Interconnection Guideline

Customer Generation Capacity Not Exceeding 100 kW

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1. **Purpose**

This document establishes the minimum requirements for safe and effective operation of small-scale (i.e. not exceeding 100 kW) generation facilities interconnected with the Nova Scotia Power Inc. (NS Power) Distribution System. This guide describes NS Power’s interconnection requirements, as well as the minimum design standards the Customer-generator must satisfy, and a range of normal and emergency system conditions the generating facility could encounter while connected to the Distribution System.

Customer-generators should discuss project plans with NS Power before purchasing or installing equipment, as requirements will vary depending on capacity, type, location and the existing NS Power facilities in place.

Implementing the requirements of this guideline will help ensure that the Customer-generator’s equipment does not operate in a manner that would compromise the safe operation, reliability or power quality of the Distribution System. The Customer-generator is required to install, operate and maintain its generating and interconnection facilities in accordance with manufacturer’s recommendations to ensure good working order and fitness for service at all times.

This guideline is based on the following assumptions and principles:

- The addition of the Customer-generator’s equipment to the Distribution System will not appreciably change the Distribution System and its characteristics.

- The installation meets the installation requirements of the Canadian Electrical Code (CE Code) Part 1 and the equipment is certified to the relevant CE Code Part 2 product standard. Other local and provincial construction and installation regulations may apply.

- The safety of NS Power personnel, the public and equipment is of primary concern in the design of the interconnection systems.

1.1. **Interconnecting Generation to the Distribution System.**

A Customer-generator may be permitted to operate 60 Hertz, three phase generators up to 100 kW or single phase generators up to 30 kW, in parallel with the Distribution System, provided the Customer-generator and their facilities meet or exceed the requirements of these interconnection guidelines and supporting interconnection agreements and documents.

The Customer-generator is required to install, operate and maintain its facilities in good order and repair at all times (in conformity with good electrical practice) to ensure safe and reliable parallel operation with the Distribution System. In all cases, agreement to and execution of the “Class 1 Interconnection Agreement”\(^1\) between the Customer-generator and Nova Scotia Power is required before the Generating Facility can be interconnected to the Distribution System.

1.2. **Limitations**

The criteria and requirements of this document are applicable to all generation technologies, with aggregate capacity up to 100 kW (three phase generators) and 30 kW (single-phase generators) which are interconnected to NS Power’s Distribution System. Based on this size limitation, it is anticipated that the generation systems will be interconnected with radial Distribution Systems at typical primary voltages (rated less than 26,400 V phase to phase) or secondary voltages (less than 750 volts phase to phase).
For generators with capacity greater than 100 kW refer to the document “Nova Scotia Power –
Interconnection Guideline (Applicable to Generating Facilities ≥ 101 kW - Connected to Distribution
Systems Rated 26,400 V and under)”

The requirements of this document do not apply to emergency back-up generators utilizing
automatic or manual transfer schemes in which load is transferred between a generator and the
Distribution System in a momentary “break-before-make” operation.

The requirements in this guideline are not intended to provide protection of the Customer-
generator’s facilities. The Customer-generator is fully responsible for protecting their facilities in
such a manner that faults or other disturbances on the NS Power system do not cause damage to
their equipment, and NS Power shall not be liable for any such fault, damage or disturbance.

This document is not intended or provided as a design specification or as an instruction manual for
the Customer-generator or their agents. Persons using information included in the document do so
at their own risk and at no risk to Nova Scotia Power, and they rely solely upon themselves to ensure
that their use of all or part of this document is appropriate in the particular circumstances.

The Customer-generator or their agents recognize that they are, at all times, solely responsible for
the Customer-generator’s facilities design, construction, and operation. Nova Scotia Power, its
servants or agents shall not be or become an agent of the Customer-generator in any manner
howsoever arising.

The advice of Nova Scotia Power, its servants or agents, that the Customer-generator facilities
design or equipment meets certain limited requirements of Nova Scotia Power does not mean,
expressly or by implication, that all or any of the requirements of the law or other Good Utility
Practices have been met by the Customer-generator in their facilities.

The use of this document does not supersede or exclude any requirements for interconnection
described by the document “Nova Scotia Power Rates, Regulations and Procedures”, or orders of
the Nova Scotia Utility and Review Board.

Agreement to and execution of the “Class 1 Interconnection Agreement” between the Customer-
generator and Nova Scotia Power is required before the Generating Facility can be interconnected
to the Distribution System

All technical requirements mandated by the latest revisions of this document, system assessments
or studies, or any associated documents must be complied with.

2. Definitions

Advanced Inverter: A Generating Facility’s Inverter that performs functions that, when activated,
can autonomously contribute to grid support during excursions from normal system operating
voltage and frequency conditions by providing: dynamic reactive/real power support, voltage and
frequency ride through, ramp rate controls, and other functions.

Applicable Laws and Regulations: All duly promulgated applicable federal, provincial and local laws,
regulations, rules, ordinances, codes, decrees, judgments, directives, or judicial or administrative
orders, permits and other duly authorized actions of any Governmental Authority.

Cease to Energize: In response to an abnormal excursion, the inverter-based Generating Facility
shall, without intentional delay, cease to provide real and reactive current. Note: Cease to Energize
does not necessitate physical isolation or a trip of the Generating Facility.
**Class 1 Interconnection Agreement:** A document which defines the responsibilities of the Customer-generator and NS Power, identifies key contacts, electrical characteristics of the Customer-generator’s equipment and requirements for the safe and orderly operation and of the Customer-generator’s facilities with NS Power’s Distribution System.

**CSA:** Canadian Standards Association, an accredited standards development organization within Canada.

**Customer-generator:** The owner/operator of the interconnected Generating Facility.

**Distribution System:** NS Power’s facilities that operate at a nominal voltage of 24,940 V or less, which are used to distribute electric power between substations and customer loads.

**Generating Facility:** The Customer-generator’s electricity production device of to be interconnected with the Distribution System.

**Good Utility Practice:** Those practices, methods or acts (including but not limited to the practices, methods and acts engaged in or approved by a significant portion of the electric utility industry in North America) that at a particular time, in the exercise of reasonable judgment, would have been expected to accomplish the desired reliability, safety, environmental protection, economy and expedition as applied and practiced in the utility industry with respect to power generation, delivery, purchase and sale.

**Hertz (Hz):** A measure of the number of times or cycles that a periodic signal repeats in a second, also denoted as cycles per second.

**IEEE:** The Institute of Electrical and Electronics Engineers, Inc., an organization that develops voluntary standards relating to electrical safety and product performance.

**Interconnection:** The addition of a Generating Facility to the Distribution System.

**Inverter:** An electronic device that converts direct current (DC) to alternating current (AC). The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the power is provided by a DC source, such as photovoltaic panels.

