Interconnection Feasibility Study Report
GIP-IR638-FEAS-R2

Generator Interconnection Request 638
100 MW Wind Generating Facility
Hants County, NS

2022-04-09

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 for a proposed 100 MW wind generation facility interconnected to the NSPI transmission system, with a Commercial Operation Date of 2025-10-30. The Point of Interconnection (POI) requested by the customer is the 138kV line L-6011, approximately 7.4 km from 17V-St. Croix substation.

There are five transmission and three distribution Interconnection Requests in the Advanced Stage Transmission and Distribution Queue that must be included in the study models for IR#638. 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 (TSR-411). The TSR is expected to be in service in 2025 and a system 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:

Effective January 19th, 2021, please be advised that the completion of advanced-stage Interconnection Studies under the Standard Generator Interconnection Procedures (GIP) may be delayed pending the outcome of the Transmission Service Request (TSR) 411 System Impact Study, which is expected to identify significant changes to the NSPI transmission system. The revised expected completion date for the study is February 28, 2022. Feasibility Studies initiated prior to the completion of the TSR System Impact Study will be performed based on the current system configuration.

This study assumes that the addition of generation from IR#638 will displace coal-fired generation in eastern Nova Scotia for both NRIS and ERIS.

Interconnection with line L-6011 will be a direct line tap with transfer trip protection to the generation facilities. This will require a circuit breaker at IC substation 138 kV side. As IR#638 has dispersed generation totalling more than 75 MVA, each generator will be classified as a NERC Bulk Electric System (BES) element. The 34.5 kV bus and the 138kV bus would also be considered BES. There is the potential for an exclusion from BES to be granted for the high side (138kV) bus based on further analysis as per the NS BES Exception Procedure. This analysis will be initiated as part of the System Impact Study (SIS) and exclusion from BES will only be granted upon subsequent approval by the Nova Scotia Utility and Review Board.

No violations of thermal or voltage criteria were found for IR#638.

Data provided by the IC indicated that IR#638 will be utilizing the Siemens Gamesa SG 5.0-145 wind turbines. Based on the typical impedances of the transformers and typical collector circuit impedances, IR#638 would not be able to meet the net power factor of +0.95 to -0.95 at the Interconnection Facility 138kV bus. As specific details of the collector circuits become available, the adequacy of reactive power supply will be further investigated in the System Impact Study. It is noted that the proposed Siemens Gamesa SG 5.0-145 models do not meet the requirement to produce full Mvar capability down to zero MW output.

IR#638 was not found to adversely impact the short-circuit capabilities of existing circuit breakers. It is assumed that the project design meets NSPI requirements for low-voltage ride-through and voltage control. Harmonics must meet the Total Harmonics Distortion provisions of IEEE 519. The minimum short circuit level at the Interconnection Facility 138 kV bus is 967 MVA with all lines in service which corresponds to a short-circuit ratio of 9.7, and 701 MVA with L-6011 open at 120H-Brushy Hill which corresponds to a short-circuit ratio of 7.0.

The total system losses decrease by 0.1 MW with IR#638 in-service, the preliminary value for the unit loss factor is calculated as -0.1% at the POI at L-6011, net of any losses on the IC facilities up to the POI.

The preliminary non-binding cost estimate for interconnecting 100 MW to the POI at L-6011, including the cost of the protection upgrades at each end of L-6011 to the Interconnection Customer's Interconnection Facility is $1,441,000. In this estimate, $550,000 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.

The cost estimates include a contingency of 10%, and this estimate will be further refined in the System Impact Study and the Facility Study.

The estimated time to construct the Transmission Providers Interconnection Facilities and any Network Upgrades is 18-24 months after receipt of funds from the customer.

Table of Contents

1 Introduction

The Interconnection Customer (IC) submitted a Network Resource Interconnection Service (NRIS) and Energy Resource Interconnection Service (ERIS) Interconnection Request for a proposed 100 MW wind generation facility interconnected to the NSPI transmission system, with a Commercial Operation Date of 2025-10-30. The Point of Interconnection (POI) requested by the customer is the 138kV line L-6011, approximately 7.4 km from 17V-St. Croix substation.

