Interconnection Feasibility Study Report

GIP-IR586-FEAS-R1

Generator Interconnection Request 586

50 MW Battery Energy Storage System Facility

Colchester County, NS

2021-12-03

Control Centre Operations
Nova Scotia Power Inc.

Executive Summary

The Interconnection Customer (IC) submitted an Interconnection Request (IR#586) for Energy Resource Interconnection Service (ERIS) for a proposed 50 MW Battery Energy Storage System (BESS) facility interconnected to the NSPI transmission system, with a Commercial Operation Date of 2022-11-01. The Point of Interconnection (POI) requested by the customer is the 138 kV voltage level at 1N-Onslow. This BESS facility will be interconnected to the POI via a ~150 m long 138 kV transmission line from the Point of Change of Ownership (PCO).

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

- TSR 411 (800 MW): SIS in Progress
- TSR 412 (500 MW): 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 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 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. The increase in short circuit level is still within the capability of associated breakers. The minimum three phase short circuit level at the Interconnection Facility's (IF) high side bus is 1,056 MVA with line L-6527 out of service and IR#586 in service.

Voltage flicker will not be an issue based on the data provided.

The project design must meet NSPI interconnection technical requirements, which include aspects like frequency and voltage ride-through, reactive power and voltage control, active power control, power quality, and low temperature operation. Harmonics must meet the Total Harmonic Distortion requirements in IEEE 519.

Supplementary reactive power support for IR#586 is required as it is unable to meet NSPI's ±0.95 net power requirements at the IF 138 kV bus. The Hitachi BESS selected for IR#586 have current-limited, bi-directional inverters capable of full four-quadrant operation at nominal voltage; however, they are only capable of >0.97 pf at 50MW output. Net power factor requirements are met when IR#586's output levels are just below 48.5 MW. Supplementary reactive power support will be further investigated in the System Impact Study.

The preliminary value for the unit loss factor is calculated as 3.96% at the 1N-Onslow 138kV bus POI. This preliminary loss factor excludes losses associated with the TPIF, ICIF transformer, and generation facility.

Assuming that other projects with a higher queue position do not proceed, the preliminary non-binding estimated cost of facilities required to interconnect the IR#586 to the 138kV bus at 1N-Onslow is $1,999,800 including a contingency of 10%.

These non-binding estimates will be further refined in the System Impact Study and the Facility Study.

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

Table of Contents

Executive Summary 1
List of Tables and Figures 3
1.0 Introduction 4
2.0 Scope 6
3.0 Assumptions 7
3.1 System Assumptions 7
3.2 Project Assumptions 7
4.0 Projects with Higher Queue Positions 8
5.0 Short-Circuit Duty / Short Circuit Ratio 9
6.0 Voltage Flicker and Harmonics 10
7.0 Thermal Limits 11
8.0 Voltage Limits 12
9.0 System Security / Bulk Power Analysis 14
10.0 Loss Factor 15
11.0 Expected Facilities Required for Interconnection 15
12.0 Facilities and Network Upgrades Cost Estimate 16
13.0 Preliminary Scope of the SIS 17

List of Tables and Figures

Table 1: Local Transmission Elements 7
Table 2: Maximum Short circuit levels, 3-ph, in MVA 9
Table 3: Minimum Short circuit levels, 3-ph, in MVA 10
Table 4: Flicker Requirements 11
Table 5: Base Case Dispatch (MW) 11
Table 6: Power Factor at IR#586 Transformer HV Terminals 13
Table 7: Loss Factor while discharging 15
Table 8: Cost Estimate 17

Figure 1: Utility Battery Site Location 4
Figure 2: Point of Interconnection (not to scale) 5
Figure 3: PS1000 capability curve 12
Figure 4: NERC PRC-024-2 Attachment 2 14
Figure 5: NERC BES Definition- Exclusion Criteria E1 14

1.0 Introduction

The Interconnection Customer (IC) submitted an Interconnection Request (IR#586) for Energy Resource Interconnection Service (ERIS) for a proposed 50 MW Battery Energy Storage System (BESS) facility interconnected to the NSPI transmission system, with a Commercial Operation Date of 2022-11-01. The Point of Interconnection (POI) requested by the customer is the 138kV voltage level at 1N-Onslow. There are congestion issues at the site north of the 1N-Onslow substation due to the Right of Way (ROW) associated with transmission lines L-6503 and L-5040.