**Islanding:** A condition in which a portion of the Distribution System is energized solely by a Generating Facility.

**Isolation:** Physically disconnected or separated from all sources of dynamic energy by approved devices or procedures.

**Metering Equipment:** All metering equipment installed or to be installed at the Generating Facility pursuant to the Class 1 Interconnection Agreement at the metering points, including but not limited to instrument transformers, MWh-meters, data acquisition equipment, transducers, remote terminal unit, communications equipment, phone lines, cellular modems and fiber optics.

**Parallel (-ed, -ing):** A condition in which the Interconnection Customer’s Generating Facility is connected a bus common with the Distribution System, with the intent to transfer power between the two systems.
Point of Interconnection: The point where the Interconnection Facilities are connected to NS Power’s Distribution System.

Stabilized: A condition where the Distribution System has returned to normal voltage (110% ≥ Voltage ≥ 88%) and frequency (60.7 Hz ≥ f ≥ 59 Hz) for 5 minutes or an alternate time determined by NS Power, following a system disturbance which has resulted in a disconnection of the Generating Facility.

Standard Protection Code: NS Power’s set of safe work practices for work on the Distribution System designed to ensure the safety of workers and security of the Distribution System.

3. Getting Connected – The Interconnection Process

The first step in getting connected is to have the project assessed. This is initiated by completing and submitting the applicable “Interconnection Request and Equipment Information Form”.

The basic steps in the process are as follows:

- The NS Power coordinator will acknowledge receipt of the Interconnection Request and will then initiate a review of the Interconnection Request and NS Power’s field conditions (e.g., is the transformer large enough, is there three phase at site, does the metering have to be changed, etc.) This review will identify any new NS Power equipment or upgrades to the existing Distribution System that are required to enable the connection of the generator. This review takes into account the size, type, ratings and location of the proposed generation equipment.

- NS Power will develop specific interconnection requirements and cost estimates for required system additions/upgrades (If required), including changes to the NS Power revenue Metering Equipment.

- The cost estimates for the required system additions or changes will be provided to the Customer-generator for review.

- Once the Customer-generator accepts the requirements and pays the identified costs, the required construction work can be scheduled to commence.

- The “Class 1 Interconnection Agreement” between the Customer-generator and NS Power is executed.

- As part of the electrical and generating equipment installation, the Customer-generator’s electrician must obtain a Wiring Permit and arrange to have all required electrical inspections performed and passed.

- After the wiring inspections are performed and passed, and the Interconnection Agreement is signed, NS Power will advise the Customer-generator that interconnection of the generator with the NS Power system can proceed.

- At this stage, NS Power may require and/or witness the commissioning and testing of the generation equipment.

Final reconciliation of NS Power’s costs will determine the actual costs (or refunds) to be paid by (to) the Customer-generator.

The Customer-generator Generating Facility is now operational.
4. Safety Requirements

4.1. **NS Power Safety Requirements - Standard Protection Code**

Safe work procedures described in NS Power’s Standard Protection Code will be followed by NS Power in providing isolation for work on any part of the interconnected Distribution System, including providing isolation.

4.2. **Electrical Inspection Act and the Canadian Electrical Code Parts I& II**

The Customer-generator’s installation must meet all applicable national, provincial and municipal electrical construction and safety codes, including, without limitation, the Electrical Installation and Inspection Act and Code Regulations. Except as expressly permitted by law, all electrical equipment must be approved by a recognized certification agency e.g. CSA, or equivalent, approval.

Information Bulletins regarding Nova Scotia Power Electrical Permits (B-B1-002), and Customer Owned High Voltage Equipment (B-36-000), along with other bulletins can be found at: www.nspower.ca under “For My Home” and “For Your Business”, “Electrical Inspections”.

4.3. **Permission to Operate**

Under no circumstances shall the Customer-generator begin interconnected operation of the generator until final written approval in the form of a signed “Class 1 Interconnection Agreement” has been given by NS Power.

4.4. **Islanded Operation**

Under no circumstances shall a Generating Facility be permitted to operate in an islanded condition (i.e., the portion of distribution line to which the generator is connected becomes isolated from the Distribution System).

5. Interconnected Systems – Characteristics and Requirements

An interconnected system is defined as one in which the Customer-generator’s generation is connected at a point common with the Distribution System, resulting in a transfer of power between the two systems. As a result of this interconnection, the generator system becomes an integral part of the Distribution System and must be considered in the electrical protection and operation of the Distribution System.

Section 5.1 lists the typical Distribution System operating and power quality conditions within which the Customer-generator’s equipment must operate. It lists representative values of parameters that the Distribution System normally maintains and some abnormal conditions that the Generating Facility needs to be designed to withstand. It is the Customer-generator’s responsibility to ensure that the Generating Facility operates correctly in this environment.

Sections 5 & 6 list typical conditions and responses to abnormal conditions that the Customer-generator’s system must meet as well as the interconnection protective function requirements.
5.1. **NS Power Distribution System**

5.1.1. **Distribution System Configuration**

NS Power’s primary Distribution System is a 3-phase, 4-wire multi-grounded common neutral system ("effectively grounded-wye") operated at three typical voltage levels:

- 4,160 Volts line to line (4 kV),
- 12,470 Volts line to line (12 kV)
- 24,940 Volts line to line (25 kV)

Distribution transformers, which step the primary voltage down to utilization voltages, are mainly single-phase units with primaries connected phase to ground. Three phase distribution transformers are normally configured grounded wye-grounded wye. This generally provides a single intentional ground path for short-circuit currents (one zero-sequence path) and has been utilized in the design of short-circuit protection applied to distribution feeder systems. NS Power’s standard secondary voltages are:

- 120/240 Volts 1-Phase
- 120/208 Volts Solidly Grounded Wye 3-Phase,
- 4-Wire 347/600 Volts Solidly Grounded Wye 3-Phase, 4-Wire

5.1.2. **System Grounding**

Distribution Systems are typically three-phase 4-wire multi-grounded systems incorporating single-phase distribution taps. They are typically operated as effectively (solidly) grounded.

Following the addition of any Generating Facility, the Distribution System must remain effectively grounded at all locations.

5.1.3. **Phasing**

Phasing is not standardized across Distribution Systems. For three phase generation, the phase sequence and the direction of rotation must be coordinated with NS Power’s Distribution System.

5.1.4. **System Frequency**

The power system in Nova Scotia is connected to the North American grid. As a result of this tie, the Nova Scotia system has tight frequency control which rarely varies more than 0.2 Hz from its 60 Hz nominal value.

5.1.5. **System Voltage**

NS Power’s Regulation 2.7 provides general guidance as to appropriate Distribution System steady state service voltage levels, in accordance with “CSA CAN-3-C235-1983 (R2015) Preferred Voltage Levels for AC Systems, 0 to 50,000 Volts, Electric Power Transmission and Distribution”.