The IC signed a Feasibility Study Agreement to study the connection of their proposed generating facility to the NSPI transmission system dated 2021-10-15, and this report is the result of that Study Agreement. This project is listed as Interconnection Request 638 in the NSPI Interconnection Request Queue and will be referred to as IR#638 throughout this report.

Figure 1 shows the proposed geographic location of IR#638 in relation to the NSPI transmission system.

Figure 1 IR#638 Site Location

Figure 2 is a simplified one-line diagram of the transmission system configuration in Valley NS. Figure 3 shows the circuit breaker configuration of transmission lines in the vicinity of the POI.

Figure 2 Point of Interconnection (not to scale)

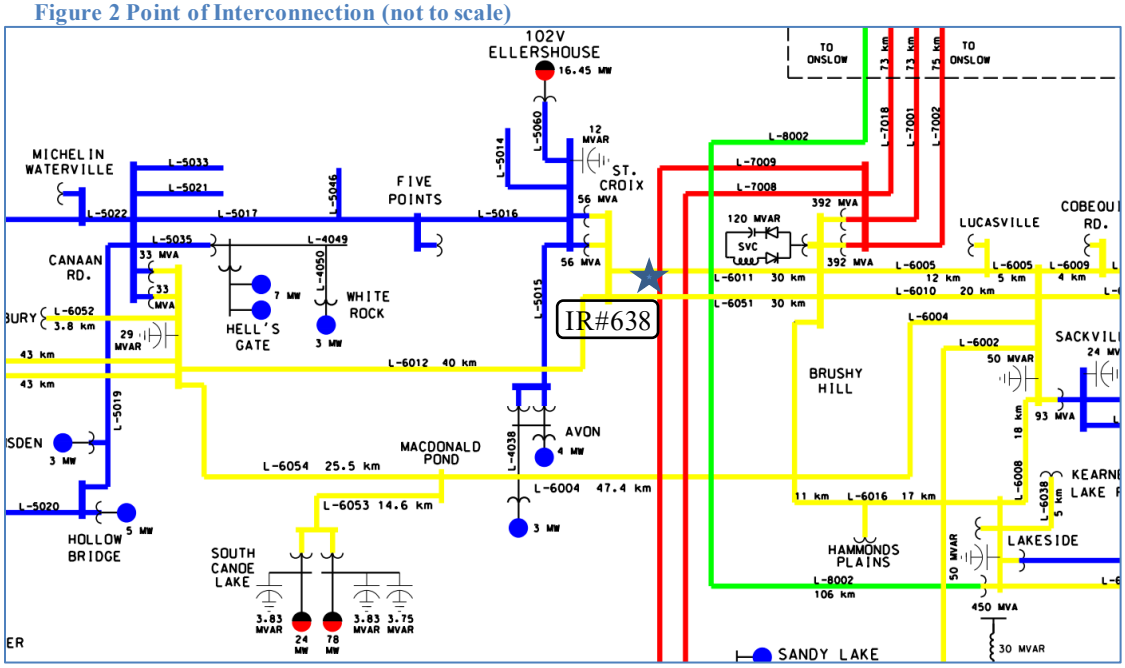
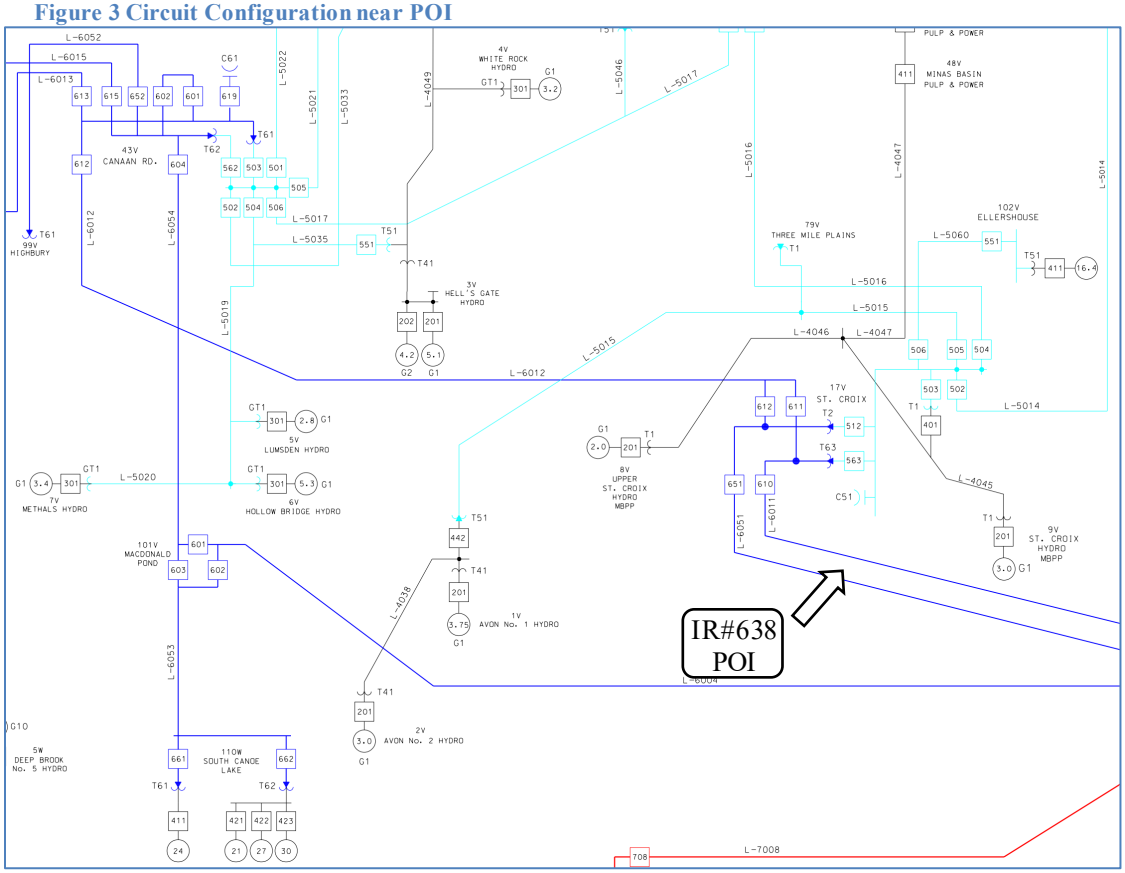


