# Interconnection Feasibility Study Report
# GIP-IR732-FEAS-R1

## Generator Interconnection Request 732
## 150 MW Wind Generating Facility
## Connors Mountain North, NS

2024-05-31

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 (IR#732) for a proposed 150 MW wind generation facility interconnected to the NSPI Transmission System, with a Commercial Operation Date of 2027-12-31. The Point of Interconnection (POI) requested by the customer is the 230 kV 127C-Weavers Mountain substation.

There are twenty-two (22) transmission Interconnection Requests in the Advanced Stage Transmission and Distribution Queue that must be included in the study models for IR#732.

This study assumes that the addition of generation from IR#732 will displace coal-fired generation in eastern Nova Scotia for both NRIS and ERIS.

Interconnection at 127C-Weavers Mountain will require an expansion of the three-breaker 230 kV ring bus to a four-breaker ring bus. 127C-Weavers Mountain substation is classified as a Bulk Power System (BPS) element. This substation is classified as BPS under NPCC criteria and Bulk Electric System (BES) under NERC criteria. As IR#732 has dispersed generation totaling more than 75 MVA, each generator will be classified as a NERC BES element. The IR#732 Interconnection Customer substation is also classified as part of the BES, subject to the applicable NERC Reliability Criteria.

A few post-contingency thermal loading violations occur due to IR#732 on transmission line L-7003 and L-7024. The following upgrades are proposed for NRIS designation:

- Uprate of L-7003, for approximately 98.6 km, from 275 MVA (Summer) to at least 357.5 MVA (Summer).
- Uprate of L-7024, for approximately 11.8 km, from 275 MVA (Summer) to at least 357.5 MVA (Summer).

No violations of voltage criteria were found for IR#732.

Data provided by the IC indicates that IR#732 will be utilizing the Nordex Delta 4000 - N163/5.X 5.9 MW wind turbines. Based on supplied interconnection data and assumptions, IR#732 may not meet 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.

IR#732 was not found to adversely impact the short-circuit capabilities of existing circuit breakers. The short circuit level at the Interconnection Facility 34.5 kV bus is 495 MVA with all lines in service and IR#732 off-line, resulting in a 3.3 Short Circuit Ratio (SCR). This falls to 384 MVA with L-7024 open at 3C-Port Hastings, resulting in a SCR of 2.6. Windfarms in proximity to IR#732 (e.g. 127C, as well as 91N, IR#618, and IR#670) will also reduce the effective SCR in the area. These conditions should be discussed with the wind turbine manufacturer to determine if the equipment can operate, or if modifications are required. NSPI system short circuit level may decline over time with changes to transmission configuration and generation mix, as noted in TSIR section 7.4.15. IR#732 must be able to accommodate these changes.

The largest calculated voltage flicker $P_{st}$=$P_{lt}$ of 0.138 for continuous operation does not exceed NSPI's required limit with L-7024 open at the 3C-Port Hastings end. The project design must meet NSPI requirements for low-voltage ride-through and voltage control. Harmonics must meet the Total Harmonics Distortion provisions of IEEE 519.

The preliminary value for the unit loss factor is calculated as +9.0% at the POI, net of any losses on the IC facilities up to the POI.

To connect IR#732 as NRIS, the preliminary non-binding cost estimate for interconnecting 150 MW to the 127C-Weavers Mountain POI is $231,227,500, including a 25% contingency. This cost estimate includes:

- A new 230 kV line terminal in the existing 127C-Weavers Mountain substation.
- Protection upgrades at 127C-Weavers Mountain, 125C-Goose Harbour Lake, and 67N-Onslow.
- A 21 km spur line from the POI to the Interconnection Customer's Interconnection Facility (ICIF).
- Uprate of L-7003 (98.6 km).
- Uprate of L-7024 (11.8 km).

In this estimate, $154,852,000 (plus 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 the GIP. The remainder of the costs are fully funded by the Interconnection Customer.

To connect IR#732 as ERIS, the preliminary non-binding cost estimate for interconnecting at the POI is $40,787,500, including a 25% contingency. This estimate includes:

- A new 230 kV line terminal in the existing 127C-Weavers Mountain substation.
- Protection upgrades at 127C-Weavers Mountain, 125C-Goose Harbour Lake, and 67N-Onslow.
- A 21 km spur line from the POI to the Interconnection Customer's Interconnection Facility (ICIF).

In this estimate, $2,500,000 (plus 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 the GIP.

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, costs related to findings of the electromagnetic transient (EMT) analysis, and it assumes that RAS modifications are approved by NPCC.

The estimated time to construct the Transmission Providers Interconnection Facilities and any 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 Facility Study.

# Table of Contents

# 1 Introduction

This Feasibility Study report (FEAS) presents the results of a Feasibility Study Agreement for the connection of “Connors Mountain North” with an installed capacity of 153.4 MW, capped at output of 150 MW. This wind generation facility is being studied for interconnection to NSPI system as both Network Resource Interconnection Service (NRIS) and Energy Resource Interconnection Service (ERIS).

This project is listed as Interconnection Request #732 in the NSPI Interconnection Request Queue and will be referred to as IR#732 throughout this report. Interconnection Customer (IC) identified 127C-Weavers Mountain as the Point of Interconnection (POI). This wind generation facility will be connected to the POI via a 21 km long 230 kV transmission line from the Point of Change of Ownership (PCO). Figure 1 shows the approximate geographic location of the proposed POI (blue circle) and Figure 2 shows the approximate electrical location (blue circle).

