Rule 21  
GENERATING FACILITY INTERCONNECTIONS  
(Continued)

Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS  
(Continued)

2. Prevention of Interference (Continued)

i. Fixed Power Factor

Producer shall provide adequate reactive power compensation on site to maintain the Smart Inverter power factor near unity at rated output or a Distribution Provider specified power factor in accordance with the following requirements:

  i. Default Power Factor setting: Absorbing reactive power at 0.95 lagging power factor

  ii. Aggregate generating facility is greater than 15 kW: 1.0 +/- 0.15 (0.85 Lagging to 0.85 Leading) down to 20% rated power based on available reactive power

  iii. Aggregate generating facility is less than or equal to 15 kW: 1.0 +/- 0.10 (0.90 Lagging to 0.90 Leading) down to 20% rated power based on available reactive power

j. Dynamic Volt/Var Operations

The Smart Inverter shall be capable of operating dynamically within a power factor range of +/- 0.85 PF for larger (>15 kW) systems, down to 20% of rated active power, and +/- 0.9 PF for smaller systems (≤15 kW), down to 20% of rated active power, based on available reactive power. This dynamic volt/var capability shall be able to be activated or deactivated in accordance with Distribution Provider requirements.

The Distribution Provider may permit or require the Smart Inverter systems to operate in larger power factor ranges, including in 4-quadrant operations for storage systems with the implementation of additional anti-islanding protection as determined by the Distribution Provider.

The Smart Inverter shall be capable of providing dynamic reactive power compensation (dynamic Volt/Var operation) within the following constraints:

- The Smart 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.

- 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 the Distribution Provider.
k. Ramp Rate Requirements

The Smart Inverter is required to have the following ramp controls for at least the following conditions. These functions can be established by multiple control functions or by one general ramp rate control function. Ramp rates are contingent upon sufficient energy available from the Smart Inverter.

- Normal ramp-up rate: For transitions between energy output levels over the normal course of operation. The default value is 100% of maximum current output per second with a range of adjustment between 1% to 100%, with specific setting as mutually agreed by the Distributor Provider and the Producer.

- Connect/Reconnect Ramp-up rate: Upon starting power into the grid, following a period of inactivity 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 mutually agreed upon by the Distributor Provider and the Producer.

l. Frequency-Watt Requirements

This requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after 12 months from the date the Phase 3 Smart Inverter Advanced Function Advice Letter (AL 3647-E) was made effective by the Commission. Smart inverters shall reduce their real power production as a function of system frequency in accordance with the following:

- When system frequency exceeds 60.1 Hz, the active power output produced by the Smart Inverter shall be reduced by 50% of real power nameplate rating per hertz (5% of real power nameplate rating reduction per 0.1 hertz)

- When system frequency moves under 59.9 Hz, the active power output produced by the Smart Inverter shall be increased by 50% of real power nameplate rating per hertz (5% of real power nameplate rating increase per 0.1 hertz) when inverter is capable of increasing real power production.

- The default dead-band should be +/- 0.1 Hz from 60 hertz (59.9 Hz to 60.1 Hz). When the system frequency is in range of 59.9 Hz and 60.1 Hz, the Smart Inverter is not required to increase or decrease power as a function of system frequency.
2. Prevention of Interference (Continued)

- Figure Hh-2 illustrated this requirement for three levels of output power. Figure Hh-2 is for illustration purpose only.
- Open loop response time for Frequency-Watt shall be 5 seconds

Figure Hh-2: Active power as a function of system frequency

m. Voltage-Watt Default Settings Requirements

This requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after 12-months from the Phase 3 Smart Inverter Function Advice Letter (AL 3647-E) was made effective by the Commission. Smart Inverters shall reduce their real power production as a function measured voltage at the inverter terminal or at the Generating Facility Point of Common Coupling (PCC) in accordance with the following:

- When the measured voltage is greater than 106% of nominal voltage (Example: 127.2 volts on a 120 volts nominal), the active power output produced by the Smart Inverter shall be reduced at a rate of 50% of real power nameplate rating per one percent of nominal voltage. Figure Hh-3 Volt-Watt Requirements illustrate the required rate of reduction.