Figure 3 Circuit Configuration near POI



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 the short circuit issues associated with the IR. Expected minimum short circuit capability will also be identified for the purposes 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 transmission elements. Voltage violations occur when the post-contingency transmission bus voltage is outside the range of +/-10% of 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#638 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

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

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 is studied as follows:

1. NRIS and ERIS as per section 3.2 of the Generator Interconnection procedures (GIP).

2. Commercial Operation date 2025-10-30.

3. The Interconnection Customer Interconnection Facility (ICIF) consists of up to 20 Wind Energy Converter System (WECS) units; Siemens Gamesa SG 5.0-145 Type 3 DFIG generator units, each rated at 5.0 MW AC; for a total of 100 MW, connected to collector circuits operating at a voltage of 34.5kV.

4. In accordance with Table 8 of the TSIR, the POI on L-6011 can utilize a direct line tap with transfer trip protection to the generation facilities. The ICIF will require a 138kV circuit breaker.

5. The ICIF is adjacent to the 138 kV transmission right-of-way (50 m) and therefore will not need a spur line from the POI to the IC 138kV/34.5kV transformers.

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 IC substation interconnection facility. The 138kV/34.5kV station transformers is rated at 67/89/111 MVA and modeled with a positive-sequence impedance of 9.0% on 67 MVA with an X/R ratio of 45. The IC indicated that these interconnection facility transformers have a wye-wye-delta winding configuration with +/-10% off-load tap changer with five steps. The impedance of each generator step-up transformer is 8.77% on 5.5 MVA with an assumed X/R ratio of 12.

8. Detailed collector circuit data was not provided, so typical data (R+jX = 0.01+j0.04 p.u. 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. The FEAS analysis assumes that IR's higher in the Generation Interconnection Queue and OATT Transmission Service Queue that have completed a System Impact Study, or that have a System Impact Study in progress will proceed, as listed in Section 4 below.