**Figure 1 Approximate geographic location of IR#732**

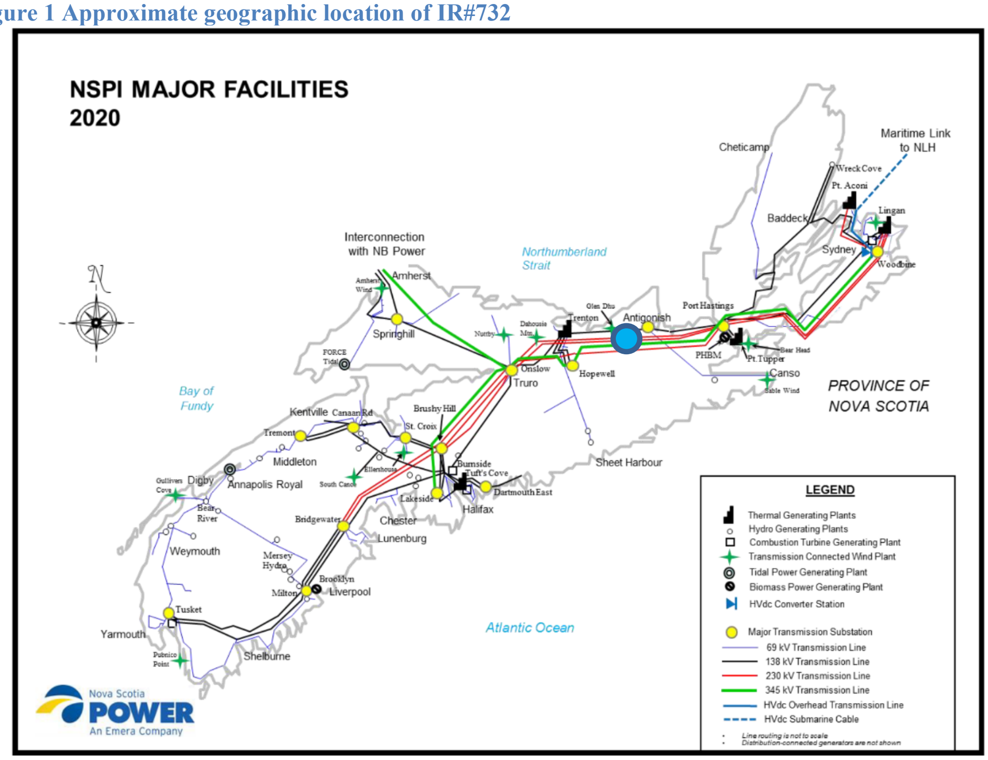
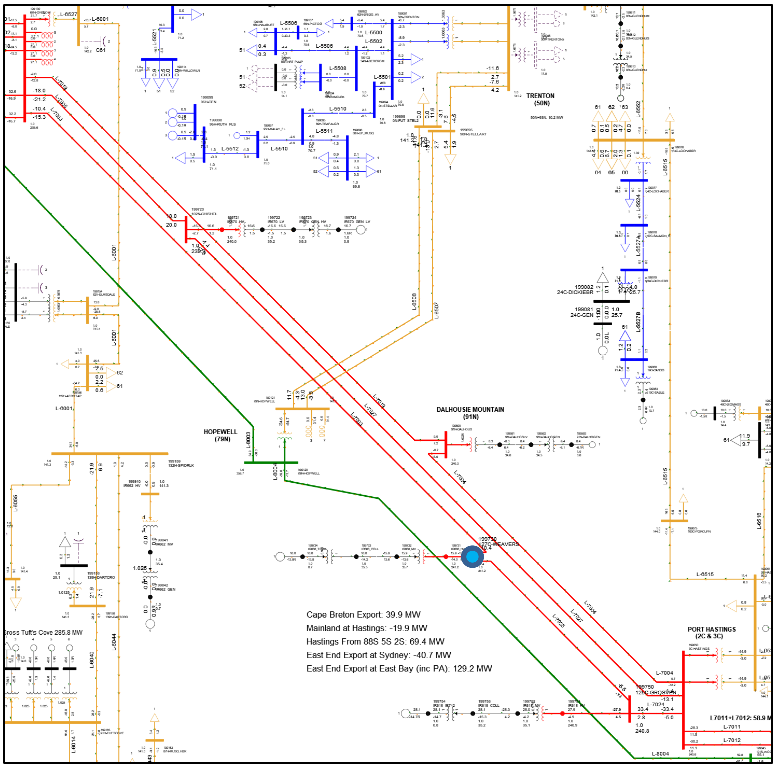


Figure 2 Approximate electrical location of IR#732




## 2 Scope

The objective of this 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 modeling 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 is 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 IR#732. 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 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[1] (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 IR#732 on incremental 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 IC. The 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: 2027-12-31.

3. The Interconnection Customer Facility (ICIF) consists of 26 Nordex Delta 4000 (N163/5.X) wind turbine generators (WTG), each rated 5.9 MW (153.4 MW total) connected to six collector circuits operating at voltage of 34.5 kV.

4. The POI (127C-Weavers Mountain) is categorized Bulk Power System and will therefore require compliance with applicable NPCC requirements.

[1] transmission-system-interconnection-requirements (nspower.ca)

5. The ICIF will require the construction of a 21 km, 230 kV transmission spur line from the POI to the IC 230/34.5kV transformers. The IC will be responsible for providing the applicable Right-of-Way.

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. The IC has indicated that Nordex Delta 4000 (N163/5.X) has a nominal power factor range from 0.929 capacitive to 0.929 inductive on the LV terminals of the GSU transformer.

7. Preliminary data was provided by the IC for the IC substation interconnection facility. The transformer was rated at 101/134/167 MVA and modeled with a positive-sequence impedance of 9.5% on 101 MVA with an X/R ratio of 50. The IC indicated this interconnection facility transformer has a wye-delta winding configuration with +/- 10% on-load tap changer. The impedance of each generator step-up transformer was modeled as 9% on 6.35 MVA with an assumed X/R ratio of 8.53.

8. Detailed collector circuit data was not provided, so typical data (R+jX = 0.01+j0.04 pu, with 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.

9. 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.

10. 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.

    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.

11. The rating of transmission facilities in the vicinity of IR#732 are shown in Table 1.

| Table 1 Local Transmission Element Ratings | | | | | |
|---|---|---|---|---|---|
| Line | Conductor | Design Temp | Limiting Element | Summer Rating Normal/Emergency | Winter Rating Normal/Emergency |
| L-6503 | 1113 Beaumont | 85°C | Conductor/ Switchgear/ Breaker/ CT Relaying | 287/316 MVA | 287/316 MVA |
| L-6511 | 556.5 Dove | 60°C | Conductor | 140/154 MVA | 184/202 MVA |
| L-6552 | 556.5 Dove | 50°C | Conductor/ Switchgear | 110/121 MVA | 143/157 MVA |
| L-6515 | 556.5 Dove | 50°C | Conductor/ Switchgear | 110/121 MVA | 143/157 MVA |
| L-7003 | 556.5 Dove | 60°C | Conductor | 275/303 MVA | 348/383 MVA |
| L-7004 | 556.5 Dove | 60°C | Conductor | 233/256 MVA | 307/338 MVA |
| L-7005 | 1113 Beaumont | 70°C | CT Relaying | 398/398MVA | 398/398MVA |
| L-7019 | 555.5 Dove | 70°C | Conductor | 273/300 MVA | 345/380 MVA |
| L-7024 | 556.5 Dove | 60°C | Conductor | 275/303 MVA | 348/383 MVA |
| L-7026 | 556.5 Dove | 60°C | Conductor | 275/303 MVA | 348/383 MVA |
| L-7027 | 1113 Beaumont | 70°C | CT Relaying | 398/398MVA | 398/398MVA |

# 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 2024/02/15, the following projects are higher queued in the Advanced Stage Interconnection Request Queue and are committed to the study base cases:

- IR426: GIA Executed
- IR516: GIA Executed
- IR540: GIA Executed
- IR542: GIA Executed
- IR517: GIA in Progress
- IR574: GIA Executed
- IR598: GIA Executed
- IR597: GIA Executed
- IR647: GIA in Progress
- IR664: FAC Complete
- IR662: FAC Complete
- IR670: FAC Complete
- IR671: FAC in Progress
- IR669: FAC Complete
- IR668: FAC Complete
- IR618: FAC Complete

- IR673: FAC Complete
- IR675: FAC Complete
- IR677: SIS in Progress
- IR697: SIS in Progress
- IR739: SIS in Progress
- IR742: SIS in Progress

The power system base cases for the feasibility study include all transmission connected IRs in the GIP queue up to and including IR742 with the exception of IR686, as the IR686 SIS was not completed when IR732 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[2]:

> *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 maximum (design) expected short-circuit level is 5,000 MVA (21 kA) on 138 kV systems and 10,000 MVA (25 kA) on 230 kV systems. The fault current characteristics for Nordex Delta 4000 (N163/5.X) wind turbine is given as 3.36 times rated current, or X'd = 0.298 per unit on machine base MVA.