5.1.6. **Voltage and Current Distortion**

NS Power has adopted Standard IEEE-519-2014 IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems which establishes harmonic distortion limits for the Distribution System. It provides the harmonic voltage distortion levels that can be expected on
Distribution Systems and the current distortion limits that the Generating Facility must operate within.

### 5.1.7. Voltage Flicker, Dips and Unbalance

NS Power has established guidelines for the power system regarding voltage dips and voltage flicker. These are provided in Section 7.5.

The voltage unbalance on the Distribution System under normal operating conditions is typically under 3% but may reach 5% due to the unbalanced loading and single-phase voltage regulation.

Voltage unbalance is calculated using RMS voltage levels measured phase to phase at the service entrance under no load conditions:

\[
\text{Voltage unbalance (\%)} = 100 \times \frac{\text{(max. deviation from average)}}{\text{(average)}}
\]

The addition of any Generating Facility should not increase the voltage unbalance to more than 3% at any point on the Distribution System. If the generator is unable to tolerate this inherent voltage unbalance, the Customer-generator may request that NS Power make system modifications to lower voltage unbalance (to the extent that is achievable by NS Power) at the Customer-generator’s expense.

### 5.1.8. Fault Levels, Fault Clearing and Restoration

NS Power’s power lines are subject to a variety of natural and man-made hazards. The resulting electric problems are principally short circuits, grounded conductors, and broken conductors. These fault conditions require that the damaged equipment be de-energized as soon as possible because of the potential hazards they pose to the public and the operation of the Distribution System.

Short-circuits on distribution feeders are detected and cleared by the operation of protective devices such as reclosers and circuit breakers. These protective devices detect and interrupt the fault current and then reclose the circuit to restore service. If the short circuit remains (permanent fault) then the protective device again interrupts the circuit and again recloses. Reclosing is a common utility practice. This cycle may be repeated multiple times before the protective device opens and must be manually reclosed.

Short-circuit clearing times (fault initiation to interruption) typical of NS Power’s Distribution Systems are less than 1.0 second, in some instances clearing times can be longer.

Single phase “Type T” cutout fuses are also utilized on the distribution system to operate under downline fault conditions.

The maximum design fault level of the 12.5 kV system is 9000 A. The maximum design fault level of the 25 kV system is 8000 A. Actual fault levels will vary from substation to substation and will decrease with distance from the substation.

Fault levels on down-stream distribution circuits will vary depending on circuit characteristics and configuration. NS Power will provide information on available fault levels at a given site upon request by the Customer-generator.

### 5.2. Generator Types

#### 5.2.1. Synchronous Generators

Synchronous generators are generally capable of contributing current for faults occurring on the NS Power Distribution System. Synchronous generators require synchronizing equipment to ensure proper synchronizing of the Customer-generator’s equipment to the NS Power system.
Nova Scotia Power utilizes automatic reclosing as part of its Distribution System protection scheme. This reclosing function must be taken into account in the design of a synchronous Generating Facility’s protection scheme to avoid damage to the generator due to high torques that could result during non-synchronous paralleling.

Sufficient time must be allowed to ensure the NS Power system has Stabilized following the disconnection of the generator from the NS Power system due to a protection operation.

### 5.2.2. Power Electronic Converter (Inverter) Systems

Inverters convert direct current (dc) power to alternating current (ac) power by means of electronic switching devices. Switching can be controlled by the ac voltage waveform of the NS Power’s supply system (grid-dependent) or by internal electronic circuitry (grid-independent). Inverters are generally not capable of supplying sustained fault current. Grid-independent inverters are capable of supplying load current independently of the NS Power supply system.

Advanced (Smart) Inverters have the capability to provide a range of grid-support functions. All inverter-based Generating Facilities with capacity greater than 10 kW and holding a valid interconnection request on or after the effective date of this document, shall also comply with the Advanced Inverter Requirements set forth in Appendix B of this document.

### 5.2.3. Induction Generators

Induction generators are basically induction motors that are mechanically driven above synchronous speed to produce electric power. Reactive power supply for induction generators may pose design problems, depending on the generator size. Special considerations for induction generators are:

- Capacitors may be necessary to limit the adverse effects of reactive power flow on NS Power’s system voltage regulation.
- Self-excitation of the induction generator due to installed capacitors can produce abnormal high magnitude, distorted voltages.
- Voltage flicker resulting from induction generators starting, particularly on remote portions of the Distribution Systems may be unacceptable to NS Power.

### 6. Generating Facilities - Requirements for Interconnection

This section addresses the technical requirements for the interconnection of generation with the Distribution System.

In general, the Generating Facility shall be equipped with protective functions or devices designed to:

- a) Prevent the Generating Facility from being connected to the Distribution System upon loss of the supply to the Distribution System (Islanding);
- b) Prevent connection or parallel operation of the Generating Facility with the Distribution System unless the voltage and frequency are of normal magnitude;
- c) Prevent isolated operation of the generator (islanding) with any part of the NSPI Distribution System; and,
- d) Interrupt the maximum available fault current at the point of connection with the Distribution System and promptly cease to energize the Distribution System for over-current fault conditions.
In addition to the requirements of Section 6, all Inverter-based Generating Facilities with capacity greater than 10kW and with a valid interconnection request on or after the effective date of this document shall also comply with the Advanced Inverter Requirements set forth in Appendix B of this document.

### 6.1. Adverse Effects on Other Customers

The Generating Facility must not adversely affect the Distribution System or service to any other connected customers or facilities.

To limit the potential for adverse effects on other customers, NS Power requires that Generating Facilities with capacity greater than 10 kW interconnect with the Distribution System via dedicated step-up transformer(s).

### 6.2. Isolation – Disconnect Switch

A manual disconnecting device for isolation purposes must be provided. The form of this switch will vary with the service voltage and capacity but in all cases must be:

- accessible to NS Power,
- capable of providing a visible break, breaking load, opening all phases simultaneously (Gang-operated), and
- being locked in the open position.

The location and form of the device is subject to approval by NS Power. This isolating device is owned by the Customer-generator and is therefore subject to the requirements of the Canadian Electrical Code.

Additional disconnection devices may be required for Generating Facilities with more than one generator.

### 6.3. Grounding Requirements

The Customer-generator’s equipment must be grounded as per manufacturer’s recommendations, the Canadian Electrical Code Part I, and in accordance with the normal practices of NS Power.

Following the addition of any Generating Facility to the Distribution System, the system must remain effectively grounded at all locations, in all sustained, temporary, and transient conditions. Operating temporarily ungrounded at any time is unacceptable.

Interconnection of three phase transformers and transformer grounding systems on three phase Distribution Systems shall be coordinated with NS Power and shall not cause voltage disturbances nor disrupt coordination of NS Power’s Distribution System ground fault protection.

