm and NSPI SCADA system (to be specified).

**Required Interconnection Customer's Interconnection Facilities *(ICIF)*:**

1. Facilities to provide 0.95 leading and lagging power factor when delivering rated output at the HV terminals of the IC Substation Step Up Transformer when the voltage at that point is operating between 95 and 105% of nominal. Rated reactive power shall be available through the full range of real power output, from zero to full power.
2. Centralized controls for voltage setpoint control for the low side of the ICIF transformer. Fast acting control is required and will include a curtailment scheme, which will limit/reduce total output from the facility, upon receipt of a telemetered signal from NSPI's SCADA system.
3. NSPI to have supervisory and control of this facility, via the centralized controller. This will permit the NSPI System Operator to raise/lower the voltage setpoint, change the status of reactive power controls, change the real/reactive power remotely.
4. When curtailed, the facility shall offer over-frequency and under-frequency control with ±0.2 Hz deadband and 4% droop characteristic. The active power controls shall also react to continuous

control signals from the NSPI SCADA system's Automatic Generation Control (AGC) system to control tie-line fluctuations as required.

5. The facility shall support short-duration frequency deviations by providing inertia response equivalent to a Synchronous Generator with an inertia factor (H) of at least 3.0 MW-s/MVA for a period of at least 10 seconds.
6. Voltage ride-through capability as described in the NS Power TSIR.
7. Frequency ride-through capability in accordance with the NS Power TSIR. The facility shall have the capability of riding through a rate of change of frequency of 4 Hz/s.
8. Facilities for NSPI to execute high speed generation rejection (transfer trip), if determined in the SIS. The plant may be incorporated in RAS runback or load reject schemes.
9. Operation at ambient temperatures as low as -30ºC. The IC shall also provide icing models and conduct icing studies for their facility.
10. NS Power notes that NERC standard PRC-029-1 is currently in development. As proposed, this standard will impose performance requirements for voltage and frequency ride through behaviour on inverter-based generating resources. It is anticipated that this standard will be applicable to the project currently under study. The Interconnection Customer is advised to consider the requirements of PRC-029-1 in their project design to ensure that their project can conform to these requirements. Conformance will be validated at the System Impact Study stage.

# 12 NSPI Interconnection Facilities and Network Upgrade Cost Estimate

## 12.1 NRIS With RAS Modifications

The high level, non-binding, present day cost estimate, including HST, for IR785's Interconnection Service is shown in Table 8. This estimate assumes there is adequate space for new equipment and modifications. This does not include any to-be-determined costs to address any stability issues identified at the SIS stage, based on dynamic analysis. Note that this cost estimate is subject to change based on higher queued projects.

*Table 8: NRIS Cost Estimate with RAS Modifications*

| Item | TPIF | Estimate |
|---|---|---|
| 1 | 8 km long 230 kV radial line | $ 12,000,000 |
| | Contingency (25%) | $ 3,000,000 |
| | Sub-total | $ 15,000,000 |

| | Network Upgrades | Estimate |
|---|---|---|
| 1 | Three Circuit Breaker Ring Bus station | $ 9,000,000 |
| 2 | Protection and control equipment & modifications at 3C and IR670 substation | $ 500,000 |
| 3 | Modifications to Limited Impact RAS (Group 3) | $ 200,000 |

| | | |
|---|---|---|
| 4 | Modifications to Type 1 RAS (Group 5 & 6) | $ 200,000 |
| | Contingency (25%) | $ 2,475,000 |
| | Sub-total | $ 12,375,000 |

| Determined costs | |
|---|---|
| Total of determined cost | **$ 27,375,000** |

## 12.2 NRIS Without RAS Modifications

*Table 9: NRIS Cost Estimate without RAS Modifications*

| Item | TPIF | Estimate |
|---|---|---|
| 1 | 8 km long 230 kV radial line | $ 12,000,000 |
| | Contingency (25%) | $ 3,000,000 |
| | Sub-total | $ 15,000,000 |

| | Network Upgrades | Estimate |
|---|---|---|
| 1 | Three Circuit Breaker Ring Bus station | $ 9,000,000 |
| 2 | Protection and control equipment & modifications at 3C and IR670 substation | $ 500,000 |
| 3 | Uprate of 3.2 km of L-6515-1 | $ 1,296,000 |
| 4 | Uprate of 6.5 km of L-7005 | $ 4,485,000 |
| | Contingency (25%) | $ 3,820,250 |
| | Sub-total | $ 19,101,250 |

| Determined costs | |
|---|---|
| Total of determined cost | **$ 34,101,250** |

## 12.2 ERIS

*Table 10:ERIS Cost Estimate*

| Item | TPIF | Estimate |
|---|---|---|
| 1 | 8 km long 230 kV radial line | $ 12,000,000 |
| | Contingency (25%) | $ 3,000,000 |
| | Sub-total | $ 15,000,000 |

| | Network Upgrades | Estimate |
|---|---|---|
| 1 | Three Circuit Breaker Ring Bus station | $ 9,000,000 |
| 2 | Protection and control equipment & modifications at 3C and IR670 substation | $ 500,000 |
| | Contingency (25%) | $ 2,375,000 |
| | Sub-total | $ 11,875,000 |

| Determined costs | |
|---|---|
| Total of determined cost | **$ 26,875,000** |

# 13 Loss Factor

Loss factor is calculated by running the winter peak load flow case, with and without the new facility in service, while keeping 91H-Tufts Cove (TC) as the NS Area Interchange bus. This methodology reflects the load centre in and around 91H-Tufts Cove. A negative loss factor reflects a reduction in system losses.

