



NSPI BULK POWER FACILITIES
CONNECTION GUIDE
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DOCUMENT APPROVAL

Date	Version	Role	Name	Signature
1999/04/01	Original			
2010/07/07	Rev. 1			
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REVISION RECORD

Date	Version Number	Author	Comments
1999/04/01	Original	RWC	
2010/07/07	Rev. 1	JCB	Updated to better align with NSPI Generation Interconnection Procedures and Terminology. This included using the term Connection instead of Interconnection in many instances. The terms have specific meaning in the context of the GIP.
2010/07/26	Rev. 2	JCB	Updated to add more detail to the SIS and FAC sections. Added Document Approval page.

1.0 INTRODUCTION

Nova Scotia Power Inc. (NSPI) is providing this guide to identify the process and general technical requirements for connecting to the NSPI transmission system.

All facilities involved in the generation, transmission, and use of electricity must be properly connected to the interconnected power systems to avoid degrading the reliability of the electric systems to which they are connected. To avoid adverse impacts on reliability, generation and transmission owners and electricity end-users must meet facility connection and performance requirements specified by those responsible for the reliability of the interconnected transmission systems.

As a member of the Northeast Power Coordinating Council (itself a member of the North American Electric Reliability Council), NSPI is charged with ensuring that the NSPI bulk power system is designed and operated to established standards of reliability. The primary objectives of the reliability criteria are:

- Safety of personnel, including utility workers, customers and their agents, and the public
- Continuation of electricity supplies within the interconnected bulk power system
- Power quality within accepted limits
- Prevention of damage to elements of the bulk power system
- Prevention of a cascading power system failure affecting neighbouring utilities

The North American Electric Reliability Council (NERC) was formed in 1968 in the aftermath of the November 9, 1965 blackout that affected the North-eastern United States and Ontario, Canada. NERC's mission is to promote the reliability of the electricity supply for North America. In short, NERC helps electric utilities and other electricity suppliers' work together to keep the lights on. It does this by reviewing the past for lessons learned, monitoring the present for compliance with policies, standards, principles, and guides, and assessing the future reliability of the bulk electric systems.

NERC established a set of Reliability Standards as a statement of the fundamental requirements for planning reliable interconnected bulk electric power systems. All electric industry participants must accept the responsibility to observe and comply with the NERC Reliability Standards and to contribute to their development and improvement. For this reason, mandatory compliance with the Standards will be required of the NERC Regional Councils (i.e. NPCC) and their members (i.e. NSPI).

NSPI is a public utility and regulated under the Public Utilities Act and the Nova Scotia Utility and Review Board (NSUARB). The NSUARB has supervisory powers over NSPI operations and expenditures.

The primary purpose of this document is to ensure that facilities that could have an adverse impact on the bulk power system, regardless of ownership, are planned, designed, and operated to criteria set forth by NERC and NPCC.

2.0 APPLICATION OF THIS GUIDE

2.1 Generation Facilities

Generation Interconnection, including facilities proposed by NSPI or its Affiliates, is managed within NSPI's Generator Interconnection Procedures (GIP) which is administered by Control Centre Operations. The progression and content of the associated generator interconnection studies align with Section 3.3 to 3.8 of this document.

The Generator Interconnection and Operating Agreement (GIA) established with each connected generating facility ensures ongoing compliance with NPCC/NERC reliability standards and NSPI's connection requirements.

The contact information, procedures, agreements and forms required to initiate the various generator interconnection studies and processes required by NSPI's Generation Interconnection Procedures (GIP) are available on the Open Access Same-time Information System (OASIS) website:
<http://oasis.nspower.ca/en/home/default/revisegenerationinterconnectionprocedures.aspx>.

2.2 Transmission Facilities

Nova Scotia Wholesale Electricity Market Rules (Section 1.1.4, page 1-2) state that there can be no merchant transmission and all connection requirements are internalized as NSPI is an integrated utility.

NSPI has a NSUARB approved, open access transmission tariff (OATT) that establishes various connection requirements for Network Integration Transmission Service and Network Resources. As a component of the OATT, the Standard Generator Interconnection Procedures govern the connection of generation to the NSPI transmission system. These procedures were implemented in 2005 and subsequently revised and approved by the NSUARB in 2010.

2.3 End-user Facilities

The End-user Connection Customer will be guided through the processes, assessments and requirements outlined in Sections 3, 4 and 5 of this document.

