Interconnection Feasibility Study Report
GIP-IR606-FEAS-R3

Generator Interconnection Request 606
96 MW Wind Facility
Antigonish County, NS

2022-02-03

Control Centre Operations
Nova Scotia Power Inc.

Executive summary

This Feasibility Study report (FEAS) presents the results of a Feasibility Study Agreement for the connection of a 96 MW wind generation facility interconnected to the NSPI system as Network Resource Interconnection Service (NRIS).

This project is designated as Interconnection Request #606 in the NSPI Interconnection Request Queue and will be referred to as IR606 throughout this report. The proposed Commercial Operation Date is 2023/12/31.

The Interconnection Customer (IC) identified a 230 kV tap on L-7003 as the Point Of Interconnection (POI). This wind generation facility will be interconnected to the POI via a 0.075 km long 230 kV transmission line from the Point of Change of Ownership (PCO).

There are two long-term firm Transmission Service Reservations (TSR) in the System Impact Study (SIS) stage in the Transmission Service Queue, with a requested in-service 2025/01/01 date. These are TSR411 (800 MW from NB to NS) and TSR412 (500 MW from NFLD to NS) and are expected to alter the configuration of the Transmission System in Nova Scotia As a result, the following notice has been posted to the OASIS site[1]:

> *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 and 412 System Impact Studies, which are expected to identify significant changes to the NSPI transmission system. The expected completion date for these studies is December 31, 2021. Feasibility Studies initiated prior to the completion of these TSR System Impact Studies will be performed based on the current system configuration.*

There are no concerns regarding increased short circuit levels or voltage flicker. The increase in short circuit level is still within the capability of associated breakers. The minimum short circuit level at the Interconnection Facility's (IF) high side bus is 1,077 MVA. The minimum fault level at the IF high side bus when L-7003 is open at 67N is 633 MVA and the SCR is calculated to be 6.59 at the high voltage terminals of IR606's substation step-up transformer.

Voltage flicker will be examined when data is made available for the SIS, however Type 4 wind turbines, like the Vestas V162 used in this IR, are not expected to introduce significant voltage flicker under minimum generation conditions.

[1] OASIS Generation Interconnection Procedures; https://www.nspower.ca/oasis/generation-interconnection-procedures

The project design must meet NSPI requirements for voltage ride-through, frequency ride-through, reactive power range, and voltage control. Harmonics must meet the Total Harmonic Distortion requirements in IEEE 519.

Power factor correction for IR606 is required to meet NSPI's ±0.95 net power requirements at the IF 230 kV bus. This is in situations when the wind facility is operating at max output and full reactive power is required.

The POI for IR606 is classified as NERC BES and will be categorized as NPCC BPS due to BPS categorization of surrounding elements and therefore protection systems at that site also needs to meet NPCC BPS criteria.

The preliminary loss factor is calculated as 8.65% with IR606 modelled in the winter peak case.

This study's power flow analysis did not identify any transmission contingencies inside Nova Scotia which would violate thermal loading criteria. The necessary Network Upgrades required for NRIS operation are:

- Three 230kV circuit breakers and associated switches in a ring-bus arrangement in accordance with NPCC and NERC Criteria

The preliminary non-binding cost estimate for interconnecting IR606 to the 230 kV L-7003 line with a three breaker ring bus as Network Resource is $9,097,000. $297,000 of this amount is the TPIF (Transmission Provider's Interconnection Facilities) costs, with the remainder as the Network Upgrade costs. This includes a 10% contingency. This estimate will be further refined in the SIS and Facility (FAC) studies.

The estimated time to construct the Network Upgrades and TPIF for NRIS operation is 18-24 months after the receipt of funds.

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1.0 Introduction

This Feasibility Study report (FEAS) presents the results of a Feasibility Study Agreement for the connection of a 96 MW wind generation facility interconnected to the NSPI system as Network Resource Interconnection Service (NRIS).

This project is listed as Interconnection Request #606 in the NSPI Interconnection Request Queue and will be referred to as IR606 throughout this report. The proposed Commercial Operation Date is 2023/12/31

The Interconnection Customer (IC) identified L-7003 as the Point Of Interconnection (POI), 98 km from the 67N-Onslow substation. This wind generation facility will be interconnected to the POI via a 0.075 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 and Figure 2 shows the approximate electrical location.