### 6.4. Synchronizing

Generating systems that can generate an ac voltage waveform independent of the Distribution System shall be connected in parallel with NS Power only in combination with synchronizing capabilities. The generator shall synchronize to the Distribution System while meeting the flicker requirements of Section 6.5 and without causing voltage variation at the Point of Interconnection of greater than 5%. The generating system may synchronize to the Distribution System only if the Distribution System is Stabilized.
6.5. **Voltage Regulation and Power Factor Control**

The Customer-generator’s equipment shall not cause the voltage level of the local distribution system to be sustained outside the limits of CSA CAN3-C235-83, Normal Operating Conditions Range\(^7\) (Table in NS Power Regulation 2.7\(^6\)), measured at the Point of Interconnection.

The generator is not required to be capable of adjusting the power factor, but each generating unit shall be capable of operating within a range of 0.95 power factor lag to 0.95 power factor lead.

Refer to Appendix B for additional voltage regulation and power factor control requirements specific to the interconnection of smart/advanced inverter-based generation.

6.6. **Response to Abnormal Frequencies**

Every grid-connected generator requires under/over frequency protection to detect abnormal frequencies and to disconnect the generator from the system.

When a system frequency is in a range given in Table 1 below, the Customer-generator’s equipment shall automatically cease to energize the Distribution System. Adjustable under-frequency settings shall be coordinated with the Distribution System representative.

<table>
<thead>
<tr>
<th>Utility Voltage Condition</th>
<th>Frequency Condition</th>
<th>Maximum number of Seconds to disconnect*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Voltage</td>
<td>&gt;60.7</td>
<td>0.16</td>
</tr>
<tr>
<td>Normal Voltage</td>
<td>&lt;59</td>
<td>0.16</td>
</tr>
</tbody>
</table>

*Refer to Appendix B for frequency protection and frequency ride-through requirements specific to Inverter-based generation with capacity greater than 10 kW.

6.7. **Response to Abnormal Voltage Levels**

Every grid-connected generator requires under/over voltage protection to detect abnormal voltages and to disconnect the generator from the system.

Three-phase generator systems shall automatically cease to energize when any individual phase-to-neutral voltage on a grounded-wye system or any individual phase-to-phase voltage on an ungrounded-wye or delta system goes outside the range of Table 2. Single-phase inverter systems shall detect the phase-to-neutral voltage if connected to neutral. Single-phase equipment connected line-to-line but not to the neutral conductor shall detect the line-to-line voltage.

When any voltage is in an abnormal range of Table 2 below, the Customer-generator’s equipment shall cease to energize the Distribution System.
Table 2 - Response to Abnormal Voltages - Default Settings

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Maximum Clearing Time*</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Of Base Voltage</td>
<td>Default Setting (seconds): adjustable up to and including (seconds):</td>
</tr>
<tr>
<td>V &lt; 45%</td>
<td>0.16</td>
</tr>
<tr>
<td>45% ≤ V &lt; 60%</td>
<td>1</td>
</tr>
<tr>
<td>60% ≤ V &lt; 88%</td>
<td>2</td>
</tr>
<tr>
<td>88% ≤ V ≤ 110%</td>
<td>Normal Operation</td>
</tr>
<tr>
<td>110% &lt; V &lt; 120%</td>
<td>1</td>
</tr>
<tr>
<td>V ≥ 120%</td>
<td>0.16</td>
</tr>
</tbody>
</table>

*Refer to Appendix B for voltage protection and voltage ride-through requirements specific to Inverter-based generation with capacity greater than 10 kW.

6.8. Islanding

Islanding is not permitted, i.e. a Generating Facility shall not energize the Distribution System when the Distribution System is de-energized. The Generating Facility shall not remain energized after the portion of the Distribution System to which it is connected has become electrically separated from the rest of the Distribution System.

The Customer-generator’s equipment shall be equipped with an approved non-islanding protection function design to prevent the generator from being connected to a circuit that is not energized by the utility supply. Alternatives to this protection function will be considered at NS Power’s discretion, where local loads sufficiently exceed the generator capacity (i.e. the aggregate capacity is less than 50% of the minimum circuit loading, or where a transfer trip function is deployed.)

All inverters shall be “non-islanding type” as defined by CSA C22.2 No. 107.1-01 Standard.

6.9. Thermal Limits

Thermal limits of NS Power equipment shall not be exceeded as the result of the addition of the Generating Facility.

6.10. Flicker

The Customer-generator’s facility shall not create objectionable flicker for other customers served from the Distribution System. It is recognized that flicker is a site dependent condition.

The Customer-generator is to ensure that the operation of the Generating Facility does not cause voltage variations on the Distribution System that result in objectionable lamp flicker to other connected customers.

The voltage variations will be measured at the Point of Interconnection (POI). These variations can be caused by the start-up and shut-down sequences of the generator (capacitor switching, inrush, resistive bypass etc.), referred to as “voltage dips”, or may be caused by the quasi-continuous variation of the prime mover (typically wind) which is referred to as “flicker”.

From IEEE P1547a
The acceptable limits of flicker emissions from any generation facility on NS Power’s Distribution System, measured at the designated Point of interconnection in accordance with the IEC Standard IEC 61000-4-15 Ed. 1.1 b:2003 are:

\[
\begin{align*}
    \text{Pst99\%} & \leq 0.35 \\
    \text{Plt99\%} & \leq 0.35
\end{align*}
\]

In computing the flicker emission levels, only periods in which the Generating Facility is in operation shall be included. These limits apply to all consecutive periods.

6.11. Voltage and Current Distortion

The harmonic current injection from the Generating facility to the Distribution System measured at the Point of Interconnection shall not cause the limits established by IEEE 519-2014 to be exceeded.

The Generating Facility must be tolerant of harmonic voltage distortion levels that are indicated in IEEE 519-2014 for Distribution Systems. These distortion levels may be present in the absence of any harmonics generated by the Interconnecting Customer’s facility.

6.12. Over-current Protection

The Customer-generator’s interconnection equipment must detect and promptly cease to energize for over-current fault conditions.

6.13. Protection of Equipment & Fault Detection

The proper detection and isolation of all types of faults whether they occur on the Distribution System, or within the Customer-generator’s facilities, are essential to ensure safe operation and limit damage to equipment. The Customer-generator must ensure that their protection devices detect abnormal system conditions and isolate their facilities from the Distribution System. The Generating Facility shall be equipped with the protection set out in Table 3: Protection Requirements Summary.

6.14. Protection Requirements Summary

*See Appendix B for Advanced Requirements for Inverters >10 kW*
6.15. **Automatic Start/Restart of Generation Facilities**

The Customer-generator may reconnect only when the utility Distribution System voltage and frequency return to normal range (Table 2 & 3) and is Stabilized for a period of at least five (5) minutes.