- When the measured voltage is greater than 108% of nominal voltage (Example: 129.6 volts on a 120 volts nominal), the active power output produced by the Smart Inverter shall be reduced to 0 watts.
Rule 21
GENERATING FACILITY INTERCONNECTIONS

(Continued)

Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Continued)

2. Prevention of Interference (Continued)

Figure Hh-3: Volt-Watt Requirements

- Set Active Power Level Mode Function

The utilization of this function is optional and allowed upon mutual agreement with the Distribution Provider and the Applicant.

- Dynamic Reactive Power Support Function

The utilization of this function is optional and allowed upon mutual agreement with the Distribution Provider and the Applicant.
Rule 21
GENERATING FACILITY INTERCONNECTIONS

(Continued)
Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS
(Continued)

2. Prevention of Interference (Continued)

p. Default Activation States for Phase 1 Functions

Unless otherwise provided by Distribution Provider, pursuant to Distribution Provider’s Distribution Generation Interconnection Handbook, the default settings will be as follows:

Table Hh-4: Default Activation States for Phase 1 Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-islanding</td>
<td>Activated</td>
</tr>
<tr>
<td>Low/High Voltage Ride Through</td>
<td>Activated</td>
</tr>
<tr>
<td>Low/High Frequency Ride Through</td>
<td>Activated</td>
</tr>
<tr>
<td>Dynamic Volt/Var operations</td>
<td>Activated</td>
</tr>
<tr>
<td>Ramp rates</td>
<td>Activated</td>
</tr>
<tr>
<td>Fixed power factor</td>
<td>Deactivated</td>
</tr>
<tr>
<td>Reconnect by “soft-start” methods</td>
<td>Activated</td>
</tr>
<tr>
<td>Frequency/Watt</td>
<td>Activated</td>
</tr>
<tr>
<td>Volt/Watt</td>
<td>Activated</td>
</tr>
<tr>
<td>Set Active Power Function Mode(Optional)</td>
<td>Activated under mutual agreement</td>
</tr>
<tr>
<td>Dynamic Reactive Power Support Mode (Optional)</td>
<td>Activated under mutual agreement</td>
</tr>
</tbody>
</table>
Rule 21
GENERATING FACILITY INTERCONNECTIONS

(Continued)

Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS

(Continued)

2. Prevention of Interference (Continued)

These default activation states may be modified by mutual agreement between Distribution Provider and Producer.

q. Load Shedding or Transfer

The voltage and frequency ride-through requirements of Hh.2.b.ii) and Hh.2.f.i) shall not apply if either: a) The real power across the Point of Common Coupling is continuously maintained at a value less than 10% of the aggregate rating of the Smart Inverters connected to the Generating Facility prior to any voltage disturbance, and the Generation Facility disconnects from the Distribution Provider’s Distribution or Transmission System, along with Generating Facility load, such that the net change in real power flow from or to the Distribution Provider’s Distribution or Transmission System is less than 10% of the aggregate Smart Inverter capacity; or b) Generating Facility load real power demand equal to 90% to 120% of the predisturbance aggregate Smart Inverter real power is shed within 0.1 seconds of Smart Inverter disconnection.

3. Technology Specific Requirements

Grid-interactive inverters do not require separate synchronizing equipment. Non grid-interactive or “stand-alone” inverters shall not be used for Parallel Operation with Distribution Provider’s Distribution or Transmission System.

4. Supplemental Smart Inverter Requirements

a. Fault Detection

A Smart Inverter with an SCCR exceeding 0.1 or one that does not cease to energize Distribution Provider’s Distribution or Transmission System within two seconds of the formation of an Unintended Island shall be equipped with Protective Functions designed to detect Distribution or Transmission System faults, both line-to-line and line-to-ground, and cease to energize Distribution Provider’s Distribution or Transmission System within two seconds of the initiation of a fault.
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GENERATING FACILITY INTERCONNECTIONS

(Continued)

Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS

(Continued)

4. Supplemental Generating Facility Requirements (Continued)

b. Transfer Trip

For a Generating Facility that cannot detect Distribution or Transmission System faults (both line-to-line and line-to-ground) or the formation of an Unintended Island, and cease to energize Distribution Provider’s Distribution or Transmission System within two seconds, Distribution Provider may require a Transfer Trip system or an equivalent Protective Function.

c. Reclose Blocking

Where the aggregate Generating Facility capacity exceeds 15% of the peak load on any automatic reclosing device, Distribution Provider may require additional Protective Functions, including, but not limited to reclose-blocking on some of the automatic reclosing devices.