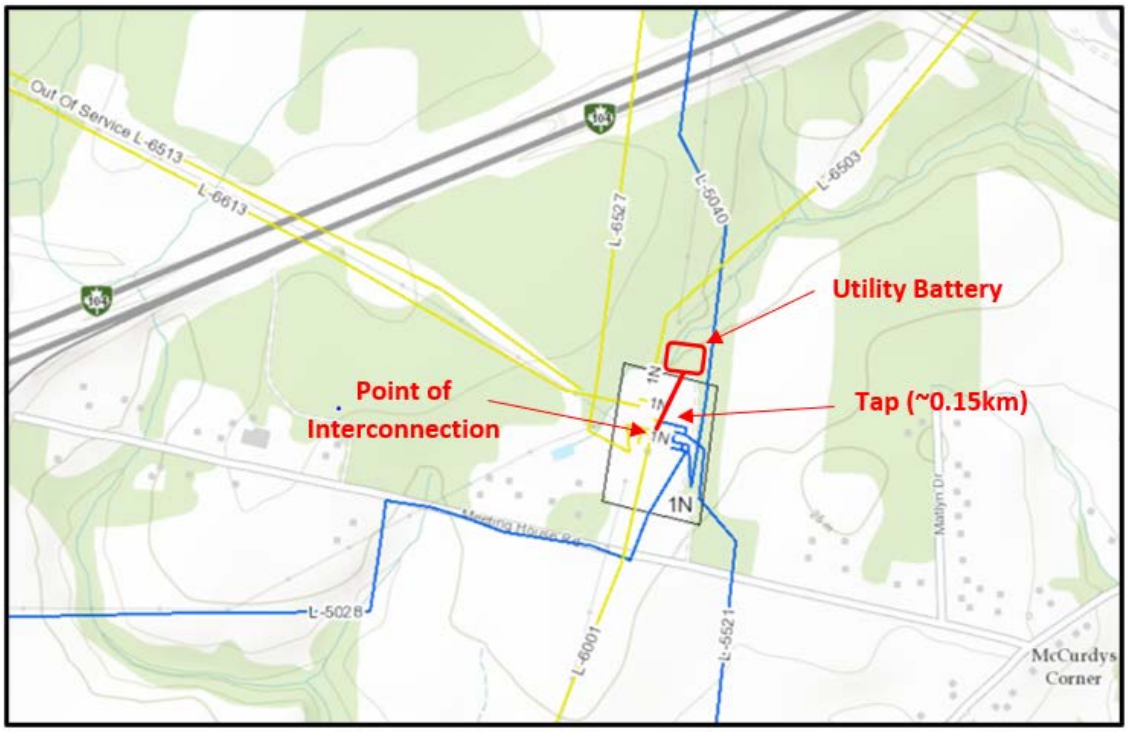

Figure 1: Utility Battery Site Location

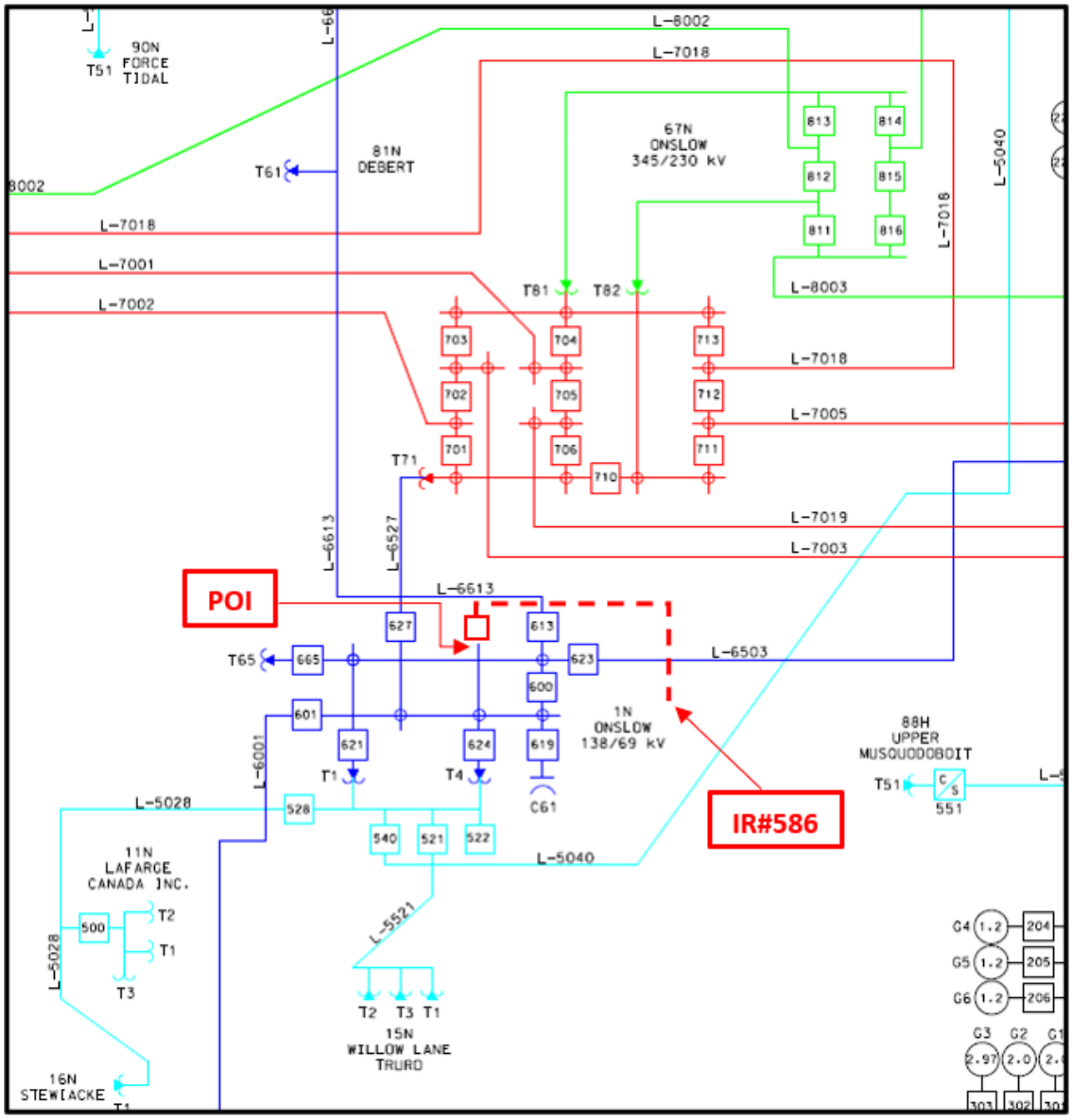

Figure 2: Point of Interconnection (not to scale)

The Interconnection Customer (IC) signed a Feasibility Study Agreement to study the connection of their proposed BESS facility to the NSPI transmission system dated 2021-04-21, and this report is the result of that Study Agreement. This project is listed as Interconnection Request #586 in the NSPI Interconnection Request Queue and will be referred to as IR#586 throughout this report.

2.0 Scope

The objective of this Interconnection Feasibility Study (FEAS) is to provide a preliminary evaluation of system impacts from interconnecting the proposed Battery Energy Storage System (BESS) 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 circuit breakers beyond their rated capacity, the circuit breakers must be upgraded. Single contingency criteria are applied.

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

- Preliminary identification of any circuit breaker short circuit capability limits exceeded as a result of the interconnection, and any network upgrades necessary to address the short circuit issues associated with the IR.

- 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.

- 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.

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.

Applicable Planning criteria 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.