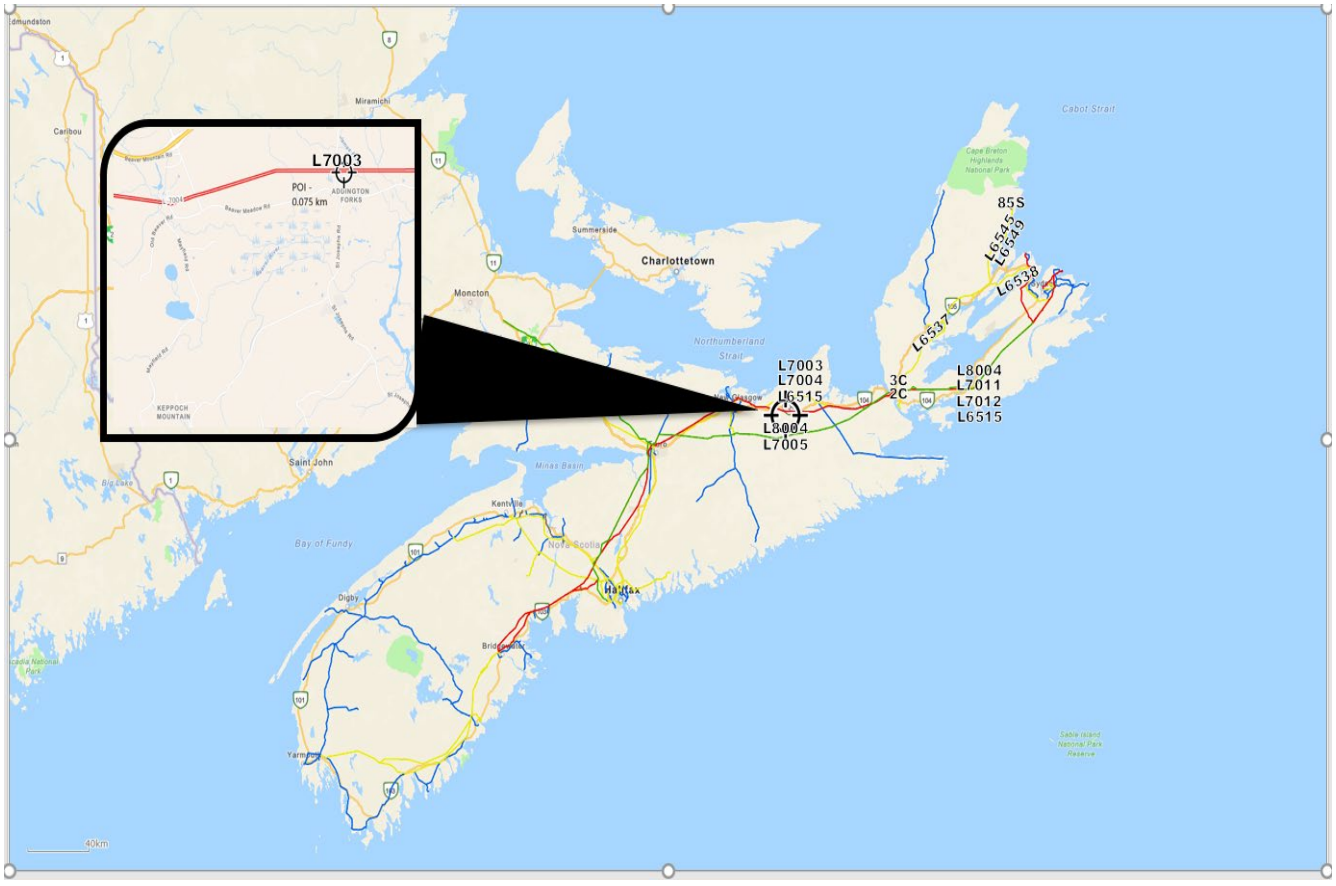


Figure 1: IR606 approximate geographic location

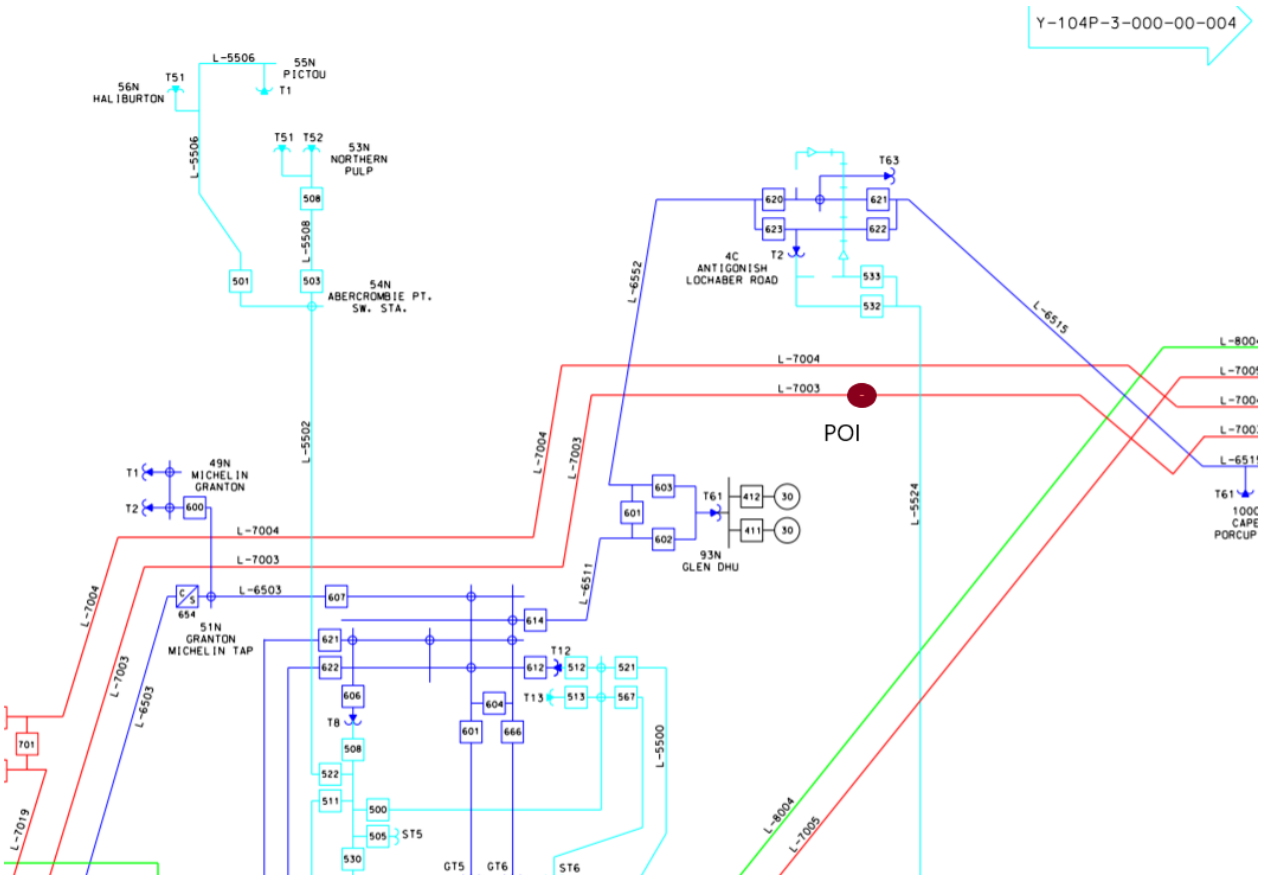


Figure 2: IR606 Point Of Interconnection

2.0 Scope

This Interconnection Feasibility Study's (FEAS) objective is to provide a preliminary evaluation of system impact and a high-level non-binding cost estimate of interconnecting the new wind generation facility to the NSPI Transmission System at the designated location based on single contingency criteria. This assessment will identify potential impacts on transmission element loading, which must remain with their thermal limits. Any potential voltage criteria violations will be identified and addressed. Circuit breakers must be upgraded if the proposed facility increases the short-circuit duty of any circuit breakers beyond their rated capacity.

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

- 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.

- Identification of any thermal overload or voltage limit violations resulting from the interconnection and identify the necessary network upgrades to allow full output of the proposed facility.
- Description and high-level non-binding estimated cost of and time to construct the facilities required to interconnect the generating facility to the transmission system.

This FEAS does not include a complete determination of facility changes/additions required to increase the system transfer capabilities that may be required to the transmission system 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 in order to ascertain the final cost estimate to the interconnect the generating facility.

3.0 Assumptions

This FEAS is based on technical information provided by the IC. The Point Of Interconnection (POI) and configuration is studied as follows:

1. Network Resource Interconnection Service (NRIS) per section 3.2 of the Generation Interconnection Procedures (GIP).
