Interconnection Feasibility Study Report

GIP-242-FEAS-R1

System Interconnection Request #242

49.6 MW Wind Generating Facility

Cumberland County (L-5550)

2011-10-25

Control Centre Operations
Nova Scotia Power Inc.

Executive Summary

The IC submitted an Interconnection Request (IR#242) for Energy Resource Interconnection Service (ERIS) to NSPI for a proposed 49.6 MW wind generation facility interconnected to the NSPI transmission system. The Point of Interconnection (POI) requested by the customer is on L-5550, approximately 25.7 km from 30N-Maccan substation.

This facility will be interconnected to L-5550 by constructing approximately 100 m of 69kV transmission line with 556 ACSR Dove conductors and maximum operating temperature of 100ºC. L-5550 is presently limited to 29 MVA by protection and the CT ratios of circuit breakers 30N-529 and 30N-548 at 30N-Maccan terminal, therefore it is expected that these circuit breakers will be replaced to accommodate this project (30N-548 provides alternate source feeding L-5550).

To provide service reliability to customers in the area of Pugwash, Oxford, Springhill and Amherst, the 138/69 transformers at 30N-Maccan and 74N-Springhill provide alternate sources for the 69 kV system in the event that one transformer should fail or have to be removed from service for maintenance. Should the 30N-Maccan 138/69 kV transformer fail or be removed from service for maintenance then Springhill, Oxford and Pugwash would be supplied from the 74N-Springhill 138/69kV transformer via L-5029. Under these conditions, the addition of this generation project would overload L-5029 and 74N-T61. Similarly, the 30N-Maccan 138/69 kV transformer would be overloaded due to the addition of this generating facility when the 74N-Springhill transformer is out of service. Although transformer failures are infrequent they have a long repair/replacement period (6-18 months). During such a period the operation of this facility would be restricted to less than 36 MW.

Besides this proposed generating facility, Transmission Service Request (TSR-100) will have an impact on the transfer capability between Nova Scotia and New Brunswick and on the special protection systems (SPS) that has been installed to facilitate those transfers. While TSR-100 is higher queued, it has an in-service date of 2016, whereas IR#242 has an in-service date of late 2012. Therefore the FEAS for this IR is performed twice – for 2012 without TSR100 in service and again for 2016 with TSR100 in-service.

With the addition of IR#242 under the existing SPS arming level (before TSR-100 is in service), loss of L-3025/L-8001 or L-3006 could cause L-6513 to be overloaded by up to 80% of its conductor thermal rating during periods when summer line ratings are in effect, provided that other generation in this area is generating at full output. Therefore operating restrictions must be established to curtail this wind facility whenever NS is importing 30-100MW from NB during periods when summer line ratings are in effect. The operating restrictions would also depend on the real-time local load demands and other local generation facilities' output. Otherwise transmission expansions will be required for system security.

Operating restrictions on IR#242 while NS is importing 30-100 MW from NB can be eliminated when TSR-100 is in-service with the proposed system network upgrades in 2016. By then the "Import Power Monitor" SPS will also be eliminated and IR#242 can operate without restrictions until NS imports more than 600 MW. When NS imports above 600 MW, the contingency of loss of one 345 kV transmission line from New Brunswick will cause L-6513 to exceed its conductor

thermal limits. Therefore IR#242 would have to be curtailed or the NS Import would have to be reduced in order to avoid further transmission expansion requirements.

No concern regarding short-circuit or voltage flicker was found for this project on its own, provided that the project design meets NSPI requirements for low-voltage ride-through, reactive power range and voltage control system. Harmonics must meet the Total Harmonics Distortion provisions of IEEE 519.

The preliminary value for the unit loss factor is calculated to be 3.8% (system losses increased by net 1.9 MW when IR #242 is operated at 49.6 MW).

The preliminary non-binding estimated cost of facilities required to interconnect IR#242 to L-5550 with the curtailment scheme is $2.4 Million including a contingency of 10%. This estimate will be further refined in the System Impact Study and the Facility Study.

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1 Introduction

The Interconnection Customer submitted an Interconnection Request (IR) for Energy Resource Interconnection Service (ERIS) to NSPI for a proposed 49.6 MW wind generation facility interconnected to the NSPI transmission system. The Point of Interconnection (POI) requested by the customer is on line L-5550, approximately 25.7 km from 30N-Maccan substation. The line tap from the wind farm is assumed to be approximately 100 m.