The short circuit analysis is performed using PSS®E version 34.7 for a classical fault study, 3LG and flat voltage profile at 1.0 pu. The maximum short circuit MVA values calculated for scenarios with and without IR#732 at the POI and one substation away are compared in Table 2.

[2] https://www.nspower.ca/oasis/generation-interconnection-procedures

| Table 2: Short-Circuit Levels. IR#732 (Type 3) at 127C-Weavers Mountain Three-phase MVA [(1)] | | |
|---|---|---|
| Location | Without IR#732 | With IR#732 |
| Maximum Generation Conditions - All transmission facilities in service | | |
| POI (230 kV) | 2110 | 2365 |
| Interconnection Facility (230 kV) | 1485 | 1754 |
| Interconnection Facility (34.5 kV) | 621 | 983 |
| 67N-Onslow (230 kV) | 4786 | 4876 |
| 3C-Port Hastings (230 kV) | 3954 | 4068 |
| 2C-Port Hastings (138 kV) | 3405 | 3450 |
| Minimum Generation Conditions (TC3, LG1, ML In-Service) | | |
| Interconnection Facility (230 kV), all lines in-service | 925 | 1195 |
| Interconnection Facility (230 kV), L-7003 open at 67N | 685 | 954 |
| Interconnection Facility (230 kV), L-7024 open at 3C | 600 | 869 |
| Interconnection Facility (34.5 kV), all lines in-service | 495 | 857 |
| Interconnection Facility (34.5 kV), L-7003 open at 67N | 417 | 779 |
| Interconnection Facility (34.5 kV), L-7024 open at 3C | 384 | 746 |

(1) Classical fault study, flat voltage profile

The maximum short circuit analysis for the system under normal condition shows that the development of IR#732 will not require upgrades in the local substation breakers.

Inverter-based generation installations often have a minimum Short Circuit Ratio (SCR) for proper operation of converters and control circuits. The minimum short circuit ratio at the 34.5 kV ICIF bus is 3.3 with all lines in service and IR#732 offline. This falls to 2.8 and 2.6 with L-7003 open at 67N-Onslow and L-7024 open at 3C-Post Hastings, respectively.

Documentation supplied by the IC states that a study is needed to optimize the turbine for connections with SCRs between 1.5-3.0. The IC is advised to share these short circuit levels with the turbine vendor to be incorporated into the facility design.

NSPI system short circuit level may decline over time with changes to transmission configuration and generation mix. IR#732 must be able to accommodate these changes, per TSIR section 7.4.15. Windfarms in proximity to IR#732 (e.g. IR#668 as well as 91N, IR#618, and IR#670) will also reduce the effective SCR in the area. The impact of the low SCR will be further examined when detailed data for the machine is made available for the SIS.

# 6 Voltage Flicker and Harmonics

The voltage flicker calculations use IEC Standard 61400-21 based on estimated data provided by Nordex Delta 4000 N163/5.X 5.9 MW wind turbines (4.0 flicker coefficient c(ψk, va) at 85° system angle). The flicker step factor Kf (ψk) for switching operations at a system angle of 85° is given as 0.2 for start-up at both cut-in wind speed and rated wind speed. The maximum number of switching operations within a 10-minute period (N10m) is given as 1. The maximum number of switching operations within a 120-minute period (N120m) is given as 10 for cut-in speed and 12 for rated wind speed. The voltage flicker $P_{st}$ and $P_{lt}$ levels are calculated at the Interconnection Facility for various system conditions and are shown in Table 3 below.

**Table 3: Calculated Voltage Flicker at 230 kV Bus**

| System Conditions | $P_{st}=P_{lt}$ Continuous | Switching | | | |
|---|---|---|---|---|---|
| | | $P_{st}$ | | $P_{lt}$ | |
| | | Cut-in speed | Rated speed | Cut-in speed | Rated speed |
| Maximum Generation | | | | | |
| All Transmission in Service | 0.069 | 0.033 | 0.033 | 0.030 | 0.032 |
| Minimum Conditions (TC3, LG1, ML In-Service) | | | | | |
| All Transmission in Service | 0.101 | 0.049 | 0.049 | 0.044 | 0.047 |
| L-7003 open at 67N | 0.126 | 0.061 | 0.061 | 0.055 | 0.059 |
| L-7024 open at 3C | 0.138 | 0.067 | 0.067 | 0.061 | 0.064 |

NSPI's required limits are 0.35 for $P_{st}$ and 0.25 for $P_{lt}$. IR#732 is able to meet the flicker requirement in all studied system conditions, including both N-1 minimal generation conditions. This should be further evaluated in the SIS.

The generator is expected to meet IEEE Standard 519-2014 limiting voltage Total Harmonic Distortion (all frequencies) to a maximum of 2.5%, with no individual harmonic exceeding 1.5% 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 scenarios intended to cover a broad range of operating conditions.

Table 4 includes the list of base cases considered, along with a brief description.

| Table 4: List of Base Cases | |
|---|---|
| **Case Name** | **Description** |
| SML_01 | Spring Minimum Load with low wind (nearby and other WTG at 17%) |
| SML_02 | Spring Minimum Load with high wind (nearby and other WTG at 43% and 17%, respectively) |
| SSH_01 | Summer Shoulder Load with low wind (nearby and other WTG at 17%) |
| SSH_02 | Summer Shoulder Load with high wind (nearby and other WTG at 53% and 17%, respectively) |
| SUM_01 | Summer Peak Load with low wind (nearby and other WTG at 17%) |
| SUM_02 | Summer Peak Load with high wind (nearby and other WTG at 100% and 29%, respectively) |
| SUM_03 | Summer Peak Load with moderate wind (nearby and other WTG at 30%). Wreck Cove dispatched at historical seasonal maximum and with Port Hawkesbury Paper at maximum load. |
| SUM_04 | Summer Peak Load with low wind (nearby and other WTG at 17%) and with power flow between NS and NB at 320 MW, simulating delivery of reserve to NB. Wreck Cove is dispatched at historical seasonal maximum. |
| WIN_01 | Winter Peak Load with low wind (nearby and other WTG at 17%) |
| WIN_02 | Winter Peak Load with high wind (nearby and other WTG at 100% and 73%, respectively) |
| WIN_03 | Winter Peak Load with high wind (nearby and other WTG at 88%) and with maximum load at Port Hawkesbury Paper. |
| WIN_04 | Winter Peak Load with low wind (nearby and other WTG at 17%) and with power flow between NS and NB at 170 MW, simulating delivery of reserve to NB. This case represents stressed corridors with heavy flow from eastern NS to the load centre. |

These 12 base scenarios were studied with and without IR#732. This FEAS added IR#732 and displaced an equivalent amount of existing generation according to dispatch guidelines provided by NSPI[3]. Figure 3 shows the relevant corridors, generators and loads on the NSPI transmission system. The arrow by each corridor shows the power flow direction of positive values.

