Interconnection Feasibility Study Report
GIP-IR713-FEAS-R1

Generator Interconnection Request 713
42 MW Wind Generating Facility
Inverness County, NS

2024-05-31

Control Centre Operations
Nova Scotia Power Inc.

Executive Summary

The Interconnection Customer (IC) submitted a Network Resource Interconnection Service (NRIS) and Energy Resource Interconnection Service (ERIS) Interconnection Request for a 42 MW wind generation facility interconnected to the NSPI transmission system, with a Commercial Operation Date of 2025-12-30. The Point of Interconnection (POI) requested by the customer is the 138kV line L-6537, approximately 8.2 km from 2C-Port Hastings substation.

There are twenty-two (22) transmission Interconnection Requests in the Advanced Stage Transmission and Distribution Queue that must be included in the study models for IR#713.

This study assumes that the addition of generation from IR#713 will displace coal-fired generation primarily in eastern Nova Scotia for both NRIS and ERIS.

Since L-6537 is classified as Bulk Power System, interconnection will require a three-breaker 138kV ring bus substation. Bulk Power System determination of the new facility will be performed in the System Impact Study (SIS) report. This new substation will be categorized Bulk Electric System under NERC criteria.

Several post-contingency thermal loading violations occur due to IR#713, notably on transmission lines L-6515, L-6537, L-6538, and transformer 3C-T71. The following upgrades are proposed:

- Modifications to arming/limit levels of existing Type 1 RAS (Group 5 and Group 6) to alleviate L-6515 overloads, subject to NPCC approval. The alternative is an uprate of L-6515, for approximately 50.7 km, from 143 MVA (Winter) to at least 170 MVA (Winter).
- Re-design of existing Limited Impact RAS (Wreck Cove Overload) to alleviate L-6537 and L-6538 overloads, subject to NPCC approval. IR#713 may be included in the RAS logic and should be designed appropriately to receive the trip signals. The alternative is to uprate L-6537 (from 2C to IR#713 POI) and L-6538. L-6538 includes a water crossing that will require an engineering study to more accurately determine the extent of cost and work required.
- Uprate of L-6538 and L-6539 CTs by CT winding ratio modification.
- Replacement of 3C-T71 transformer.

If, during the SIS, it is determined that modifying existing RAS does not provide an acceptable solution, then an uprate of these lines will be required.

No violations of voltage criteria were found for IR#713.

Data provided by the IC indicates that IR#713 will be utilizing the Nordex N163/6.X 7.0 MW Doubly-Fed Induction Generator (DFIG) wind turbines. Based on supplied interconnection data and assumptions, IR#713 does not meet the net power factor requirement of +0.95 at the high voltage side of Interconnection Facility. The adequacy of reactive power supply will be further investigated in the System Impact Study as specific details of the collector circuits become available.

IR#713 was not found to adversely impact the short-circuit capabilities of existing circuit breakers. The minimum short circuit level is 147 MVA with L-6537 open at 2C-Port Hastings, resulting in a SCR of 3.4. These conditions should be discussed with the wind turbine manufacturer to determine if the equipment can operate, or if modifications are required. NSPI system short circuit level may decline over time with changes to transmission configuration and generation mix, as noted in TSIR section 7.4.15. IR#713 must be able to accommodate these changes.

The calculated voltage flicker P_{lt} for continuous operation does not exceed NS Power's required limit with all elements in service. With L-6537 open at 2C-Port Hastings end, concurrent with minimum system generation, voltage flicker P_{lt} for continuous operation is exceeded. This will be examined in the System Impact Study (SIS), as more detail is provided. The project design must meet NSPI requirements for low-voltage ride-through and voltage control. Harmonics must meet the Total Harmonics Distortion provisions of IEEE 519.

The preliminary value for the unit loss factor is calculated as +9.9% at the POI on L-6537, net of any losses on the IC facilities up to the POI.

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

To connect IR#713 as NRIS, the preliminary non-binding cost estimate for interconnecting 42 MW to the L-6537 POI is $27,251,250. This cost estimate includes:

- A 3 breaker ring bus substation at the POI.
- Protection upgrades at 2C-Port Hastings, 5S-Glen Tosh.
- A 9.3 km spur line from the POI to the Interconnection Customer's Interconnection Facility (ICIF).
- Modifications to arming/limit values of existing Type 1 RAS (Group 5 and Group 6), subject to NPCC approval.
- Redesign/modifications to the existing Limited Impact RAS (Wreck Cove), subject to NPCC approval.
- Uprate of L-6538 and L-6539 CTs by CT winding ratio modification.
- Replacement of 3C-T71 transformer.

This cost estimate assumes the modifications to existing RAS will be approved by NPCC and includes a 25% contingency. In this estimate, $13,118,000 (plus 25% contingency) of the amount represents Network Upgrade costs which are funded by the Interconnection Customer, but which are eligible for refund under the terms of the GIP. The remainder of the costs are fully funded by the Interconnection Customer.

If transmission upgrades, instead of RAS modifications and additions, are found to be necessary to address the aforementioned thermal overloads in the SIS study stage, the total cost of Network

Upgrades would increase by an estimated $37,786,500 for the upgrades of L-6515, L-6537 and L-6538. This cost estimate does not include any contingency. Note that L-6538 includes a water crossing that will require an engineering study to more accurately determine the extent of cost and work required.

To connect IR#713 as ERIS, the preliminary non-binding cost estimate for interconnecting 42 MW to the L-6537 POI is $20,126,250, including a 25% contingency. This estimate includes:

- A 3 breaker ring bus substation at the POI.
- Protection upgrades at 2C-Port Hastings, 5S-Glen Tosh.
- A 9.3 km spur line from the POI to the Interconnection Customer’s Interconnection Facility (ICIF).
- Modifications to arming/limit values of existing Type 1 RAS (Group 5 and Group 6), subject to NPCC approval.
- Redesign/modifications to the existing Limited Impact RAS (Wreck Cove), subject to NPCC approval.
- Uprate of L-6538 and L-6539 CTs by CT winding ratio modification.

In this estimate, $7,418,000 (plus 25% contingency) of the amount represents Network Upgrade costs which are funded by the Interconnection Customer, but which are eligible for refund under the terms of the GIP.

The preliminary cost estimate does not include any supplemental devices that are potentially required to meet the NSPI power factor and/or inertia requirements. It also does not include costs to address any potential stability issues identified at the SIS stage based on dynamic analysis, and it assumes that RAS additions are approved by NPCC.

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

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1 Introduction

This Feasibility Study report (FEAS) presents the results of a Feasibility Study Agreement for the connection of "Rhodena Wind" with a capacity of 42 MW. This wind generation facility is requesting interconnection to NSPI system, studied as Network Resource Interconnection Service (NRIS) and Energy Resource Interconnection Service (ERIS).

This project is listed as Interconnection Request #713 in the NSPI Interconnection Request Queue and will be referred to as IR#713 throughout this report. Interconnection Customer (IC) identified L-6537 as the Point of Interconnection (POI), 8.2 km from the 2C-Port Hastings substation. This wind generation facility will be connected to the POI via a 9.3 km long 138 kV transmission line from the Point of Change of Ownership (PCO). Figure 1 shows the approximate geographic location of the proposed POI (red circle) and Figure 2 shows the approximate electrical location (red circle).