5. Communication Requirements

The communication protocol requirements included in this Hh.5 shall become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted beginning August 22, 2019. The utilization of this function is permissible under mutual agreement between Distribution Provider and the generating facility before the effective date. The communications requirements herein shall be between (i) the Distribution Provider and the individual Generating Facility’s inverter control or energy management system; (ii) the Distribution Provider and communication to the Generating Facility through an aggregator not co-located or part of the Generating Facility; or (iii) other communication options as mutually agreed to by Applicant and Distribution Provider.

a. Generating Facilities utilizing inverter-based technologies must adhere to all of the following communication protocol requirements for communication between Distribution Provider and the communication option selected under section Hh.5. This Rule does not specify the communication between the selected communication option and Smart Inverter but performance will be enforced by this Rule:

i. Shall be capable of communications;

ii. Software shall be updateable via communications remotely;

iii. The transport level protocol shall be TCP/IP; and,

iv. The default application-level protocol shall be IEEE 2030.5 (i.e., Smart Energy Profile 2.0 (SEP 2)) as defined in the California IEEE 2030.5 Implementation Guide, but other application-level protocols may be used by mutual agreement of the parties including IEEE 1815/DNP3 for SCADA real-time monitoring and control and IEC 61850.

(Continued)
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GENERATING FACILITY INTERCONNECTIONS

(Continued)

Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS
(Continued)

4. Supplemental Generating Facility Requirements (Continued)
   
b. Transfer Trip

   For a Generating Facility that cannot detect Distribution or Transmission System faults (both line-to-line and line-to-ground) or the formation of an Unintended Island, and cease to energize Distribution Provider’s Distribution or Transmission System within two seconds, Distribution Provider may require a Transfer Trip system or an equivalent Protective Function.

   c. Reclose Blocking

   Where the aggregate Generating Facility capacity exceeds 15% of the peak load on any automatic reclosing device, Distribution Provider may require additional Protective Functions, including, but not limited to reclose-blocking on some of the automatic reclosing devices.

5. Communication Requirements

   The communication protocol requirements included in this Hh.5 shall become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after the later of (a) March 1, 2018 or (b) nine months after the release of the SunSpec Alliance communication protocol certification test standard or the release of another industry-recognized communication protocol certification test standard. Until such date, this subsection may be used in all or in part by inverter-based technologies by mutual agreement of the Distribution Provider and the Applicant. The communications requirements herein shall be between (i) the Distribution Provider and the individual Generating Facility’s inverter control or energy management system; (ii) the Distribution Provider and communication to the Generating Facility through an aggregator not co-located or part of the Generating Facility; or (iii) other communication options as mutually agreed to by Applicant and Distribution Provider.

   a. Generating Facilities utilizing inverter-based technologies must adhere to all of the following communication protocol requirements for communication between Distribution Provider and the communication option selected under section Hh.5. This Rule does not specify the communication between the selected communication option and Smart Inverter but performance will be enforced by this Rule:

      i. Shall be capable of communications;

      ii. Software shall be updateable via communications remotely;

      iii. The transport level protocol shall be TCP/IP; and,

      iv. The default application-level protocol shall be IEEE 2030.5 (i.e., Smart Energy Profile 2.0 (SEP 2)) as defined in the California IEEE 2030.5 Implementation Guide, but other application-level protocols may be used by mutual agreement of the parties including IEEE 1815/DNP3 for SCADA real-time monitoring and control and IEC 61850.