2. Commercial Operation date: 2023/12/31
3. The Interconnection Facility consists of 16 Vestas V162-6.0 MW wind energy converters, totalling 96 MW. These are modelled as Type 4 inverter-based generators, split between three collector circuits.
4. The IC identified the POI at L-7003, a 230 kV line, approximately 98 km from the 67N-Onslow substation.
5. IR606 will be interconnected adjacent to L-7003 via a three-ring bus with Transfer Trip protection and the ICIF (Interconnection Customer Interconnection Facility) substation will be connected to the POI via 0.075 km of 556 ACSR Dove conductor following NSPI standards.
6. Preliminary data was provided by the IC for the substation step-up transformer and generator step-up transformers.
   6.1. The substation step-up transformer is modelled as one 230 kV (wye) - 34.5 kV (wye) transformer rated at 66/110 MVA, with a positive sequence impedance of 7% and 22 X/R ratio.
   6.2. The generator step-up transformers were modelled as an equivalent transformer based off 16 (sixteen) 34.5 kV (delta) - 0.720 kV (grounded wye) 7 MVA transformers, with a 9.9% positive sequence impedance and an assumed 13.0 X/R ratio.

7. An assumed collector circuit layout is used, based off the site plan included in the application, since a detailed collector circuit design was not provided. Note the plant's net real and reactive power will be impacted by losses through the transformers and collector circuits.
8. The FEAS analysis is based on the assumption that IRs higher in the Generation Interconnection Queue and OATT Transmission Service Queue that have a completed System Impact Study, or have a System Impact Study will proceed, as listed in Section 4.0: Project queue position.
9. Transmission line ratings used in this study are listed in Appendix A: Transmission line ratings.

4.0 Project queue position

All in-service generation is included in this FEAS.