The Interconnection Customer (IC) signed a Feasibility Study Agreement to study the connection of their proposed generating facility to the NSPI transmission system dated 2011-06-24, and this report is the result of that Study Agreement. This project is listed as Interconnection Request #242 in the NSPI Interconnection Request Queue, and will be referred to as IR#242 throughout this report.

2 Scope

This Interconnection Feasibility Study (FEAS) consists of a power flow and short circuit analysis. Based on this scope, the FEAS report shall provide the following information:

1. Preliminary identification of any circuit breaker short circuit capability limits exceeded as a result of the interconnection;
2. Preliminary identification of any thermal overload or voltage limits violations resulting from the interconnection;
3. Preliminary description and high level non-bonding estimated cost of facilities required to interconnect the Generating Facility to the Transmission System, the time to construct such facilities, and to address the identified short circuit and power flow issues.

The Scope of this FEAS includes modeling the power system in normal state (with all transmission elements in service) under anticipated load and generation dispatch conditions.

In accordance with Section 3.2.1.2 of Revised Generation Interconnection Procedures (RGIP), the FEAS for ERIS consists of short circuit/fault duty, steady state (thermal and voltage) analyses. The short circuit/fault duty analysis would identify direct Interconnection Facilities required and the Network Upgrades necessary to address short circuit issues associated with the Interconnection Facilities. The steady state studies would identify necessary upgrades to allow full output of the proposed Generating Facility and would also identify the maximum allowed output, at the time the study is performed, of the interconnecting Generating Facility without requiring additional Network Upgrades. It is therefore assumed that transmission interfaces limits will not be exceeded to avoid system upgrades in an ERIS study.

A more detailed analysis of the technical implications of this development will be included in the System Impact Study (SIS) report. The SIS includes system stability analysis, power flow analysis such as single contingencies (including contingencies with more than one common element), off-nominal frequency operation, off-nominal voltage operation, low voltage ride through, harmonic current distortion, harmonic voltage distortion, system protection, special protection systems (SPS), automatic generation control (AGC) and islanded operation. The impacts on neighbouring power systems and the requirements set by reliability authorities such as Northeast Power Coordinating Council (NPCC), North American Electric Reliability Corporation (NERC), and NSPI will be addressed at that time and will include an assessment of the status of the Interconnection Facility as a Bulk Power System element. The SIS may identify and provide a non-binding estimate of any additional interconnection facilities and/or network upgrades that were not identified in this FEAS.

An Interconnection Facilities Study follows the SIS in order to ascertain the final cost estimate to interconnect the generating facility.

3 Assumptions

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

1. Energy Resource Interconnection Service type per section 3.2 of the RGIP.
2. 49.6 MW wind with 31 units of GE 1.6-100SLE Wind Turbines.
3. The generation technology used must meet NSPI requirement for reactive power capability of 0.95 capacitive to 0.95 inductive at the HV terminals of the IC Substation Step Up transformer. The generator is assumed to be specified for 34.5 kV at a rated power factor of 0.9 for both lagging and leading. It is also required to have high-speed Automatic Voltage Regulation to maintain constant voltage at the generator terminals during and following system disturbances as determined in the subsequent System Impact Study.
4. The Interconnection Customer indicated that the generation interconnection point is on line L-5550, approximately 25.7 km from the 30N-Maccan substation. The line tap to the wind facility is approximately 100 m.
5. Preliminary data was provided by the Interconnection Customer for the generator step-up and IC substation step-up transformers. Modeling was conducted with a 69/138kV-34.5kV 33/44/55 MVA Interconnection Facility transformer with a positive sequence impedance of 7.5% and an assumed X/R ratio of 20. The Interconnection Customer indicated that this Interconnection Facility step-up transformer has a grounded wye-delta-wye winding configuration with +/-10% off-load tap changer. The generator step-up transformers are indicated with an impedance of 6% on 1.75 MVA.

6. 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 such, IR#8, IR #45, IR#56, IR#151, TSR 100, IR#219, IR#227, IR#225 and IR#234 are included in this study.

4 Projects with Higher Queue Positions

All in-service generation is included in the FEAS.

As of 2011-10-25 the following projects are higher queued in the Interconnection Request Queue and OATT Transmission Service Queue, and have the status indicated.