3.0 Assumptions

3.1 System Assumptions

The rating of Lines L-6001, L-6503, L-6527 and L-6613 are listed below in Table 1: Local Transmission Elements.

Table 1: Local Transmission Elements

Line	Conductor	Design Temperature	Limiting Element	Summer Rating Normal/Emergency (MVA)	Winter Rating Normal/Emergency (MVA)
L-6001	556.5 Dove	60°C	Conductor	140/154	184/202
L-6503	1113 Beaumont	85°C	Switchgear	287	287
L-6527	795 Drake	100°C	Switchgear	268/287	287
L-6613	1113 Beaumont	100°C	Switchgear	287	287

3.2 Project 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: Sample below

1. Energy Resource Interconnection Service (ERIS) type per section 3.2 of the Generator Interconnection procedures (GIP).
2. Commercial Operation date 2022-11-01.
3. The Interconnection Facility consists of 36 x 1.5MVA Hitachi (ABB) PS1000 690VAC battery system units, capped at 50 MW total. These are grouped in blocks of 3MVA with two PS1000 units per block. Each block is connected to a collector circuit via a 3MVA padmount transformer, with a total of 6 blocks per collector circuit (18MVA). Three collector circuits connect the battery blocks to the main 30/40/50 MVA substation step-up transformer.
4. The POI is located at the 138kV bus at the 1N-Onslow substation. This study will use 556 ACSR Dove conductor for the 150m transmission line between 1N and the IC facility.
5. 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 BESS facility 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.

6. Preliminary data was provided by the IC for the IC substation step-up transformers.
    a. The substation step-up transformer was modelled as one 138 kV (delta) – 13.8 kV (wye) transformer rated at 30/40/50 MVA, with a positive sequence impedance of 6%. An X/R ratio of 30 was assumed for this unit.
    b. The padmount transformers were modelled as an equivalent transformer based off eighteen 13.8 kV (delta) - 0.69 kV (wye) 3.0 MVA transformers, with a 6% positive impedance. An X/R ratio of 10 was assumed for this unit.
7. The Hitachi battery racks are the 690 VAC, 1500 kVA nameplate variant. A 1.2 PU fault current is used for short circuit analysis.
8. Collector circuit data was not provided, however impedance is considered negligible for a BESS facility of this magnitude, with the understanding that net real and reactive power output of the plant will be impacted by losses through transformers.
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, or that have a System Impact Study in progress will proceed, as listed in Section 4 below.
10. The BESS charge/discharge rate is 50 MW.
11. Discharging occurring in light load, summer peak, and winter peak conditions.
12. Charging occurs in light load and summer peak conditions. During the winter season, charging is studied only under off-peak load conditions several hours after winter peak, which coincides with loading levels of ≤ 91% peak load.

4.0 Projects with Higher Queue Positions

All in-service generation is included in the FEAS.

As of 2021/10/18, 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
- IR557: SIS complete
- IR569: GIA executed
- IR568: GIA executed

- IR566: GIA executed
- IR574: FAC in progress
- IR595: SIS complete

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

- TSR 411 (800 MW): SIS in Progress
- TSR 412 (500 MW): 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 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 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 Duty / Short Circuit Ratio

Short circuit analysis was performed using PSS/e v34.8 for a classical fault study, flat voltage profile at 1 VPU, 3LG and 1LG. The short-circuit levels in the area before and after this development are provided below in Table 2 and Table 3.

Table 2: Maximum Short circuit levels, 3-ph, in MVA

Maximum Generation: All Generation On, All Transmission Lines In Service					
IR#586	**Radial Location**	**Three Phase MVA**	**X/R**	**Single Phase MVA**	**X/R**
On	Interconnection Facility (138kV)	2341	13.9	-	-
	1N-Onslow 138 kV (POI)	2359	14.0	2513	13.2
Off	Interconnection Facility (138kV)	2297	13.7	-	-
	1N-Onslow 138 kV (POI)	2316	13.7	2481	13.2

