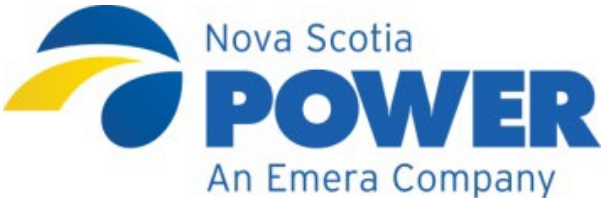

Interconnection Feasibility Study Report
GIP-IR646-FEAS-R0

Generator Interconnection Request 646
16.68 MW Wind Generating Facility
Cape Breton, NS

2022-04-20

Control Centre Operations
Nova Scotia Power Inc.

Executive Summary

The Interconnection Customer (IC) submitted an Interconnection Request (Network Resource Interconnection Service (NRIS) and Energy Resource Interconnection Service (ERIS)) for a 16.68 MW wind generation facility interconnected to the NSPI transmission system, with a Commercial Operation Date of 2023-12-31. The Point of Interconnection (POI) requested by the customer is the 69kV line L-5573, approximately 4.18 km from 2S-Victoria Junction 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#646. 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#646 will displace coal-fired generation in eastern Nova Scotia for both NRIS and ERIS.

Interconnection with line L-5573 will require direct line tap with transfer trip protection for the IR#646 generation facility. IR#646 is not categorized as NERC Bulk Electric System (BES) since it is connected at < 100 kV. Final NPCC Bulk Power System determination analysis will be performed in the SIS.

No violations of thermal or voltage criteria were found for IR#646.

Data provided by the IC indicated that IR#646 will be utilizing the Enercon E160 EP5 E3 FT option. Based on the typical impedances of the transformers and typical collector circuit impedances, IR#646 would not be able to meet the net power factor of +0.95 to -0.95 at the Interconnection Facility 69 kV bus. The adequacy of reactive power supply will be further investigated in the System Impact Study as specific details of the collector circuits become available. It is noted that the proposed Enercon E160 EP5 models do not meet the requirement to produce full Mvar capability down to zero MW output.

IR#646 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 69 kV bus is 595 MVA with all

lines in service which corresponds to a short-circuit ratio of 35.7, and 462 MVA with 2S-T2 out of service which corresponds to a short-circuit ratio of 27.7.

The preliminary value for the unit loss factor is calculated as +9.7% at the POI at L-5573, net of any losses on the IC facilities up to the POI.

The preliminary non-binding cost estimate for interconnecting 16.68 MW to the POI at L-5573 is $1,039,500. The cost estimates include a contingency of 10%, In this estimate, $100,000 (plus 10% contingency) of the amount represents Network Upgrade costs which are funded by the Interconnection Customer, but eligible for refund under the terms of the GIP. The remainder of the costs are fully funded by the Interconnection Customer.

The estimated time to construct the Transmission Providers Interconnection Facilities and any Network Upgrades is 18-24 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

The Interconnection Customer (IC) submitted an Interconnection Request for Network Resource Interconnection Service (NRIS) and Energy Resource Interconnection Service (ERIS) for a 16.68 MW wind generation facility interconnected to the NSPI transmission system, with a Commercial Operation Date of 2023-12-31. The Point of Interconnection (POI) requested by the customer is the 69kV line L-5573, approximately 4.18 km from the 2S-Victoria Junction substation.

The IC signed a Feasibility Study Agreement to study the connection of their proposed generating facility to the NSPI transmission system dated 2021-10-25, and this report is the result of that Study Agreement. This project is listed as Interconnection Request 646 in the NSPI Interconnection Request Queue and will be referred to as IR#646 throughout this report.

Figure 1 shows the proposed geographic location of IR#646 in relation to the NSPI transmission system.