[3] Thermal generation was decreased to Pmin based on a merit order provided by NSPI, followed by small hydro units. If further generation was required to be decreased, "other" wind farms (i.e., not "nearby" wind farms that would impact thermal overloads near the IC) were decreased.

Figure 3 Relevant transmission interfaces

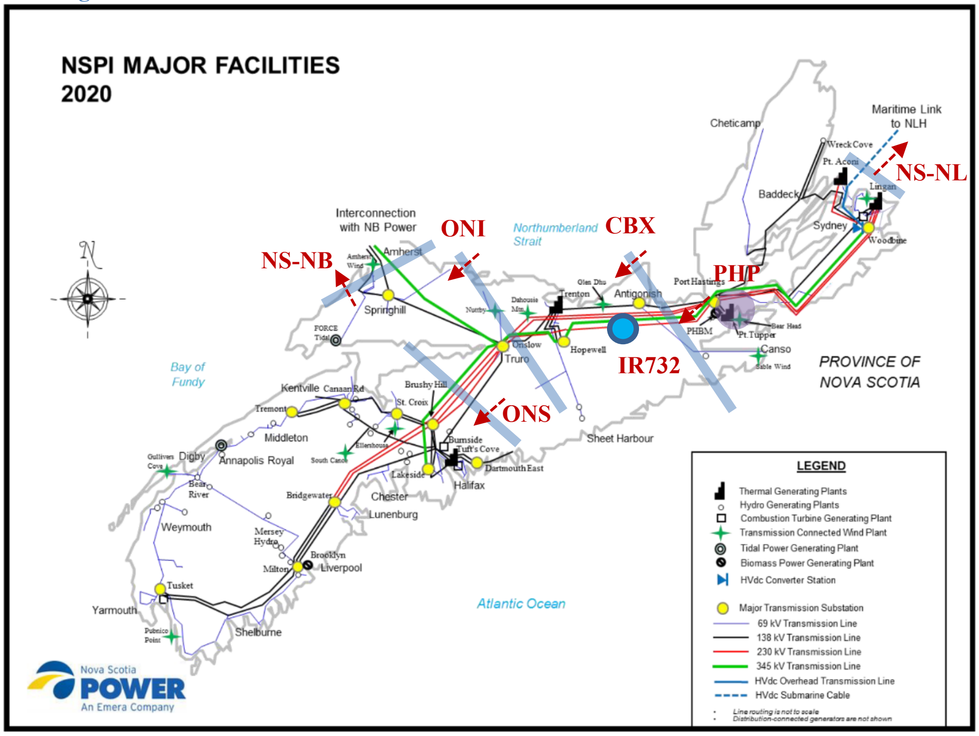



Table 5 summarizes the base cases and the dispatch scenarios to compare the effect of IR#732 on the loading of key NS corridors and generators. The case name followed by 1 (e.g., SML_01-1) stands for the case without IR#732 and the case name followed by 2 (e.g., SML_01-2) stands for the case with IR#732.

| Case | NS-Load | NS-NB | NS-NL | ONS | ONI | CBX | PHP | Wind | IR#732 |
|---|---|---|---|---|---|---|---|---|---|
| SML_01-1 | 727 | 151 | -170 | -94 | 68 | 39 | 176 | 236 | - |
| SML_01-2 | 727 | 150 | -170 | 24 | 186 | 12 | 176 | 236 | 150 |
| SML_02-1 | 759 | 150 | -170 | 106 | 268 | -19 | 209 | 516 | - |
| SML_02-2 | 759 | 152 | -170 | 106 | 270 | -25 | 209 | 366 | 150 |
| SSH_01-1 | 1161 | 151 | -330 | 163 | 369 | 291 | 146 | 236 | - |
| SSH_01-2 | 1161 | 147 | -330 | 261 | 462 | 239 | 146 | 236 | 150 |
| SSH_02-1 | 1157 | 154 | -330 | 415 | 624 | 260 | 146 | 571 | - |
| SSH_02-2 | 1157 | 151 | -330 | 417 | 623 | 254 | 146 | 416 | 150 |
| SUM_01-1 | 1545 | 150 | -330 | 411 | 659 | 558 | 145 | 236 | - |
| SUM_01-2 | 1545 | 150 | -330 | 411 | 659 | 411 | 145 | 236 | 150 |
| SUM_02-1 | 1604 | 151 | -330 | 491 | 690 | 284 | 207 | 901 | - |
| SUM_02-2 | 1604 | 150 | -330 | 603 | 830 | 282 | 207 | 759 | 150 |
| SUM_03-1 | 1604 | 152 | -330 | 596 | 823 | 423 | 207 | 768 | - |
| SUM_03-2 | 1604 | 144 | -330 | 693 | 934 | 391 | 207 | 658 | 150 |
| SUM_04-1 | 1541 | 323 | -475 | 516 | 939 | 852 | 145 | 236 | - |

| Case | NS-Load | NS-NB | NS-NL | ONS | ONI | CBX | PHP | Wind | IR#732 |
|---|---|---|---|---|---|---|---|---|---|
| SUM_04-2 | 1541 | 326 | -475 | 516 | 942 | 706 | 145 | 236 | 150 |
| WIN_01-1 | 2354 | 0 | -170 | 855 | 1040 | 886 | 15 | 236 | - |
| WIN_01-2 | 2354 | 0 | -170 | 855 | 1040 | 791 | 15 | 236 | 150 |
| WIN_02-1 | 2349 | -3 | -170 | 795 | 851 | 447 | 15 | 1286 | - |
| WIN_02-2 | 2349 | 0 | -170 | 903 | 990 | 445 | 15 | 1147 | 150 |
| WIN_03-1 | 2545 | 3 | -170 | 689 | 741 | 396 | 220 | 1286 | - |
| WIN_03-2 | 2545 | 2 | -170 | 689 | 740 | 247 | 220 | 1286 | 150 |
| WIN_04-1 | 2354 | 168 | -330 | 852 | 1206 | 1043 | 15 | 236 | - |
| WIN_04-2 | 2354 | 168 | -330 | 852 | 1206 | 968 | 15 | 236 | 150 |

(1) For inter-area flows, +ve indicates export and -ve indicates import.
(2) The Wind column accounts only for transmission-connected wind facilities (excluding the IR under study).

Due to the newly introduced wind generation by IR#732, the loading of corridors west to the POI (i.e., Onslow Import - ONI and Onslow South - ONS) has increased and loading of corridors east to the POI (i.e., Cape Breton Export - CBX) has decreased. This is due to the displacement of generation in the east of the province based on the merit order. Inter-provincial power flows between NS-NB are varied in these base cases, but only export conditions are considered in order to assess the impact of IR#732 integration with stressed CBX/ONI corridors.

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 IR#732. Automated analysis searched for violations of emergency thermal ratings and emergency voltage limit for each contingency. Contingencies studied are listed in Table 6.

