Interconnection Feasibility Study Report
GIP-128-FEAS-R2

Generator Interconnection Request #128

40.5MW Wind Generating Facility

Cumberland (L-6536), NS

August 17, 2007

Control Centre Operations
Nova Scotia Power Inc.

Executive Summary

A feasibility study was conducted in response to Interconnection Request number 128 (IR128) which proposes to connect 40.5 MW of wind powered generation in Cumberland Co., Nova Scotia. The customer has requested ERIS service. This facility would connect to the transmission system at a location adjacent to the New Brunswick border on 138 kV line L-6536 or to the 69 kV system via a new line to 17N-Brownell Avenue, Amherst.

Both the 69 kV and 138 kV interconnections appear feasible. The direct interconnection costs of the 69 kV interconnection are estimated at $3.8 million with a 12 to 24 month time to construct. The direct interconnection costs of the138 kV interconnection are estimated to be $6.0 million with a 12 to 24 month time to construct. However, the 69 kV interconnection will require a 69 kV circuit breaker to be installed at the Interconnection Customer's (IC) Substation, which is not included in the above estimate, whereas the 138 kV interconnection does not. If the 138 kV IC substation is constructed adjacent to the Point of Interconnection POI (L-6536), development costs may be reduced and the cost of the 138 kV and 69 kV interconnections comparable. The 138 kV interconnection will also be significantly more reliable than the 69 kV interconnection. Also a number of projects compete with IR128 for the same 69 kV transmission capacity. Should any of these projects proceed then the 69 kV option will not be available to IR128. Therefore, the 138 kV interconnection appears to be the most viable.

Generating facilities added to the system in northern Nova Scotia (between Truro and New Brunswick) can have an impact on the transfer capability between Nova Scotia and New Brunswick and the special protection systems (SPS) that have been installed to facilitate those transfers. This project will necessitate upgrading these SPSs but allocation of those costs are dependent on whether projects that are ahead of this project in the Generation Interconnection Queue (Queue) proceed. These costs are identified as indirect or to be determined (TBD) in section 10. A discussion regarding these transfer capabilities and the SPSs is included in section 8.

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1 Introduction

The Interconnection Customer (IC) submitted an Interconnection Request to NSPI for a proposed 40.5 MW wind generation facility interconnected to the NSPI system via 138 kV line L-6536 that runs between the 74N-Springhill and 410N-Memramcook substations. The 69 kV system in the Amherst area was identified as an alternative Point of Interconnection (POI). The IC signed a Feasibility Study Agreement to study the connection of their proposed generation to the NSPI transmission system. This report is the result of that Study Agreement. The generation site would be located adjacent to the Nova Scotia – New Brunswick border and in between lines L-6535 and L-6536, and connect to either L-6536 or alternatively L-5548.

2 Scope

The Interconnection Feasibility Study (FEAS) report shall provide the following information:

i. preliminary identification of any circuit breaker short circuit capability limits exceeded as a result of the interconnection;

ii. preliminary identification of any thermal overload or voltage limit violations resulting from the interconnection; and

iii. preliminary description and non-binding 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.

For Energy Resources Integration Service (ERIS), if the FEAS determines that transmission upgrades are required as a result of thermal overload, voltage violation, or equipment rating, then the FEAS will determine the amount of generation that can be installed without necessitating major transmission upgrades. The FEAS will provide a preliminary high level cost estimate of the direct interconnection costs.

For NRIS service type, the FEAS will identify any transmission upgrades required as the result of thermal overload, voltage violation, or equipment rating. The FEAS will attempt to provide high level cost estimates for such upgrades and the direct interconnection costs.

A more detailed analysis of the technical implications of this development will be included in the System Impact Study (SIS) report. This may include system stability analysis, single or double contingencies, off-nominal frequency operation, off-nominal voltage operation, low voltage ride through, harmonic current distortion, harmonic voltage distortion, system protection, special protection system (SPS), automatic generation control (AGC) and islanded operation. The impacts on neighboring power systems and the requirements set by reliability authorities such as Northeast Power Coordinating Council (NPCC), North American Reliability Council (NERC), and Nova Scotia Power (NSPI) will be addressed at that time. The SIS may identify additional costs and upgrades that were not identified in this FEAS.