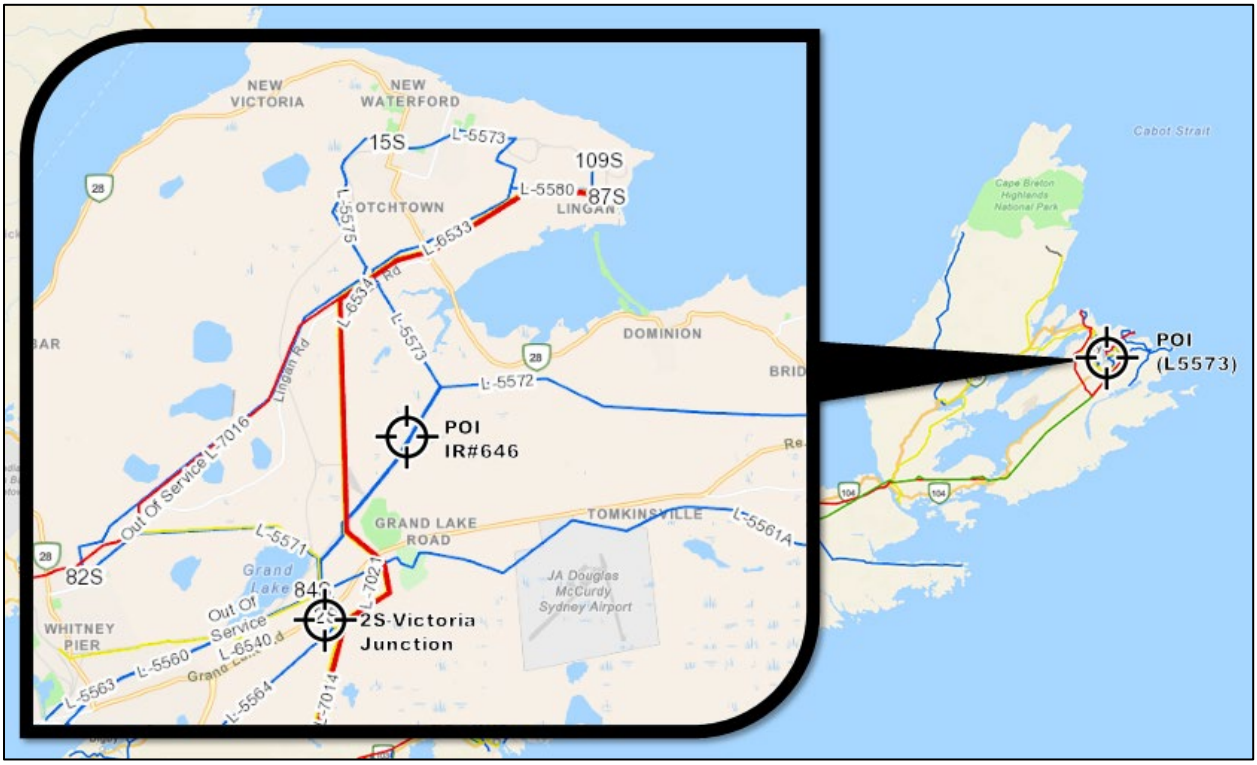

Figure 1 IR#646 Site Location

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

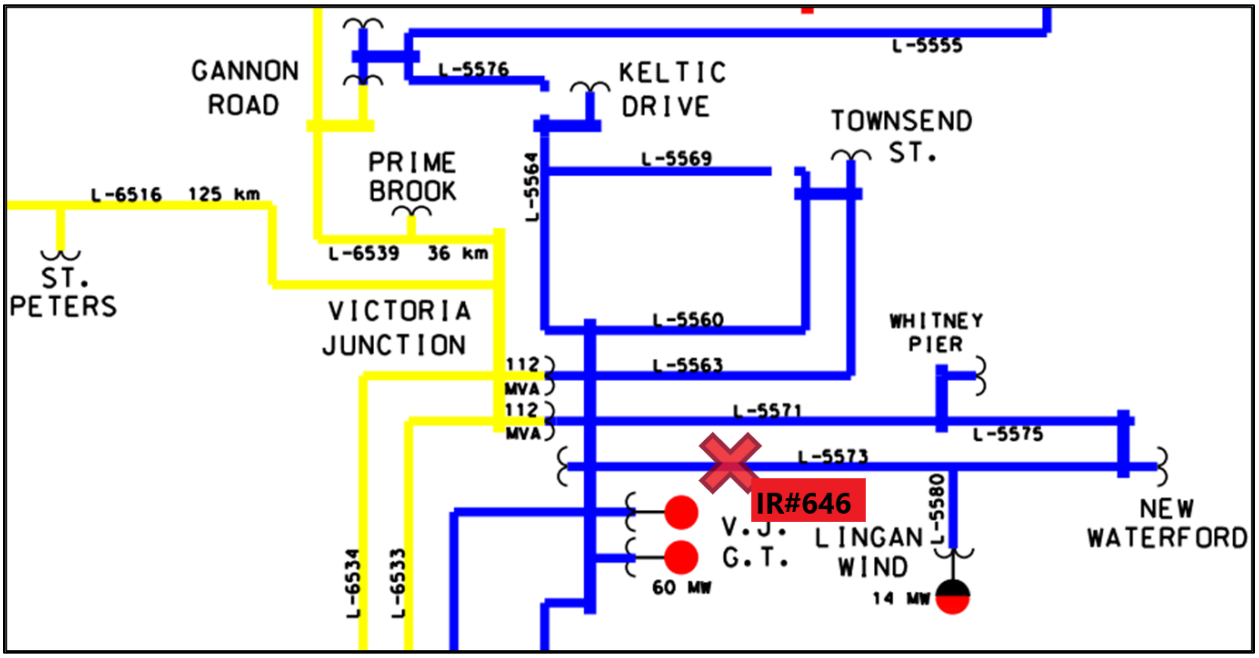

Figure 2 Point of Interconnection (not to scale)

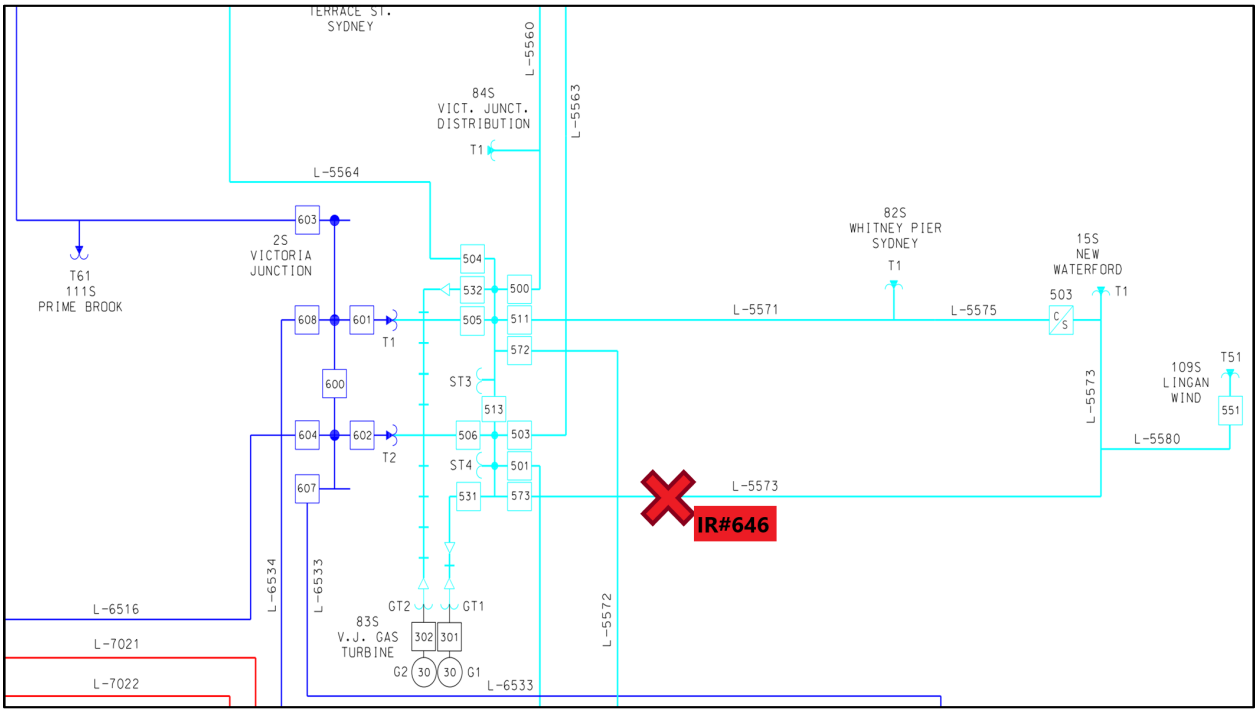

Figure 3 Circuit Configuration near POI

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 because 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#646 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.

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

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 2023-12-31.