Figure 1: Approximate geographic location of IR#713

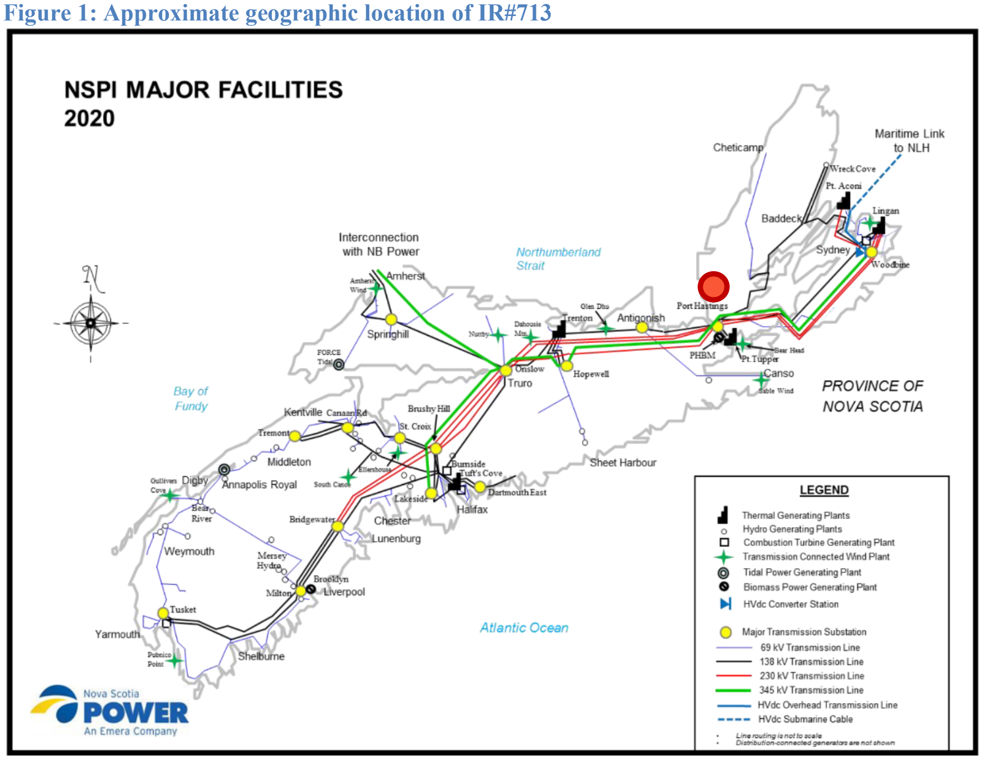
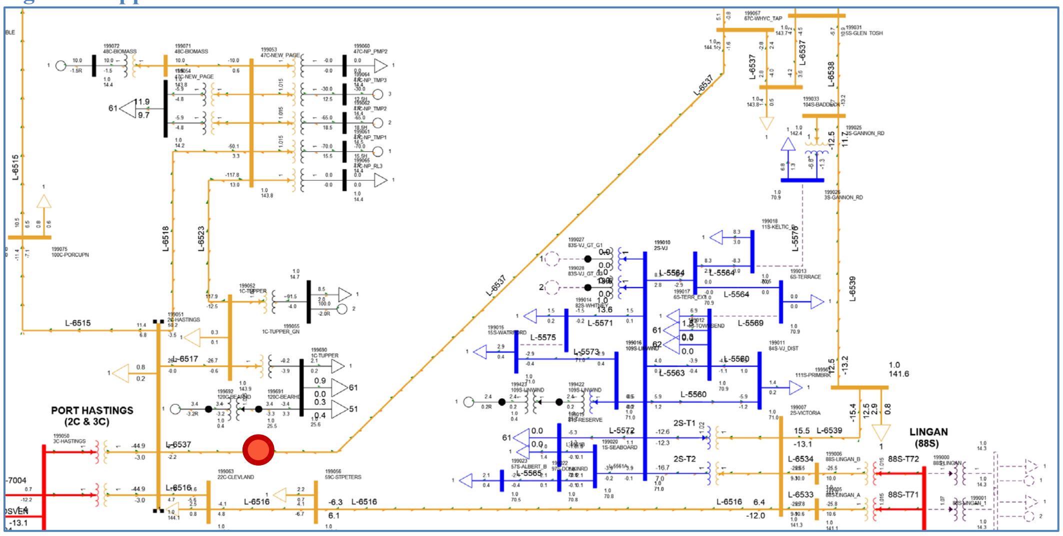


Figure 2: Approximate electrical location of IR#713



2 Scope

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

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

- Preliminary identification of any circuit breaker short circuit capability limits exceeded as a result of the interconnection, and any network upgrades necessary to address the short circuit issue associated with IR#713. Expected minimum short circuit capability will also be identified for the purpose of Short Circuit Ratio analysis.

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

- Preliminary analysis of the ability of the proposed Interconnection Facility to meet the reactive power, power quality and cold-weather capability requirements of the NSPI *Transmission System Interconnection Requirements*[1] (TSIR).

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

- For comparative purposes, the impact of IR#713 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 interconnect the generating facility.

The NRIS study identifies necessary upgrades to allow full output of the proposed generating facility. The ERIS study identifies the maximum allowed output, at the time the study is performed, of the interconnecting generating facility without requiring additional network upgrades.

3 Assumptions

This FEAS is based on the technical information provided by the IC. The POI and configuration are studied as follows:

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

2. Commercial Operation date 2025-12-30.

3. The Interconnection Customer Facility (ICIF) consists of 6 Nordex Delta 4000 (N163/6.X) wind turbine generators (WTG), each rated 7.0 MW (42 MW total) connected to two collector circuits operating at a voltage of 34.5 kV.

4. The POI on L-6537 is categorized Bulk Power System and will therefore require a three-breaker ring bus in accordance with Table 8 of the TSIR.

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

5. The ICIF will require the construction of a 9.3 km 138 kV transmission spur line from the POI to the IC 138kV/34.5kV transformer. The IC will be responsible for providing Right-of-Way for the lines. Detailed line data was not provided, so the same conductor as L-6537 was assumed.

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 (SIS). 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 transformer was rated at 45 MVA and modeled with a positive-sequence impedance of 7.5% on 45 MVA with an X/R ratio of 50. The IC indicated this interconnection facility transformer has a YNd5 winding configuration with +/- 15% on-load tap changer. The impedance of each generator step-up transformer was modeled as 9% on 7.8 MVA with an X/R of 9.13.

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 is based on the assumption that IR's higher in the Generation Interconnection Queue and OATT Transmission Service Queue that have completed a System Impact Study (SIS), or that have an SIS in progress will proceed, as listed in Section 4 below.

10. It is noted that Nordex Delta4000 (N163/6.X) has an operating temperature range from -30 ^{0}C to +40 ^{0}C (“Cold Climate Version”). Therefore, these are suitable for delivering full power under environmental conditions in Nova Scotia according to section 7.6.9 of the TSIR.