10. Although the generator information package indicated a minimum ambient temperature for operation of -20°C, it is assumed that the wind turbines are equipped with a "cold weather option" suitable for delivering full power under expected Nova Scotia winter environmental conditions specified in the TSIR as -30°C

11. Planning criteria meeting NERC Standard TPL-001-4 *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.

12. The rating of transmission facilities in the vicinity of IR#638 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-6054	556.5 Dove	75°C	Conductor	174/191 MVA	210/231 MVA
L-6011	556.5 Dove	100°C	Conductor	215/237 MVA	242/266 MVA
L-6051	795 Drake	100°C	Conductor	268/295 MVA	287/316 MVA
L-6004	556.5 Dove	75°C	Conductor	174/191 MVA	210/231 MVA
L-6013	556.5 Dove	100°C	Conductor	215/237 MVA	242/266 MVA
L-6012	556.5 Dove	100°C	Conductor	215/237 MVA	242/266 MVA

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 2021-10-25, 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
- IR574: FAC complete

- IR598: FAC in progress

The following projects have been submitted to the Transmission Service Request (TSR) Queue:

- TSR411: SIS in progress

TSR-411 is a long-term firm point-to-point transmission service reservation in the amount of 550 MW from New Brunswick to Nova Scotia; The TSR is expected to be in service in 2025 and a system study is currently underway to determine the required upgrades to the Nova Scotia transmission system. As a result, the following notice has been posted to the OASIS site at https://www.nspower.ca/oasis/generation-interconnection-procedures:

> *Effective January 19th, 2021, please be advised that the completion of advanced-stage Interconnection Studies under the Standard Generator Interconnection Procedures (GIP) may be delayed pending the outcome of the Transmission Service Request (TSR) 411 System Impact Study, which is expected to identify significant changes to the NSPI transmission system. The revised expected completion date for the study is February 28, 2022. Feasibility Studies initiated prior to the completion of the TSR System Impact Study will be performed based on the current system configuration.*

5 Short-Circuit Duty / Short Circuit Ratio

The maximum expected (design) short-circuit level is 5,000 MVA (21 kA) on 138kV systems and 3,500 MVA (31.5 kA) on 69 kV system. The fault current characteristic for this Siemens Gamesa SG 5.0-145 WTG is X'd = 0.82 per unit on machine base MVA as indicated on the IC, which is equivalent to 1.2 times rated current.

Short circuit analysis was performed using PSS®E for a classical fault study, 3LG and flat voltage profile at 1.0 p.u. V. The short-circuit levels in the area before and after this development are provided below in Table 2.

Table 2: Short-Circuit Levels. IR#638 on L-6011 Three-phase MVA (1)

Location	Without IR#638	With IR#638
All transmission facilities in service		
POI on L-6011 (138kV)	1790	1894
Interconnection Facility (138kV)	1790	1894
120H-Brushy Hill (230kV)	3491	3546
120H-Brushy Hill (138kV)	3453	3541
17V-St.Croix (138kV)	1855	1932
17V-St.Croix (69kV)	844	857

Minimum Conditions (PA, LG1, ML In-Service)		
Interconnection Facility (138 kV), all lines in-service	967	1071
Interconnection Facility (138kV), L-6011 open at 17V	771	875
Interconnection Facility (138kV), L-6011 open at 120H	701	805

(1) Classical fault study, flat voltage profile

The interrupting capability of the 69 kV circuit breakers is at least 1600 MVA at 17V-St. Croix. The interrupting capability of the 138 kV circuit breakers is at least 5000 MVA at 17V-St. Croix and 120H-Brushy Hill. The interrupting capability of the 230 kV circuit breakers is at least 10,000 MVA at 120H-Brushy Hill. As such, the interrupting rating at these substations will not be exceeded by this development on its own.

Inverter-based generation installations often have a minimum Short Circuit Ratio (SCR) for proper operation of converters and control circuits. Based on the calculated short circuit levels, a POI on L-6011, and a 100 MW installation consisting of 20 units each at 5.0 MW, the short circuit ratio would be 9.7 at the 138kV Interconnection Facility of the IR#638 substation with all lines in service and IR#638 offline. This falls to 7.7 with L-6011 open at 17V-St. Croix, and 7.0 if L-6011 is open at 120H-Brushy Hill.