**Table 6: Contingency List**

| | | | | |
|---|---|---|---|---|
| 88S_L7014 | 3C_T72 | 1N_L6001 | 103H_881 | 101V_L6004 |
| 88S_L7021 | 3C_710* | 1N_T1 | 103H_600 | 101V_601 |
| 88S_L7022 | 3C_711 | 1N_T4 | 103H_608 | 99W_BESS |
| 88S_710 | 3C_712* | 1N_T65 | 103H_681 | 43V_BESS |
| 88S_711 | 3C_713 | 1N_C61 | 91H_L5049 | 132H_BESS |
| 88S_713 | 3C_714 | 1N_B61 | 91H_L5012 | 99W_708 |
| 88S_714 | 3C_715* | 1N_B62 | 91H_L5041 | 99W_709 |
| 88S_715 | 3C_716 | 1N_600 | 91H_T62 | 99W_T71 |
| 88S_720 | 2C_L6515 | 1N_601 | 91H_T11 | 99W_T72 |
| 88S_721 | 2C_L6516 | 1N_613 | 91H_511 | DCT_L5039_L6033 |
| 88S_722 | 2C_L6517 | 120H_L7008 | 91H_516 | DCT_L7009_L8002 |
| 88S_723* | 2C_L6518 | 120H_L7009 | 91H_521 | DCT_L6011_L6010 |
| 88S_T71 | 2C_L6537 | 120H_L6005 | 91H_523 | DCT_L6010_L6005 |
| 88S_T72 | 2C_B61 | 120H_L6010 | 91H_G3 | DCT_L6005_L6016 |
| 88S_G2 | 2C_B62 | 120H_L6011 | 91H_G4 | DCT_L7008_L7009 |

| Table 6: Contingency List | | | | |
|---|---|---|---|---|
| 88S_G3 | 79N_L8003* | 120H_L6051 | 91H_G5 | DCT_L7003_L7004* |
| 88S_G4 | 79N_L6507 | 120H_L6016 | 91H_G6 | DCT_L7024_L7004* |
| 101S_ML_POLE1 | 79N_L6508 | 120H_T71 | 14H_GT1 | DCT_L6507_L6508 |
| 101S_ML_POLE2 | 79N_T81* | 120H_T72 | 14H_GT3 | DCT_L7021_L6534 |
| 101S_ML_BIPOLE | 67N_L8001* | 120H_SVC | 83S_GT1 | DCT_L6033_L6035 |
| 101S_T81 | 67N_L8002 | 120H_710 | 83S_GT2 | 85S_L6545 |
| 101S_T82 | 67N_L7019 | 120H_711 | 85S_GT1 | 5S_L6538 |
| 101S_L7011* | 67N_L7001 | 120H_712 | 85S_GT2 | 3S_L6539 |
| 101S_L7012* | 67N_L7002 | 120H_713 | 132H_602 | 5S_L6537 |
| 101S_L7015 | 67N_L7018 | 120H_714 | 132H_603 | 5S_L6516 |
| 101S_L8004* | 67N_T81 | 120H_715 | 132H_605 | 5S_606 |
| 101S_701 | 67N_T82 | 120H_716 | 132H_606 | 5S_607 |
| 101S_702 | 67N_T71 | 120H_720 | 91N_701 | 2S_513 |
| 101S_703 | 67N_811* | 120H_621 | 91N_702 | 89S_G1 |
| 101S_704 | 67N_812 | 120H_622 | 91N_703 | 1C_G2 |
| 101S_705 | 67N_813 | 120H_623 | 91N_B71 | 48C_G1 |
| 101S_706 | 67N_814* | 120H_624 | 125C_L7025 | 50N_G5 |
| 101S_711 | 67N_701 | 120H_626 | 125C_701 | 50N_G6 |
| 101S_712 | 67N_702 | 120H_627 | 125C_B71 | 104W_G1 |
| 101S_713 | 67N_703 | 120H_628 | 127C_L7003 | 110W_T62 |
| 101S_811 | 67N_704 | 120H_629 | 127C_701 | 104H_600 |
| 101S_812* | 67N_705 | 103H_L6008 | 127C_B71 | SALISBURY_L3004 |
| 101S_813* | 67N_706 | 103H_L6033 | 102N_L7005 | SALISBURY_L3013 |
| 101S_814 | 67N_710 | 103H_L6038 | 102N_701 | SALISBURY_SA3_2* |
| 101S_816 | 67N_711* | 103H_T81 | 102N_B71 | SALISBURY_L3006* |
| 3C_L7024 | 67N_712 | 103H_T61 | 100N_L6555 | MEMRAMCOOK_L1159 |
| 3C_L7004 | 67N_713 | 103H_T63 | 100N_601 | MEMRAMCOOK_L1160 |
| 3C_L7027* | 1N_L6613 | 103H_B61 | 100N_B61 | MEMRAMCOOK_ME3_1* |
| 3C_T71 | 1N_L6503 | 103H_B62 | 101V_L6054 | |

## 7.1 NRIS Results

With the interconnection of IR#732 as NRIS several contingencies resulted in thermal overload on L-7003 and L-7024. Table 7 shows the highest thermal overloads found; other conditions were found that also violated thermal loading criteria, but to a lesser degree. Note that for outages of L-7024, overloads were observed on L-7003 due to the combined MW output of IR#732, IR#668 (Weavers Mountain) and IR#618/IR#742 (Goose Harbour Lake I & II) totaling 409 MW. Similarly, for outages of L-7003, overloads were observed on L-7024 due to the combined MW output of these three plants. No contingencies resulted in a violation of voltage limit criteria.

| Table 7: Contingencies Resulting in Highest Line Overload | | | |
|---|---|---|---|
| Line | Overload (% of Emergency Rating) | Case | Contingency |
| L-7003 | 130.2 | SUM_02, WIN_02, SUM_03 | DCT_L7024_L7004_G0, DCT_L7024_L7004_G3, 3C_L7024, 3C_712, 3C_712_G4_1, 3C_712_G4_2, 3C_713 |
| L-7024 | 130.2 | SUM_02, WIN_02, SUM_03 | DCT_L7003_L7004_G0, DCT_L7003_L7004_G3, 67N_702, 67N_703, 127C_L7003 |

For the contingencies resulting in the thermal overloads on L-7003, the options examined include:

- Thermal uprating of L-7003 (up to at least 357.5 MVA), approximately 98.6 km, at a cost of $136,068,000.

For the contingencies resulting in the thermal overloads on L-7024, the options examined include:

- Thermal uprating of L-7024 (up to at least 357.5 MVA), approximately 11.8 km, at a cost of $16,284,000.

An additional potential option to address both of the aforementioned thermal overloads is as follows:

- Expand the planned IR#668 substation to facilitate the termination of L-7004 in addition to L-7003. Expected to require 9 breakers (6 additional) for 6 nodes in a breaker-and-a-half scheme.

It should be noted that that this option was outside the scope of this study and will require additional analysis to prove that it resolves the thermal overloads under all anticipated contingency scenarios. This scenario may be investigated in the SIS if this project progresses.