As well, a separate facility study will follow the SIS in order to ascertain the final cost estimate for the transmission upgrades requirement.

3 Assumptions

The POI and configuration studied is as follows:

i. 40.5 MW wind farm comprised of 27 – 1.5 MW GE 1.5 SLE wind turbines and has requested ERIS service.

ii. The wind generating facility will interconnect to L-6536 at a location adjacent to the New Brunswick border. An alternative POI is the 69 kV system near Amherst.

iii. Transformer Impedance assumed at 7% (on ONAN Base), rated 28/37/46.5 MVA.

iv. This feasibility study is based on the assumption that projects that are ahead of this project in the Generation Interconnection Queue (Queue) will not proceed but impacts are reviewed qualitatively.

4 Projects With Higher Queue Positions

As of 30 June 2007 the following projects can proceed ahead of this project, due to their position in the Queue, and have the status indicated.

In-service and committed generation projects

Wind Generation - 30.5 MW - connected to L-5027 (in-service)
Wind Generation – 15 MW – connected to L-5573 (in-service)
Wind Generation – 20 MW - distribution connected (in-service)
Wind Generation – 40 MW – distribution connected (committed)

Generation projects with a higher Queue position, not yet committed

IR008 Wind – Guysborough (L-5527B) 15 MW NRIS – FAC complete
IR017 Wind – Lunenburg (L-6004) 100 MW NRIS- FEAS complete
IR023 Wind – Inverness (L-6549) 100 MW NRIS - FEAS complete
IR042 Wind – Cape Breton (VJ) 100 MW NRIS- FEAS complete
IR044 Wind – Colchester (L-6503) 35 MW NRIS- FEAS complete
IR045 Wind – Cumberland (L-6535) 35 MW NRIS- SIS complete
IR046 Wind – Colchester (L-6513) 32 MW ERIS- FEAS complete
IR056 Wind – Cumberland (L-5058) 60 MW ERIS- FEAS complete
IR067 Wind – Annapolis (L-5026) 32 MW ERIS- FEAS in progress
IR068 Wind – Digby (L-6513) 32 MW ERIS- FEAS in progress
IR072 Wind – Guysboro (L-6515) 100 MW NRIS- FEAS in progress
IR079 Wind – Antigonish (L-6515) 50 MW NRIS- FEAS in progress
IR080 Wind – Cumberland (L-5550) 30 MW NRIS- FEAS in progress
IR081 Wind – Shelburne (L-5027) 50 MW NRIS- FEAS in progress
IR082 Wind – Colchester (L-5040) 45 MW ERIS- FEAS in progress
IR083 Wind – Shelburne (L-6021) 150 MW NRIS- FEAS in progress
IR084 Wind – Pictou (L-7004) 50 MW ERIS- FEAS in progress
IR085 Wind – Pictou (L-6511) 50 MW NRIS- FEAS in progress
IR086 Wind – Pictou (L-7003) 50 MW NRIS- FEAS in progress
IR100 Wind – Yarmouth (Tusket) 52 MW NRIS- FEAS in progress
IR114 Wind – Pictou (L-6511) 60 MW NRIS- FEAS in progress
IR115 Wind – Pictou (L-7003) 120 MW NRIS- FEAS in progress
IR117 Wind – Shelburne (L-5027) 10 MW ERIS- FEAS in progress
IR126 Wind – Cumberland (L-6513) 70 MW ERIS- FEAS in progress

This project and projects IR045, 046, 056, 080 and 126 add generation to transmission facilities that are part of the Nova Scotia to New Brunswick interconnection. These projects will compete for 138 kV transmission capacity. This project and projects IR056 and 080 will connect to the 69 kV systems supplied from the 30N-Maccan and 74N-Springhill substations. The remaining projects may have an impact on this project in that all projects will require use of transmission facilities to deliver power to the load centers.

The SIS will be based on the assumption that all projects that are ahead of this project in the Queue are in-service. Should any project that is ahead of this project be withdrawn, or changed, within the established procedures then the SIS for this project must be updated accordingly, at the project proponents expense.

5 Short-Circuit Duties

The maximum (future) expected short-circuit levels are 5000MVA and 3500 MVA on 138 and 69 kV systems respectively.