As of 2021/10/26, the following projects are higher queued in the Advanced Stage Interconnection Request Queue and are included in this study's base cases:

- IR426: GIA executed
- IR516: GIA executed
- IR540: GIA executed
- IR542: GIA executed
- IR557: SIS complete
- IR569: GIA executed
- IR568: GIA executed
- IR566: GIA executed
- IR574: FAC Complete
- IR598: SIS in Progress

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

- TSR 411: SIS in Progress
- TSR 412: SIS in Progress

TSRs 411 and 412 have an expected 2025 in service date and system studies to determine required upgrades to the NS transmission system are currently in progress. As a result, the following notice has been posted to the OASIS site[2]:

> *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*

[2] OASIS Generation Interconnection Procedures; https://www.nspower.ca/oasis/generation-interconnection-procedures

of the Transmission Service Request (TSR) 411 and 412 System Impact Studies, which are expected to identify significant changes to the NSPI transmission system. The expected completion date for these studies is December 31, 2021. Feasibility Studies initiated prior to the completion of these TSR System Impact Studies will be performed based on the current system configuration.

5.0 Short circuit

IR606 will not impact neighbouring breaker's interrupting capability based on this study's short circuit analysis. Analysis was performed using PSS/e 34.8, classical fault study, flat voltage profile at 1.0 PU voltage, and 3LG faults.

The maximum design interrupting capability of the neighbouring 230 kV circuit breakers are at least 10,000 MVA. The Vestas V162 PSS/e User Manual specified the wind turbine generators contribute a maximum of 1.2 PU during a fault. The short circuit levels in the area before and after this development are provided in Table 1: *Short circuit levels, 3-ph, in MVA*.

The IC should discuss wind turbine design with Vestas for low SCR *(Short Circuit Ratio)* levels. Minimum fault levels occur when L-7003 is open at the 67N-Onslow end. In this scenario, the SCR is calculated to be 6.59 at the high voltage terminals of IR606's substation step-up transformer. The SCR is 11.21 when all transmission elements are in service. The SCR will be lower at the generator terminals due to losses associated with the substation step-up transformer, collector circuit, and generator step-up transformers.

The SCR may change when a more detailed collector circuit design is submitted. This study used an assumed collector circuit layout, that followed roads on the geographic site layout.

Table 1: Short circuit levels, 3-ph, in MVA

Location	IR606 not in service	IR606 in service	Post % increase
2023, max generation, all facilities in service			
3C-Hastings:230 kV bus	2,765	2,824	2%
79N-Hopewell:345 kV bus	3,324	3,345	1%
50N-Trenton:138 kV bus	2,652	2,658	0%
67N-Onslow:230 kV bus	3,957	4,008	1%
IR606-hv:230 kV bus	1682	1,775	6%
IR606-mv:34.5 kV bus	609	712	17%
2023, min generation, all elements in service			
3C-Hastings:230 kV bus	1,084	1,154	6%
79N-Hopewell:345 kV bus	1,695	1,746	3%
50N-Trenton:138 kV bus	1,012	1,030	2%

67N-Onslow:230 kV bus	1,553	1,940	25%
IR606-hv:230 kV bus	1,077	1,173	9%
IR606-mv:34.5 kV bus	503	574	14%
2023, min generation, L-7003 open at 67N-Onslow			
3C-Hastings:230 kV bus	989	1,081	9%
79N-Hopewell:345 kV bus	1,389	1,450	4%
50N-Trenton:138 kV bus	903	927	3%
67N-Onslow:230 kV bus	1,550	1,624	5%
IR606-hv:230 kV bus	633	729	15%
IR606-mv:34.5 kV bus	379	487	28%
2023, min generation, L-7003 open at 3C-Hastings			
3C-Hastings:230 kV bus	989	1,019	3%
79N-Hopewell:345 kV bus	1,389	1,443	4%
50N-Trenton:138 kV bus	903	925	2%
67N-Onslow:230 kV bus	1,550	1,639	6%
IR606-hv:230 kV bus	634	730	15%
IR606-mv:34.5 kV bus	380	487	28%

6.0 Voltage flicker & harmonics

Voltage flicker will be examined when data is made available for the SIS. However, Type 4 wind turbines, like the Vestas V162's used in IR606, are not expected to introduce significant voltage flicker under minimum generation conditions.

NS Power's voltage flicker requirements are:

- $P_{st} \leq 0.25$
- $P_{lt} \leq 0.35$

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

7.0 Thermal limits

The steady state contingencies evaluated in this study demonstrate IR606 does not require Network upgrades beyond the POI to operate at its full capacity of 96 MW under NRIS.

Base cases used in this study are listed in Table 2: *Base case dispatch*. They were selected to reflect conditions under grid modernization plan and objective towards the greener generation mix. Assumption was to replace the conventional generation at Cape Breton Island with the renewable and greener source. Also, the dispatch takes care of various levels of Maritime Link energy based on winter and summer peaks.

Area transmission line ratings are listed in Appendix A: *Transmission line ratings*.