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

Minimum Generation: TC1, LG2, ML & TR5 On, All Transmission Lines In Service					
IR#586	**Radial Location**	**Three Phase MVA**	**X/R**	**Single Phase MVA**	**X/R**
On	Interconnection Facility (138kV)	1688	16.8	-	-
	1N-Onslow 138 kV (POI)	1697	16.9	1948	13.2
Off	Interconnection Facility (138kV)	1644	16.4	-	-
	1N-Onslow 138 kV (POI)	1654	16.5	1909	13.2
Minimum Generation: TC1, LG2, ML & TR5 On, L6527 Out of Service					
On	Interconnection Facility (138kV)	1056	9.3	-	-
	1N-Onslow 138 kV (POI)	1060	9.3	1022	9.1
Off	Interconnection Facility (138kV)	1013	9	-	-
	1N-Onslow 138 kV (POI)	1017	9	995	9.1

The maximum short-circuit level at the POI at 1N-Onslow with IR#586 on-line, the short-circuit level will increase to 2,359 MVA at the POI. Under minimum generation conditions, with only Tuft's Cove 1, Lingan 2, the Maritime Link, and Trenton 5 in service, and transmission line L-6527 out of service, the fault level at the POI falls to 1,017 MVA with IR#586 off.

The interrupting capability of the 138 kV circuit breakers at 1N-Onslow is at least 3,500 MVA. As such, the interrupting ratings at this substation will not be exceeded by this development on its own. Therefore IR#586 will not impact the circuit breakers at 1N-Onslow.

Further short circuit analysis will be performed in the SIS and will also examine Short Circuit Ratio (SCR) under minimum short circuit level conditions.

6.0 Voltage Flicker and Harmonics

The IC supplied manufacturer test data, with Pst and Plt values meeting NS Power's voltage flicker requirements. A summary is listed in Table 4: Flicker requirements.

Table 4: Flicker Requirements		
	P_{st}	P_{lt}
NS Power's requirements	≤ 0.25	≤ 0.35
Manufacturer-supplied test data (12 samples)	Min: 0.08 Max: 0.13 Avg: 0.09	0.09

The battery system must meet IEEE Standard 519-2014 limiting voltage Total Harmonic Distortion (all frequencies) to no higher than 1.5% with no individual harmonic exceeding 1.5% on 138 kV.

7.0 Thermal Limits

The load flow analysis was completed for generation dispatches under system light load, summer peak load, and winter peak load conditions. Generation dispatch was also chosen to represent import and export scenarios that take into account expected flows from the existing transmission service reservation associated with the Maritime Link.

Transmission connected wind generation facilities were typically dispatched at approximately 40%, with some low and high wind scenarios included. The cases and dispatch scenarios considered are shown in Table 5: Base Case Dispatch (MW).

Table 5: Base Case Dispatch (MW)							
Case	NL-NS	NS-NB	ONI	CBX	M at H	ONS	Wind
LL01	330	332	325	245	70	-4	367
S01	475	332	1000	897	463	596	371
S02	475	393	1148	980	524	696	243
S03	475	0	636	634	319	494	149
S04	0	-298	277	228	136	491	225
W01	320	150	1075	939	532	759	196
W02	475	500	1267	1119	605	642	378
W03	475	0	1020	1068	591	849	164
W04	0	-202	752	600	373	782	177
LL - Light Load			**S - Summer Peak**		**W - Winter Peak**		

This FEAS added IR#586 and displaced generation east of Onslow, decreasing Onslow Import (ONI) transfers. Single contingencies were applied at the 345 kV, 230 kV, and 138 kV voltage levels for the above system conditions with IR#586 interconnected to the 138kV bus at 1N-Onslow.

The POI for IR#586 is at a facility that constitutes part of the Onslow Import (ONI) and Onslow South (ONS) transmission interfaces. This can also have interactions with the Cape Breton Export (CBX) transmission interface. Both ONI and CBX have an Interconnection Reliability Operating Limit associated with them while ONS has a System Operating Limit associated with it.

The load flow results with IR#586 operating at full output show all remaining system elements operating within 110% of their posted seasonal equipment ratings or operating within documented maximum equipment ratings.