The short-circuit levels in the area before and after this development are provided in Table 5-1 below.

Table 5-1: Short-Circuit Levels. Three-phase MVA (1)

Location	This generating facility in service	This generating facility not in service
All transmission facilities in service – 138 kV Interconnection		
74N-Springhill – 138 kV	1240	1185
L-6536 Tap – 138 kV(2)	1290	1185
L-6536A (74N-Springhill to POI) Out - 138 kV Interconnection		
74N-Springhill – 138 kV	950	900
L-6536 Tap – 138 kV(2)	640	540
All transmission facilities in service – 69 kV Interconnection		
IC Substation	355	250
17N-Brownell – 69 kV	380	280
19N-Hickman St – 69 kV	395	295
30N-Maccan – 69 kV	460	365
Maccan 139/69 kV Transformer Out – 69 kV Interconnection		
IC Substation	260	155
17N-Brownell – 69 kV	270	170
19N-Hickman St – 69 kV	275	175
30N-Maccan – 69 kV	290	200

(1) Classical fault study
(2) POI

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. This provides a worst case estimation.

There are no concerns with regard to increased short-circuit levels whether the interconnection is at 138 or 69 kV. However, interconnection at 69 kV will result in protection coordination issues that can be corrected with upgrades to protection and control facilities between 30N-Maccan and IC substation.

6 Thermal Limits

a) 138 kV Interconnection

Line L-6536 is currently rated 110/165 MVA (summer/winter). The thermal ratings of L-6536 are limited by ground clearance. The summer and winter rating of L-6536 are 110 and 165 MVA respectively. The addition of this facility alone will not result in any thermal overloads.

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

This generating facility will require a curtailment scheme and high speed rejection scheme for integration with NSPI SCADA controls and SPSs) to maximize the capability of NSPIs transmission system, system security, and production of all generating facilities.

b) 69 kV Interconnection

The facility would be interconnection to NSPI system by constructing approximately 5 km of 69 kV transmission from a point near 17N-Brownell substation. The 17N-Brownell substation is supplied from 30N-Maccan via line L-5548. Line L-5548 also supplies substations of 19N-Hickman St and 20N-Park St. A second 69 kV line from 30N-Maccan provides a backup supply to these substations.

The conductors on line L-5548 between 30N-Maccan and 19N-Hickman are 336 MCM ACSR and rated 51/67 (summer/winter) although the protective relaying and metering limits this line to less than 28 MVA. The conductors between 19N-Hickman and 17N-Brownell are 2/0 ACSR and rated 23/34 MVA. A voltage regulator is in service at 19N-Hickman on L-5548 to maintain customer service voltages at 20N-Park and 17N-Brownell. This voltage regulator, rated 15 MVA is most critical when the 30N-Maccan 138/69 kV transformer is out of service and this system is supplied from Springhill. The conductors on line L-5549 are 4/0 ACSR and rated 31/45 MVA.

To increase the rating on L-5548 between 19N-Hickman and 17N-Brownell would require a 100C rating. It is not likely that this can be achieved without partial or total rebuild of this 3.7 km line. In addition to upgrading this line section a number of 69 kV switches and the relaying at 30N-Maccan will require upgrading. The voltage regulator at 19N-Hickman can be removed by installing either 4 kV voltage regulators at 20N-Park and 17N-Brownell, or by installing

switched capacitors at the IC substation (to provide voltage support when the wind farm is not producing and replace the 69kV voltage regulator).

Line L-5029 connects the 74N-Springhill substation with the 30N-Maccan substation. The substations 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 areas of Pugwash, Oxford, Springhill and Amherst the 138/69 kV transformers at 74N-Springhill and 30N-Maccan 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. In order to permit removal or loss of one of these transformers, without curtailing generation, either the total generation connected to the 69 kV systems (Maccan and Springhill) must be limited or 50 MW or the system reinforced. The system can be reinforced by adding 138/69 kV transformer capacity. Alternatively the generation may be connected to the 138 kV system. This project is feasible, for interconnection at 69 kV, without such reinforcement provided that the generating capacity installed by IR056 and IR080 does not exceed 10 MW. These projects propose the addition of 90 MW.