Table 2: Base case dispatch

Case name	NS load	IR status	Wind	NS/NB	ML	CBX	ONI	ONS	Mainland @ Hastings
sp01-1	1,401	-	108	332	-475	971	1,007	572	375
sp01-2	1,392	96	204	342	-475	887	1,016	572	373
sp02-1	1,488	-	108	0	-475	782	883	782	306
sp02-2	1,488	96	204	2	-475	748	885	782	302
sp03-1	1,372	-	299	333	-475	868	822	426	344
sp03-2	1,372	96	395	333	-475	775	822	426	339
sp04-1	1,485	-	108	-	-475	750	796	695	353
sp04-2	1,485	96	204	2.5	-475	658	799	695	248
sp05-1	1,477	-	108	-	-475	727	775	674	266
sp05-2	1,477	96	204	-	-475	634	777	674	263
sp06-1	1,494	-	108	-	-475	758	805	704	376
sp06-2	1,494	96	204	-	-475	666	807	704	261
wp01-1	2,310	-	175	150	-320	912	1,120	791	347
wp01-2	2,310	96	271	152	-320	820	1,122	791	343
wp02-1	2,210	-	72	150	-320	998	1,119	790	569
wp02-2	2,210	96	168	152	-320	906	1,121	790	402
wp03-1	2,370	-	235	150	-320	851	1,063	792	313
wp03-2	2,370	96	331	152	-320	759	1,065	792	309
wp04-1	2,310	-	75	-	-475	1,004	1,109	930	389
wp04-2	2,310	96	171	2.5	-475	912	1,111	930	385
wp05-1	2,201	-	75	0.3	-475	1,003	1,107	929	406
wp05-2	2,201	96	171	1.9	-475	910	1,109	929	401
wp06-1	2,310	-	75	-	-475	992	1,102	924	373
wp06-2	2,310	96	171	-	-475	900	1,105	924	370
wp07-1	2,093	-	75	-	-475	1,005	1,150	972	406
wp07-2	2,093	96	171	1.7	-475	912	1,152	972	401
wp08-1	2,198	-	75	-	-475	1,013	1,158	980	391
wp08-2	2,198	96	171	2.6	-475	921	1,161	980	388
wp09-1	2,210	-	66	66	-475	1,057	1,154	910	426
wp09-2	2,210	96	162	68	-475	1,058	1,156	910	422

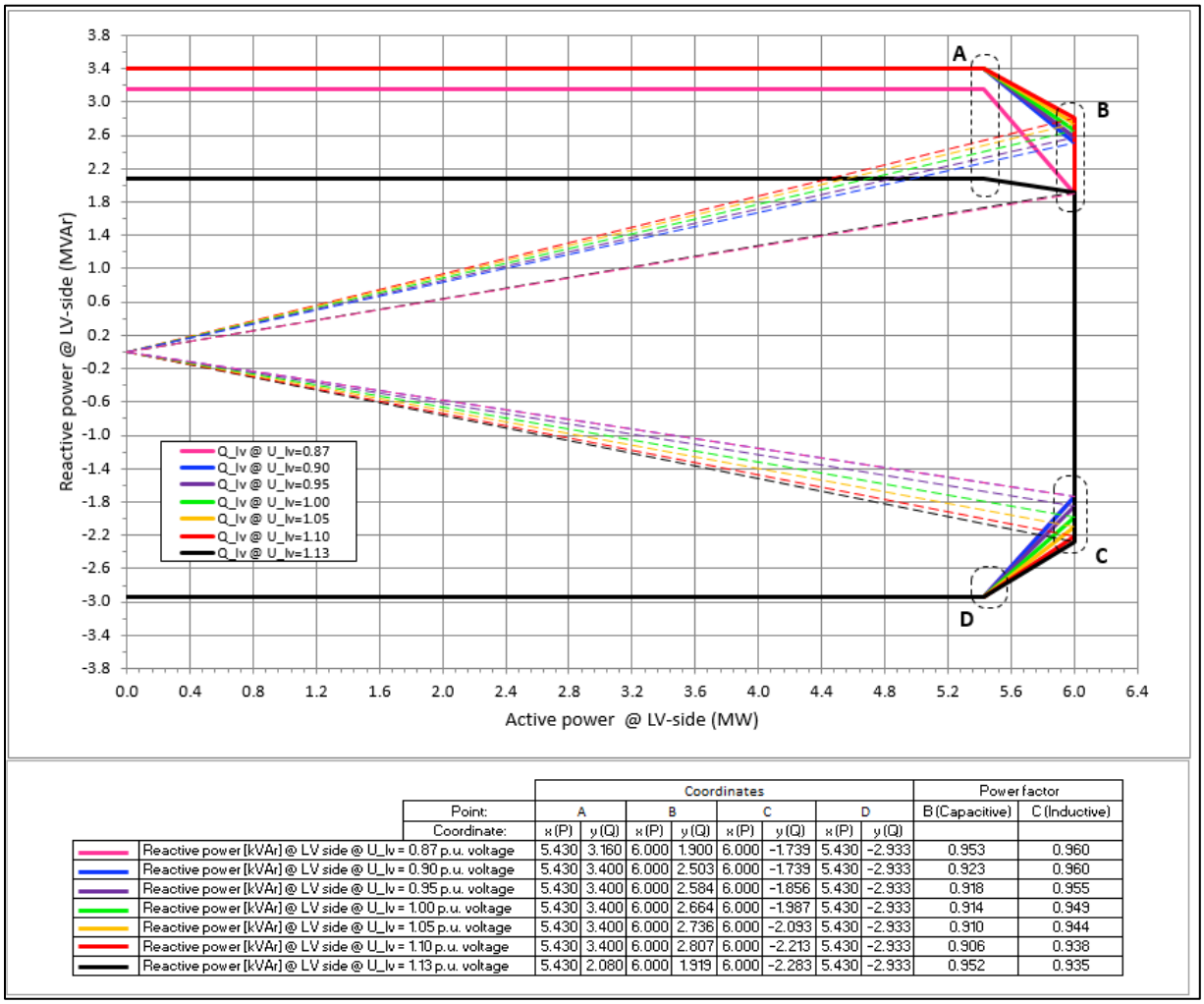
Note 1: All values are in MW.
Note 2: CBX (Cape Breton Export) and ONI (Onslow Import) are Interconnection Reliability Operating Limit (IROL) defined interfaces.
Note 3: Wind refers to only transmission connected wind.

