Interconnection Feasibility Study Report
GIP-056-FEAS-R2

System Interconnection Request # 56
60 MW Wind Generating Facility
Cumberland (L-5058), NS

August 17, 2007

Control Centre Operations
Nova Scotia Power Inc.

Executive Summary

A feasibility study was conducted in response to Interconnection Request number 056 (IR056) which proposes to connect 60 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 2 km from 7N-Pugwash on line L-5058.

At the proposed Point of Interconnection (POI) the system was found to have insufficient strength (short-circuit) and thermal capacity to accommodate the addition of the full capacity of this generating facility. For connection to the 69 kV system at this location the capacity must be limited to 40 MW or less. The direct interconnection costs for the 69 kV interconnection are estimated to be $1.1 million with a 12 to 24 month time to construct. Alternatively a 138 kV interconnection can be provided, which will permit the full 60 MW capacity, with an estimated direct interconnection cost of $5.7 million with a 12 to 24 month time to construct. The interconnection costs are provided in section 10.

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 is 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 9.

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1 Introduction

The Interconnection Customer submitted an Interconnection Request to NSPI for a proposed 60 MW wind generation facility interconnected to the NSPIs 69 kV line L-5058. The Point of Interconnection (POI) will be approximately 2 km from NSPIs 7N-Pugwash substation. The Interconnection Customer 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 Interconnection Customers (IC) substation would be located adjacent to L-5058 and not require any new 69 kV line construction to interconnect.

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 Point of Interconnection and configuration studied is as follows:

i. 60 MW wind farm comprised of 30 – 2.0 MW Enercon E82 wind turbines and has requested ERIS service.

ii. The wind generating facility is located 2 km from the 7N-Pugwash 69 kV substation immediately adjacent to L-5058.

iii. Transformer impedance assumed at 8% (on ONAN Base), rated 40/53//66 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 (Victoria Junction) 100 MW NRIS- FEAS complete
IR044 Wind – Colchester (L-6503) 35 MW NRIS- FEAS in progress
IR045 Wind – Cumberland (L-6535) 35 MW NRIS- SIS
IR046 Wind – Colchester (L-6513) 32 MW ERIS- FEAS in progress

This project and projects IR045 and IR046 add generation to transmission facilities that are part of the Nova Scotia to New Brunswick interconnection. These projects will compete for transmission capacity. 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 level on 69kV systems is 3500MVA.

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 project not in service	This project in service
All transmission facilities in service		
74N-Springhill 69 kV	400	520
69 kV Connection Pt (2)	159	313
7N-Pugwash 69 kV	154	295
74N Springhill to 1N-Onslow 138 kV line L-6513 Out of Service		
74N-Springhill 69 kV	345	449
69 kV Connection Pt (2)	149	302
7N-Pugwash 69 kV	144	284
74N-Springhill 138/69 kV Transformer Out of Service		
74N-Springhill 69 kV	188	288
69 kV Connection Pt (2)	110	266
7N-Pugwash 69 kV	107	248

(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.

The maximum short-circuit level on the 74N-Springhill 69kV bus is presently 420 MVA. With the addition of this facility this may increase to 520 MVA. With the 74N-Springhill transformer out of service the increase is significant where the level at Springhill has increased by 50% and at Pugwash by 130%. While the absolute short-circuit levels will be dependent on the specific type of generator, the increase will not be significant enough, from an equipment rating perspective to warrant equipment upgrades. However, the addition may cause protection coordination issues and may require protection upgrades and communications additions to resolve. The protection additions and changes necessary to resolve coordination issues will be studied in the SIS and Facility Study (FAC).

6 Thermal Limits

The 69 kV line L-5058 serves to transmit power from Springhill to substations at 3N-Oxford Junction and 7N-Pugwash. Line L-5029 connects the Springhill substation with the 30-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. Thus power flows on L-5058, L-5029, 138/69 kV transformers and substation buses at 30N-Maccan and 74N-Springhill are impacted by this generation addition.

Line L-5058 (Springhill to Pugwash) is presently limited to 43 MVA by protection and metering at the Springhill terminal. It is expected that the L-5058 rating can be raised at little cost, to accommodate this project.

Should the 74N-Springhill 138/69 kV transformer fail or be removed from service for maintenance then Springhill, Oxford and Pugwash are supplied from 30N-Maccan via L-5029. The addition of this generation project will overload L-5029 in this operating condition. 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 constrained to less than 40 MW unless L-5029 is upgraded.

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.

7 Voltage Control

The ratio of short-circuit level to generating capacity (SCR) under system normal conditions is 2.7 (160/60). Such a low ratio is indication of voltage control and voltage flicker issues that must be addressed by the SIS. During operation following the loss of the 74N-Springhill 138/69 kV transformer the SCR drops to 1.8 (110/60). This will not result in acceptable voltage control. In order to cater to this contingency the capacity of this facility should not be larger than 40 MW. It can be expected that fast acting voltage controls will be required and it is advisable to evaluate generators other than conventional induction machines.