2.4 Limitation of this Guide

This Guide is not intended or provided as a design specification for the customer or their agents. Persons using information included in the Guide do so at no risk to NSPI, and they rely solely upon themselves to ensure that their use of all or part of this guide is appropriate in the particular circumstances.

The customer or his agents recognize that they are, at all times, solely responsible for the customer-owned plant design, construction, and operation. NSPI, its servants or agents shall not be or become an agent of the customer in any manner howsoever arising.

The advice of NSPI, its servants or agents, that the customer-owned plant design or equipment meets certain limited requirements of NSPI does not mean, expressly or by implication, that all or any of the requirements of the law or other good engineering practices have been met by the customer in his plant.

The use of this guide does not supersede or exclude any requirements for connection described by the document *Nova Scotia Power Tariffs and Regulations*, or orders of the Nova Scotia Utilities and Review Board.

In some cases, due to the nature of the connected facility, or its operating characteristics, an Operating Agreement between the facility operator and NSPI may be required

The connection requirements provided herein are intended to protect NSPI facilities and are not to be relied upon to protect the Connection Customer facility. It is the responsibility of the Connection Customer to ensure that their facilities are adequately designed and operated.

3.0 CONNECTION CUSTOMER PROCESS

The following process provides a general overview of the sequential steps taken by a Connection Customer to connect to the NSPI system. To expedite the process, the following may be considered:

- The preliminary review can be as little as a meeting with the Connection Customer where it may be agreed upon by both parties to move directly to a System Impact Study (SIS)
- The SIS and the Facilities Study may be combined or performed concurrently

NSPI will provide non-binding, good faith estimated cost of facilities required to connect to the Transmission System and to address the identified short circuit, instability, and power flow issues. The Transmission Provider shall charge and the Connection Customer shall pay the actual costs of all studies and assessments performed.

The contact information, procedures, agreements and forms required to initiate the various generator interconnection studies and processes required by NSPI's Generation Interconnection Procedures (GIP) are available on the OASIS website:

<http://oasis.nspower.ca/en/home/default/revisedgenerationinterconnectionprocedures.aspx>.

NSPI will provide notification of new or modified facilities to those parties responsible for the reliability of the interconnected transmission systems as soon as feasible.

3.1 Primary Point of Contact

The Primary Point of Contact for Connection Customers is the Customer Contact Centre.

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For rate and service options available, the End-user Connection Customer information will be handed over to Performance and Regulation work group for follow-up.

For technical connection information and assistance, the End-user Connection Customer information will be forwarded to the appropriate Territory Engineer for assessment. The Territory Engineer will assess the load and determine if the Connection Customer will require a Distribution or Transmission connection. If the Territory Engineer determines that a Distribution level connection is required the project will be managed at the Territory level. If a Transmission level connection is required, the Connection Customer information will be handed over to Transmission Planning, within the Project Implementation work group.

The Generator Interconnection Customer will be directed to the OASIS website and processed through the Sr. Interconnection Engineer within Control Centre Operations as per Section 2.1. (Contact information available on OASIS)

3.2 Information Required

The request for connection and/or system studies shall include sufficient information to permit evaluation of the project, but it is recognized that additional relevant information may be requested at any time during the review of the project.

The following constitutes the minimum information required:

- Name, address, phone number, and e-mail address of the Applicant
- Contact information for technical information (consultant, project engineer, etc.)
- Expected in-service date
- Location of facility, including a site plan or area map
- Electrical one-line diagram of facility
- General description of connection (new load, expansion of existing facility, new generation)
- Load characteristics:
 1. Size of load (rated electrical power)
 2. Rated voltage, rated power factor
 3. Load pattern (e.g. cyclic, seasonal, ramping, oscillatory)
 4. Motor starting characteristics (motors over 500 hp)
 5. Type of load (e.g. DC motor, arc furnace, electrolytic, variable speed drive)

For generation interconnections, the Appendix 1 of the GIP defines information requirements required to initiate a request for an interconnection generating facility.

3.3 Preliminary Transmission Review

Based on the information provided in the Request for Information/Application for connection, NSPI will conduct an initial review of the potential for the proposed facility to have an impact on the reliability of the bulk power system.

The initial review will be determined by the scope of the project. For End-user connection, the preliminary review may consist of a scope meeting with the Connection Customer and a decision to move directly to a detailed SIS as per Section 3.4. If a more detailed initial assessment is required to determine the viability of the project, a preliminary review (referred to as a Feasibility Study in the GIP) with a formal report of the expected technical requirements and high level cost estimates can be provided.