8.0 Voltage control

IR606 requires power factor correction to meet NS Power's ±0.95 net power factor requirement at the HV terminals of the ICIF substation in addition to producing/ absorbing reactive power at all production levels up to its full rated output.

Using the Vestas reactive power capability, shown in Figure 3: *Vestas V162 6 MW reactive power capability*, various levels were calculated and are displayed in Table 3: *Power factor analysis results*.

Operational Envelope – Reactive Power Capability



		Coordinates								Power factor	
	Point:	A		B		C		D		B (Capacitive)	C (Inductive)
	Coordinate:	x (P)	y (Q)	x (P)	y (Q)	x (P)	y (Q)	x (P)	y (Q)		
	Reactive power [kVAr] @ LV side @ U_lv = 0.87 p.u. voltage	5.430	3.160	6.000	1.900	6.000	-1.739	5.430	-2.933	0.953	0.960
	Reactive power [kVAr] @ LV side @ U_lv = 0.90 p.u. voltage	5.430	3.400	6.000	2.503	6.000	-1.739	5.430	-2.933	0.923	0.960
	Reactive power [kVAr] @ LV side @ U_lv = 0.95 p.u. voltage	5.430	3.400	6.000	2.584	6.000	-1.856	5.430	-2.933	0.918	0.955
	Reactive power [kVAr] @ LV side @ U_lv = 1.00 p.u. voltage	5.430	3.400	6.000	2.664	6.000	-1.987	5.430	-2.933	0.914	0.949
	Reactive power [kVAr] @ LV side @ U_lv = 1.05 p.u. voltage	5.430	3.400	6.000	2.736	6.000	-2.093	5.430	-2.933	0.910	0.944
	Reactive power [kVAr] @ LV side @ U_lv = 1.10 p.u. voltage	5.430	3.400	6.000	2.807	6.000	-2.213	5.430	-2.933	0.906	0.938
	Reactive power [kVAr] @ LV side @ U_lv = 1.13 p.u. voltage	5.430	2.080	6.000	1.919	6.000	-2.283	5.430	-2.933	0.952	0.935

Figure 3: Vestas V162 6 MW reactive power capability[3]

[3] Vestas General Description 6MW platform, document no: 0098-0840 V04, 2021-04-14

Table 3: Power factor analysis results

Breakpoints on Vestas reactive capability curve	IR606 output				Measurements at the HV terminals of the ICIF substation			
	MW	MVAR	MVA	pf	MW	MVAR	MVA	pf
A	86.9	54.4	102.51	0.85	83.9	35.5	91.10	0.92
B	96	42.62	105.04	0.91	93.6	21.5	96.04	0.97
C	96	-31.79	101.13	0.95	92.5	-62.8	111.80	0.83
D	86.9	-46.93	98.74	0.88	83.5	-69.6	108.70	0.77

The IR606 does not meet NS Power's ±0.95 net power factor requirement is when the wind farm is operating between A-B on the above curve. The Vestas technical bulletin's reactive power capability, shown in Figure 3, shows that the reactive power capability is slightly reduced at full output (regions A-B, and C-D).

The net power factor will be re-evaluated when the detailed information on the transformers and collector circuit are available in the SIS stage, to determine how much supplemental reactive power support is required.

A centralized controller will be required, which continuously adjusts the individual generator reactive power output within the plant capability limits and regulates the voltage at the low voltage terminal of the ICIF transformer. The voltage controls must be responsive to voltage deviations, be equipped with a voltage setpoint control, and have facilities that will slowly adjust the setpoint over several (5-10) minutes to maintain reactive power within the individual generators' capabilities. Details of the specific control features, control strategy, and settings will be reviewed and addressed in the SIS.