7 Voltage Control

The ratio of short-circuit level to generating capacity, with a 138 kV interconnection, under system normal conditions is 29 (1185/40.5) and is 13 (540/40.5) with one line out of service. Such a high ratio is indication of ease of integration. There should be no specific issues regarding voltage control and power quality due to the addition of this facility alone. The ratio of short-circuit level to generating capacity, with a 69 kV interconnection, under system normal conditions is 6 (250/40.5) and is 4 (155/40.5) with one line out of service. This indicates that care should be taken with regard to the selection of generator and controls to ensure good voltage control and acceptable levels of voltage flicker.

The facilities included with this installation must be such that the facility is capable of providing both lagging and leading power factor of 0.95, measured at the high voltage (transmission) IC substation, when the facility is delivering full power. A centralized controller will be required which adjusts individual generator real and reactive power output, in real time, and regulate the voltage at the high-voltage terminals of the IC substation. The voltage controls must be responsive to voltage deviations at the high voltage terminals of the IC substation, be equipped with a voltage set-point control, and also have facilities that will slowly adjust the set-point over several minutes (5-10) to maintain reactive power just within the individual generators capabilities. The latter control may be referred to as a slow-Q control. Details of the specific control features, control strategy and settings will be reviewed and addressed in the SIS.

NSPI must have manual and remote control of the voltage set-point, the slow-Q controls and reactive power output from this facility.

This facility must also have low-voltage ride-through capability as per FERC order 661A. The SIS will state any additional specific options, controls and additional facilities that are required to achieve this.

8 System Limitations (Transfer Capability)

The existing Nova Scotia import capability, measured at the Nova Scotia – New Brunswick border, is limited to the lesser of 300 MW or 22% of load. This is the maximum import that can be scheduled across the Nova Scotia – New Brunswick interface with all facilities in service. In addition, when Nova Scotia is importing 300 MW the loss of the largest NSPI generating contingency (two units) will increase the import level an additional 328 MW to 628 MW. The Nova Scotia Power System operator will then return the import level to 300 MW as quickly as possible and within 30 minutes of the generation loss. This is achieved by loading generation reserves and, if necessary, shedding load. Thus the system must be capable of operating with a Nova Scotia import of 300 MW and the subsequent loss of 328MW of generation and with acceptable voltages and all facilities within their thermal capabilities. As generation is added in northern Nova Scotia transmission reinforcement will be required in order to maintain this transmission capability. L-6513 is the limiting transmission facility with a summer thermal rating of 110 MVA. When the generation installed in northern Nova Scotia exceeds 60 to 90 MW (depending on location) upgrading of L-6513 will be required or a second 138 kV line be constructed. Alternatively the two unit contingency can be removed by adding a circuit breaker at 50N-Trenton and reconfiguring the 88S-Lingan bus. If projects that are ahead of this project in the Queue proceed, then this project may cause overloading of L-6513, following this contingency, thereby necessitating upgrades to line L-6513.

The existing Nova Scotia export capability, measured at the Nova Scotia – New Brunswick border, is 300 MW but can be increased to 350 MW under certain operating conditions. NSPI has a commitment to hold portion of the total export capability in reserve, on a long term basis, as part of its reserve sharing agreement with the New Brunswick System Operator (NBSO). With all facilities in service and a 350 MW export, all facilities must be loaded within their thermal capabilities and with acceptable system voltages.

NSPI has made extensive use of Special Protection Systems (SPS) in order to reduce/avoid capital expenditures and improve overall cost efficiencies. These systems act to maintain system stability and remove equipment overloads, post contingency, by rejecting generation and/or shedding load. NSPI continues to have no objection to the application of such systems to reduce interconnection

costs. However, these systems must be designed, installed and periodically tested in accordance with criteria, guidelines and procedures that are set forth by reliability organizations which include NSPI, NPCC and NERC. The application, design, maintenance and testing of SPSs must comply with all present and future requirements. The NSPI system has several congested interfaces (transmission corridors that are regularly operated at limits). NSPI has made use of SPS to increase transfer limits on these interfaces. There are practical limits to the amount of generation and load that can be rejected by SPSs and the amount of generation that can be curtailed following a single contingency loss before system stability and reliability are compromised.