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

12. The ratings of the transmission facilities in the vicinity of IR#713 are shown in Table 1 and Table 2.

Table 1: Local Transmission Element Ratings

Line	Conductor	Design Temperature (^{0}C)	Limiting Element (Summer/Winter)	Summer Rating Normal/Emergency	Winter Rating Normal/Emergency
L-6503	1113 Beaumont	85	Conductor/Switchgear	287/315 MVA	287/315 MVA
L-6511	556.5 Dove	60	Conductor	140/154 MVA	184/202 MVA
L-6552	556.5 Dove	50	Conductor/Switchgear	110/121 MVA	143/157 MVA
L-6515	556.5 Dove	50	Conductor/Switchgear	110/121 MVA	143/157 MVA
L-6537	556.5 Dove	60	Conductor	140/154 MVA	184/202 MVA
L-6538	Spec. Galv. Steel/556.5 Dove	50	Conductor	110/121 MVA	165/181 MVA
L-6539	556.5 Dove	100	Switchgear	115/126 MVA	115/126 MVA
L-7004	556.5 Dove	60	Conductor	233/256MVA	307/337 MVA
L-7024	556.5 Dove	70	Conductor	275/302 MVA	348/383 MVA
L-7027	1113 Beaumont	70	Switchgear	398/437 MVA	398/437 MVA

Table 2: Local Transformer Ratings

Transformer	Normal Rating/15 min Emergency Summer / Winter
3C-T71	224/235 MVA
3C-T72	224/235 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 2024/02/21, the following projects are higher queued in the Advanced Stage Interconnection Request Queue and are committed to the study base cases:

- IR426: GIA Executed
- IR516: GIA Executed
- IR540: GIA Executed
- IR542: GIA Executed
- IR517: GIA in Progress
- IR574: GIA Executed
- IR598: GIA Executed

- IR597: GIA Executed
- IR647: GIA in Progress
- IR664: FAC Complete
- IR662: FAC Complete
- IR670: FAC Complete
- IR671: FAC in Progress
- IR669: FAC Complete
- IR668: FAC Complete
- IR618: FAC Complete
- IR673: FAC Complete
- IR675: FAC Complete
- IR677: SIS in Progress
- IR697: SIS in Progress
- IR739: SIS in Progress
- IR742: SIS in Progress

The power system base cases for the feasibility study include all transmission connected IRs in the GIP queue up to and including IR742 with the exception of IR686, as the IR686 SIS was not completed when IR713 was initiated.

In addition, TSR-411 is included in the queue, which reflects the study of long-term firm Transmission Service Reservation (TSR) from New Brunswick to Nova Scotia. If approved by the NSUARB, the TSR is expected to be in service in 2028 and a system study is currently underway to determine the required updates to the Nova Scotia transmission system. This has not been included in the feasibility study and the following notice is posted to the OASIS site[2]:

Due to ongoing development discussions and engineering studies, the Transmission System Network Upgrades identified as part of Transmission Service Request #411 will not be included in the System Impact Study (SIS) Analysis for Generator Interconnection Procedures (GIP) Study Groups #32 to 35. GIP Study Group #32 to #35 analysis will be limited to the 2022 Transmission System configuration plus any material Network Upgrades identified in higher queued projects.

5 Short-Circuit Duty / Short Circuit Ratio

The maximum (design) expected short-circuit level is 5,000 MVA (21 kA) on 138 kV systems and 10,000 MVA (25 kA) on 230 kV systems. The transient fault current

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

characteristics for the Nordex Delta 4000 (N163/6.X) wind turbine are given as 3.36 times rated current, or X'd = 0.298 per unit on machine base MVA.

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

Table 3: Short Circuit Levels in the Area with and without IR#713.

Location	Short Circuit MVA Without IR#713	Short Circuit MVA With IR#713
Maximum generation, all transmission facilities in service		
POI on L-6537 (138 kV)	2,161	2,248
Interconnection Facility (138 kV)	1,422	1,503
ICIF bus (34.5 kV)	422	525
3C-Port Hastings (230 kV)	3,956	3,996
2C-Port Hastings (138 kV)	3,406	3,482
5S-Glen Tosh (138 kV)	1,336	1,340
Minimum Conditions (TC3, LG1 In -Service)		
Interconnection Facility (138 kV), all lines in-service	838	924
Interconnection Facility (138 kV), L-6537 open at 2C	193	281
Interconnection Facility (138 kV), L-6537 open at 5S	800	886
ICIF bus (34.5 kV), all lines in-service	350	453
ICIF bus (34.5 kV), L-6537 open at 2C	147	250
ICIF bus (34.5 kV), L-6537 open at 5S	343	446

The interrupting capability of the 230 kV circuit breakers at 3C-Port Hastings and 67N-Onslow is at least 10,000 MVA. The interrupting capability of the 138 kV circuit breakers at 2C-Port Hastings, 5S-Glen Tosh is at least 3,500 MVA. As such, the interrupting rating at these substations will not be exceeded by this development on its own. However, the short circuit level at 2C-Port Hastings 138 kV substation is 3,482 MVA with IR#713 included, which is close to the limit of 3,500 MVA. This short circuit level will be further evaluated in the SIS.

Inverter-based generation installations often have a minimum Short Circuit Ratio (SCR) for the proper operation of converters and control circuits. Based on the calculated short circuit levels, a POI on 138 kV L-6537, and a 42 MW installation consisting of 6 Nordex Delta 4000 (N163/6.X) units, the SCR would be 8.1 at the 34.5 kV ICIF bus of the IR#713 substation with all lines in service and IR#713 offline. This falls to an SCR of 8.0 if L-6537 opens at 5S-Glen Tosh end and 3.4 with L-6537 open at 2C-Port Hastings end. These expected SCR conditions should be discussed with the wind turbine manufacturer to determine if the equipment can operate, or if modifications are required.

NSPI system short circuit level may decline over time with changes to transmission configuration and generation mix. IR#713 must be able to accommodate these changes, per TSIR section 7.4.15. Windfarms in proximity to IR#713 will also reduce the effective SCR in the area. The impact of the low SCR will be further examined when detailed data for the machine is made available for the SIS.

6 Load Flow Analysis

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

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

Table 4: List of Base Cases

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

These 12 base scenarios were studied with and without IR#713. This FEAS added IR#713 and displaced an equivalent amount of existing generation according to dispatch guidelines provided by NSPI[3]. Figure 3 shows the relevant corridors, generators, and loads on the NSPI transmission system. The arrow by each corridor shows the power flow direction of positive values.