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

This facility must have voltage ride-through capability as detailed in section 7.4.1 of Transmission System Interconnection Requirements (TSIR). The SIS will examine the plant capabilities and controls in detail to specify options, controls, and additional facilities that are required to achieve low voltage ridethrough.

9.0 System security

Transmission System Elements are required to meet NPCC[4] BPS *(Bulk Power System)* and/or NERC[5] BES *(Bulk Electric System)* requirements.

The 230kV buses at the 67N-Onslow EHV Substation and the 3C-Port Hastings Substation are already part of the Nova Scotia Bulk Power System (BPS). As such, all protection systems associated with the new three-breaker ring bus at either the POI must comply with NPCC Directory 4 *System Protection Criteria*.

Portions of IR606 will be categorized as NERC BES, due to BES inclusion criteria I4. The IR606 facilities categorized BES are:

- The individual generating resources.
- The 34.5 kV bus of the ICIF substation step-up transformer.
- The ICIF substation step-up transformer.
- The IR606 230 kV bus.

Presently L-7003 is categorized as NERC BES, and NPCC BPS due to it being a part of east to metro corridor and backbone of NSPI system. Table summarizes the BPS & BES classification of neighbouring elements.

Table 4: BPS & BES classification of neighbouring elements

Neighbouring element classification	NPCC BPS	NERC BES
IR606	Yes	Yes
3C- Port Hastings_230 kV	Yes	Yes
67N- Onslow_230 kV	Yes	Yes
79N- HopeWell_345 kV	Yes	Yes

Presently there is a Type III RAS (Remedial Action Scheme) on L-7003 (Group 3) that will be impacted by the installation of IR606. Modifications may require approval by NPCC.

The injection point of IR606 could also reduce total transfer capacity due to it being located on the system's backbone corridor. It may result in modification/mitigation in Remedial Action Schemes.

10.0 Expected facilities required for interconnection

The following facilities are required to interconnect IR606 to the NSPI system via the 230 kV bus as NRIS:

[4] Northeastern Power Coordination Council.
[5] North American Electric Reliability Corporation.

1) **Network upgrades:**
   a) Three 230kV circuit breakers and associated switches in a ring-bus arrangement
2) **Transmission Provider's Interconnection Facilities (TPIF):**
   a) Construct a 230 kV transmission line, with OHGW & OPGW, approximately 0.075 km long, built to NSPI standards from the POI at L-7003 to the IR606 substation.
   b) Control and communications between the ICIF and the NSPI SCADA and protection system.
3) **Interconnection Customer's Interconnection Facilities (ICIF):**
   a) This facility must meet NSPI's TSIR as published on the NSPI OASIS site at https://www.nspower.ca/oasis/standards-codes.
   b) Facilities to provide ±0.95 power factor when delivering rated output (96 MW) at the 230 kV bus when voltage is operating between ±5% of nominal. Rated reactive power shall be available through the full range of real power output, from zero to full power.
   c) Centralized controls for voltage setpoint control for the low side of the ICIF transformer. Fast acting control is required and will include a curtailment scheme, which will limit/reduce total output from the facility, upon receipt of a telemetered signal from NSPI's SCADA system.
   d) NSPI to have supervisory and control of this facility, via the centralized controller. This will permit the NSPI System Operator to raise/lower the voltage setpoint, change the status of reactive power controls, and change the real/reactive power remotely.
   e) When curtailed, the facility shall offer over-frequency and under-frequency control with ±0.2 Hz deadband and 4% droop characteristic. The active power controls shall also react to continuous control signals from the NSPI SCADA system's Automatic Generation Control (AGC) system to control tie-line fluctuations as required.
   f) Real-time telemetry will include MW, MVAR, bus voltages, curtailment state, wind speed, and wind direction.
   g) Voltage ridethrough capability as detailed in section 7.4.1 Voltage Ride-Through of TSIR
   h) Frequency ridethrough capability in accordance with section 7.4.2 Frequency Variations of TSIR The facility shall have the capability of riding through a rate of change of frequency of 4 Hz/s.
   i) Facilities for NSPI to execute high speed rejection of generation (transfer trip), if determined in the SIS. The plant may be incorporated in SPS runback schemes.
   j) The facility must use equipment capable of closing a circuit breaker with minimal transient impact on system voltage and frequency (matching voltage within ±0.05 PU and a phase angle within ±15°).

k) Operation at ambient temperatures as low as -30ºC.

11.0 NSPI Interconnection Facilities and Network Upgrades cost estimate

The high level, non-binding, cost estimate, excluding HST, for the IR606's Network Resource Interconnection Service is shown in Table 5: *NRIS cost estimate*. This estimate assumes there is adequate space for new equipment and modifications. This does not include any TBD costs to address any stability issues identified at the SIS stage, based on dynamic analysis.