## 7.2 ERIS Results

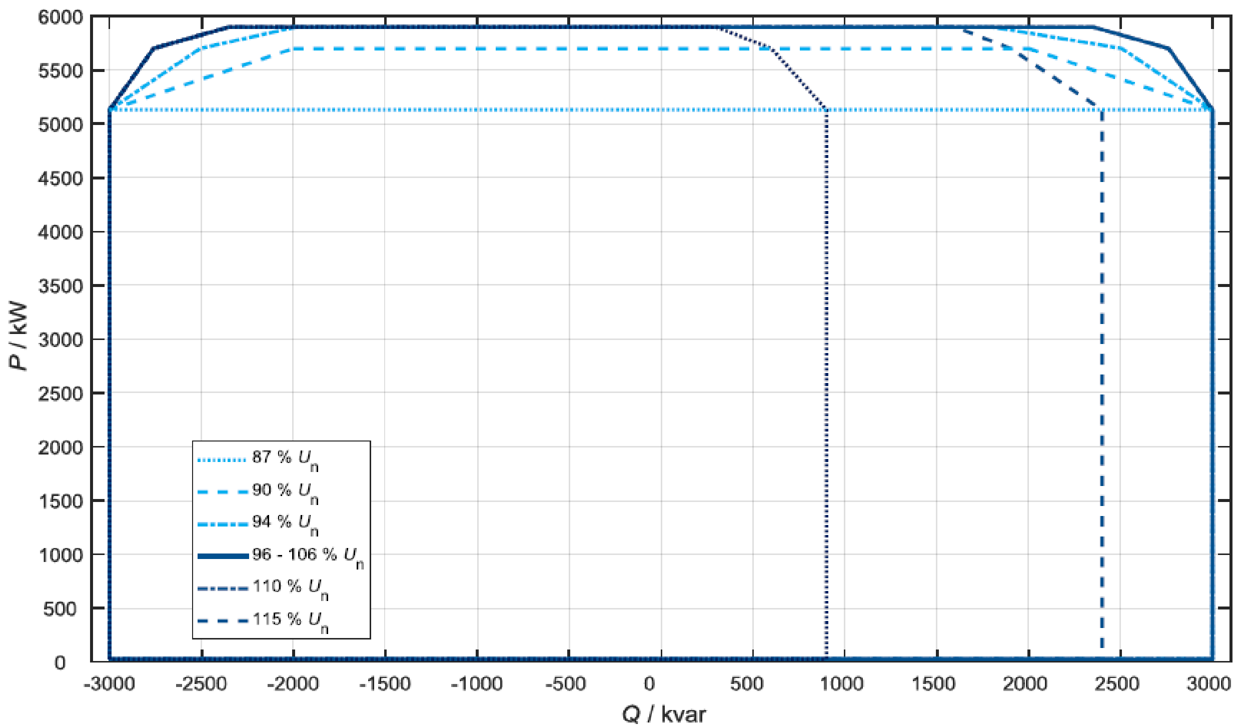
With the interconnection of IR#732 as ERIS, the facility can generate up to 58.0 MW before exceeding thermal limits on L-7003 (when L-7024 is tripped) and L-7024 (when L-7003 is tripped). This thermal loading constraint is maximized with summer ratings and is based on maximum simultaneous wind generation at IR#618/IR#742, and IR#668. The maximum combined output from IR#732, IR#618/IR#742, and IR#668 is therefore 317 MW under summer ratings.

Avoidance of transmission upgrades to avoid the aforementioned thermal overloads in the NRIS analysis results in a decrease in Network Upgrade cost by an estimated $152,352,000.

# 8 Reactive Power and Voltage Control

In accordance with TSIR Section 7.6.2, IR#732 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). Reactive power can be provided by continually acting auxiliary devices such as STATCOM, synchronous condenser, etc. supplied by the Interconnection Customer. The P-Q diagram for Mode-0a (5900 kW) by Nordex is shown in Figure 4.

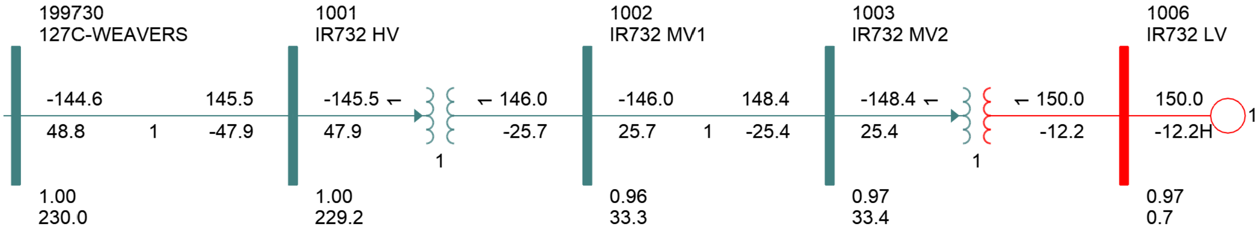
**Figure 4: P-Q diagram for Mode-0a (5900 kW) by Nordex**



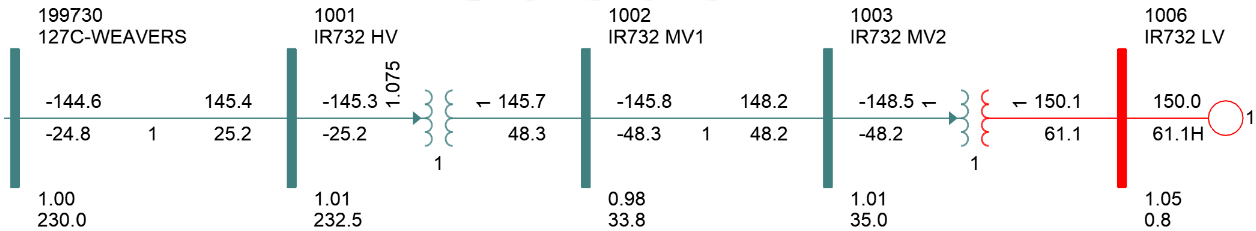

When the active power is zero, the reactive power is zero. The optional "STATCOM function" can be added and enabled to inject/absorb reactive power also when active power is zero, but at a reduced capacity.

The power factor analysis is conducted using a SMIB (Single Machine Infinite Bus) case for IR#732. The leading power factor analysis for IR#732 results in power factor values less than 0.95. This verifies the ability of the configuration to meet the leading power factor requirement. IR#732 cannot meet the lagging power factor requirement of 0.95, but a power factor of 0.95 is possible by reducing the active power output down to 80%. Analysis shown in Figure 5 verifies the reactive power capability of the system.