6 Voltage Flicker and Harmonics

Flicker coefficient information was not provided for the Siemens Gamesa SG 5.0-145 machine. Voltage flicker will be further examined when data for the machine is made available for the SIS.

The generating facility 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 138 kV.

7 Load Flow Analysis

The load flow analysis was completed for generation dispatches under system summer peak load and winter peak load conditions which are expected to stress the east-west corridor across the transmission interfaces Cape Breton Export (CBX) and Onslow Import (ONI). Generation dispatch was also chosen to represent import and export scenarios that consider expected flows from the existing transmission service reservation associated with the Maritime Link, and scenarios where Maritime Link imports displace NS thermal generation.

Transmission connected wind generation facilities were typically dispatched at approximately 40%, except in the vicinity of IR#638. There is high co-relation between wind plants in the valley area, so it is reasonable to expect that these other wind plants would be near full output when IR#638 is at rated output. The cases and dispatch scenarios considered are shown in Table 3.

Table 3: Base Case Dispatch (MW) IR#638 On-Line

Case	MLI	NS-NB	CBX	ONI	LIN	TRE	Wind	Valley Import
SP02	452(1)	0	267	210	0(1)	0	359	16
SP04	475	330	749	674	168	0	456	124
WP02	320	175	841	1,068	351	324	525	187

S - Summer W - Winter LIN – Lingan Gen TRE – Trenton Gen
(1) IR#638 displaces 62 MW of Lingan, 22 MW of Tupper, and 13 MW MLI

For both NRIS and ERIS analysis, this FEAS added IR#638 and displaced coal-fired generation in Cape Breton, reducing Cape Breton Export (CBX) transfers and Onslow Import (ONI) transfers. Single contingencies were applied at the 230 kV, 138 kV and 69 kV voltage levels for the above system conditions with IR#638 interconnected to the POI at L-6011. Automated analysis searched for violations of emergency thermal ratings and emergency voltage limits for each contingency. Contingencies studied are listed in Table 54.

Table 4 Contingency List

Transmission Line	Transformer / Bus	Circuit Breaker Failure	Double Circuit Tower
L-7008, L-7009, L-5545, L-5546, L-6531, L-6006, L-6025, L-6002	99W: T61, T71, T72	90H: 611, 608, 605, 602, 612, 609, 606, 603, 610, 607, 601, 503, 506, 501	L-7008+ L-7009 L-7009+ L-8002
L-6012, L-6013, L-6054, L-6015, L-6052, L-6052, L-5017, L-5022, L-5035, L-5019, 50V-Load (138kV),	43V- T61, T62,	120H: 710, 711, 712, 713, 714, 715, 716, 720, 621, 622, 623, 624, 626, 627, 628, 629	L-6005+ L-6016 L-6011+ L-6010 L-6005+ L-6016
L-6051, L-6011, L-5014, L-5060, L-5015, L-5016	17V-T2, T63, T1		
L-5025*, L-6053, L-6004	51V- T61*, B51*, B52, B61		
L-5531, L-5532*, L-5026*	13V- B51, 11V-B51*		
L-6002, L-6009, L-6008, L-6003, L-5003, L-5004	90H: T1		
L-6005, L-6010, L-6011	120H: T71, T72		