Interconnection Requests -Included in FEAS

- IR #8 GIA Executed
- IR #45 GIA Executed
- IR #56 GIA Executed
- IR #151 GIA Executed
- IR #219 GIA in progress
- IR #227 FAC in progress
- IR #225 FAC in progress
- IR #234 SIS completed

OATT Transmission Service Queue– Included in FEAS

- TSR 100 SIS in progress

Interconnection Requests not included in FEAS

The following IRs either have SIS Agreements complete (but have not yet met the RGIP SIS progression milestones), or have Feasibility Study agreements complete. As such, they are not included in this FEAS.

IR #67	IR #68	IR #86	IR #115	IR #117	IR #126
IR #128	IR #130	IR #131	IR #149	IR #163	IR #213
IR #222	IR #235	IR #238	IR #241		

OATT Transmission Service Queue– Not Included in FEAS

- TSR 400 SIS Agreement Completed

If any of the higher-queued projects included in this FEAS are subsequently withdrawn from the Queue, the results of this SIS may require updating or a re-study may be necessary. The re-study cost incurred as a result of the withdrawal of the higher-queued project shall be the responsibility of the Interconnection Customer that withdraws the higher queued project.

Besides IR#242, TSR-100 will also have an impact on the transfer capability between Nova Scotia and New Brunswick and on the special protection systems (SPS) that has been installed to facilitate those transfers. While TSR-100 is higher queued, it has an in-service date of 2016, whereas IR#242 has an in-service date of late 2012. Therefore the FEAS for this IR will be performed twice – for 2012 without TSR-100 in service and again for 2016 onwards with TSR-100 in-service.

5 Objective

The objective of this FEAS is to provide a preliminary evaluation of the system impact and the high-level non-binding cost estimate of interconnecting the 49.6 MW generating facility to the NSPI transmission system at the designated location. The assessment will identify potential impacts on the loading of transmission elements, which must remain within their thermal limits. Any potential violations of voltage criteria will be identified and addressed. If the proposed new generation increases the short-circuit duty of any circuit breakers beyond their rated capacity, the circuit breakers must be upgraded. Single contingency criteria[1] are applied for the ERIS assessments.

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 system transfer capabilities that may be required to the Bulk Power System to meet the design and operating criteria established by NPCC and NERC or required to maintain system stability. These requirements will be determined by the subsequent interconnection System Impact Study (SIS).

6 Short-Circuit Duty

The maximum (design) expected short-circuit level is 5000 MVA on 138kV systems and 3500 MVA on 69 kV systems. The short-circuit levels in the area before and after this development (including TSR#100) are provided below in Table 6-1.

Table 6-1: Short-Circuit Levels. Three-phase MVA (1)

Location	IR #242 in service	IR #242 not in service
All transmission facilities in service		
Interconnection Facility (POI)	409	189
30N-Maccan 138 kV	1214	1102
74N-Springhill 138 kV	1305	1229
1N-Onslow 138 kV	2522	2495
30N-Maccan 69 kV	509	368
74N-Springhill 69 kV	417	409

[1] The Single Contingency Criteria is defined by NPCC in its A-7 Document, and may involve more than one transmission element.

Minimum Conditions		
Interconnection Facility (POI)	390	170

(1) Classical fault study, flat voltage profile

In determining the maximum short-circuit levels with this generating facility in service the generators have been modeled as conventional machines with reactance comparable to induction machines regardless of the type of generators proposed, which provides a worst case scenario. The SIS will refine the fault level based on the actual machine characteristics.

The maximum short-circuit level at the POI on L-5550 is presently 189 MVA. After installing IR # 242 the increase will bring the short-circuit level to 409 MVA at the POI. Similarly, under summer light load conditions with certain generation units offline and certain lines out-of-service, the minimum short-circuit level will be approximately 170 MVA at the POI. This translates into maximum equivalent system impedance at the POI of 0.588 per unit on 100 MVA base.

The interrupting capability of the 138kV circuit breakers at 1N-Onslow is at least 3500 MVA, and the interrupting capability of the 138kV circuit breakers at 30N-Maccan is at least 3000 MVA and all 69 kV circuit breakers at that substation are rated at least 1000 MVA. As such, the interrupting ratings will not be exceeded by this development on its own. At 74N-Springhill, the breaker ratings are at least 5000 MVA (138kV breakers) and 3500 MVA (69kV breakers); therefore IR#242 will not impact the circuit breakers at these stations.