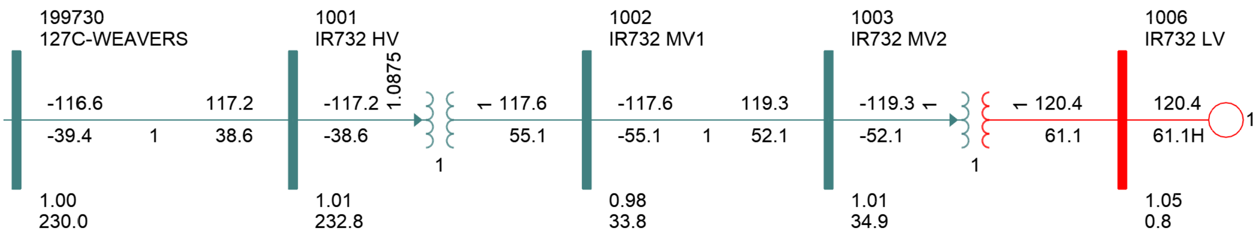
Figure 5: Power Factor Analysis




**SMIB case: Leading**



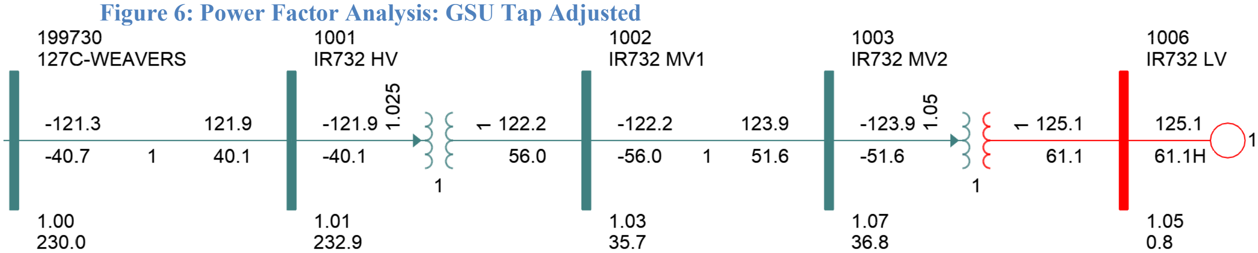

**SMIB case: Lagging Power Factor with 100% $P_{max}$**




**SMIB case: Lagging Power Factor with 80.3% $P_{max}$**

A sensitivity test was performed by adjusting the tap of the GSU. With a tap setting of 1.05, a 0.95 power factor lagging was obtained for 83.4% of Pmax.

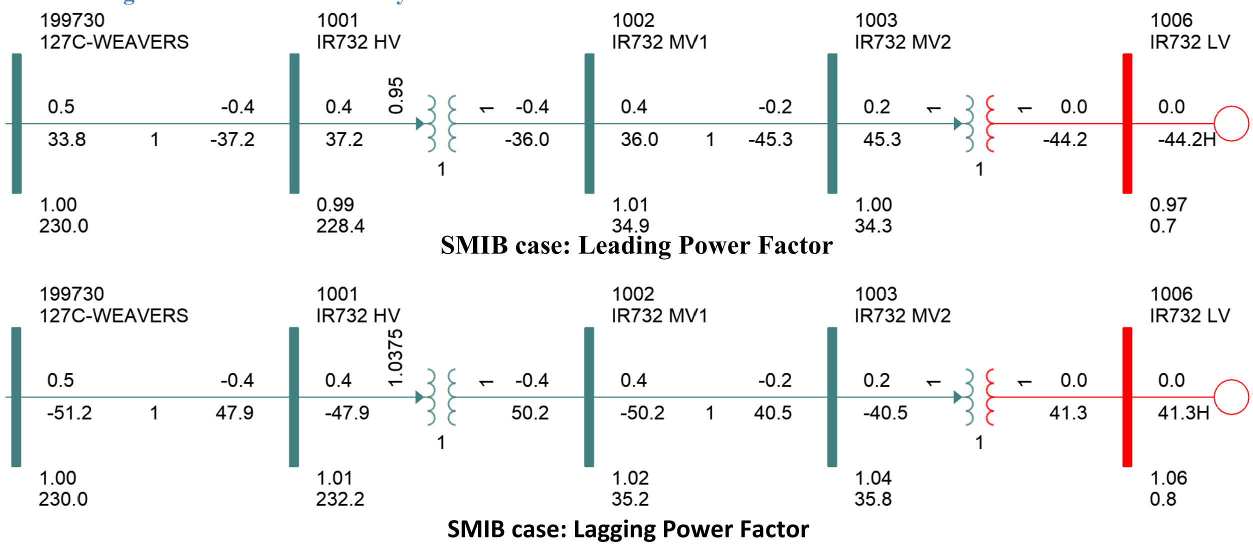
Figure 6: Power Factor Analysis: GSU Tap Adjusted




**SMIB case: Lagging Power Factor with 83.4% $P_{max}$**

A sensitivity test was performed with the wind turbine operating in STATCOM mode. In STATCOM mode, the reactive power limits are reduced.

Figure 7: Power Factor Analysis: STATCOM Mode




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). The SIS will state specific options, controls and additional facilities that are required to achieve this.

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.

# 9 Bulk Electric / Bulk Power Analysis

The 230 kV 127C-Weavers Mountain substation is part of the NPCC Bulk Power System (BPS). As such, all protection systems associated with the expansion of the ring bus POI substation must comply with NPCC Directory 4 System Protection Criteria.

Since the 127C-Weavers Mountain substation is currently classified as part of the NERC Bulk Electric System (BES), it is also subject to the applicable NERC Reliability Criteria. As IR#732 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.

# 10 Expected Facilities Required for Interconnection

The following facility changes will be required to connect IR#732 to the NSPI transmission system at the POI at 127C-Weavers Mountain under **NRIS**:

**a. Required Network Upgrades**

- Install a new 230 kV line terminal in the existing 127C-Weavers Mountain substation with control and protection. Modifications to the Remote Terminal Unit (RTU) to interface with NSPI's SCADA, with telemetry and controls as required by NSPI.
- Uprate of L-7003 from 275 MVA (Summer) to 357.5 MVA (Summer).
- Uprate of L-7024 from 275 MVA (Summer) to 357.5 MVA (Summer).

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

- Construct a 21.0 km, 230 kV transmission line between the POI and the ICIF substation. This line would be built to NSPI's 230 kV standards.
- Supervisory, control, and communications between the wind farm and NSPI SCADA system (to be specified).

The following facility changes will be required to connect IR#732 to the NSPI transmission system at the POI at 127C-Weavers Mountain under **ERIS**:

**a. Required Network Upgrades**

- Install a new 230 kV line terminal in the existing 127C-Weavers Mountain substation with control and protection. Modifications to the Remote Terminal Unit (RTU) to interface with NSPI's SCADA, with telemetry and controls as required by NSPI.

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

- Construct a 21.0 km, 230 kV transmission line between the POI and the ICIF substation. This line would be built to NSPI's 230 kV standards.
- Supervisory, control, and communications between the wind farm and NSPI SCADA system (to be specified).