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

Figure 3: Relevant transmission corridors, generators, and loads on the NSPI transmission system

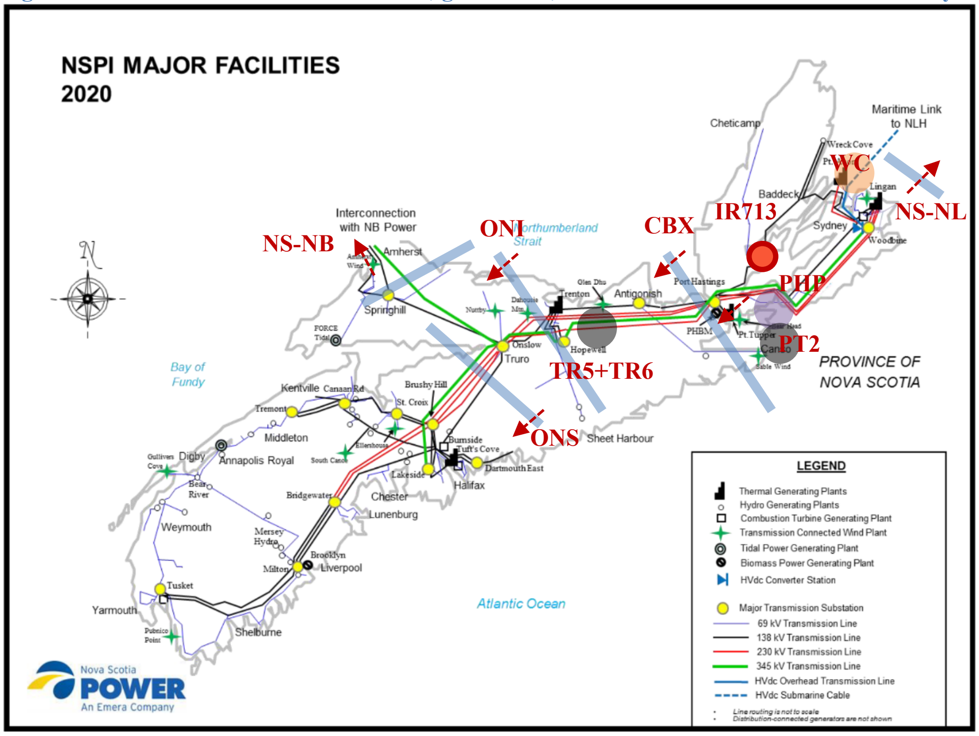


Table 5 summarizes the base cases and the dispatch scenarios to compare the effect of IR#713 on the loading of key NS corridors and generators. The case name followed by 1 (e.g., SML_01-1) stands for the case without IR#713 and the case name followed by 2 (e.g., SML_01-2) stands for the case with IR#713.

Table 5: Load Flow Data for Base Cases in MW

Case	NS-Load	NS-NB	NS-NL	ONS	ONI	CBX	PHP	TR5+TR6	PT2	WC	Wind	IR#713
SML_01-1	727	151	-170	-94	68	39	176	0	100	0	236	-
SML_01-2	727	150	-170	-79	82	54	176	0	73	0	278	42
SML_02-1	759	150	-170	106	268	-19	209	0	73	0	516	-
SML_02-2	759	151	-170	106	269	20	209	0	73	0	516	42
SSH_01-1	1161	151	-330	163	369	291	146	100	75	0	236	-
SSH_01-2	1161	150	-330	181	386	330	146	78	73	0	278	42
SSH_02-1	1157	154	-330	415	624	260	146	78	73	0	571	-
SSH_02-2	1157	150	-330	421	626	299	146	78	73	0	571	42
SUM_01-1	1545	150	-330	411	659	558	145	160	150	80	236	-
SUM_01-2	1545	150	-330	411	659	559	145	160	150	80	278	42
SUM_02-1	1604	151	-330	491	690	284	207	78	73	40	901	-
SUM_02-2	1604	149	-330	524	730	325	207	78	73	40	901	42
SUM_03-1	1604	152	-330	596	823	423	207	78	73	190	768	-
SUM_03-2	1604	149	-330	639	863	464	207	78	73	190	810	42
SUM_04-1	1541	323	-475	516	939	852	145	160	150	190	236	-
SUM_04-2	1541	324	-475	516	939	852	145	160	150	190	278	42
WIN_01-1	2354	0	-170	855	1040	886	15	295	155	211	236	-

Case	NS-Load	NS-NB	NS-NL	ONS	ONI	CBX	PHP	TR5+TR6	PT2	WC	Wind	IR#713
WIN_01-2	2354	-3	-170	855	1037	927	15	253	155	211	278	42
WIN_02-1	2349	-3	-170	795	851	447	15	156	73	211	1286	-
WIN_02-2	2349	0	-170	821	890	487	15	156	73	211	1286	42
WIN_03-1	2545	3	-170	689	741	396	220	78	150	211	1286	-
WIN_03-2	2545	3	-170	689	741	396	220	78	150	211	1328	42
WIN_04-1	2354	168	-330	852	1206	1043	15	315	155	211	236	-
WIN_04-2	2354	165	-330	852	1204	1085	15	273	155	211	278	42

As shown in Table 5 the loading of corridors west to the POI (i.e. Cape Breton Export - CBX and Onslow Import - ONI) can be affected by the addition of IR#713. In cases where the IR#713 generation is displacing thermal units in Cape Breton, the CBX and ONI flow is unchanged, but where Trenton generation is displaced, CBX is increased. Inter-provincial power flows between NS-NB are varied in these base cases, but only export conditions are considered in order to assess the impact of IR#713 integration with stressed CBX/ONI corridors.

Single contingencies were applied at the 345 kV, 230 kV and 138 kV voltage levels for the above system conditions with and without IR#713. Automated analysis searched for violations of emergency thermal ratings and emergency voltage limit for each contingency. Contingencies studied are listed in Table 6. Contingencies marked with * denote applicable in service SPS may be armed.

Table 6: Contingency List

Contingencies Studied				
88S_L7014	3C_T72	1N_L6001	103H_881	101V_L6004
88S_L7021	3C_710*	1N_T1	103H_600	101V_601
88S_L7022	3C_711	1N_T4	103H_608	99W_BESS
88S_710	3C_712*	1N_T65	103H_681	43V_BESS
88S_711	3C_713	1N_C61	91H_L5049	132H_BESS
88S_713	3C_714	1N_B61	91H_L5012	99W_708
88S_714	3C_715*	1N_B62	91H_L5041	99W_709
88S_715	3C_716	1N_600	91H_T62	99W_T71
88S_720	2C_L6515	1N_601	91H_T11	99W_T72
88S_721	2C_L6516	1N_613	91H_511	DCT_L5039_L6033
88S_722	2C_L6517	120H_L7008	91H_516	DCT_L7009_L8002
88S_723*	2C_L6518	120H_L7009	91H_521	DCT_L6011_L6010
88S_T71	2C_L6537	120H_L6005	91H_523	DCT_L6010_L6005
88S_T72	2C_B61	120H_L6010	91H_G3	DCT_L6005_L6016
88S_G2	2C_B62	120H_L6011	91H_G4	DCT_L7008_L7009
88S_G3	79N_L8003*	120H_L6051	91H_G5	DCT_L7003_L7004*
88S_G4	79N_L6507	120H_L6016	91H_G6	DCT_L7024_L7004*
101S_ML_POLE1	79N_L6508	120H_T71	14H_GT1	DCT_L6507_L6508
101S_ML_POLE2	79N_T81*	120H_T72	14H_GT3	DCT_L7021_L6534
101S_ML_BIPOLE	67N_L8001*	120H_SVC	83S_GT1	DCT_L6033_L6035