*Indicates contingency was studied with/without RAS action

Results

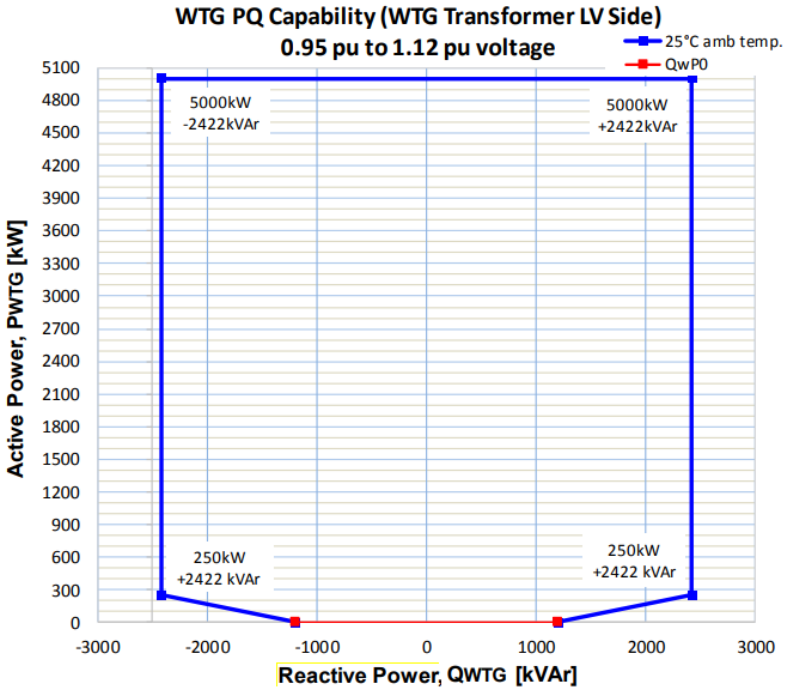
The study shows no contingencies resulted in a violation of thermal or voltage limit criteria.

8 Reactive Power and Voltage Control

In accordance with the *Transmission System Interconnection Requirements* Section 7.6.2, IR#638 must be capable of delivering reactive power at 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 the asynchronous generator or by continually acting auxiliary devices such as STATCOM, DSTATCOM or synchronous condenser, supplied by the Interconnection Customer.

The information (Figure 4) provided by Siemens indicates that the Siemens Gamesa SG 5.0-145 at 60 Hz have a rated power factor of 0.90 lagging and leading at the machine terminal voltage between 0.95 p.u. and 1.12 p.u., from 5% to 100% of rated power. However, the NSPI Transmission System Interconnection Requirements (Section 7.6.2) requires that rated reactive power shall be available through the full range of real power output of the Generating Facility, from zero to full power. It is noted that the proposed SG 5.0-145 models do not meet the requirement to produce full Mvar capability from 5% of rated power down to zero MW output.

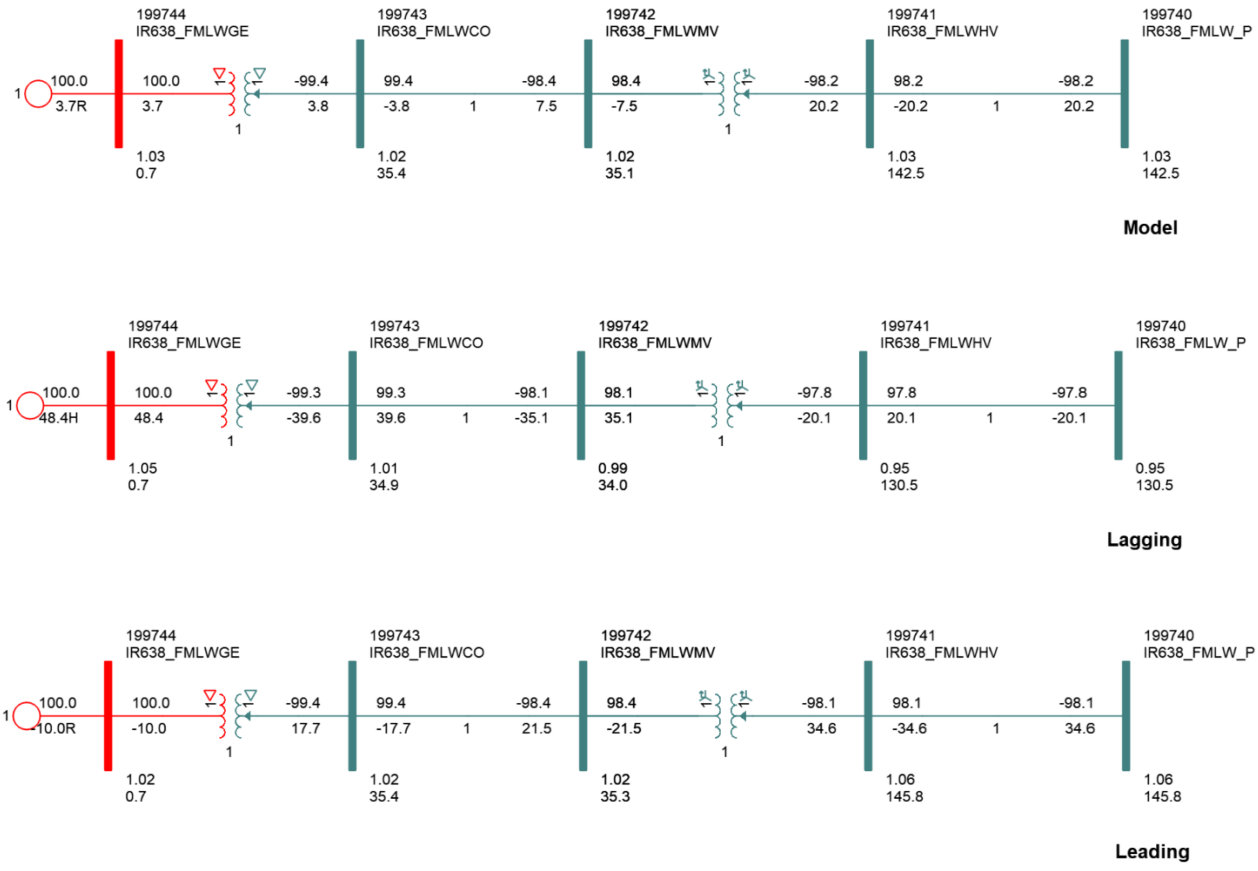
Figure 4: SG 5.0-145 Model WTG Reactive Capability