The following will be required to connect IR#732 to the NSPI transmission system at the POI at 127C-Weavers Mountain under **NRIS or ERIS**:

### c. Required Interconnection Customer's Interconnection Facilities (ICIF)

- 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.
- Facilities to meet the requirement that rated reactive power be delivered from zero to full rated real power. Supplemental equipment will be required as noted in Section 8.
- Centralized controls. These will provide centralized voltage set-point controls and are known as Farm Control Units (FCU). The FCU will control the 34.5 kV bus voltage and the reactive output of the machines. Responsive (fast-acting) controls are required. The controls will also include a curtailment scheme which will limit or reduce total output from the facility, upon receipt of a telemetered signal from NSPI's SCADA system.
- NSPI will have control and monitoring of reactive output of this facility, via the centralized controller. This will permit the NSPI Operator to raise or lower the voltage set-point remotely.
- Low voltage ride-through capability per Section 7.4.1 of the TSIR.
- Real-time monitoring (including an RTU) of the interconnection facilities. Local wind speed and direction, MW and MVAr, as well as bus voltages are required.
- Facilities for NSPI to execute high speed rejection of generation (transfer trip) if determined in SIS. The plant may be incorporated into RAS run-back schemes.
- Automatic Generation Control to assist with tie-line regulation.
- Compliance with section 7.6.7 of TSIR, "WECS Generating Facilities 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." This item will be assessed in the SIS, which may identify additional resources such as synchronous condenser, Flexible AC Transmission System (FACTS) devices, etc.
- Operation at an ambient temperature of -30°C, section 7.6.9 of the TSIR.

- 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.
- The facility must meet NSPI's TSIR as published on the NSPI OASIS site.

# 11 NSPI Interconnection Facilities and Network Upgrades Cost Estimate

**NRIS Cost Estimate**

Estimates for NSPI Interconnections Facilities and Network Upgrades for interconnecting 150 MW wind energy at the 230 kV POI at 127C-Weavers Mountain are included in Table 8.

| **Table 8 Cost Estimate NRIS @ POI 127C-Weavers Mountain** | | |
|---|---|---|
| **Item** | **Network Upgrades** | **Estimate** |
| 1 | Install a new 230 kV line terminal in the existing 127C-Weavers Mountain substation with control and protection. Modification of Remote Terminal Unit (RTU) to interface with NSPI's SCADA, with telemetry and controls as required by NSPI | $2,500,000 |
| 2 | Thermal Uprate of L-7003 (98.6 km) | $136,068,000 |
| 3 | Thermal Uprate of L-7024 (11.8 km) | $16,284,000 |
| | Sub-total for Network Upgrades | $154,852,000 |
| **Item** | **TPIF Upgrades** | **Estimate** |
| 1 | Build 21 km 230 kV spur line from TPIF to ICIF, with IC responsible to provide right-of-way | $28,980,000 |
| 2 | NSPI P&C relaying equipment | $300,000 |
| 3 | NSPI supplied RTU | $100,000 |
| 4 | Tele-protection and SCADA communications | $750,000 |
| | Sub-total for TPIF Upgrades | $30,130,000 |
| | **Total Upgrades** | **Estimate** |
| | Network Upgrades + TPIF Upgrades | $184,982,000 |
| | Contingency (25%) | $46,245,500 |
| | Total (Incl. 25% contingency and Excl. HST) | $231,227,500 |

The preliminary non-binding cost estimate for interconnecting IR#732 at the POI at 127C-Weavers Mountain under NRIS is $231,227,500 including a contingency of 25%. In this estimate, $154,852,000 (plus 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 the GIP. This does not include costs to address any potential stability issues identified at the SIS stage based on dynamic analysis, costs related to findings of the electromagnetic transient (EMT) analysis.

The estimated time to construct the Transmission Providers Interconnection Facilities and the Network Upgrades is 24-36 months after receipt of funds and cleared right of way from the IC.

**ERIS Cost Estimate**

Estimates for NSPI Interconnections Facilities and Network Upgrades for interconnecting IR#732, capped at 58.0 MW for ERIS at the 230 kV POI at 127C-Weavers Mountain are included in Table 9.

| **Table 9 Cost Estimate ERIS @ POI 127C-Weavers Mountain** | | |
|---|---|---|
| **Item** | **Network Upgrades** | **Estimate** |
| 1 | Install a new 230 kV line terminal in the existing 127C-Weavers Mountain substation with control and protection. Modification of Remote Terminal Unit (RTU) to interface with NSPI's SCADA, with telemetry and controls as required by NSPI | $2,500,000 |
| | Sub-total for Network Upgrades | $2,500,000 |
| **Item** | **TPIF Upgrades** | **Estimate** |
| 1 | Build 21 km 230 kV spur line from TPIF to ICIF, with IC responsible to provide right-of-way | $28,980,000 |
| 2 | NSPI P&C relaying equipment | $300,000 |
| 3 | NSPI supplied RTU | $100,000 |
| 4 | Tele-protection and SCADA communications | $750,000 |
| | Sub-total for TPIF Upgrades | $30,130,000 |
| | **Total Upgrades** | **Estimate** |
| | Network Upgrades + TPIF Upgrades | $32,630,000 |
| | Contingency (25%) | $8,157,500 |
| | Total (Incl. 25% contingency and Excl. HST) | $40,787,500 |

The preliminary non-binding cost estimate for interconnecting IR#732 at the POI at 127C-Weavers Mountain under ERIS is $40,787,500 including a contingency of 25%. In this estimate, $2,500,000 (plus 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 the GIP. This does not include costs to address any potential stability issues identified at the SIS stage based on dynamic analysis, costs related to findings of the electromagnetic transient (EMT) analysis.

The estimated time to construct the Transmission Providers Interconnection Facilities and the Network Upgrades is 24-36 months after receipt of funds and cleared right of way from the IC.

## 12 Loss Factor

Loss factor is calculated by running the winter peak load flow case (WIN_01) with and without the new facility in service, while keeping 91H-Tufts Cove as the NS Area interchange bus. This methodology reflects the load center in and around 91H-Tufts Cove. A negative loss factor reflects a reduction in system losses.

The loss factor is calculated using the equation (01) and the data given in Table 10.

$$Loss\ Factor = \frac{(IR732_{POI} + TC_{withIR732}) - TC_{withoutIR732}}{IR732_{POI}} \tag{01}$$

**Table 10 Data for Loss Factor Calculation**

| Parameter/Measurement | Value (MW) |
|---|---|
| Power at POI of IR#732 | 145.4 |
| Power generation at TC with IR#732 | 16.4 |
| Power generation at TC without IR#732 | 148.3 |
| **Loss Factor** | **9.2 %** |

## 13 Preliminary Scope of Subsequent SIS

The following provides a preliminary scope of work for the subsequent SIS for IR#732.

The SIS will include a more comprehensive assessment of the technical issues and 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:

***NSPI-TPR-015-2: PSSE and PSCAD Model Requirements and NSPI-TPR-014-1: Model Quality Testing will undergo revision as the grid evolves and performance criteria changes. The most up to date version will be provided as they become available.***

***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 NSPI-TPR-015-2: PSSE and PSCAD Model Requirements, and***
- ***Provision of test data demonstrating model testing in compliance with NERC, NPCC and NSPI criteria. NSPI-TPR-014-1: Model Quality Testing 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 TPL-001-5.1.
- NSPI System Design Criteria, report number NSPI-TPR-003-6.

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[4] and NERC[5] criteria as well as NSPI guidelines and good utility practice. The SIS will also determine the contingencies for which this facility must be curtailed.

[4] NPCC criteria are set forth in its Reliability Reference Directory #1 Design and Operation of the Bulk Power System
[5] NERC transmission criteria are set forth in NERC Reliability Standard TPL-001-5.1