3. The Interconnection Customer Interconnection Facility (ICIF) consists of up to 3 Enercon E-160 EP5 E3 generator units (FT option), each rated at 5.56 MW AC; capped at a total of 16.68 MW, connected to collector circuits operating at a voltage of 25 kV.

4. The interconnection configuration for the POI on L-5573 will be a direct line tap with transfer trip protection to the generation facilities, based on the distance from the POI to the IC's facility in the following assumption.

5. The ICIF will require the construction of a 0.3 km 69 kV transmission tap line from the POI to the IC 69kV/25kV transformer based on the map provided by the IC. The IC is responsible for providing the Right-of-Way for the lines. Detailed line data was not provided, so typical data was assumed based on 4/0 Penguin conductor and 50°C.

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 69kV/25kV station transformer is rated at 6.6/13.2/20 MVA and modeled with a positive-sequence impedance of 7.0% on 6.6 MVA with an assumed X/R ratio of 40. The IC indicated that these interconnection facility transformers have a wye-wye-delta winding configuration with +/-10% on-load tap changer. The impedance of each generator step-up transformer was not provided by the IC and is assumed as 9.9% on 6.35 MVA with an X/R ratio of 12.14.

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. The Interconnection Request document indicate that the summer winter rating is based on ambient temperature of +/-40°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.

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#646 are shown in Table 1.

Table 2 Local Transmission Element Ratings

Line	Conductor	Design Temp	Limiting Element	Summer Rating Normal/Emergency	Winter Rating Normal/Emergency
L-5573	336.4 Linnet	50°C	Conductor	41/45 MVA	60/66 MVA
L-5573-2	336.4 Linnet	50°C	Conductor	31/34 MVA	45/50 MVA
L-5571	336.4 Linnet	60°C	Conductor	51/56 MVA	61/74 MVA
L-5564	556.5 Dove	50°C	Conductor	55/60 MVA	72/79 MVA
L-5560	336.4 Linnet	50°C	Conductor	41/45 MVA	60/66 MVA
L-5572	336.4 Linnet	50°C	Conductor	41/45 MVA	60/66 MVA
L-5561a	Copper 2/0 Cu	50°C	Conductor	29/32 MVA	42/46 MVA
L-5561b	336.4 Linnet	50°C	Conductor	41/45 MVA	60/66 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
- TSR412: Withdrawn

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

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 3.

The fault current characteristic for this Enercon E-160 EP5 WECS is assumed as 1.2 times rated current, or X'd = 0.8307 per unit on machine base MVA.

Table 3: Short-Circuit Levels. IR#646 on L-5573 three-phase MVA (1)

Location	Without IR#646	With IR#646
All transmission facilities in service		
POI on L-5573 (69 kV)	962	979
Interconnection Facility (69 kV)	961	978
88S-Lingan (230 kV)	3,862	3,871
88S-Lingan (138 kV)	2,021	2,028
88S-Lingan (138 kV)	2,029	2,036
2S-Victoria Junction (138 kV)	2,155	2,169
2S-Victoria Junction (69 kV)	1,335	1,352
Minimum Conditions (TC3, TC1, ML In-Service)		
Interconnection Facility (69 kV), all lines in-service	595	611

Interconnection Facility (69 kV), transformer 2S-T2 OOS	462	479
Interconnection Facility (69 kV), L-6533 or L-6534 open at 2S	530	547

(1) Classical fault study, flat voltage profile

The interrupting capability of the 230 kV circuit breakers is at least 10,000 MVA at 88S-Lingan. The interrupting capability of the 138 kV circuit breakers is at least 3,500 MVA at 2S-Victoria Junction. The interrupting capability of the 69 kV circuit breakers is at least 2,500 MVA at 2S-Victoria Junction. 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 and data supplied by the IC, the SCR would be 35.7 at the 69kV Interconnection Facility of the IR#646 substation with all lines in service and IR#646 offline. This falls to 27.7 with 2S-T2 out of service, and 31.8 if L-6533 or L-6534 is open at 2S end.

6 Voltage Flicker and Harmonics

Flicker coefficient information was not provided for the E-160 EP5 E3 machine. However, Type 4 wind turbines typically have a flicker coefficient of 2.0 - 2.4 at angle of 85°, which is about half that of Type 3 machines. 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 5.0%, with no individual harmonic exceeding 3.0% on 69 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#646. It is reasonable to expect that neighbouring plants would be near full output when IR#646 is at rated output. The cases and dispatch scenarios considered are shown in Table 4.