The analysis shown in Figure 5 indicates that IR#638 may not be able to meet the full-load reactive power requirement. The model shows that with SG 5.0-145 WTG units operating at a total 100 MW and 48.4 Mvar (maximum), the delivered power to the high side of the ICIF transformers is 97.8 MW and 20.1 Mvar, or a power factor of 0.98 with SG 5.0-145 terminal voltage at 1.05 p.u.

This configuration would be able to meet the leading power factor requirement of -0.95 at the high side of ICIF transformer while the SG 5.0-145 are operating at a total of 100 MW and -10.0 Mvar at a terminal voltage of 1.02 p.u.

Figure 5: Power Factor Analysis



Because this analysis is based on preliminary transformer data and assumed collector circuit models, reactive capability will be confirmed in the SIS.

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 also have the ability to 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.

9 System Security / Bulk Power Analysis

Although L-6011 is presently classified as Bulk Power System (BPS), that status only applies to the 120H-Brushy Hill terminal and not the entire line. Therefore, the POI on L-6011 will be a direct line tap with transfer trip protection to the IR#636 generation facilities. Since IR#636 has dispersed generation totalling more than 75 MVA, Inclusion I4 of the NERC BES Definition would apply, and each generator would be classified as a BES element. The 34.5 kV bus and the 138kV bus would also be considered BES. There is the potential for an exclusion from BES to be granted for the high side (138kV) bus based on further analysis per the NS BES Exception Procedure. This analysis will be initiated as part of the System Impact Study (SIS) and exclusion from BES will only be granted upon subsequent approval by the Nova Scotia Utility and Review Board.

10 Expected Facilities Required for Interconnection

The following facility changes will be required to connect IR#638 to the NSPI transmission system at a POI on L-6011 under both NRIS and ERIS:

a. Required Network Upgrades

- Modification of NSPI protection systems to L-6011 at 17V- St Croix and 120H-Brushy Hill to three-terminal line protection.

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

- Construct a 138kV line tap with transfer trip at the POI on L-6011

- Add control and communications between the wind farm and NSPI SCADA system (to be specified).