There are a number of SPSs and protective systems employed by NSPI and the NBSO to permit these high transfer levels between the two systems. NSPI has an "Import Power Monitor" that acts to separate the two systems following the loss of the 345 kV tie (L-8001/L-3025), by cross-tripping L-6513. Currently this system is armed when imports exceed 100MW. 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. As generation is located in northern Nova Scotia, unless changes are made to this SPS, the scheme will be compromised (as will the Nova Scotia import capability) as it will disconnect generation resources (in northern NS) from the NSPI system. When generation in this area exceeds 40 MW, this SPS will as a minimum, have to be modified by relocating the system separation point from L-6513 at Onslow to the NB border (Maccan and Memramcook). When the generation in northern Nova Scotia exceeds 125 MW then either L-6513 must be thermally upgraded or an additional 138 kV line constructed. Stability and ride-through capability of generation in this area will be critical. This import SPS can also be triggered by a number of SPSs in New Brunswick for contingencies near Memramcook and Salisbury.

When NSPI is exporting power such that the loss of L-8001/L-3025 will result in thermally overloading L-6513 (NS export approximately 100 MW) the "NS Export Power Monitor" is armed. Should L-8001 trip, then this SPS will reject generation in eastern Nova Scotia to ensure that L-6513 is not thermally overloaded and does not trip. We do not expect this project, in addition to projects that precede it in the Queue, to compromise this SPS.

There are a number of proposed generation additions in New Brunswick that may have an impact on projects in northern NS and visa 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.

As the penetration of wind generation increases in this area it is expected that the reliance on the existing SPS scheme may compromise system security. This will depend on the amount of wind and its variability. At some level we expect either this SPS scheme will be redesigned or transmission expansions required for system security. The transmission expansions, if required, may include a second 138 kV transmission line between 1N-Onslow and 74N-Springhill. This requirement will be determined by the SIS.

This generating facility will also increase loading on the Onslow South corridor (Truro to Halifax) by replacing generation south and west of Truro. This may require increased reactive support requirements 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 the facility changes that are required to permit higher transmission loadings while maintaining compliance with NERC/NPCC standards and in keeping with good utility practices.

9 Expected Facilities Required for Interconnection

We expect that based on the above discussions that this project is feasible at the requested capacity, subject to the SIS. The interconnection facilities required are as follows:

a) 69 kV Interconnection L-5548

The maximum transmission capacity available at this location, for generation interconnection at the 69 kV level, will depend on the total capacity installed by projects IR056 and IR080. Total installed capacity of the three projects can not exceed 50 MW.

Additions/Changes to NSPI systems

i. Construct 5 km 69 kV line from 17N-Hickman to the IC Substation

ii. Control and Communications between 30N-Maccan/NSPI and the interconnection substation

iii. Inclusion of generating facility into NSPIs generation rejection SPSs and load curtailment schemes

iv. Rebuild 3.7 km L-5548 between 19N-Hickman and 17N-Brownell

v. Replace two 69 kV switches at 20N-Park and 19N-Hickman

vi. Upgrade protection on L-5548 at 30N-Maccan.

vii. Replace 69 kV voltage regulator by installing a switched capacitor bank at the IC substation or 17N-Hickman, approximately 6 MVAr. These will be switched and have both automatic and remote controls

viii. Relocation of separation point for the "NS Import Power Monitor" from the 1N-Onslow terminal of L-6513 to the 30N-Maccan terminal of L-6535 and the Memramcook terminal of L-6536. Should IR045 proceed then the SPS would be moved to that POI substation rather than Maccan.

ix. Install circuit breaker at 50N-Trenton and reconfigure the 88S-Lingan bus. This may not be required depending on the status of preceding projects in the Queue.

x. Upgrade (rebuild) L-6513 to 70C. This may not be required depending on the status of preceding projects in the Queue.

xi. Upgrade L-6536 to 60C between Springhill and the New Brunswick border

Additions/Changes to be included at the IC's Interconnection Facilities:

xii. 69 kV IC Substation (dual rated 138/69 kV). This will include a 138/69 kV circuit breaker and protections as acceptable to NSPI, An RTU to interface with NSPIs SCADA with telemetry and controls as required by NSPI. NSPI will require real-time monitoring of the IC substation.

xiii. Facilities to provide 0.95 leading and lagging power factor when delivering rated power at the 69kV IC substation when the voltage at that point is operating between 95 and 105 % of nominal.