Table 4: Base Case Dispatch (MW) IR#646 On-Line								
Case	NSX	CBX	ONI	ONS	MLI	LIN	TRE	Wind
LL01	230	357	451	174	170	0	135	113
LL02	225	356	450	177	170	0	135	113
SP01	330	934	989	566	475	266	160	221
SP02	330	905	962	539	475	275	160	221
SP03	330	896	954	531	475	307	160	221
WP01	150	1058	1177	847	320	453	324	119
WP02	0	787	949	789	320	377	324	221
S - Summer W - Winter LIN – Lingan Gen TRE – Trenton Gen								

For both NRIS and ERIS analysis, this FEAS added IR#646 and displaced coal-fired generation in Cape Breton. Single contingencies were applied at the 230 kV, 138 kV and 69 kV voltage levels for the above system conditions with IR#646 interconnected to the POI at L-5573. Automated analysis searched for violations of emergency thermal ratings and emergency voltage limits for each contingency. Contingencies studied are listed in Table 5.

Table 5 Contingency List			
Transmission Line	**Transformer / Bus**	**Circuit Breaker Failure**	**Double Circuit Tower**
L-7014, L-7021, L-7022	88S: T71, T72	88S: 710, 711, 713, 690, 721, 722, 723*	L-6534 + L-7021
L-7011, L-7012, L-7015, L-8004*	101S: T81, T82	101S: 701, 702, 703, 704, 705, 706, 711, 712, 713, 811, 812*, 813*, 814, 816	
L-6515, L-6516, L-6537*	2C: B61, B62	4C: 620, 621, 622, 623	
L-7003, L-7004, L-7005, L-7019	3C-T71, 3C-T72	3C: 710, 712, 713, 715, 716, 711, 714	L-7003+L-7004* Canso Causeway
L-6503, L-6613	1N: B61, B62	1N: 600, 613	
L-8001*, L-8002	67N: T71, T81	67N: 701, 702, 7-3, 705, 711, 712, 713, 811*, 812, 813, 814*, 815*	L-7003+L7004 Trenton area
L-6507, L-6508, L-8003*	79N: T81*	79N: 601*, 606*, 803*, 810*	
L-6537, L-6538*, L-6539	91N: B71	91N: 701, 702, 703 5S: 606, 607	
L-5561, L-5572, L-5573, L-5571, L-5564, L-5563, L-5560, L-6539, L-6516,	2S: T1, T2, GT1, GT2	2S: 573, 501, 511, 500, 602, 607, 604, 603, 601, 608	

*Indicates contingency was studied with/without RAS action

Results

The study shows no contingencies resulted in a violation of thermal or voltage limit criteria due to IR#646.

8 Reactive Power and Voltage Control

In accordance with the *Transmission System Interconnection Requirements* Section 7.6.2, IR#646 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 Enercon indicates that the Enercon E-160 EP5 E3 -FT 5.56 MW WECS have a rated power factor of 0.90 lagging and leading (+/- 2.7 Mvar per WECS) at the machine terminal voltage of 1.0 p.u. or above, from 10% 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 Enercon models do not meet the requirement to produce full Mvar capability down to zero MW output.