The preliminary report/feasibility study would include the following:

- Preliminary identification of any circuit breaker short circuit capability limits exceeded as a result of the connection
- Preliminary identification of any thermal overload or voltage limit violations resulting from the connection
- Preliminary description and non-bonding estimated cost of facilities required to connect the Load Facility to the Transmission System and to address the identified short circuit and power flow issues

For generation interconnections, the Section 6 of the GIP, Interconnection Feasibility Study, provides study detail.

3.4 System Impact Study

For both End-user and Generator Interconnection Customers, the Connection SIS will consist of a short circuit analysis, a stability analysis, and a power flow analysis. The SIS will state the assumptions upon which it is based; state the results of the analyses; and provide the requirements or potential impediments to providing the requested connection service, including a preliminary indication of the cost and length of time that would be necessary to correct any problems identified in those analyses and implement the connection. The Connection SIS will provide a list of facilities that are required as a result of the Connection Request and a non-binding good faith estimate of cost responsibility and a non-binding good faith estimated time to construct.

Connection facilities that have the potential for impact on neighbouring systems will require coordinated joint studies with the affected parties.

The scope of the SIS will include, but will not be limited to:

- Assessment of the impact of the proposed project on the Maritime Area regional bulk power system and its component systems as well as neighbouring and remote systems
- Estimation of the transmission facility additions and modifications necessary to avoid adverse impact on the reliability or operating characteristics of the transmission system identified to be caused by the proposed project
- Determination of the protective relay and other protection and control additions and modifications
- Determination of metering and communication additions and modifications
- Estimate costs within budget-estimate accuracy the costs of all facilities required to connect the proposed facility

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The SIS will, at a minimum, address the following:

- Steady state load flow analyses (including post-contingency) to determine the impact of the proposed plant on transmission element loading (lines and transformers), as well as system voltage, reactive power performance and power factor control
- Short-term (angle) stability analyses, including post-transient damping analysis to determine that the facility meets the stability performance requirements of NPCC D#1 *Design and Operation of the Bulk Power System*, Section 5.1.
- Short circuit analysis to determine the impact of the plant on the transmission protective equipment, including relay settings and circuit breaker interrupting capability
- Transfer limit impact analysis to ensure that the facility does not degrade the transfer limit of existing System Operating Limits.
- Transient network analysis, if the nature of the facility or the results of the preceding studies indicate a requirement
- Power quality analyses, to determine the incremental impact on power quality issues
- System Operational Impact analysis, which will review the flexibility and maintainability of the power system with the proposed facility
- Connection Design Analysis, which will review the options for station layout and transmission connection – this will be conducted jointly with the Facility Owner
- Environmental Impact analysis, if required, from the perspective of the proposed transmission modifications and additions

These studies provide the framework for the assessments, estimates and design determinations to be completed in the Facilities Study.

3.5 Facilities Study

The Connection Facilities Study for both End-user and Generation Interconnection Customers shall specify and estimate the cost of the equipment, engineering, procurement and construction work needed to implement the conclusions of the Connection SIS in accordance with Good Utility Practice to physically and electrically connect the Connection Facility to the Transmission System. The Connection Facilities Study shall identify the electrical switching configuration of the connection equipment, including, without limitation: the transformer, switchgear, meters, and other station equipment; the nature and estimated cost of any Transmission Provider's Connection Facilities and Network Upgrades necessary to accomplish the Connection; and an estimate of the time required to complete the construction and installation of such facilities.

The Facilities Study will provide the design specifications for the physical plant to be constructed in order to connect the facility. At a minimum, the study will address the following:

- Transmission line: structure type, conductor, overhead ground wire, hardware grounding and minimum insulation
- Substation Layout

- Station Service
- Surge protection
- System protection and coordination design
- Metering and telecommunications
- Grounding and safety issues
- Insulation and insulation coordination
- Equipment Ratings
- Estimated Schedule for Construction and Commissioning
- Scope of work and ownership by the various parties

3.6 Construction and Commissioning

The Facilities Study design would be implemented by the Technical and Construction Services workgroup.

The Transmission Provider and the Connection Customer shall negotiate in good faith concerning a schedule for the construction of the Transmission Provider's connection. In general, the In-Service Date of a Connection Customer seeking connection to the Transmission System will determine the sequence of construction.