Contingencies Studied				
101S_T81	67N_L8002	120H_710	83S_GT2	85S_L6545
101S_T82	67N_L7019	120H_711	85S_GT1	5S_L6538
101S_L7011*	67N_L7001	120H_712	85S_GT2	3S_L6539
101S_L7012*	67N_L7002	120H_713	132H_602	5S_L6537
101S_L7015	67N_L7018	120H_714	132H_603	5S_L6516
101S_L8004*	67N_T81	120H_715	132H_605	5S_606
101S_701	67N_T82	120H_716	132H_606	5S_607
101S_702	67N_T71	120H_720	91N_701	2S_513
101S_703	67N_811*	120H_621	91N_702	89S_G1
101S_704	67N_812	120H_622	91N_703	1C_G2
101S_705	67N_813	120H_623	91N_B71	48C_G1
101S_706	67N_814*	120H_624	125C_L7025	50N_G5
101S_711	67N_701	120H_626	125C_701	50N_G6
101S_712	67N_702	120H_627	125C_B71	104W_G1
101S_713	67N_703	120H_628	127C_L7003	110W_T62
101S_811	67N_704	120H_629	127C_701	104H_600
101S_812*	67N_705	103H_L6008	127C_B71	SALISBURY_L3004
101S_813*	67N_706	103H_L6033	102N_L7005	SALISBURY_L3013
101S_814	67N_710	103H_L6038	102N_701	SALISBURY_SA3_2*
101S_816	67N_711*	103H_T81	102N_B71	SALISBURY_L3006*
3C_L7024	67N_712	103H_T61	100N_L6555	MEMRAMCOOK_L1159
3C_L7004	67N_713	103H_T63	100N_601	MEMRAMCOOK_L1160
3C_L7027*	1N_L6613	103H_B61	100N_B61	MEMRAMCOOK_ME3_1*
3C_T71	1N_L6503	103H_B62	101V_L6054	

6.1 NRIS Results

With the interconnection of IR#713 as NRIS several contingencies resulted in thermal overload on L-6515, L-6537, L-6538, L-6539 and 3C-T71. Table 7 shows the highest thermal overloads found, but other conditions were found that also violated thermal loading criteria, but to a lesser degree. No contingencies resulted in a violation of voltage limit criteria.

Table 7: Contingencies Resulting in Highest Line Overload

<table>
<tr><th>Line</th><th>Line Segment</th><th>Overload (% of Emergency Rating)</th><th>Case</th><th>Contingency</th></tr>
<tr><td>L-6515</td><td>2C-Hastings/4C-Lochaber</td><td>118.2%</td><td>WIN_04-2</td><td>101S-813</td></tr>
<tr><td>L-6537</td><td>IR#713/2C-Hastings</td><td>128.8%</td><td>SUM_03-2, SUM_04-2</td><td>L-6538</td></tr>
<tr><td>L-6538</td><td>3S-Gannon/5S-Glen Tosh</td><td>166.4%</td><td rowspan="2">SUM_03-2, SUM_04-2</td><td rowspan="2">L-6537 (2C to IR#713) or 2C_B61</td></tr>
<tr><td>L-6539</td><td>3S-Gannon/111S-Prime Brook</td><td>147.3%</td></tr>
<tr><td>3C-T71</td><td>3C - Hastings</td><td>114.4%</td><td>WIN_04-2</td><td>2C_B62</td></tr>
</table>

For the contingencies resulting in the thermal overloads on L-6515, the options examined include:

1. Thermal uprating of L-6515, approximately 50.7 km, at a cost of $20,533,500.
2. Modifications to arming values for existing Type 1 RAS (Group 5 and Group 6), estimated at $200,000 and is subject to NPCC approval.

For the contingencies resulting in the thermal overloads on L-6537, the options examined include:

1. Thermal uprating of L-6537 between 2C and IR#713 POI, approximately 8.2 km, at a cost of $3,321,000.
2. Modification of the existing Limited Impact RAS (Wreck Cove Overload), which IR#713 may be included in to also consider the loading of L-6537. This is estimated to cost $200,000 and is subject to NPCC approval.

For the contingencies resulting in the thermal overloads on L-6538, the options examined include:

1. Thermal uprating of L-6538 conductor, approximately 34.4 km, at a cost of approximately $13,932,000. Note that L-6538 includes a water crossing and requires a more detailed engineering study to more accurately determine the cost.
2. Modification of the existing Limited Impact RAS (Wreck Cove Overload), which IR#713 may be included in. This is estimated to cost $200,000 and is subject to NPCC approval.

All options will require uprating of the L-6538 CTs by CT winding ratio modification. For the contingencies resulting in the thermal overloads of L-6539, the only mitigation option identified is uprating of the L-6539 CTs by CT winding ratio modification. The cost of CT uprating for L-6538 and L-6539 is $18,000.

For the contingencies resulting in the thermal overloads of 3C-T71, the only mitigation option identified is replacement of 3C-T71 at a cost of $5,700,000. This overload will be investigated further in the SIS, should this project proceed, to determine any potential additional overload capabilities.

If, during the System Impact Study, it is determined that modifications to the existing RASs do not provide an acceptable solution, then the respective transmission line thermal uprate will be required.

The proposed upgrades for NRIS connection at the POI on L-6537 are:

1. Modifications to existing Type 1 RAS (Group 5 and Group 6) arming/limit values to mitigate overloads on L-6515.

2. Redesign or modification to the Limited Impact RAS (Wreck Cove Overload) to mitigate thermal overloads on L-6537 and L-6538.
3. Uprate of L-6538 and L-6539 CTs by CT winding ratio modification.
4. Replacement of 3C-T71.

6.2 ERIS Results

With the interconnection of IR#713 as ERIS, the facility can only generate up to 1.7 MW before exceeding thermal limits on 3C-T71 transformer for the 2C-B62 contingency. This thermal constraint is based on maximum generation at Wreck Cove and significant loading on the CBX corridor. The proposed upgrades for ERIS connection at the POI on L-6537 are :

1. Modifications to existing Type 1 RAS (Group 5 and Group 6) arming/limit values to mitigate overloads on L-6515.
2. Redesign or modification to the Limited Impact RAS (Wreck Cove Overload) to mitigate thermal overloads on L-6537 and L-6538.
3. Uprate of L-6538 and L-6539 CTs by CT winding ratio modification.

These requirements are remaining because any amount of active power output from IR#713 increases the severity of the overload these existing overloads.

Re-design of a RAS is subject to the approval of NPCC. If, during the System Impact Study, it is determined that modifications to the existing RASs do not provide an acceptable solution, then the respective transmission line thermal uprate will be required.

If transmission upgrades were found to be necessary to address the aforementioned thermal overloads, the total cost of Network Upgrades would increase by an estimated $37,786,500:

- $20,533,500 for the upgrade of L-6515.
- $3,321,000 for the upgrade of L-6537 between 2C and IR#713 POI.
- $13,932,000 for the upgrade of L-6538. Note that L-6538 includes a water crossing and requires a more detailed engineering study to more accurately determine the cost.