8.0 Voltage Limits

In accordance with the Transmission System Interconnection Requirements Section 7.6.2, IR#586 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. Rated reactive power shall be available through the full range of real power output of the Generating Facility, from zero to full power.

The PQ curve for the PS1000 unit is shown in Figure 3. However, despite the -750kVar to 600kVar reactive range indicated in Figure 3, the IC has confirmed that the units will have full -1500kVar to 1500kVar capability at 0 MW real power.

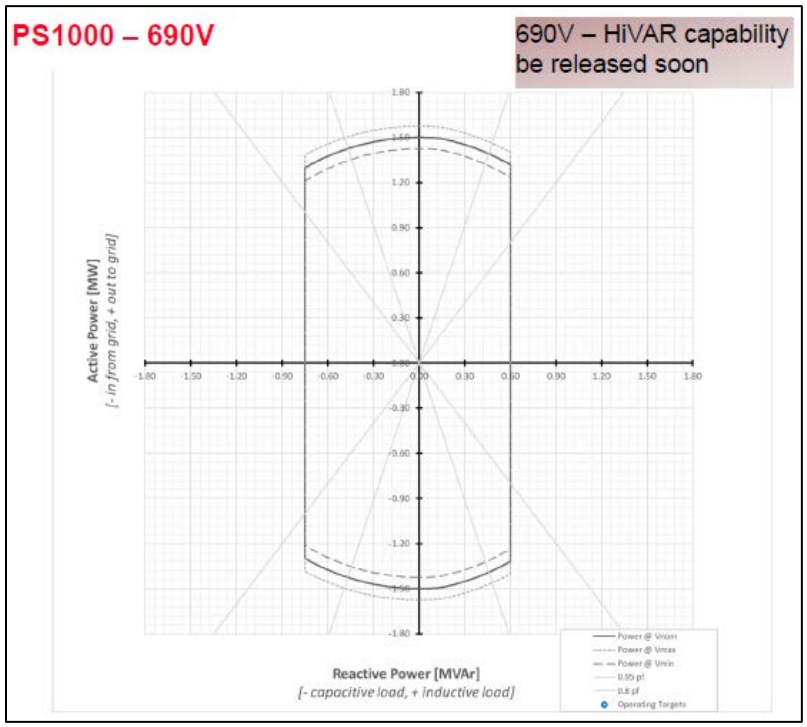

Figure 3: PS1000 capability curve

IR#586 has a total of 36 x 1.5 MVA PS1000's that use current-limited, bi-directional inverters, capable of full four-quadrant operation at nominal voltage, for a total of

54MVA. The site capacity for IR#586 was given as 50 MW in the interconnection request and real power will be capped at that value.

IR#586 is capable of reaching > 0.97 power factor at the HV terminals of the facility step up transformer at full output and nominal voltage. As a result, supplementary reactive support will be required at the low voltage terminals of the Interconnection Transformer to meet NS Power's requirements.

Net power factor requirements for supplying VARs are met when the batteries are operating just below 48.5 MW *(23.7 MVAR supplied from the machine with 15.9 MVAR calculated at the high side of the ICIF transformer)*. The following table shows the power factor for BESS output levels of 48.5MW to 50MW. Supplementary reactive power support will be further investigated in the System Impact Study.

Table 6: Power Factor at IR#586 Transformer HV Terminals

Machine terminals		High side of ICIF transformer (supplying VARs)			High side of ICIF transformer (absorbing VARs)			Net power factor requirements met?
MW	MVAR	MW	MVAR	pf	MW	MVAR	pf	
50	20.4	49.5	12.4	0.970	49.4	-31.6	0.842	no
49.5	21.6	49	13.7	0.963	48.9	-32.9	0.830	no
49	22.7	48.5	14.8	0.956	48.4	-34.2	0.817	no
48.5	23.7	48.1	15.9	0.949	47.7	-35.1	0.805	yes

A centralized controller will be required, which continuously adjusts the individual battery 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 batteries' 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 of the NS Power Transmission System Interconnection Requirements (TSIR)[1]. The SIS will examine the battery/plant capabilities and controls in detail to specify options, controls, and additional facilities that are required to achieve low voltage ride-through.