Generation interconnection facilities engineering, procurement and construction are addressed in detail in Article 5 of the GIA (Appendix 6 to GIP)

3.7 Operation and Maintenance

NSPI reserves the right to have a separate service agreement if, in the opinion of the Company, there are issues to be addressed for the ongoing benefit of the Company and its customers.

Operating and Maintenance requirements may include, but will not be limited to:

- Synchronizing of facilities
- Maintenance coordination
- Operational issues (abnormal frequency and voltages)
- Communications and procedures during normal and emergency operating conditions

For generation facilities, a standard-form GIA is established and executed prior to connection.

3.8 Inspections and Permitting

NSPI reserves the right to inspect the Facility prior to connection to ensure that the Facility design and construction will not adversely affect the Bulk Power System.

Customers' electrical installations are required to comply with the Canadian Electrical Code. NSPI's Inspection Authority Bulletin B-36 defines the electrical code and inspection requirement for Customer Owned High Voltage Installations.

4.0 RELIABILITY PRINCIPLES

Section 3, Reliability Planning Requirements, of *Nova Scotia Wholesale Electricity Market Rules* sets out the reliability related obligations of all parties in the planning timeframe. These rules apply to the NSPSO, to NSPI transmission, and to Market Participants who are responsible for Facilities registered in the market, and to Connection Applicants. The Wholesale Market Documents are available at <http://oasis.nspower.ca>.

4.1 Design and Operating Criteria

It is the goal of NSPI to ensure that facilities that have the potential to create an adverse impact on the reliability of the Bulk Power System are designed and operated to the same approved criteria regardless of their ownership.

NSPI is compliant with the planning and operating reliability criteria of the Northeast Power Coordinating Council (NPCC). That body, which itself is compliant with the requirements of the North American Electric Reliability Council (NERC), sets out criteria, guidelines, and procedures for reliable operation of the connected power system which can be retrieved on-line at <http://www.npcc.org>.

NSPI has developed its *System Design Criteria*, based on the NPCC Criteria, which is approved by the Nova Scotia Utilities and Review Board, and is available from NSPI.

4.2 NERC Planning and Operating Standards

NERC has established Planning Standards and Operating Standards that extend the traditional approach to ensuring consistent and relevant criteria, particularly during the restructuring of the North American electric power industry. These standards require extensive and timely reporting of relevant data, as well as equipment testing, computer modeling, and establishment of procedures. The NSPI Control Centre acts as the coordinator for all facilities within Nova Scotia to which these Standards apply, regardless of ownership. As these Standards are phased-in and refined, the compliance process will be monitored and enforced via the NSPI Control Centre.

5.0 FACILITY CONNECTION REQUIREMENTS

The technical requirements determined by the SIS, as described in Section 3.4, or in the GIA for Generation Interconnection, will provide the specific requirements for individual projects.

Nova Scotia Power Tariffs and Regulations apply the special conditions that “customers will make all necessary arrangements to ensure that its load does not unduly deteriorate the integrity of the power supply system”. This requirement includes Power Quality issues. In general, limits on voltage flicker (due to motor starting or fluctuating load), voltage and current harmonics, and phase unbalance govern the Facility.

Harmonic effects are, in general, governed by the IEEE Standard 519-1992 *IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power*

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Systems. Certain types of loads, such as electric arc furnaces, may require special consideration with respect to harmonics.

Voltage flicker and deviation is governed by the flicker curve attached as Appendix A. This dictates the permissible voltage fluctuation base on the frequency of the change, based on the annoyance factor of lamp flicker. Certain types of loads, such as electric arc furnaces, will be closely monitored via flicker meters, weighted to an appropriate scale. A Point of Common Coupling, at which other customers could be affected by the fluctuating voltage, will be established for each Proposed Facility.

Phase unbalance increases electrical losses and can cause damage to electronic equipment and motors, and therefore will be limited to values that are appropriate to the voltage level of the connection.

Certain types of generating equipment may produce non-sinusoidal waveforms that could impact power quality. Generation equipment which uses electronic rectification equipment to produce the alternating current needed for connection with the power system is also subject to harmonics and other power quality concerns. Induction generators that rely on the power system to provide exciting current will draw reactive power for which appropriate arrangements must be made.

Details of connection requirements suitable for the specific nature of the Proposed Facility will be discussed with the Connection Customer during the planning process.

APPENDIX A

Voltage Deviation (Flicker) Curve

Limit of Objectionable Voltage Drop