7. **Metering**

Revenue-class Metering Equipment will be supplied, installed and maintained in accordance with Section 4.1 of the Class 1 Interconnection Agreement.

Power flows to and from the Generating Facility shall be measured at, or at NS Power’s option, compensated to, the Point of Interconnection to ensure that all required billing quantities are recorded as necessary for application of NS Powers’ tariffs or power purchase agreements. Unless otherwise agreed by the Parties, NS Power will install Metering Equipment at the Point of Interconnection prior to any operation of the Generating Facility and shall own, operate, test and maintain such Metering Equipment.

The Customer-generator shall be responsible for all costs associated with the purchase, installation, operation, testing and maintenance of the Metering Equipment.

All revenue Metering Equipment installations shall at all times meet the requirements of Good Utility Practice and all Applicable Laws and Regulations.

7.1. **Customer-generator Requirements**

The Customer-generator must provide and install at Customer-generator’s expense, and in accordance with NS Power Metering Standards, meter sockets and metering cabinets in a suitable location to permit access to Metering Equipment by NS Power.

8. **Operating Requirements**

8.1. **General Operating Requirements**

NS Power may require operational control over interconnection equipment, as necessary, to ensure safety, reliability or serviceability of the Distribution System.

8.2. **Interconnection Agreement**

Prior to the interconnected operation of the Generating Facility, a Class 1 Interconnection Agreement shall be established between the Customer-generator and NS Power to identify key contacts, desired electrical operating characteristics, and other relevant operating responsibilities considerations.

8.3. **Testing**

All protective devices or functions supplied to satisfy the requirements in Section 7 and Appendix B shall be routinely tested by qualified personnel at the Customer-generator’s expense. Reports and findings of this routine testing shall include the "as left" settings. Test reports will be made available to NS Power.

Special tests may also be requested by NS Power to investigate apparent mis-operations that have had an adverse effect on the NS Power system. The Customer-generator shall conduct, or allow NS Power to conduct such tests and the costs of such tests will be at Customer-generator’s expense.
9. Responsibility for Costs

The Customer-generator is responsible for all capital, operating and maintenance costs of all equipment on the generator side of the Point of Interconnection.

Where upgrades and/or revisions are required to existing NS Power systems, to accommodate the generation addition, the Customer-generator shall pay the actual cost of the installation/changes. The Customer-generator shall pay a capital contribution for any required line extensions necessary to extend the NS Power system to the point of interconnection. If this line is dedicated to serve the Customer-generator, all maintenance, repair and replacement costs are the responsibility of the Customer-generator. NS Power will perform and manage the maintenance of these facilities.

10. Appendices

Appendix A - Interconnection Request and Equipment Information Form
Appendix B - Specific Technical Requirements – Inverter-Based Systems > 10kW
Appendix C – References
Appendix A: Interconnection Request And Equipment Information Form

<table>
<thead>
<tr>
<th>Section 1.0: Customer Information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer-Generator (Applicant) and/or Company Name:</td>
<td>Applicant Mailing Address:</td>
</tr>
<tr>
<td>Address (Location of Generator):</td>
<td></td>
</tr>
<tr>
<td>Property Identification Number (P.I.D.):</td>
<td></td>
</tr>
<tr>
<td>Is the generator located on property owned by the applicant?</td>
<td>Applicant Telephone:</td>
</tr>
<tr>
<td>If the generator is not located on the land owned by the applicant, the applicant must provide a copy of the document authorizing the generator to be installed on the property that has been registered on the side of the property.</td>
<td>Applicant Email Address:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section 1.1: Technical Designer Information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Design or Consulting Company:</td>
<td>Telephone:</td>
</tr>
<tr>
<td>Technical Contact:</td>
<td>Mailing Address:</td>
</tr>
<tr>
<td>Email Address:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section 1.2: Electrical Contractor Information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Electrical Contracting Company:</td>
<td>Company Telephone:</td>
</tr>
<tr>
<td>Certificate Number:</td>
<td>Email Address:</td>
</tr>
<tr>
<td>Site Contact:</td>
<td>Contact Phone:</td>
</tr>
<tr>
<td>Wiring Permit Number:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section 2.0: Energy Reconciliation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Anniversary Month: (Please circle month for annual energy reconciliation) JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC</td>
<td>Expected in-Service Date:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section 3.0: Customer-Generator’s Existing NSPI Supply</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing NSPI Electric Service Type:</td>
<td>Single Phase</td>
</tr>
<tr>
<td>Primary NSPI Account:</td>
<td>Meter Number:</td>
</tr>
</tbody>
</table>
### Account Number: Meter Number: Amps: Volts: HST Number (if Applicable):

2

3

If you intend to supply generation to more than 3 accounts, please capture account details on a separate piece of paper and include with your application form.

### Section 4.0: Proposed Interconnection Details

Indicate the appropriate NSPI system interconnection voltage:

- [ ] Single Phase
- [ ] Three Phase

- [ ] 120V
- [ ] 240V
- [ ] Other ________

Indicate the total generation capacity (kW) and estimated annual energy (kWh)

<table>
<thead>
<tr>
<th>Total kW Output</th>
<th>Estimated Annual kWh</th>
</tr>
</thead>
</table>

### Section 5.0: Generating Equipment Information (See Section 5.2 for Solar Installations)

**Generation Source:**
- [ ] Solar
- [ ] Wind
- [ ] Micro-Hydro
- [ ] Other:

**Generator Type:**
- [ ] Synchronous
- [ ] Induction

**Manufacturer:**

**Nameplate Rating kW:**

**kW:**

**Number of Units:**

**Watts per Unit:**

**Product Certification Information:**

**Rated Voltage:**

**Rated Power Factor:**

**Frequency:**

- [ ] Single Phase
- [ ] Three Phase

**Three Phase Connection:**
- [ ] Delta
- [ ] Wye
- [ ] Ground Wye

### Section 5.1: Synchronizer Information (For Synchronous Generators)

**Synchronizer:**
- [ ] Automatic
- [ ] Manual

**Manufacturer:**

**Manufacturer’s Reference Number:**

### Section 5.2: Solar Modules (Where Applicable)

**Module Nameplate Rating (kW):**

**Manufacturer:**

**Number of Units:**

**Model Number:**

**Dc Output Voltage (each):**

**Rated Efficiency:**

**Max. Dc String Voltage [at Inverter]:**

**Product Certification Information:**

*Manufacturer specification sheets and certification compliance reports shall be provided with all for all solar modules in addition to the interconnection request form. Equipment that does not have a recognized factory certification marking shall be subject to Field Evaluation under the SPE-1000 Model Code.*
### Section 5.3: Inverter Information (Where Applicable)

- **Inverter Type:**
  - [ ] String
  - [ ] Micro
- **Manufacturer:**
- **Nameplate Rating:**
  - kVA:
  - kW:
- **Number of Units:**
- **Max. Continuous Inverter Output Rating:**
  - kW:
- **Max. DC Input Voltage:**
- **Ac Output Voltage:**
- **Rated Power Factor:**
- **Frequency:**
  - [ ] Single Phase
  - [ ] Three Phase
- **Product Certification Information:**

Manufacturer specification sheets and certification compliance reports shall be provided with all for all inverter based installations in addition to the interconnection request form. Equipment that does not have a recognized factory certification marking shall be subject to Field Evaluation under the SPE-1000 Model Code.