The loss factor is calculated using the data given in Table 9 and equation (01)

*Table 9: Loss Factor Calculation*

| Name | Value (MW) |
|---|---|
| IR785 nameplate | 223.2 |
| TC with IR785 | 257.9 |
| TC without IR785 | 470 |
| loss factor | 4.97% |

$$Loss\ factor = \frac{(IR785_{nameplate} + TC_{with/IR785}) - TC_{without/IR785}}{IR785_{nameplate}} \quad (01)$$

# 14 Preliminary scope of subsequent SIS

The following provides a preliminary scope of work for the subsequent SIS for IR785.

The SIS will include a more comprehensive assessment of the technical issues and requirements such as confirming that the IC's design meets the TSIR's inertia requirements to interconnect generation as requested. It will include contingency analysis, system stability, transient stability, ride through capability, and operation following a contingency (N-1 operation). The SIS must determine the facilities required to operate this facility at full capacity, withstand any contingencies (as defined by the criteria appropriate to the location) and identify any restrictions that must be placed on the system following a first contingency loss.
The SIS will confirm the options and ancillary equipment that the customer must install to control flicker, voltage response, frequency response, control interactions with other IBR facilities, active power and ensure that the facility has the required ride-through capability. The SIS will be conducted in accordance with the GIP with the assumption that all appropriate higher-queued projects proceed, and the facilities associated with those projects are installed.

The following notice on OASIS provides additional clarification on the SIS model requirements:

> *To be eligible for inclusion in the Interconnection System Impact Study stage, and thereby advance the Interconnection Request's initial Queue Position, the Interconnection Customer must meet the progression milestone requirements of Section 7.2 of the GIP at least ten (10) Business Days prior to the Interconnection System Impact Study commencement date. For clarity, item 7.2 (i) – provision of a detailed stability model for the generator(s) shall mean:*

- *Provision of PSSE and PSCAD models in compliance with documents <u>NSPI-TPR-015-2: PSSE and PSCAD Model Requirements</u>, and*
- *Provision of test data demonstrating model testing in compliance with NERC, NPCC and NSPI criteria. <u>NSPI-TPR-014-1: Model Quality Testing</u> lists the minimum requirements that will be performed by NSPI. Additional testing may be performed to assess compliance with all applicable criteria. Any test not meeting the minimum NSPI requirements will be documented in the MQT report to the IC.*

The following outline provides the minimum scope that must be complete to assess the impacts. It is recognized the actual scope may deviate, to achieve the primary objectives.
The assessment will consider but not be limited to the following.

- Facilities that the customer must install to meet the requirements of the GIP and the TSIR.
- The minimum transmission additions/upgrades that are necessary to permit operation of this Generating Facility, under all dispatch conditions, catering to the first contingencies listed.
- Guidelines and restrictions applicable to first contingency operation (curtailments etc.).
- Under-frequency load shedding impacts.

The SIS will assess system contingencies such that the system performance will meet the following criteria:

- Table 1 “Planning Design Criteria” of NPCC Directory 1.
- Table 1 “Steady State & Stability Performance Planning Events” of NERC TPL001-5.
- NSPI System Design Criteria, report number NSPI-TPR-003-5.

Any changes to RAS schemes required for operation of this generating facility, in addition to existing generation and facilities that can proceed before this project, will be determined by the SIS as well as any required additional transmission facilities. The determination will be based on NPCC[1] and NERC[2] criteria as well as NSPI guidelines and good utility practice. The SIS will also determine the contingencies for which this facility must be curtailed.

# Appendix A: Transmission line ratings

| LINE | STATION | CONDUCTOR | | | | | | BREAKER | SWITCH | CURRENT TRANSFORMER | | | | | | PROTECTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TYPE | MAX OPERATING TEMP. (°C) | HOT SEASON RATING 25°C (MVA) | WARM SEASON RATING 5°C (MVA) | COOL SEASON RATING 5°C (MVA) | COLD SEASON RATING 5°C (MVA) | 100% NAME PLATE (MVA) | 100% NAME PLATE (MVA) | RELAYING | | | FULL SCALE METERING | | | TRIP MVA |
| | | | | | | | | | | Ratio | R.F. | MVA | Ratio | R.F. | MVA | |

[1] NPCC criteria are set forth in its Reliability Reference Directory #1 *Design and Operation of the Bulk Power System*
[2] NERC transmission criteria are set forth in *NERC Reliability Standard TPL-001-5*

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L-7005 | 3C Pt. Hastings EHV | ACSR 1113 Beaumont | 70 | 417 | 523 | 523 | 523 | 797 | 797 | 800 | 2 | 637 | 1000 | 1 | 462 | 656 |
| | 67N Onslow EHV | | | | | | | 797 | 797 | 800 | 2 | 637 | 800 | 1 | 385 | 597 |
| L-7003 | 3C Pt. Hastings EHV | ACSR 556 Dove | 60 | 238 | 318 | 318 | 318 | 797 | 797 | 800 | 2 | 637 | 1000 | 1 | 462 | 550 |
| | 67N Onslow EHV | | | | | | | 797 | 797 | 800 | 2 | 637 | 1000 | 1 | 462 | 550 |
| L-7019 | 91N Dalhousie Mountain | ACSR 556 Dove | 70 | 277 | 345 | 345 | 345 | 797 | 797 | 800 | 2.5 | 797 | 800 | 2.5 | 797 | 3155 |
| | 67N Onslow EHV | | | | | | | 797 | 797 | 800 | 2 | 637 | 1000 | 1 | 462 | 2382 |
| L-6515a | 2C Pt. Hastings | ACSR 556.5 Dove | 50 | 114 | 172 | 172 | 172 | 287 | 287 | 1200 | 2 | 574 | 1200 | 2 | 574 | 651 |
| | 100C Cape Porcupine | | | | | | | | 143 | | | | NA | | | |