7 Voltage Flicker and Harmonics

Due to the lack of flicker coefficient information on the GE 1.6-100SLE machine, this study assumes the same flicker data as for the GE 1.5SLE machine. The calculated voltage flicker at the POI on line L-5550 using IEC Standard 61400-21 and the published values for GE 1.5 SLE machines is 0.052 under normal conditions and 0.055 under minimum generation conditions. These are both below NSPI's required limit of 0.35 for P_{st}. Therefore voltage flicker should not be a concern for this project.

The generator is expected to meet IEEE Standard 519 limiting Total Harmonic Distortion (all frequencies) to a maximum of 5%, with no individual harmonic exceeding 1%.

8 Thermal Limits

This facility will be interconnected to L-5550 via approximately 100m of 69kV transmission line with 556 ACSR Dove conductors and a maximum operating temperature of 100ºC. L-5550 was built to 138 kV standards but is currently operating at 69 kV; therefore the new interconnection facilities will be built to 138 kV standards as well. L-5550 is built with 556 ACSR Dove conductors and maximum operating

temperature of 50ºC with conductor thermal ratings of 54/82 MVA (summer/winter). However this line is presently limited to 29 MVA by protection and the CT ratios of circuit breakers 30N-529 and 30N-548 at 30N-Maccan terminal. As such, these breakers will be replaced to accommodate this project (30N-548 provides alternate source feeding L-5550).

L-5029 connects the 30N-Maccan substation with 74N-Springhill substation. The substation at 30N-Maccan and 74N-Springhill contain one 138/69 kV transformer each. These transformers have maximum thermal ratings of 56 MVA and both serve local distribution loads as well as the 69 kV system. To provide service reliability to customers in the area of Pugwash, Oxford, Springhill and Amherst, the 138/69 transformers at 30N-Maccan and 74N-Springhill provide alternate sources for the 69 kV system in the event that one transformer should fail or have to be removed from service for maintenance. Should the 30N-Maccan 138/69 kV transformer fail or be removed from service for maintenance then Springhill, Oxford and Pugwash would be supplied from the 138/69 kV transformer at 74N-Springhill via L-5029. Under these conditions, the addition of this generation project will overload L-5029 and 74N-T61. Similarly, the 30N-Maccan transformer will be overloaded due to the addition of this generating facility when 74N-Springhill 138/69kV transformer is out of service. Although transformer failures are infrequent they have a long repair/replacement period (6-18 months). During such a period the operation of this facility would be restricted to no more than 36 MW.

The requirement for restrictions or curtailments of this facility when operating with an element (transmission line, transformer etc) out of service (N-1 operation) will be further assessed in the SIS.

9 Voltage Limits

This project, like all new generating facilities must be capable of providing both lagging and leading power factor of 0.95, measured at the HV terminals of the IC Substation Step Up Transformer, at all production levels up to the full rated load of 49.6 MW. A centralized controller will be required which continuously adjusts individual generator reactive power output within the plant capability limits and regulates the voltage at the 34.5 kV bus voltage. The voltage controls must be responsive to voltage deviations at the terminals of the Interconnection Facility substation, be equipped with a voltage set-point control, and also have the ability to slowly adjust the set-point over several (5-10) minutes to maintain reactive power within the individual generators 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.

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 to the Standard Generator Interconnection and Operating Agreement (GIA). The SIS will state specific options, controls and additional facilities that are required to achieve this.