[1] NS Power Transmission System Interconnection Requirements; https://www.nspower.ca/oasis/standards-codes

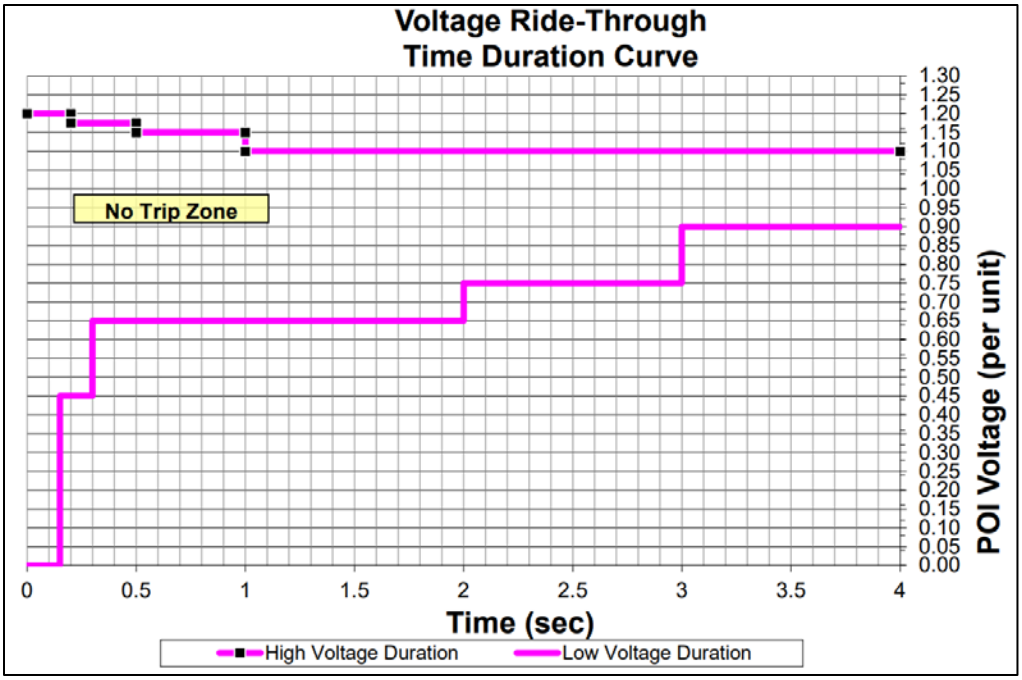

Figure 4: NERC PRC-024-2 Attachment 2

9.0 System Security / Bulk Power Analysis

The 138kV bus at the 1N-Onslow Substation is already part of the Nova Scotia Bulk Power System (BPS). As such, all protection systems associated with the new 138kV breaker supplying the radial line to IR#586 must comply with NPCC Directory 4 *System Protection Criteria*.

The 1N-Onslow substation is also currently classified as part of the NERC Bulk Electric System (BES), subject to the applicable NERC Reliability Criteria. While elements of IR#586 meet the core definition of a Bulk Electric System (BES) categorization, IR#586 will not be designated NERC BES because it meets BES exclusion criteria E1, as shown in Figure 5.

Exclusions:

E1: Radial systems: A group of contiguous transmission Elements that emanates from a single point of connection of 100 kV or higher and:

- Only serves Load. Or,
- Only includes generation resources not identified in Inclusions I2, I3, or I4 with an aggregate capacity less than or equal to 75 MVA (gross nameplate rating). Or,
- Where the radial system serves Load and includes generation resources not identified in Inclusions I2, I3, or I4 with an aggregate capacity of non-retail generation less than or equal to 75 MVA (gross nameplate rating).

Note 1: A normally open switching device between radial systems as depicted on prints or one-line diagrams for example, does not affect this exclusion)

Note 2: The presence of a contiguous loop, operated at a voltage level of 50 kV or less between configurations being considered as radial systems, does not affect this exclusion.