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

- Facilities for NSPI to execute high speed rejection of generation (transfer trip) with a circuit breaker at IC substation 138 kV side. The plant may be incorporated into RAS run-back schemes.
- 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. This study shows that Siemens Gamesa 5.0-145 models may not be able to meet this requirement. The data provided did not meet the requirement that rated reactive power be delivered from zero to full rated real power.
- 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 as per Section 7.4.1 of the Nova Scotia Power Transmission System Interconnection Requirements (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.
- Synthesized inertial response controls within the WECS.
- Automatic Generation Control to assist with tie-line regulation.
- Operation at ambient temperature of -30°C.

11 NSPI Interconnection Facilities and Network Upgrades Cost Estimate

Estimates for NSPI Interconnections Facilities and Network Upgrades for interconnecting 100 MW wind energy at the 138 kV POI on L-6011 are included in Table 5.

Table 5 Cost Estimate NRIS & ERIS @ POI L-6011		
Item	**Network Upgrades**	**Estimate**
1	Modification of protection systems to L-6011 at 120H- Brushy Hill and 17V-St. Croix to three-terminal line protection	$500,000
	Sub-total for Network Upgrades	$500,000
Item	**TPIF Upgrades**	**Estimate**
1	Direct line tap with protection, with the provision that the ICIF includes a high-side switching device for transfer-trip from L-6011 line protection	$500,000
2	NSPI P&C relaying equipment	$100,000
3	NSPI supplied RTU	$60,000
4	Tele-protection and SCADA communications	$150,000
	Sub-total for TPIF Upgrades	$810,000
	Total Upgrades	**Estimate**
	Network Upgrades + TPIF Upgrades	$1,310,000
	Contingency (10%)	$131,000
	Total (Incl. 10% contingency and Excl. HST)	$1,441,000

The preliminary non-binding cost estimate for interconnecting 100 MW at the POI at L-6011 under both NRIS and ERIS is $1,441,000 including a contingency of 10%. In this estimate, $500,000 (plus 10% 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 TBD costs to address any stability issues identified at the SIS stage based on dynamic analysis.

The estimated time to construct the Network Upgrades and Transmission Providers Interconnection Facilities is 18-24 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 with and without the new facility in service while keeping 91H-Tufts Cove as the Nova Scotia Area Interchange bus. This methodology reflects the load centre in and around Metro.

Without IR#638 in service, losses in the winter peak case total 86.2 MW. With IR#638 in service at the POI of L-6011, displacing generation at 91H, and not including losses associated with the IR#638 Generation Facilities or TPIF Interconnection Facilities, the system losses total is 86.1 MW- a decrease of 0.1 MW. The power delivered to the POI is 98.2 MW, therefore the loss factor is calculated as -0.1/98.2 = -0.1%.

13 Issues to be addressed in SIS

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, ride through, 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, frequency response, 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 outline provides the minimum scope that must be complete in order to assess the impacts. It is recognized that the actual scope may deviate to achieve the primary objectives.

The assessment will consider but not be limited to the following:

- Contingency analysis for both steady state and system stability.
- Ride-through and operation following a contingency (n-1 operation).
- The minimum transmission and substation additions/upgrades that are necessary to permit operation of this generating facility, under all dispatch conditions, catering to, at a minimum, the first contingencies listed below.
- Options and ancillary equipment that the customer must install to control flicker, voltage and ensure that the required ride-through capability.
- Identify guidelines and restrictions applicable following a first contingency (curtailments, etc.).
- Loss Factor.
- Determination of BPS designation.

- Changes to SPS schemes required for operation of this generating facility.
- Under-frequency load shedding.
- Facilities that the customer must install to meet the requirements of the GIP.

Parameters for a generic model must be supplied for transient analysis in PSS/e.

The SIS will determine the facilities required to operate this facility at full capacity, withstand the contingencies as defined by NPCC/NERC and identify any restrictions that must be placed on the system following a first contingency loss. The SIS will be conducted with the assumption that all projects higher queued will proceed and the facilities associated with those projects are installed.

Any changes to SPS 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 all NERC and NPCC criteria approved by the UARB as well as NSPI guidelines and good utility practice. The SIS will also determine the contingencies for which this facility must be curtailed.

A thorough assessment will be provided to ensure that the facilities will meet applicable NSPI, NPCC and NERC transmission design criteria.

Nova Scotia Power
Transmission System Operations
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