10 System Security / Stability Limits (Transfer Capability)

There are a number of Special Protection Systems and protective systems employed by NSPI and the NBSO to permit high transfer levels between Nova Scotia and New Brunswick. NSPI has an "Import Power Monitor" that acts to separate the two systems following the loss of the 345 kV tie (L-8001/L-3012), by cross-tripping L-6513. Once this SPS operates, the load and generation in northern Nova Scotia are disconnected from the Nova Scotia system (but remain connected to New Brunswick). The Nova Scotia system is then islanded and relies on under frequency load shedding (UFLS) schemes to shed load across Nova Scotia to make up the generation deficiency and restore balance. Any new generating facilities added to the system in northern Nova Scotia (between Truro and New Brunswick) can have an impact on the transfer capability between two systems and the SPSs. Currently this SPS is armed when imports exceed 100MW. With the addition of IR#242 under existing SPS arming level, loss of L-8001 could cause L-6513 to be overloaded by up to 80% of its conductor thermal rating during periods when summer line ratings are in effect, assuming other generation in this area is generating at full output. The facility records on transmission line ratings show that L-6513 is built with 556 ACSR Dove conductors and a maximum operating temperature of 50ºC, therefore it is currently rated 110/165 MVA (summer/winter) which is limited by conductor size. Reducing SPS arming level may compromise system security and have negative impact on the NS under frequency load shedding (UFLS) scheme. Therefore operating restrictions would have to be established to curtail this wind facility whenever NS is importing 30-100MW from NB while summer conductor thermal ratings are in effect. Restrictions would also depend on the real-time local load demands and other local generation output. To avoid the operating restrictions, transmission expansions will be necessary to meet system security requirements. The SIS will determine the detailed system requirements to accommodate IR#242.

Operating restrictions on IR#242 while NS is importing 30-100 MW from NB can be eliminated when TSR-100 is in-service after 2016. TSR-100 requested an NS import from New Brunswick of 720 MW (non-firm) and 320 MW (firm) to Newfoundland. System network upgrades associated with TSR-100 include:

- New 345 kV transmission line from Coleson Cove, NB to Salisbury, NB
- New 345 kV transmission line from Salisbury NB to Memramcook, NB
- New 345 kV transmission line from Memramcook, NB to Onslow NS
- Switches capacitor banks in NB at Memramcook, Salisbury and Norton
- Static Var Compensators (SVC) in NB at Salisbury and Memramcook

Once these upgrades are completed, the "Import Power Monitor" SPS will be eliminated and IR#242 can operate without restrictions until NS imports more than 600 MW. When NS imports more than 600 MW, the contingency of loss of one 345 kV transmission line

from New Brunswick will cause L-6513 to exceed its conductor thermal limits. Therefore IR#242 would have to be curtailed or the NS Import reduced.

There are a number of proposed generation additions in New Brunswick that may have an impact on projects in northern NS and vice versa. Their POI, size and relative position of the NS and NB interconnection Queues will determine the impact. This will be resolved through collaboration with NBSO at the SIS stage.

This generating facility will also increase loading on the Onslow South corridor (Truro to Halifax) by replacing generation located south and west of Truro. This may require increased reactive support in the Halifax area or invoke facility additions that can reduce the reactive support requirements. This will be evaluated in the SIS.

The SIS will determine if any facility changes are required to permit the proposed higher transmission loadings while maintaining compliance with NERC/NPCC standards and in keeping with good utility practice.

11 Expected Facilities Required for Interconnection

The following facility changes are required to interconnect IR #242 to the 69 kV line L-5550:

Additions/Changes to POI on line L-5550:

1. A direct line tap off L-5550 (Transfer trip protection required at the generation side via a circuit breaker)
2. 100 m newly-constructed 138kV line from POI to customer substation (operating at 69kV) consisting of 556 Dove ACSR conductor rated 100°C conductor temperature.
3. Replacement of circuit breakers 30N-529& 30N-548 to uprate L-5550
4. Control and communications between the Generating Facility and NSPI SCADA system including transfer trip signals to the Generating Facility from 30N-Maccan and 74N-Springhill.
5. Protection upgrades at 30N-Maccan and 74N-Springhill substation.

Requirements for the Generating Facility

1. 138 kV Interconnection Substation (operating as 69kV). This will include a circuit breaker at high side of customer power transformer and protections as acceptable to NSPI. An RTU to interface with NSPI's SCADA, with telemetry and controls as required by NSPI.
2. Facilities to provide 0.95 leading and lagging power factor when delivering rated output (49.6 MW) 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.

3. 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. The controller will also limit the load ramp rate of the facility to within limits set by NSPI and/or telemetered from NSPI's SCADA system.
4. NSPI to 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.
5. Low voltage ride-through capability as per Appendix G to the Standard Generator Interconnection and Operating Agreement (GIA).
6. Real-time monitoring (including a Remote Terminal Unit) of the interconnection facilities.
7. Facilities for NSPI to execute high speed rejection of generation (transfer trip) if determined in SIS.

12 NSPI Interconnection Facilities and Network Upgrades Cost Estimate

Estimates for NSPI Interconnections Facilities and Network Upgrades for interconnecting 49.6 MW wind energy onto 69 kV systems are included in Table 12-1.