Figure 5: NERC BES Definition- Exclusion Criteria E1

10.0 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 91H.

With IR#586 in service and discharging, the loss factor is calculated as 3.96% at the POI as shown in Table 7: Loss Factor while discharging. This preliminary loss factor excludes losses associated with the TPIF, ICIF transformer, and generation facility.

Table 7: Loss Factor while discharging

	MW
IR#586 at POI	50
TC3 with IR#586	102.1665
TC3 without IR#586	150.1852
Delta	1.9813
Loss Factor	**3.96%**

11.0 Expected Facilities Required for Interconnection

The following facility changes will be required to connect IR#586 to the NSPI transmission system at 1N-Onslow:

a. Required Network Upgrades

- Modification of NSPI protection systems at 1N-Onslow.

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

- Add a 138kV transmission line built to NSPI standards from the 1N-Onslow 138 kV bus to the IR#586 substation.
- Add one new 138kV circuit breaker, associated switches, and substation modifications at 1N-Onslow.
- Add control and communications between the ICIF and NSPI SCADA and protection system.

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

- Facilities to provide 0.95 leading and lagging power factor when delivering rated output at the HV terminals of the IC Substation Step Up Transformer when the

voltage at that point is operating between 95 and 105 % of nominal. Rated reactive power shall be available through the full range of real power output, from zero to full power.

- 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 load/output from the facility, upon receipt of a telemetered signal from NSPI's SCADA system.
- 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, change the real/reactive power remotely. NSPI will also have remote manual control of the load curtailment scheme.
- Low voltage ride-through capability per Section 7.4.1 of the Nova Scotia Power Voltage ride-through capability as detailed in Figure 2 of NERC Standard PRC-024-2 Attachment 2. As well as operation within NSPI's continuous nominal voltage range (0.95 to 1.05 VPU) and during stressed (contingency) conditions (0.90 to 1.10 VPU).
- Frequency ridethrough capability in accordance with section 7 of the Transmission System Interconnection Requirements (TSIR). The facility shall have the capability of riding through a rate of change of frequency of 4 Hz/s as well as continuous operation in the 59.5 Hz to 60.5 Hz frequency range.
- Real-time monitoring (including an RTU) of the interconnection facilities. MW, MVAR, bus voltages, curtailment state, and state of charge are required.
- Facilities for NSPI to execute high speed rejection of generation and load (transfer trip) if determined in SIS. The plant may be incorporated into SPS run-back or load reject schemes.
- When not at full output, the facility shall offer over-frequency and under-frequency control with a deadband of ±0.2 Hz and a droop characteristic of 4%. The active power controls shall also have the capability to react to continuous control signals from the NSPI SCADA system's Automatic Generation Control (AGC) system to control tie-line fluctuations as required.
- 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°).
- Operation at ambient temperatures as low as -30°C.

12.0 Facilities and Network Upgrades Cost Estimate

Estimates for NSPI Interconnections Facilities and Network Upgrades for interconnecting included in Table 8: Cost Estimate.

The preliminary non-binding cost estimate for interconnecting 50 MW at the POI at 1N-Onslow under ERIS is $1,999,800 including a contingency of 10%. This does not include any yet to be determined 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 is 18-24 months after receipt of funds.

Table 8: Cost Estimate

Item	Network Upgrades	Estimate
I	P&C modifications at 1N-Onslow.	$200,000
	Sub-total	**$200,000**
	TPIF	**Estimate**
I	Modifications at 1N-Onslow, including a new 138kV breaker, switches and associated equipment.	$1,200,000
II	Transmission line from 1N-Onslow to the PCO.	$127,000
III	P&C relaying equipment.	$100,000
IV	NSPI supplied RTU.	$59,000
V	Teleprotection and SCADA communications via overhead fiber from 1N-Onslow.	$132,000
	Sub-total	**$1,618,000**
	Total	**$1,818,000**
	Contingency (10%)	**$181,800**
	Total of determined cost items	**$1,999,800**

13.0 Preliminary Scope of the 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.

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
2021-12-03