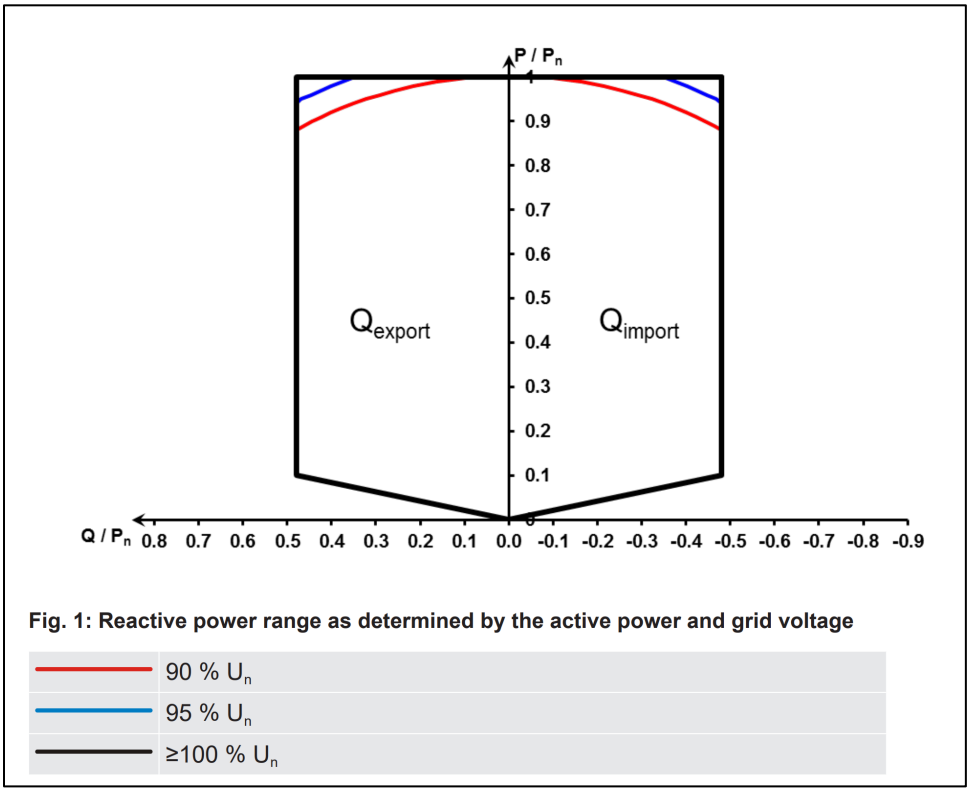

Figure 4 E-160 EP5 E3 -FT reactive power capability

The analysis shown in Figure 5 indicates that IR#646 may not be able to meet the full-load reactive power requirement. The model shows that with 3 WECS units (E3-FT version) operating at a total 16.68 MW and 8.1 Mvar (maximum), the delivered power to the high side of the ICIF transformers is 16.4 MW and 3.3 Mvar, or a power factor of 0.98 with WECS terminal voltage at 1.08 p.u. The IC can consider the use of a capacitor bank on the 25 kV bus, or the use of Enercon model FTQ which has a higher reactive power range. It is noted from Figure 4 that reactive power does not extend from standstill to full load as required by the TSIR.

This configuration would be able to meet the leading power factor requirement of -0.95 at the high side of ICIF transformer while the WECS are operating at a total of 16.68 MW and -0.8 Mvar at a terminal voltage of 0.99 p.u.