7 Voltage Flicker and Harmonics

The voltage flicker calculations use IEC Standard 61400-21 based on estimated data provided by Nordex N163/6.X DFIG wind turbines (4.0 flicker coefficient c(ψk, va) at 85°

system angle). The flicker step factor Kf (ψk) for switching operations at a system angle of 85° is given as 0.2 for start-up at both cut-in wind speed and rated wind speed. The maximum number of switching operations within a 10-minute period N10m is given as 1. The maximum number of switching operations within a 120-minute period N120m is given as 10 for cut-in speed and 12 for rated speed. The voltage flicker P_{st} and P_{lt} levels are calculated at the Interconnection Facility for various system conditions and are shown in Table 8.

Table 8: The Voltage Flicker Pst and Plt Levels

System Condition	Flicker at 138 kV Bus				
	P_{st}=P_{lt} Continuous	P_{st}		P_{lt}	
		Cut-in speed	Rated Speed	Cut-in speed	Rated Speed
Maximum Generation					
All Transmission in Service	0.044	0.028	0.028	0.026	0.027
Minimum Conditions (TC3, LG1 in-service)					
All Transmission in Service	0.08	0.051	0.051	0.046	0.049
L-6537 open at 2C	0.345	0.221	0.221	0.2	0.212
L-6537 open at 5S	0.083	0.053	0.053	0.048	0.051

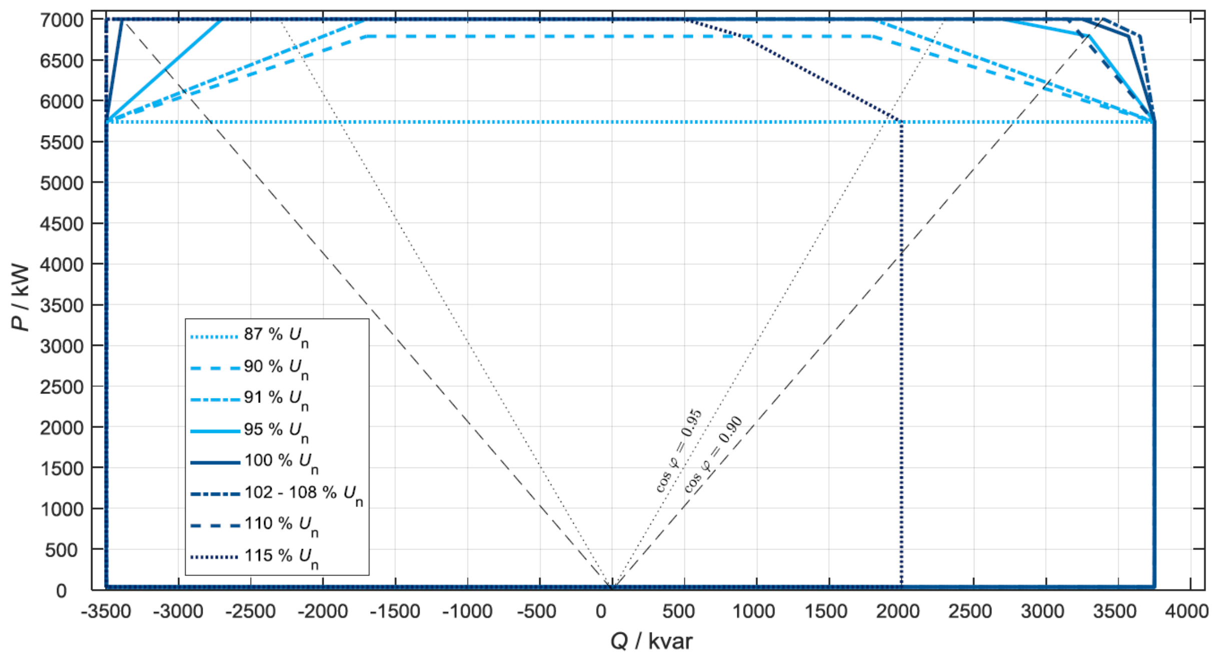
NS Power's required limits are 0.35 for P_{st} and 0.25 for P_{lt} (applicable to scenarios with all transmission in service). IR#713 meets flicker requirements based on this analysis but it is noted that flicker limits are exceeded in minimum generation conditions with L-6537 open at the 2C-Hastings end. This will be further evaluated in the SIS as more detail is available.

The generator is expected to meet IEEE Standard 519-2014 limiting voltage Total Harmonic Distortion (all frequencies) to a maximum of 2.5%, with no individual harmonic exceeding 1.5% on 138 kV.

8 Reactive Power and Voltage Control

In accordance with the *Transmission System Interconnection Requirements* Section 7.6.2, IR#713 must be capable of delivering reactive power for a net power factor of at least +/- 0.95 of rated capacity (i.e. 13.8 MVAR) to the high side of the plant interconnection transformer. Reactive power can be provided by continually acting auxiliary devices such as STATCOM, synchronous condenser, etc. supplied by the Interconnection Customer. The provided P-Q diagram for Mode-0 (7000 kW) is shown in Figure 4.