Table 5: NRIS cost estimate

Network Upgrades:

3 Circuit Breaker Ring Bus with NPCC Compliance		
Item	**Network Upgrades**	**Estimate**
I	Site Preparation	$1,500,000
II	Primary Equipment incl Control Bldg.	$5,000,000
III	Remote P&C Modifications	$1,000,000
IV	Communications	$500,000
	Total	$8,000,000

TPIF :

I	Transmission line, w/ OHGW & OPGW, from POI to the IR606	$60,000
II	NSPI supplied RTU & labour.	$60,000
III	Teleprotection and SCADA communications via OPGW	$150,000

Total Cost: $ 8,270,000
10% contingency: $ 827,000
Net Cost: $ 9,097,000

The estimated time to construct the Network Upgrades and Transmission Provider's Interconnection Facilities is 18-24 months after receipt of funds.

12.0 Loss factor

With IR606 in service, the loss factor is calculated as 10.625%. The data and calculation is detailed in Table 6: *IR606 loss factor data* and Equation 1: *IR606 loss factor calculation*, respectively.

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 NS Area Interchange bus. This methodology reflects the load centre in and around 91H-Tufts Cove. A negative loss factor reflects a reduction in system losses.

Table 6: IR606 loss factor data

	Value
IR606 nameplate	96
TC w/ IR606	329.7
TC w/o IR606	417.4
Delta	8.3
2023 loss factor	8.65%

Equation 1: IR606 loss factor calculation

$$loss\ factor = \frac{(IR606_{nameplate} + TC_{w/\ IR606}) - TC_{w/o\ IR606}}{IR606_{nameplate}} = 8.65\%$$

13.0 Preliminary scope of subsequent SIS

The SIS will be conducted in accordance with the GIP with the assumption that all appropriate higher-queued projects will proceed, and the facilities associated with those projects are installed. It will provide a more comprehensive assessment, based on NSPI, NPCC, and NERC criteria, of the technical issues and requirements to interconnect the proposed facility as requested.

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

Nova Scotia Power
Transmission System Operations
2021/02/03

Appendix A: Transmission line ratings

NSPI Transmission Line Ratings

Last Updated: 2021-08-27

LINE	STATION	CONDUCTOR				BREAKER	SWITCH	CURRENT TRANSFORMER						TRIP MVA
								RELAYING			FULL SCALE METERING			
		Type	Maximum Operating Temp. (Celsius)	SUMMER RATING 25 DEG (MVA)	WINTER RATING 5 DEG (MVA)	100% Name-plate	100% Name-plate	Ratio	R.F.	MVA	Ratio	R.F.	MVA	
L-7003	3C Pt. Hastings EHV	ACSR 556 Dove	60	233	307	797	797	500	2	398	1000	1	462	533
	67N Onslow EHV					797	797	500	2	398	1000	1	462	468
L-7004	3C Pt. Hastings EHV	ACSR 556 Dove	60	233	307	797	797	500	2	398	1000	1	462	533
	91N Dalhousie Mountain					797	797	800	2	600	800	1	368	600
L-7005	3C Pt. Hastings EHV	ACSR 1113 Beaumont	70	404	502	797	797	500	2	398	1000	1	462	533
	67N Onslow EHV					797	797	500	2	398	1000	1	462	533
L-7019	91N Dalhousie Mountain	ACSR 556 Dove	70	273	345	797	797	800	2	956	800	1	368	600
	67N Onslow EHV					797	797	500	2	398	1000	1	462	469
L-6515	2C Pt. Hastings	ACSR 556.5 Dove	50	110	165	287	287	600	2	287	600	1	173	560
	4C Lochaber Rd.					191	143	600	2	287	600	1	173	752
L-6511	93N Glen Dhu	ACSR 556.5 Dove	60	140	184	478	478	800	2	382	800	2	441	895
	50N Trenton					287	287	600	2	287	800	1	231	895

L-6552	4C Lochaber Road	ACSR 556.5 Dove	50	110	165	191	143	600	2	287	600	1	173	1470
	93N Glen Dhu					478	478	800	2	382	800	2	441	1470

L-6503a	50N Trenton	ACSR 1113 Beaumont	100	320	363	287	287	1000	2	287	1000	1	554	589
	49N/51N Michelin Granton						404				NA			

NSPI Transmission Line Ratings

Last Updated: 2021-08-27

LINE	STATION	CONDUCTOR				BREAKER	SWITCH	CURRENT TRANSFORMER						TRIP MVA
								RELAYING			FULL SCALE METERING			
		Type	Maximum Operating Temp. (Celsius)	SUMMER RATING 25 DEG (MVA)	WINTER RATING 5 DEG (MVA)	100% Name-plate	100% Name-plate	Ratio	R.F.	MVA	Ratio	R.F.	MVA	
L-6503b	51N Michelin Granton	ACSR 1113 Beaumont	85	287	335		404				NA			
	1N Onslow					478	287	1200	2.5	717	1200	1	665	449