### Section 5.4: Rapid Shutdown Equipment (Where Applicable)

- **Manufacturer:**
- **Number of Units:**
- **Model Number:**

Manufacturer specification sheets and certification compliance reports shall be provided with all for all rapid shutdown equipment in addition to the interconnection request form. Equipment that does not have a recognized factory certification marking shall be subject to Field Evaluation under the SPE-1000 Model Code.

### Section 6.0: Interconnection Transformer and Fuse Information (Where Applicable)

- **Nameplate Rating:**
  - kVA:
- **Manufacturer:**
- **Number of Units:**
- **Primary Volts:**
- **Secondary Volts:**
- **Connection:**
  - [ ] Single Phase
  - [ ] Three Phase
- **Primary Fuse Data:**
  - Type:
  - Size:
  - Speed:
- **Three Phase Connection:**
  - [ ] Delta
  - [ ] Wye
  - [ ] Ground Wye

### Section 6.1: Interconnection Circuit Breaker Information (Where Applicable)

- **OC Rating:**
- **Interrupting Rating:**
- **Manufacturer:**
- **Trip Speed:**
- **Cycles:**
- **Type Number:**

### Section 6.2: Protective Equipment (Complete all applicable items. Where requested a separate sheet shall be provided with the manufacturer’s product information)

- **6.2 (a) Provide manufacturers information for the protection package or devices**
  - Provide manufacturers documentation for protective functions:
    - Under/Over Voltage
    - Anti-islanding
    - Under/Over Frequency
    - Over-current

- **6.2 (b) Range of available settings for each protective function**
  - Provide list of protection functions with available ranges of protection setting for tripping and shutdown, along with time delays.

- **6.2 (c) Proposed settings (Set point and times)**
  - Provide list of protection functions with settings for tripping or shutdown, along with time delays. Example: High Voltage Trip 127V, Time Delay 0.1 Sec
### Section 7.0: Required Documentation (Three copies of each required)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.0 (a) Electrical One-Line Diagram</td>
<td>A single-line diagram showing the electrical relationship and descriptions of the significant electrical components such as the generator, inverters, cables and wiring, switches, meters, transformers, circuit breakers, with operation voltages and ratings.</td>
</tr>
<tr>
<td>7.0 (b) Manufacturers Information and Approvals</td>
<td>Provide manufacturer information sheets and certification compliance reports for equipment such as, inverters, generators, solar modules, rapid shutdown devices, combiner boxes, DC disconnect switches, and DC optimizers.</td>
</tr>
<tr>
<td>7.0 (c) Equipment Labelling</td>
<td>Provide a detailed list of all permanently installed labels indicating, label designation, label dimensions, label background color, label letter color, label letter height, and label verbiage.</td>
</tr>
<tr>
<td>7.0 (d) Site Plan</td>
<td>Provide a site plan showing the physical arrangement of the major equipment, including generating equipment, transformers, switches, control panels, the customer’s existing metered service and the interconnection with NSPI’s distribution system, include the civic address, references, etc. Provide Property Identification Number (PID).</td>
</tr>
<tr>
<td>7.0 (e) Protective Device Data</td>
<td>For all protective devices used to protect and control the interconnection, please provide proposed protective device settings, circuit breaker and fuse data and coordination curves, and a description of how the protection scheme is intended to function.</td>
</tr>
<tr>
<td>7.0 (f) Point of contact</td>
<td>If the interconnection and start-up process is to be coordinated through a party or individual other than the customer, provide the name, company, address, and phone number of that individual or party with whom the utility is to coordinate the interconnection.</td>
</tr>
</tbody>
</table>

---

I hereby certify that I have reviewed and agree to adhere to the Interconnection Guidelines located at [www.nspower.ca/netmetering](http://www.nspower.ca/netmetering) and to the best of my knowledge, all the information provided in this interconnection Request and Equipment Information Form is true and correct.

**Print:**

**Signature:**

**Date:**

Send completed form to: [netmetering@nspower.ca](mailto:netmetering@nspower.ca)

Nova Scotia Power  
P.O. Box 910, Halifax, NS B3J 2W5  
Attn: Net Metering Program Lead
Appendix B - Advanced Inverter Functions and Operating Requirements

In addition to the requirements listed in Section 6 of this Guideline, the Advanced Inverter Functions and Operating Requirements of this Appendix B shall apply for interconnection of all advanced inverter-based Generating Facilities with a valid interconnection request dated on or after the effective date of this document and with capacity greater than 10 kW.

All such inverter equipment shall be CSA certified and meet the requirements of UL-1741 Supplement SA “Standard for Grid Support Utility Interactive Inverters and Converters” and/or the equivalent CSA standard in place at the time of the Interconnection Application.

Advanced Inverter Protection Functions Required:

(a) Over and under voltage trip functions which i) cause the inverter to cease to energize the Distribution System whenever the Distribution System voltage at the Point of Interconnection deviates from the normal voltage limits and timeframes set out in Table B1 - Advanced Inverter Voltage Ride-Through Function Settings and ii) prevent the Advanced Inverter from restarting and re-energizing the Distribution System unless the system voltage has Stabilized; and

(b) Over and under frequency trip functions which i) cause the inverter to cease to energize the Distribution System whenever the Distribution System frequency at the Point of Interconnection deviates from the nominal 60 Hz frequency and timeframes set out in Table B2 - Advanced Inverter Frequency Ride-Through Function Settings and ii) prevent the Advanced Inverter from restarting and re-energizing the Distribution System unless the frequency has Stabilized.

(c) Anti-Islanding protection to prevent the inverter from being connected to any portion of the Distribution System that is not energized by the utility supply, in accordance with Section 5.8 of the guideline.

1. Response to Abnormal Voltage Conditions - Voltage Trip and Ride Through Settings

Table B1 defines the voltage ranges and protective trip limits. Generating Facilities shall cease to energize the Distribution System within the prescribed trip time whenever the voltage at the Point of Interconnection deviates from the allowable voltage operating range. Unless provided alternate settings by NS Power, all inverter-based Generating Facilities must comply with the standard voltage ride-through and trip settings specified in Table B1.