Table 12-1: Cost Estimates identified from FEAS scope

	Determined Cost Items	Estimate
NSPI Interconnection Facilities		
i	Build 100 m 138kV single circuit line and line tap off L-5550 (operating at 69 kV)	$ 100,000
ii	Protection, control, communication	$ 700,000
Network Upgrades		
iii	Replace circuit breakers 30N-529& 30N-548 to uprate L-5550	$ 1,400,000
Totals		
iv	Contingency (10%)	$220,000
v	Total of Determined Cost Items	$2,420,000
	To be Determined Costs	
vi	System additions to address potential stability limits	TBD (SIS)

The preliminary non-binding cost estimate for interconnecting IR#242 onto L-5550 would be $2,420,000. The Interconnection Customer is required to fund the Item iii)

costs, but would be eligible for repayment of these costs in accordance with the terms of the GIA.

13 Issues to be addressed in SIS

The following provides a preliminary scope of work for the subsequent SIS for IR#242. 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 and ride through and operation following a contingency (N-1 operation). The SIS must determine the facilities required to operate this facility at full capacity, withstand any contingencies (as defined by the criteria appropriate to the location) and identify any restrictions that must be placed on the system following a first contingency loss. The SIS will confirm the options and ancillary equipment that the customer must install to control flicker, voltage 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 will proceed and the facilities associated with those projects are installed.

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

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

i. Facilities that the customer must install to meet the requirements of the GIP
ii. 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.
iii. Guidelines and restrictions applicable to first contingency operation(curtailments etc)
iv. System loss impacts
v. Under-frequency load shedding impacts

To complete this assessment the following first contingencies, as a minimum, will be assessed:

- L-8001/3025
- L-3006 – with and without NBPT SPS operation
- Memramcook 345/138 kV transformer
- L-6513
- L-6514
- L-6535/L-1159
- L-6536/L-1160
- L-8003

- L-8002 & L-8003 (common circuit breaker)
- L-8003 & L-8004 (common circuit breaker
- L-8001 & 67N-T81 TX (common circuit breaker)
- L-8002 & 67N-T81 TX (common circuit breaker)
- L-3006 & L-3025 & Memramcook 345/138 kV Tx (common breaker)
- L-3006 & L3017 (common breaker)
- 1N-B61
- L-1108/1190 Common 138kV structure
- Loss of 180 MW of load under peak load conditions and 250 MW under light load conditions
- Loss of largest generation – Pt. Aconi 174MW net
- Loss of two generating units at Lingan – 312 Net
- Loss of the Trenton Bus (Two units with load)

To complete this assessment the dynamics of the following first contingencies, as a minimum, will be assessed:

- 3 phase fault L-8001/3025 at 67N-Onslow, NS Import SPS operation (islanding)
- 3 phase fault L-3006 at Memramcook, NB SPS/UVLS operation (islanding)
- 3 phase fault L-3006 at Salisbury, NB SPS/UVLS operation (islanding)
- 3 phase fault L-8003 at 67N-Onslow
- 3 phase fault L-8002 at 67N-Onslow
- Slg L-3017, drops L-3017&L-3006 (common CB), NB SPS/UVLS operation,
- Slg Memramcook T3, drops L-3006 (common CB), NB SPS/UVLS operation
- Slg L-8002 at Onslow, drops L-8003, Grp5 SPS Operation
- 3 phase fault at 79N-Hopewell, drops L-8003, 8004, bus, SPS operation
- 3 phase fault 1N-Onslow 138 kV bus B61
- 3 phase fault 74N-Springhill 138 kV bus

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 NERC[2] and NPCC[3] criteria as well as NSPI guidelines and good utility practice. The SIS will also determine the contingencies for which this facility must be curtailed.

The SIS will calculate the unit loss factor, which is a measure of the percentage of the net output of IR #242 which is lost through the transmission system. Preliminary value is calculated to be 3.8% (system losses increased by net 1.9 MW when IR #242 is operated at 49.6 MW).

[2] NPCC criteria are set forth in it's Reliability Reference Directory #1 *Design and Operation of the Bulk Power System*
[3] NERC transmission criteria are set forth in *NERC Reliability Standards TPL-001, TPL-002, TPL-003*

Nova Scotia Power
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