xiv. Centralized controls. These will provide centralized voltage set-point controls and slow-Q controls which acts to control the voltage on the 69 kV system 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 NSPIs SCADA system. The controller will also limit the load ramp rate of the facility to within limits set by NSPI and/or telemetered from NSPIs SCADA system.

xv. 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 and change the status of any slow-Q controls, remotely. NSPI will also have remote manual control of the load curtailment scheme.

xvi. Low voltage ride-through capability

xvii. Facilities for NSPI to execute high speed rejection of generation (transfer trip)

xviii. Accessible and tree-cleared lands or Rights Of Way (ROW) acceptable to NSPI for design and construction of any required new transmission line or Transmission Provider's substation.

b) 138 kV Interconnection L-6536

Additions/Changes to NSPI systems

i. POI Substation. Install a 3X138 kV circuit breaker ring bus at the POI on L-6536 with protection and telemetry

ii. Control and Communications between 74N-Springhill/NSPI and the IC substation

iii. Inclusion of generating facility into NSPIs generation rejection SPSs and load curtailment schemes

iv. Relocation of separation point for the “NS Import Power Monitor” from the 1N-Onslow terminal of L-6513 to the 30N-Maccan terminal of L-6535 and the Memramcook terminal of L-6536. Should IR045 proceed then the SPS would be moved to that POI substation rather than Maccan.

v. Install circuit breaker at 50N-Trenton and reconfigure the 88S-Lingan bus. This may not be required depending on the status of preceding projects in the Queue

vi. Upgrade L-6513 to 70C. This may not be required depending on the status of preceding projects in the Queue

Additions/Changes to be included at the IC’s Interconnection Facilities:

vii. 138 kV IC Substation. This will include protections as acceptable to NSPI, An RTU to interface with NSPIs SCADA with telemetry and controls as required by NSPI. NSPI will require real-time monitoring of the IC and POI substations.

viii. Facilities to provide 0.95 leading and lagging power factor when delivering rated output all at the 138kV IC Substation when the voltage at that point is operating between 95 and 105 % of nominal.

ix. Centralized controls. These will provide centralized voltage set-point controls and slow-Q controls which acts to control the voltage on the 138 kV system 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 NSPIs SCADA system. The controller will also limit the load ramp rate of the facility to within limits set by NSPI and/or telemetered from NSPIs SCADA system.

x. 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 and change the status of any slow-Q controls, remotely. NSPI will also have remote manual control of the load curtailment scheme.

xi. Low voltage ride-through capability

xii. Facilities for NSPI to execute high speed rejection of generation (transfer trip)

xiii. Accessible and tree-cleared lands or Rights Of Way (ROW) acceptable to NSPI for design and construction of any required new transmission line or Transmission Provider's substation.

10 Magnitude of NSPI Interconnection Facilities Cost Estimate

a) 69 kV Interconnection L-5548

Determined Cost Items	**Estimate**
i) Construct 5 km 69 kV transmission	1,000,000
ii) Rebuild 3.7 km 69 kV transmission	740,000
iii) Replace two 69 kV switches	40,000
iv) Upgrade L-5548 and L-5029 protection at 30N-Maccan	200,000
v) Install switched capacitors (6 MVAr)	600,000
vi) Relocate NSPI Import Power SPS cross-trip	200,000
vii) Control & Communications between NSPI and customer	500,000
viii) Additions and changes to NSPI SPSs (NSPI costs only)	100,000
ix) Contingency (10%)	340,000
Total of Determined Cost Item	**3,720,000**

To Be Determined Cost Items	TBD (SIS)
i) Upgrade L-6513 to 70C	8,000,000
ii) Circuit breaker 50N-Trenton, reconfigure 88S-Lingan	2,500,000
iii) Upgrade L-6536 to 60C between Springhill and NB	500,000
iv) System additions required for system stability and security	
v) Unforeseen impacts in NB system	
Total:	TBD

The above estimate includes the additions/changes to NSPI system only. The cost of the IC substation is not included. Items identified, to be determined (TBD), will be assessed by the SIS.