Figure 4: P-Q diagram for Mode-0 (7000 kW) by Nordex



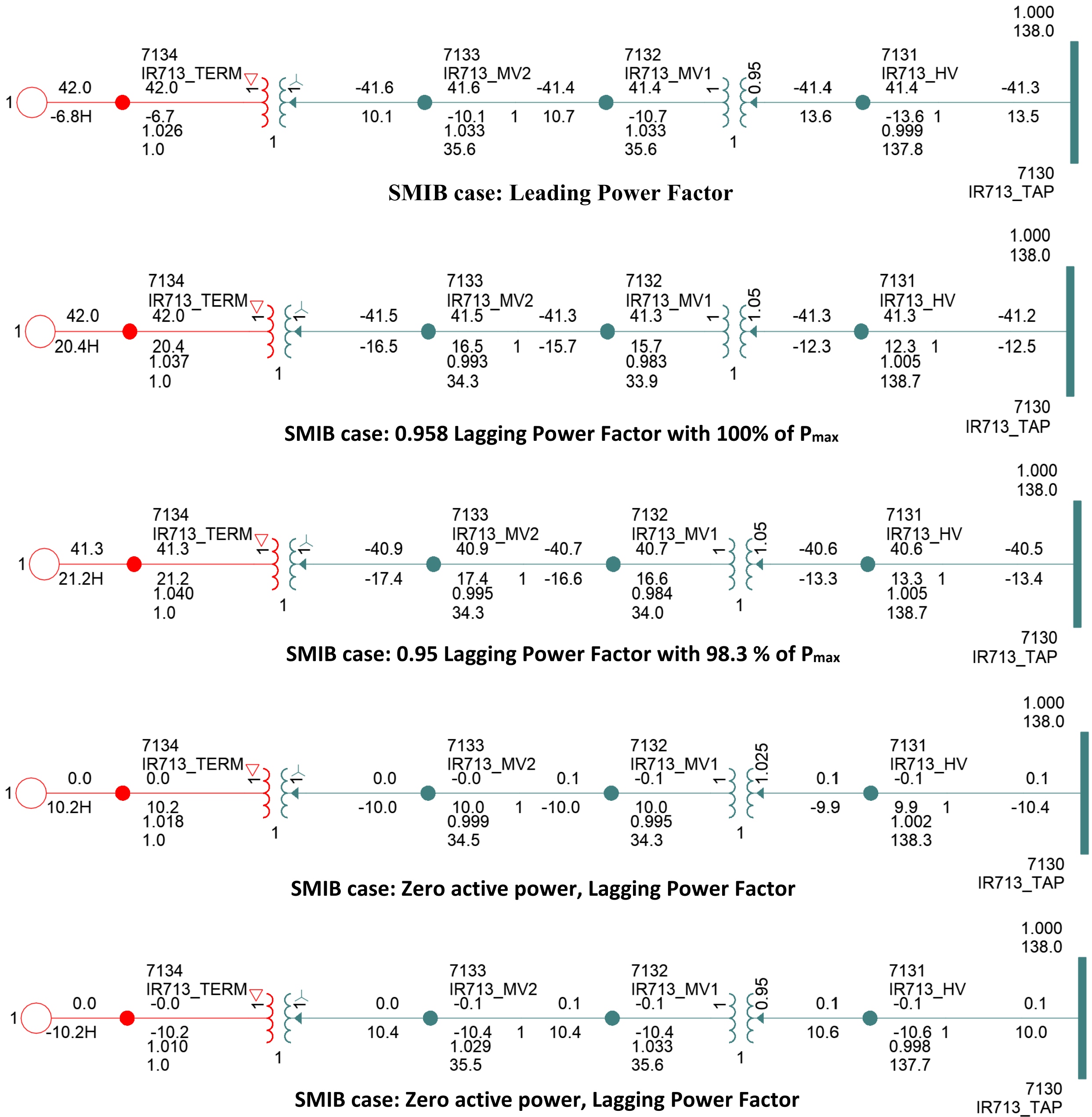
When the active power is zero, the reactive power is zero. The optional "STATCOM function" can be added and enabled to inject/absorb reactive power also when active power is zero, but at a reduced capacity (±1700 kVAR).

The power factor analysis is conducted using an SMIB (Single Machine Infinite Bus) case for IR#713. The leading power factor analysis for IR#713 results in power factor values less than 0.95. This verifies the ability of the configuration to meet the leading power factor requirement. However, IR#732 cannot meet the lagging power factor requirement of 0.95 as the same analysis for the lagging power factor results in a power factor value of 0.958.

IR#713 can meet the lagging power factor requirement of 0.95 or below while maintaining the terminal voltage at the acceptable level by reducing the active power output to 98.3% of the maximum active power output. The analysis of reactive power capability when active power is zero shows that IR#713 cannot supply the full rated reactive power and therefore does not meet the TSIR requirement for rated reactive power availability through the full range of active power output of the Generating Facility from zero to full power.

The analysis shown in Figure 5 verifies the reactive power capability of the system.

Figure 5: Reactive Power Analysis results



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

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

9 Bulk Electric / Bulk Power Analysis

Interconnection with L-6537 will require a three-breaker 138 kV ring bus since L-6537 is categorized as Bulk Power System (BPS). The final BPS determination of the new facilities will be performed in the System Impact Study.

The new POI substation will be categorized Bulk Electric System (BES) under NERC criteria.

10 Expected Facilities Required for Interconnection

The following facility changes will be required to connect IR#713 to the NSPI transmission system at a POI on L-6537:

10.1 Network Upgrades for NRIS

- Install a new 138 kV substation complete with 3 breaker ring bus at the L-6537 POI with control and protection. A Remote Terminal Unit (RTU) to interface with NSPI's SCADA, with telemetry and controls as required by NSPI.
- Modification of NSPI protection systems at 2C-Port Hastings and 5S-Glen Tosh.
- Modifications to existing NSPI Type 1 RAS (Group 5 and Group 6) arming/limit values.
- Redesign or modification to the existing Limited Impact RAS (Wreck Cove Overload), subject to NPCC approval.

- Uprate of L-6538 and L-6539 CTs by CT winding ratio modification.
- Replacement of 3C-T71.

10.2 Network Upgrades for ERIS

- Install a new 138 kV substation complete with 3 breaker ring bus at the L-6537 POI with control and protection. A Remote Terminal Unit (RTU) to interface with NSPI's SCADA, with telemetry and controls as required by NSPI.
- Modification of NSPI protection systems at 2C-Port Hastings and 5S-Glen Tosh.
- Modifications to existing NSPI Type 1 RAS (Group 5 and Group 6) arming/limit values.
- Redesign or modification to the existing Limited Impact RAS (Wreck Cove Overload), subject to NPCC approval.
- Uprate of L-6538 and L-6539 CTs by CT winding ratio modification.

10.3 Transmission Provider's Interconnection Facilities (TPIF):

- Construct a 9.3 km, 138 kV transmission line between the L-6537 POI and the ICIF substation. This line would be built to NSPI's 138 kV standards.
- Supervisory, control, and communications between the wind farm and NSPI SCADA system (to be specified).

10.4 Interconnection Customer's Interconnection Facilities (ICIF):

- Facilities to provide 0.95 leading and lagging power factor when delivering rated output at the HV terminals of the IC Substation Step Up Transformer when the voltage at that point is operating between 95 and 105% of nominal. This study shows that Nordex Delta 4000 (N163/6.X) would not meet the 0.95 lagging power factor requirement or 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 per Section 7.4.1 of the TSIR. Real-time monitoring (including an RTU) of the interconnection facilities. Local wind speed and direction, MW and MVAR, as well as bus voltages, are required. Facilities for NSPI to execute high speed rejection of generation (transfer trip) if determined in SIS. The plant may be incorporated into RAS run-back schemes.
- Automatic Generation Control to assist with tie-line regulation.
- Compliance with section 7.6.7 of TSIR, "WECS Generating Facilities shall support short-duration frequency deviations by providing inertia response equivalent to a Synchronous Generator with an inertia factor (H) of at least 3.0 MW-s/MVA for a period of at least 10 seconds." This item will be assessed in the SIS, which may identity additional resources such as synchronous condenser, Flexible AC Transmission System (FACTS) devices, etc.
- Operation at an ambient temperature of -30°C, section 7.6.9 of the TSIR.
- The facility must meet NSPI's TSIR as published on the NSPI OASIS site.
- NS Power notes that NERC standard PRC-029-1 is currently in development. As proposed, this standard will impose performance requirements for voltage and frequency ride through behaviour on inverter-based generating resources. It is anticipated that this standard will be applicable to the project currently under study. The Interconnection Customer is advised to consider the requirements of PRC-029-1 in their project design to ensure that their project can conform to these requirements. Conformance will be validated at the System Impact Study stage.