Whenever the Distribution System voltage at the Point of Interconnection is outside Normal Voltage Range for the parameters set forth in Table B1, the Advanced Inverter’s protective functions shall cause the Advanced Inverter(s) to cease to energize the NS Power’s Distribution System, as follows:

(a) The Advanced Inverter shall stay connected to the Distribution System while the system remains within the “Ride-Through Duration” voltage-time range and must function in the corresponding “Operating Mode” for each Voltage Condition listed in Table B1.

(b) In the Normal Voltage – High (NVH) region, the Advanced Inverter may be required to reduce power output as a function of voltage (per 3.1 Volt-Watt mode). The activation state and settings of this mode will be determined by NS Power in the SSGIA.

c) If the Distribution System voltage recovers to normal prior to the expiration of the Ride-Through time, the Advanced Inverter shall restore continuous operation within 2 sec.

d) If the Distribution System voltage does not exit the ride-through region and returns from the
Under Voltage UV3 region to the UV2 or UV1 region, the Advanced Inverter shall restore available current within 2 sec.

e) Post Ride-Through Start/Restart Conditions: For restarting the inverter output after a ride through event, the system voltage shall be Stabilized (i.e. between 110% to 88% of nominal system voltage for 5 minutes or another time as established by NS Power in the SSGIA).

f) Different settings than specified and operating modes than those in Table B1 may be specified by NS Power in the SSGIA.

<table>
<thead>
<tr>
<th>Voltage Condition</th>
<th>Voltage at POI (% of Nominal)</th>
<th>Ride-Through Duration Default Setting (Sec)</th>
<th>Inverter Operating Mode</th>
<th>Clearing time: Adjustable up to and including (sec)</th>
<th>Post Ride-Through Start/Restart Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 2 Over Voltage (OV2)</td>
<td>V ≥120%</td>
<td>No Ride Through</td>
<td>Cease to Energize</td>
<td>0.16</td>
<td>110% ≥ V ≥ 88%</td>
</tr>
<tr>
<td>Level 1 Over Voltage (OV1)</td>
<td>110% &lt; V &lt; 120%</td>
<td>1</td>
<td>Mandatory Operation</td>
<td>13</td>
<td>110% ≥ V ≥ 88%</td>
</tr>
<tr>
<td>Normal Voltage Range - High (NVH)</td>
<td>100% &lt; V ≤ 110%</td>
<td>Indefinite</td>
<td>Continuous Operation</td>
<td></td>
<td>Not Applicable Within Normal Voltage Range</td>
</tr>
<tr>
<td>Normal Voltage Range - Low (NVL)</td>
<td>88% ≤ V &lt; 100%</td>
<td>Indefinite</td>
<td>Continuous Operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1 Under Voltage (UV1)</td>
<td>60% ≤ V &lt; 88%</td>
<td>2</td>
<td>Mandatory Operation</td>
<td>21</td>
<td>110% ≥ V ≥ 88%</td>
</tr>
<tr>
<td>Level 2 Under Voltage (UV2)</td>
<td>45% ≤ V &lt; 60%</td>
<td>11</td>
<td>Mandatory Operation</td>
<td>11</td>
<td>110% ≥ V ≥ 88%</td>
</tr>
<tr>
<td>Level 3 Under Voltage (UV3)</td>
<td>V &lt; 45%</td>
<td>No Ride Through</td>
<td>Cease to Energize</td>
<td>0.16</td>
<td>110% ≥ V ≥ 88%</td>
</tr>
</tbody>
</table>

Table B1 - Advanced Inverter Voltage Ride-Through Function Settings

Table B1 Notes:
1 Operating modes:
   - Mandatory Operation: the inverter continues to output power during the Ride-Through Duration time and then starts the shutdown process.
   - Cease to Energize: the inverter reduces its output power to zero and then starts the shutdown process.
   - Continuous Operation: the inverter continues to output power as available.

2, 3 Actual settings will be specified by NS Power and indicated in the SSGIA.

2. Response to Abnormal Frequency Conditions - Frequency Trip and Ride Through Settings

Table B2 defines the frequency ranges and protective trip limits. Generating Facilities shall cease to energize the Distribution System within the prescribed trip time whenever the frequency at the Point of Interconnection deviates from the allowable frequency operating range. Unless provided alternate settings by NS Power all inverter-based Generating Facilities must comply with the standard frequency ride-through and trip settings specified in Table B2.

Whenever the Distribution System frequency at the Point of Interconnection is outside Nominal Operation Range for the parameters set forth in Table B2, the Advanced Inverter’s protective functions shall cause the Advanced Inverter(s) to cease to energize the NS Power’s Distribution System, as follows:
a) The Advanced Inverter shall stay connected to the Distribution System while the system remains within the “Ride-Through Duration” frequency-time range and must function in the corresponding “Operating Mode” for each Frequency Condition listed in Table B2.

c) In the OF1 region, the Advanced Inverter shall have the capability to reduce power output as a function of frequency (per 3.2 Frequency-Watt mode). The activation state and settings of this mode will be determined by NS Power in the SSGIA.

d) If the Distribution System frequency recovers to a normal range before to the expiration of the Ride-Through time, the Advanced Inverter shall restore continuous operation within 2 sec.

e) If the Distribution System voltage does not exit the ride-through region and returns from either Level 2 (Over/Under) region to the corresponding Level 1 (Over/Under) region, the Advanced Inverter shall restore available current within 2 sec.

f) Post Ride-Through Start/Restart Conditions: For restarting inverter output after a ride through event, the system voltage shall be Stabilized (i.e. between 110% and 88% of nominal system voltage for 5 minutes or another time as established by NS Power). When the system voltage is in range of 60.7 Hz and 59 Hz, the Advanced Inverter can operate according to its available power output and is not required to increase or decrease power as a function of system frequency.

g) Different settings than specified and operating modes than those in Table B2 may be specified by NS Power in the SSGIA.

<table>
<thead>
<tr>
<th>Frequency Condition</th>
<th>Distribution System Frequency</th>
<th>Ride-Through Duration</th>
<th>Inverter Operating Mode¹</th>
<th>Clearing time: adjustable up to and including (sec)²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 2 Over Frequency (OF2)</td>
<td>f &gt; 62</td>
<td>No Ride Through</td>
<td>Cease to Energize</td>
<td>0.16</td>
</tr>
<tr>
<td>Level 1 Over Frequency (OF1)</td>
<td>62 ≥ f &gt; 60.7</td>
<td>299</td>
<td>Mandatory Operation (f-W)³</td>
<td>300</td>
</tr>
<tr>
<td>Normal Frequency Range</td>
<td>60.7 ≥ f ≥ 59</td>
<td>Normal Range</td>
<td>Continuous Operation</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Level 1 Under Frequency (UF1)</td>
<td>59 &gt; f ≥ 57</td>
<td>299</td>
<td>Mandatory Operation</td>
<td>300</td>
</tr>
<tr>
<td>Level 2 Under Frequency (UF2)</td>
<td>f &lt; 57</td>
<td>No Ride Through</td>
<td>Cease to Energize</td>
<td>0.16</td>
</tr>
</tbody>
</table>

**Table B2 - Advanced Inverter Frequency Ride-Through Function Settings**

**Table B2 Notes:**

1. Operating modes:
   - **Mandatory Operation**: the inverter continues to output power during the Ride-Through Duration time and then starts the shutdown process.
   - **Cease to Energize**: the inverter reduces its output power to zero and then starts the shutdown process.
   - **Continuous Operation**: the inverter continues to output power as available.