NSPI estimates the time required to construct the above facilities at 12-24 months provided that no more than 2 to 3 projects per year go forward, and assuming all easements and permits are provided and complete.

b) 138 kV Interconnection L-6536

Determined Cost Items	**Estimate**
i) POI Substation. Install 3X138 kV circuit breaker ring bus	$3,600,000
ii) Site Development	1,000,000
iii) Control & Communications between NSPI and customer	500,000
iv) Additions and changes to NSPI SPSs (NSPI costs only)	100,000
v) Protection changes 74N-Sprinhill and Memramcook	100,000
vi) Relocate NSPI Import Power SPS cross-trip	200,000
vii) Contingency (10%)	550,000
Total of Determined Cost Item	**6,050,000**

To Be Determined Cost Items	TBD (SIS)
i) Upgrade L-6513 to 70C	8,000,000
ii) Circuit breaker 50N-Trenton, reconfigure 88S-Lingan	2,500,000
iii) System additions required for system stability and security	
iv) Unforeseen impacts in NB system	
Total:	TBD

The above estimate includes the additions/changes to NSPI system only. The cost of the IC substation is not included. Items identified, to be determined (TBD), will be assessed by the SIS.

NSPI estimates the time required to construct the above facilities at 12-24 months provided that no more than 2 to 3 projects per year go forward, and assuming all easements and permits are provided and complete.

11 Preliminary Scope of SIS

The following provides a preliminary scope of work for the subsequent SIS. It will be finalized following collaboration with NBSO. This is a generic scope applicable to all generation Interconnection Requests in this northern area.

The SIS will include a more comprehensive assessment of the technical issues and requirements to interconnect generation as requested. In addition this will include contingency analysis, system stability and 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 first 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 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 study will identify any additional required changes to SPSs and any additional facilities required to maintain the import/export capabilities. It will include the impacts of generation that precedes this project in the NS and NB Queues. The SIS will also identify any generation that must be rejected by SPSs (new or existing) to ensure acceptable post contingency voltages, equipment loadings and system stability. The SIS will also identify any generation whose operation will be curtailed with any single element out of service.

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

The SIS will determine the following

- Facilities that the customer must install to meet the requirements of the GIP
- The minimum transmission additions/upgrades that are necessary to permit operation of this generating facility, under all dispatch conditions, catering to the 1st contingencies listed.
- Impact on the operation of existing NS import/export and Lingan over-frequency SPS in terms of arming levels, arming means and operating limits.
- Impact on NB SPSs in southeast corridor
- Conceptual specification of any additional (proposed) SPSs
- Impact of generation addition on UFLS adequacy (forced islanding schemes)
- Impact of generation variability on SPS operation and forced islanding scheme
- Impact of generation variability on islanded operation
- Guidelines and restrictions applicable to N-1 operation (curtailments etc)
- In addition to the SPSs the UVLS systems in NB must be included in these assessments

The SIS will be based on the following bases cases

Power flow base cases	Variations
Winter Peak	import 200MW, export 200MW
Fall Peak	import 100,200,300, export 100,200,300
Summer Peak	import 100,200,300, export 100,200,300
Summer Light Load	import 100,200 export 100,250,350

*Summer Peak export will have high NB-NE flows
*Winter peak import case will have high NE-NB flows

In each case accommodations for the addition of wind generation will be made to the dispatch by changing the unit commitment, for that day, ensuring that sufficient capacity is available to meet the daily peak load. The assumptions regulating regulation, load following and unit commitment at the minimum daily load (two shifting etc) will be noted.

To complete this assessment the following 1st contingencies, as a minimum, will be assessed

- L-8001/L-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-3006 & L-3025 & Memramcook 345/138 kV Tx (common breaker)
- L-3006 & L-3017 (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 1st 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 (9N-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

After determining the changes/additions that are required to facilitate this interconnection "N-1" operation will be assessed. The objective is to determine the operating restrictions or curtailments that must be enforced to ensure secure operation of the system. This provides a final test to ensure that the facilities are adequate and the customers business risks conveyed.

- Contingency analysis, as required
- Dynamics simulation, as required
- Determination of total generation constrained

The "N-1" assessment will include, but not be limited to, the following. The "N-1" assessment will determine the operational constraints that must be applied for "N-1" operation after the facility upgrades/additions that are recommended, for the interconnection, are constructed.