11 NSPI Interconnection Facilities and Network Upgrades Cost Estimate

NRIS Cost Estimate

Estimates for NSPI Interconnections Facilities and Network Upgrades for interconnecting 42 MW wind energy at the 138 kV POI on L-6537 are included in Table 9.

Table 9: Cost Estimate NRIS @ POI L-6537

Item	Network Upgrades	Estimate
1	Three breaker ring bus 138 kV substation complete with P&C at NSPI POI substation and connection to L-6537, including P&C modifications at 2C-Port Hastings and 5S-Glen Tosh	$7,000,000
2	Modifications to Type 1 RAS (Group 5 and Group 6), subject to NPCC approval	$200,000
3	Redesign or modifications to Limited Impact RAS (Wreck Cove Overload), subject to NPCC approval	$200,000
4	Uprate of L-6538 and L-6539 CTs by CT winding ratio modification	$18,000

5	Replacement of 3C-T71 transformer	$5,700,000
	Sub-total for Network Upgrades	$13,118,000
Item	**TPIF Upgrades**	**Estimate**
1	Build 9.3 km 138 kV spur line from TPIF to ICIF, with IC responsible for providing Right-Of-Way	$7,533,000
2	NSPI P&C relaying equipment	$300,000
3	NSPI supplied RTU	$100,000
4	Tele-protection and SCADA communications	$750,000
	Sub-total for TPIF Upgrades	$8,683,000
	Total Upgrades	**Estimate**
	Network Upgrades + TPIF Upgrades	$21,801,000
	Contingency (25%)	$5,450,250
	Total (Incl. 25% contingency and Excl. HST)	$27,251,250

The preliminary non-binding cost estimate for interconnecting 42 MW at the POI at L-6537 under NRIS is $27,251,250 including a contingency of 25%. In this estimate, $13,118,000 (plus 25% contingency) of the amount represents Network Upgrade costs which are funded by the Interconnection Customer, but which are eligible for refund under the terms of the GIP. This does not include TBD costs to address any stability issues identified at the SIS stage based on dynamic analysis.

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

ERIS Cost Estimate

Estimates for NSPI Interconnections Facilities and Network Upgrades for interconnecting IR#713 as ERIS at the 138 kV POI on L-6537 are included in Table 10.

Table 10: Cost Estimate ERIS @ POI L-6537

Item	Network Upgrades	Estimate
1	Three breaker ring bus 138 kV substation complete with P&C at NSPI POI substation and connection to L-6537, including P&C modifications at 2C-Port Hastings and 5S-Glen Tosh	$7,000,000
2	Modifications to Type 1 RAS (Group 5 and Group 6), subject to NPCC approval	$200,000
3	Redesign or modifications to Limited Impact RAS (Wreck Cove Overload), subject to NPCC approval	$200,000
4	Uprate of L-6538 and L-6539 CTs by CT winding ratio modification	$18,000
	Sub-total for Network Upgrades	$7,418,000
Item	**TPIF Upgrades**	**Estimate**
1	Build 9.3 km 138 kV spur line from TPIF to ICIF, with IC responsible for providing Right-Of-Way	$7,533,000
2	NSPI P&C relaying equipment	$300,000
3	NSPI supplied RTU	$100,000

4	Tele-protection and SCADA communications	$750,000
	Sub-total for TPIF Upgrades	$8,683,000
	Total Upgrades	**Estimate**
	Network Upgrades + TPIF Upgrades	$16,101,000
	Contingency (25%)	$4,025,250
	Total (Incl. 25% contingency and Excl. HST)	$20,126,250

The preliminary non-binding cost estimate for interconnecting IR#713 at the POI at L-6537 under ERIS is $20,126,250 including a contingency of 25%. In this estimate, $7,418,000 (plus 25% contingency) of the amount represents Network Upgrade costs which are funded by the Interconnection Customer, but which are eligible for refund under the terms of the GIP. This does not include TBD costs to address any stability issues identified at the SIS stage based on dynamic analysis.

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

12 Loss Factor

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

The data and calculation are detailed in Table 11 and Equation (01), respectively.

Table 11: Data for Loss Factor Calculation

Parameter/Measurement	Value (MW)
Power at POI of IR#713	41.3
Power generation at TC with IR#713	111.22
Power generation at TC without IR#713	148.43
Loss Factor	**9.90 %**

$$Loss\ Factor = \frac{(IR713_{POI} + TC_{withIR713}) - TC_{withoutIR713}}{IR713_{POI}} \qquad (01)$$

13 Preliminary scope of subsequent SIS

The following provides a preliminary scope of work for the subsequent SIS for IR#713.

The SIS will include a more comprehensive assessment of the technical issues and requirements to interconnect generation as requested. It will include contingency analysis, system stability, transient stability, ride through capability, and operation following a contingency (N-1 operation). The SIS must determine the facilities required to operate this facility at full capacity, withstand any contingencies (as defined by the criteria appropriate to the location) and identify any restrictions that must be placed on the system following a first contingency loss.

The SIS will confirm the options and ancillary equipment that the customer must install to control flicker, voltage response, frequency response, control interactions with other IBR facilities, active power and ensure that the facility has the required ride-through capability. The SIS will be conducted in accordance with the GIP with the assumption that all appropriate higher-queued projects proceed, and the facilities associated with those projects are installed.

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

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

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

- Table 1 "Planning Design Criteria" of NPCC Directory 1.
- Table 1 "Steady State & Stability Performance Planning Events" of NERC TPL001-5.1.
- NSPI System Design Criteria, report number NSPI-TPR-003-6.

Any changes to RAS schemes required for operation of this generating facility, in addition to existing generation and facilities that can proceed before this project, will be determined by the SIS as well as any required additional transmission facilities. The determination will be based on NPCC[4] and NERC[5] criteria as well as NSPI guidelines and good utility practice. The SIS will also determine the contingencies for which this facility must be curtailed.

[4] NPCC criteria are set forth in its Reliability Reference Directory #1 *Design and Operation of the Bulk Power System*

[5] NERC transmission criteria are set forth in *NERC Reliability Standard TPL-001-5*

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

> *To be eligible for inclusion in the Interconnection System Impact Study stage, and thereby advance the Interconnection Request's initial Queue Position, the Interconnection Customer must meet the progression milestone requirements of Section 7.2 of the GIP at least ten (10) Business Days prior to the Interconnection System Impact Study commencement date. For clarity, item 7.2 (i) – provision of a detailed stability model for the generator(s) shall mean:*
>
> - *Provision of PSSE and PSCAD models in compliance with documents NSPI-TPR-015-2: PSSE and PSCAD Model Requirements, and*
> - *Provision of test data demonstrating model testing in compliance with NERC, NPCC and NSPI criteria. NSPI-TPR-014-1: Model Quality Testing lists the minimum requirements that will be performed by NSPI. Additional testing may be performed to assess compliance with all applicable criteria. Any test not meeting the minimum NSPI requirements will be documented in the MQT report to the IC.*
>
> *NSPI-TPR-015-2: PSSE and PSCAD Model Requirements and NSPI-TPR-014-1: Model Quality Testing will undergo revision as the grid evolves and performance criteria changes. The most up to date version will be provided as they become available.*