2, 3 The actual settings will be specified by NS Power and indicated in the Interconnection Agreement.
3. Additional Advanced Inverter Operational Functions Required

3.1. Volt-Watt Mode

The Advanced Inverter shall be capable of altering its actual real power output when the system voltage at the Point of Interconnection exceeds the defined “volt-watt start set point (%V\text{nom})”. The real power output of the inverter shall be reduced according to the “gradient setting (%P\text{nom}/%V\text{nom})”.

<table>
<thead>
<tr>
<th>Volt-Watt Default Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-W Setting Parameter</td>
</tr>
<tr>
<td>Start Voltage (% of V\text{nom})</td>
</tr>
<tr>
<td>Gradient (%P\text{nom}/%V\text{nom})</td>
</tr>
</tbody>
</table>

a) When the system voltage reaches or exceeds 106% of nominal, the active power output produced by the Advanced Inverter shall be reduced by X% of real power nameplate rating per %V\text{nom}.

b) The voltage default dead-band shall be +10%/-6% (132 V to 127 V).

c) Start Voltage and Gradient Settings to be provided by NS Power in the SSGIA.

3.2. Frequency-Watt Mode

The Advanced Inverter shall be capable of altering its actual real power output whenever the system frequency at the Point of Interconnection exceeds the defined “frequency-watt start set point (Hz)”. The real power output of the inverter shall be reduced according to the “gradient setting (%P\text{nom}/Hz)”.

<table>
<thead>
<tr>
<th>Frequency-Watt Default Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>f-W Setting Parameter</td>
</tr>
<tr>
<td>Start Frequency (Hz)</td>
</tr>
<tr>
<td>Gradient (%P\text{nom}/Hz)</td>
</tr>
</tbody>
</table>

a) When the system frequency exceeds 60.7 Hz, the active power output produced by the Advanced Inverter shall be reduced by X% of real power nameplate rating per hertz.

b) Start Frequency and Gradient Settings to be provided by NS Power in the SSGIA.

c) The frequency default dead-band shall be +0.7/-1.0 Hz (60.7 Hz to 59 Hz). When the system frequency is in range of 60.7 Hz and 59 Hz, the Advanced Inverter can operate according to its available power output and is not required to increase or decrease power as a function of system frequency.

3.3. Power Factor Control

Advanced inverters must be capable of controlling voltage and operating at a fixed, preset power factor. The controller’s voltage set-point shall be adjustable throughout the range of 95-105% of rated terminal voltage. The generator must have the capability of operating with a range of 95% lagging to 95% leading power factor when generating its real power rated capability. The actual settings will be specified by NSPI, and indicated in the SSGIA.

3.4. Dynamic Volt/VAr Operations

Advanced Inverters shall be capable of providing dynamic reactive power compensation (dynamic Volt/VAr operation) within the following constraints:
a) The Advanced Inverter shall be able to consume reactive power in response to an increase in line voltage, and produce reactive power in response to a decrease in line voltage.
b) The reactive power provided shall be based on available reactive power, but the maximum reactive power provided to the system shall be as directed by NS Power.
c) The voltage thresholds and reactive power set points are provided by NS Power.
d) This Volt/VAR capability shall be able to be activated or deactivated in accordance with NS Power requirements, as set out in the SSGIA.

3.5. Ramp Rate Requirements

The Advanced Inverter shall have the following ramp capabilities. Ramp rates are reliant on sufficient energy being available from the Advanced Inverter.

a) Continuous Operation ramp rate: For power output level changes during normal operation. The default value is 100% of maximum rated current output per second with a range of adjustment from 1% to 100%, with specific setting as provided by NS Power in the SSGIA.

b) Connect/Reconnect ramp rate: Upon starting to inject power on startup or a disconnection, the inverter shall be able to control its rate of increase of power from 1 to 100% maximum current per second. The default value is 2% of maximum current output per second with specific settings as provided by NS Power in the SSGIA.

3.6. Summary:

<table>
<thead>
<tr>
<th>Default Advanced Inverter Functions</th>
<th>Default Activation State</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Anti-islanding</td>
<td>Activated</td>
</tr>
<tr>
<td>b) Voltage Ride Through</td>
<td>Activated</td>
</tr>
<tr>
<td>c) Frequency Ride Through</td>
<td>Activated</td>
</tr>
<tr>
<td>d) Volt-Watt Mode</td>
<td>Per SSGIA</td>
</tr>
<tr>
<td>e) Frequency-Watt Mode</td>
<td>Per SSGIA</td>
</tr>
<tr>
<td>f) Fixed Power Factor</td>
<td>Per SSGIA</td>
</tr>
<tr>
<td>g) Dynamic Volt-VAr Mode</td>
<td>Per SSGIA</td>
</tr>
<tr>
<td>h) Ramp Rates – Normal Operation</td>
<td>Activated</td>
</tr>
<tr>
<td>i) Ramp Rate – Reconnect Operation</td>
<td>Activated</td>
</tr>
</tbody>
</table>
Appendix C - References

1 Nova Scotia Power “Class 1 Interconnection Agreement” Current version: Class 1 Interconnection Agreement
2 Nova Scotia Power “Class 1 Interconnection Request And Equipment Information Form” Current Version: Interconnection request - 100 kW or less
4 Province of Nova Scotia “Electrical Installation and Inspection Act” R.S.N.S. 1989, c. 141
5 CSA Canadian Electrical Code Part 1, C22.1-02, Safety Standards for Electrical Installations (CE Code)
6 NS Power Regulation 2.7 “Electric Service Availability and Standard Voltages”
7 CSA Standard CAN3 C235-83 – “Preferred Voltage Levels for AC Systems 0 to 50,000V”
8 IEEE 519 – 2014: Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
9 CSA C22.2 No.107.1-01 Standard “General Use Power Supplies”
10 IEC Standard IEC 61000-4-15 Ed. 1.1 b:2003 “Electromagnetic compatibility (EMC) – Testing and measurement techniques – Section 15: Flickermeter”
11 Nova Scotia Power Inc. “Metering Standards” Current version