1 Communication utilizing this aggregator action is not permitted at this time.

(Continued)
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(Continued)

Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS
(Continued)

5. Communication Requirements (Continued)

b. Additional communication protocol requirements shall also apply to Generating Facilities utilizing inverter-based technologies as provided in the following documents:

i. Distribution Provider Generation Interconnection Handbook, which shall include:
   A. Details and guidelines for the implementation of communications with Generating Facilities utilizing inverter-based technologies;
   B. Cybersecurity and privacy requirements (these may additionally or alternatively be included in the application-level protocol implementation guide); and,
   C. Generic device communications registration management requirements, including how to register individual Generating Facilities, Generating Facilities with energy management systems, and aggregators (these requirements additionally or alternatively may be included in the application-level protocol implementation guide).

ii. Application-Level Protocol Implementation Guide, which shall provide
   A. Communication requirements and implementation guidelines to ensure consistent interoperability of the Generating Facilities with all California investor-owned utilities under the Commission’s jurisdiction.

6. Scheduling Capability Requirements

Generating Facilities which incorporate Smart Inverters shall incorporate scheduling capabilities with minimum scheduling memory capability of at least 24 events. The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request beginning August 22, 2019. The utilization of this function is permissible under mutual agreement between Distribution Provider and the generating facility before the effective date. Each event is composed of modifications to each, selected group of, or all of the following Smart Inverter function:

(Continued)
Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS

5. Communication Requirements (Continued)

b. Additional communication protocol requirements shall also apply to Generating Facilities utilizing inverter-based technologies as provided in the following documents:

i. Distribution Provider Generation Interconnection Handbook, which shall include:

A. Details and guidelines for the implementation of communications with Generating Facilities utilizing inverter-based technologies;

B. Cybersecurity and privacy requirements (these may additionally or alternatively be included in the application-level protocol implementation guide); and,

C. Generic device communications registration management requirements, including how to register individual Generating Facilities, Generating Facilities with energy management systems, and aggregators (these requirements additionally or alternatively may be included in the application-level protocol implementation guide).

ii. Application-Level Protocol Implementation Guide, which shall provide

A. Communication requirements and implementation guidelines to ensure consistent interoperability of the Generating Facilities with all California investor-owned utilities under the Commission’s jurisdiction.

6. Scheduling Capability Requirements

Generating Facilities which incorporate Smart Inverters shall incorporate scheduling capabilities with minimum scheduling memory capability of at least 24 events. The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after the later of (a) March 1, 2018 or (b) nine months after the release of the SunSpec Alliance communication protocol certification test standard or the release of another industry-recognized communication protocol certification test standard. Each event is composed of modifications to each, selected group of, or all of the following Smart Inverter function:

(Continued)
6. Scheduling Capability Requirements (Continued)

- Modifications to the voltage and reactive set-points of the Dynamic volt/var function.
- Modification to the normal ramp-up rate and reconnect ramp-up rate set-points.
- Modifications to the reactive power set-points for the fixed power factor function.
- Modifications to the voltage and watt-reduction level set-points for the volt/watt function.

The Generating Facility’s scheduling capability requirement herein shall be met by one or more of the following options:

- Scheduling capability requirements may be stored at the Generating Facility Energy Management System (GFEMS). The GFEMS shall communicate the necessary commands to the Smart Inverters within 10 minutes from when GFEMS received the scheduling information.

- Scheduling capability requirements may be stored at the Smart Inverter Control Unit (SMCU) within the Generating Facility. The SCMU shall communicate necessary commands to the Smart Inverters within 10 minutes from when SCMU received the scheduling information.

- Scheduling capability requirements may be stored at an aggregator not co-located within the Generating Facility. The aggregator shall communicate the necessary commands to the Smart Inverter within 15 minutes of the aggregator receiving the scheduling information.

- Other options may be utilized by mutual agreement between the Applicant and Distribution Provider

The selected scheduling control system shall store the schedules and shall send operational commands to the Smart Inverters as required by the schedule received from the Distribution Provider. The Smart Inverter shall respond by changing its mode of operation as commanded with no unreasonable delay.

Each scheduled mode of operation shall include and start-time and duration. The Smart Inverter should return to its default settings at the end of the duration time or shall enter a new operational mode as directed by the scheduling control system.
7. Monitoring and Telemetry Requirements

The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted beginning August 22, 2019. The utilization of this function is permissible under mutual agreement between Distribution Provider and the generating facility before the effective date. The Smart Inverter shall have the capability to communicate its performance information including:

a. Smart Inverter production or consumption of active power (watts).

b. Smart Inverter consumption or production of reactive power (vars).

c. Phase measured at the AC terminals of the Smart Inverter (volts).

d. Frequency measured at the AC terminals of the Smart Inverter (Hz).