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) connection point, 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 (transmission) connection point. The voltage controls must be responsive to voltage deviations at the connection point, 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-3012), 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 IR045 and IR046 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

Connection to the 69 kV system appears feasible but following the loss or removal of a 138/69 kV transformer (Springhill) this facility would be curtailed to less than 40 MW to prevent overloading L-5029 (Maccan to Springhill) under most foreseeable conditions. A 40 MW facility appears feasible in all conditions and has a much more favorable short-circuit ratio. Therefore we recommend limiting this facility to 40 MW or less.

In order to provide the customer with an alternative that would not require the reduction of installed capacity we have provided a second estimate for a 138 kV interconnection.

We expect the following facilities will be required assuming the ordering of projects ahead of this projects in the Queue.

a) 69 kV Interconnection L-5058 – 40 MW or less

Additions/Changes to NSPI systems

i. Upgrade protection on L-5058 and L-5029 at Springhill.
ii. Upgrade L-6513 to 60C or remove 2 unit contingency. This may not be required if IR045 and IR046 do not proceed
iii. Install transfer trip between the L-5058 protection at 74N-Springhill and the IC substation.
iv. Control and Communications between Pugwash, Springhill & NSPI SCADA system (to be specified)
v. Inclusion of generating facility into NSPIs generation rejection SPSs and load curtailment schemes
vi. 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. 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. 138/69 kV IC substation. Substation equipment is to be rated for 138 kV to facilitate future conversion. This will include 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.
viii. Facilities to provide 0.95 leading and lagging power factor when delivering rated output (40 MW) all at the 69kV 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 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.

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.

b) 138 kV Interconnection – 60 MW

The 138 kV interconnection is facilitated by converting L-5058 to 138 kV. This line is built to 138 kV standards but is currently operated at 69 kV. The conversion of this line requires installing a 138 kV line terminal at 74N-Springhill and converting the 3N-Oxford Junction and 7N-Pugwash substations to 138 kV.

Additions/Changes to NSPI systems

i. Install 138 kV line terminal at 74N-Springhill
ii. Replace 3N-Oxford Junction transformer (change to 138 kV)
iii. Replace 7N-Pugwash transformers T3 &T54 with a unit rated 138/12.5 kV, 7.5/10//11.2 MVA
iv. Replace 7N-Pugwash transformers T1 &T55 with 12.5/4.16 kV padmounts
v. Upgrade L-6513 to 60C or remove 2 unit contingency. This may not be required if IR045 and IR046 do not proceed
vi. Install transfer trip between the L-5058 protection at 74N-Springhill and the IC substation.
vii. Control and Communications between Pugwash, Springhill & NSPI SCADA system (to be specified)
viii. Inclusion of generating facility into NSPIs generation rejection SPSs and load curtailment schemes
ix. 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. 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:

x. 138 kV IC Substation. This will include 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.
xi. Facilities to provide 0.95 leading and lagging power factor when delivering rated output (60 MW) all at the 138kV POI when the voltage at that point is operating between 95 and 105 % of nominal.
xii. 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.
xiii. 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.
xiv. Low voltage ride-through capability
xv. Facilities for NSPI to execute high speed rejection of generation (transfer trip)
xvi. 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-5058, 40 MW or less

Direct Interconnection Cost Items	**Estimate**
i) Upgrade protection L-5058 and L-5029	$200,000
ii) Control & Communications between NSPI and IC substation	$500,000
iii) Additions and changes to NSPI SPSs (NSPI costs only)	$100,000
iv) Relocate NSPI Import Power SPS cross-trip	$200,000
v) Contingency (10%)	$100,000
Total of Direct Interconnection Costs	**$1,100,000**
Indirect Cost Items (To Be Determined)	TBD (SIS)
vi) Upgrade L-6513 to 60C (32 km)	500,000
vii) System additions required for system stability and security	
viii) Unforeseen impacts in NB system	
ix) Increased voltage support requirements near load centre	

	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 – 60 MW

	Direct Interconnection Cost Items	**Estimate**
i)	Install 138 kV line terminal at (74N) Springhill	$1,000,000
ii)	138/12.5 kV 7.5/10//11.2 MVA transformer at 7N-Pugwash	1,500,000
iii)	Install two 3MVA 12.5/4.16kV transformer at 7N-Pugwash	400,000
iv)	138/25 kV 7.5/10//12.5 MVA transformer at (3N) Oxford	1,500,000
v)	Control & Communications between NSPI and customer	500,000
vi)	Additions and changes to NSPI SPSs (NSPI costs only)	100,000
vii)	Relocate NSPI Import Power SPS cross-trip	200,000
viii)	Contingency (10%)	520,000
	Total of Direct Interconnection Costs	**5,720,000**
	Indirect Cost Items (To Be Determined)	TBD (SIS)
ix)	Upgrade L-6513 to 60C (32 km)	500,000
x)	System additions required for system stability and security	
xi)	Unforeseen impacts in NB system	
xii)	Increased voltage support requirements near load centre	
	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 System Impact Study

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/L3025
- 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 & 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 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 constrain

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.