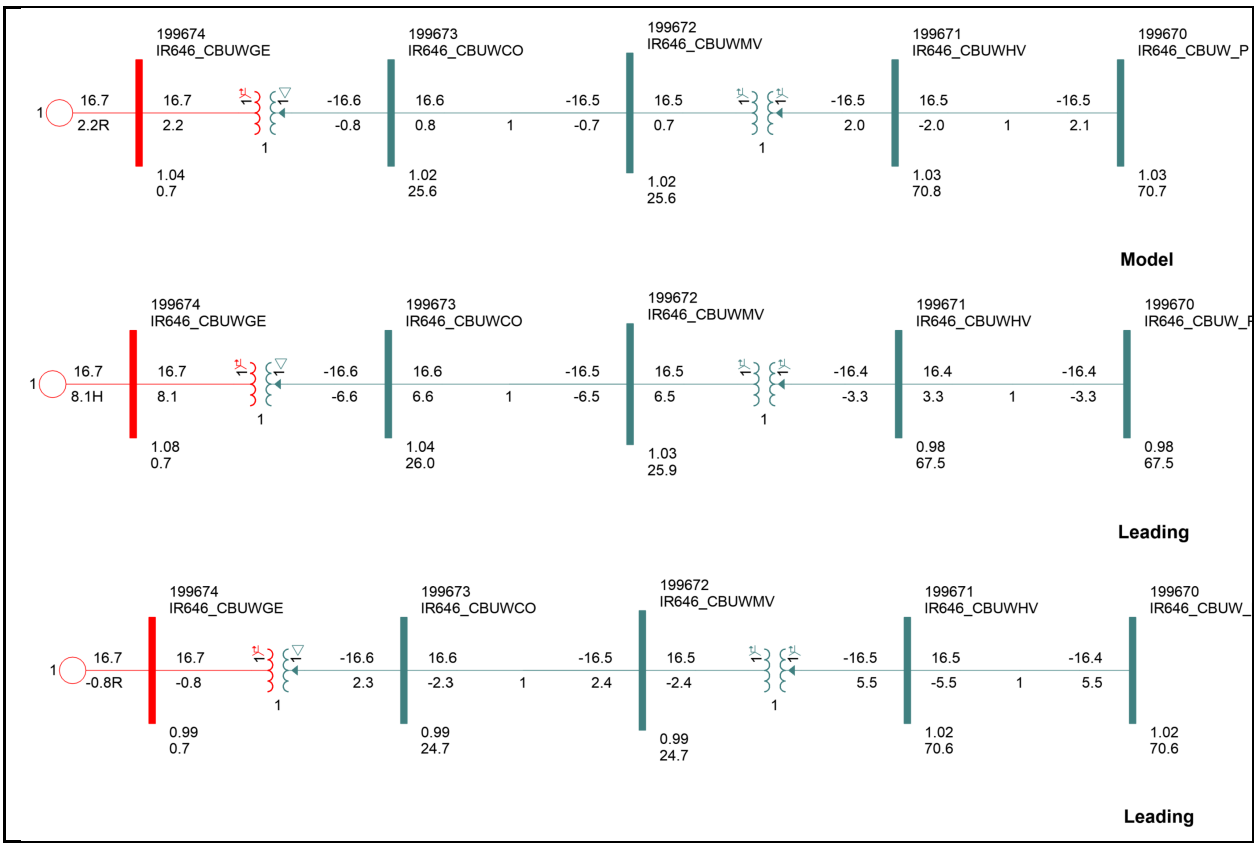

Figure 5 Power Factor analysis

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 25 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's 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 System Security / Bulk Power Analysis

Interconnection with line L-5573 will require direct line tap with transfer trip protection for the IR#646 generation facility. IR#646 is not categorized as NERC Bulk Electric System (BES) since it is connected at < 100 kV. Final NPCC Bulk Power System determination analysis will be performed in the SIS.

10 Expected Facilities Required for Interconnection

The following facility changes will be required to connect IR#646 to the NSPI transmission system at a POI on L-5573 under both NRIS and ERIS:

a. Required Network Upgrades

- Modification of NSPI protection systems to L-5573 at 2S-Victoria Junction, 109S-Lingan Wind and 15S- New Waterford.

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

- Construct a direct line tap with transfer trip for the POI on L-5573 and a total of 0.3 km tap line between the POI on L-5573 and the Interconnection Customer's Interconnection Facility. This line would be built to 69 kV standards.
- 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) to the IC facility. 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 Enercon model E3-FT 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 25 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 16.68 MW wind energy at the 69 kV POI on L-5573 are included in Table 6.

Table 6 Cost Estimate NRIS and ERIS @ POI L-5573

Item	Network Upgrades	Estimate
1	Modification of protection systems to L-5573 at 2S-Victoria Junction, 109S-Lingan Wind and 15S- New Waterford	$100,000
	Sub-total for Network Upgrades	$100,000
Item	**TPIF Upgrades**	**Estimate**
1	A direct line tap on L-5573 with transfer trip	$400,000
2	Build 0.3 km 69 kV line tap from TPIF to ICIF, with IC responsible to provide right-of-way	$135,000
3	NSPI P&C relaying equipment	$100,000
4	NSPI supplied RTU	$60,000
5	Tele-protection and SCADA communications	$150,000
	Sub-total for TPIF Upgrades	$845,000
	Total Upgrades	**Estimate**

	Network Upgrades + TPIF Upgrades	$945,000
	Contingency (10%)	$94,500
	Total (Incl. 10% contingency and Excl. HST)	$1,039,500

The preliminary non-binding cost estimate for interconnecting 16.68 MW at the POI at L-5573 under both NRIS and ERIS is $1,039,500 including a contingency of 10%. In this estimate, $100,000 (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.

These estimates do not include costs to address any stability issues that may be 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#646 in service, losses in the winter peak case total 86.2 MW. With IR#646 in service at the POI of L-6004, displacing generation at 91H, and not including losses associated with the IR#646 Generation Facilities or TPIF Interconnection Facilities, the system losses total 87.8 MW – an increase of 1.6 MW. The power delivered to the POI is 16.5 MW, therefore the loss factor is calculated as 1.6/16.5 = +9.7%.

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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