When the Generating Facility includes energy-storage with Smart Inverters, the following monitoring and telemetry capability is required:

The Smart Inverter shall be capable of communicating the operational state of charge as a percent of energy storage capacity.

Operational State as In-Service or not In-Service communication capability requirements. The Smart Inverter shall be capable of communicating when the Smart Inverter is capable of providing electric services as follows:

- **In-Service**
  An operational state which indicates that the Smart Inverter is connected to the electric system and operating as determined locally by the Generating Facility operator or by a scheduling control system as outlined in section Hh.6.

- **Not In-Service**
  An operating state which indicates that the Smart Inverter is not capable of connecting to the electric system and not capable of providing any type of electrical support as required locally or as commanded by a scheduling control system as outlined in section Hh.6.

Monitoring and performance information should be communicated in aggregate at the Generating Facility as follows:
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(Continued)

7. Monitoring and Telemetry Requirements

The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after the later of (a) March 1, 2018 or (b) nine months after the release of the SunSpec Alliance communication protocol certification test standard or the release of another industry-recognized communication protocol certification test standard. The Smart Inverter shall have the capability to communicate its performance information including:

a. Smart Inverter production or consumption of active power (watts).
b. Smart Inverter consumption or production of reactive power (vars)
c. Phase currents measure at the AC terminal of the Smart Inverter (amps)
d. Phase measured at the AC terminals of the Smart Inverter (volts)
e. Frequency measured at the AC terminals of the Smart Inverter (Hz)

When the Generating Facility includes energy-storage with Smart Inverters, the following monitoring and telemetry capability is required:

The Smart Inverter shall be capable of communicating the available kWh for the energy-storage. Available kWh of the energy storage system is amount energy which can be used to support the energy needs of the electric system including the energy needs for the load within the generating facility or the Distribution System.

Operational State as In-Service or not In-service communication capability requirements. The Smart Inverter shall be capable of communicating when the Smart Inverter is capable of providing electric services as follows:

- In-Service state
  An operational state which indicates that the Smart Inverter is connected to the electric system and operating as determined locally by the Generating Facility operator or by a scheduling control system as outlined in section Hh.6

- No In-Service state
  An operating state which indicates that the Smart Inverter is not capable of connecting to the electric system and not capable of providing any type of electrical support as required locally or as commanded by a scheduling control system as outlined in section Hh.6

Monitoring and performance information should be communicated in aggregate at the Generating Facility as follows:

(Continued)
7. Monitoring and Telemetry Requirements (Continued)

- When the Generating Facility includes only Smart Inverters, the production or consumption of active and reactive power shall be communicated as an aggregate of all Smart Inverters within the Generating Facility.

- When a Generating Facility includes Smart Inverters and other technologies such as synchronous or induction generation systems, the Generating Facility shall communicate the following:
  - The production or consumption of active and reactive power shall be communicated in aggregate of all Smart Inverters within the Generating Facility.
  - The production or consumption of active and reactive power shall be communicated in aggregate of all the other technologies within the Generating Facility.

- When the Generating Facility with Smart Inverters includes one or multiple energy storage systems. The available operational energy should be communicated as an aggregate of all the energy storage systems.

8. Control through communication capabilities

The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted the earlier of: 1) December 2019 or 2) 12 months after approval of the IEEE 1547.1 standard revision. The utilization of this function is permissible under mutual agreement between Distribution Provider and the generating facility before the effective date. Smart Inverters shall have the capabilities of accepting an operational controls through communications in accordance to the following:

a. Cease to energize control command

When the Smart Inverter receives a cease-to-energize command through communication it must enter into a cease-to-energize state of operation or shall initiate the opening of the DER switch referenced in the inverter terminal in order to galvanically isolate the DER system from the Distribution System

b. Return to service control command

When the Smart Inverter receives a return-to-service control command, the Smart Inverter may return to service operation as required by Generating Facility operator or as required by the scheduling control system as required by section H.6

c. Limit Active Power command

When the Smart Inverter receives a command to limit its production of real power, the Smart Inverter shall reduce its real power production to the specified percent of real power capacity of the Smart Inverter or to a specified real power value

(Continued)
7. Monitoring and Telemetry Requirements (Continued)

- When the Generating Facility includes only Smart Inverters, the production or consumption of active and reactive power shall be communicated as an aggregate of all Smart Inverters within the Generating Facility.

- When a Generating Facility includes Smart Inverters and other technologies such as synchronous or induction generation systems, the Generating Facility shall communicate the following:
  - The production or consumption of active and reactive power shall be communicated in aggregate of all Smart Inverters within the Generating Facility.
  - The production or consumption of active and reactive power shall be communicated in aggregate of all the other technologies within the Generating Facility.

- When the Generating Facility with Smart Inverters includes one or multiple energy storage systems. The available kWh energy should be communicated as an aggregate of all the energy storage systems.

8. Control through communication capabilities

The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after the approval of IEEE 1547.1 standard revisions. Smart Inverters shall have the capabilities of accepting an operational controls through communications in accordance to the following:

a. Cease to energize control command

When the Smart Inverter receives a cease-to-energize command through communication it must enter into a cease-to-energize state of operation or shall initiate the opening of the DER switch referenced in the inverter terminal in order to galvanically isolate the DER system from the Distribution System

b. Return to service control command

When the Smart Inverter receives a return-to-service control command, the Smart Inverter may return to service operation as required by Generating Facility operator or as required by the scheduling control system as required by section H.6

c. Limit Active Power command

When the Smart Inverter receives a command to limit its production of real power, the Smart Inverter shall reduce its real power production to the specified percent of real power capacity of the Smart Inverter or to a specified real power value.
Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS
(Continued)

8. Control through communication capabilities (Continued)

d. Suspension of Active Power restriction

When the Smart Inverter receives a command to suspend the command for active power reduction, the Smart Inverter may return to normal operation as required by Generating Facility operator or as required by the scheduling control system as required by section H.6
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GENERATING FACILITY INTERCONNECTIONS

(L) CERTIFICATION AND TESTING CRITERIA (Continued)

1. Introduction (Continued)

Section L also provides criteria for “Certifying” Generators or inverters. Once a Generator or inverter has been Certified per this Rule, it may be considered suitable for Interconnection with Distribution Provider’s Distribution or Transmission System. Subject to the exceptions described in Section L, Distribution Provider will not repeat the design review or require retesting of such Certified Equipment. It should be noted that the Certification process is intended to facilitate Generating Facilities Interconnections. Certification is not a prerequisite to interconnect a Generating Facility for Section H but it is a prerequisite for inverters installed after September 8, 2017, pursuant to Section Hh of this Rule.

2. Certified and Non-Certified Interconnection Equipment
   a. Certified Equipment

   Equipment tested and approved (i.e. “Listed”) by an accredited NRTL as having met both the Type Testing and Production Testing requirements described in this document is considered to be Certified Equipment for purposes of Interconnection with Distribution Provider’s Distribution or Transmission System. Certification may apply to either a pre-packaged system or an assembly of components that address the necessary functions. Type Testing may be done in the manufacturer’s factory or test laboratory, or in the field. At the discretion of the testing laboratory, field-certification may apply only to the particular installation tested. In such cases, some or all of the tests may need to be repeated at other installations.
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GENERATING FACILITY INTERCONNECTIONS

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Continued)

2. Certified and Non-Certified Interconnection Equipment (Continued)

a. Certified Equipment (Continued)

When equipment is Certified by a NRTL, the NRTL shall provide to the manufacturer, at a minimum, a Certificate with the following information for each device:

Administrative:

(1) The effective date of Certification or applicable serial number (range or first in series), and/or other proof that certification is current;

(2) Equipment model number(s) of the Certified equipment;

(3) The software version utilized in the equipment, if applicable;

(4) Test procedures specified (including date or revision number); and

(5) Laboratory accreditation (by whom and to what standard).

Technical (as appropriate):

(1) Device ratings (kW, kV, Volts, amps, etc.);

(2) Maximum available fault current in amps;

(3) In-rush Current in amps;

(4) Trip points, if factory set (trip value and timing);

(5) Trip point and timing ranges for adjustable settings;

(6) Nominal power factor or range if adjustable;

(7) If the equipment is Certified as Non-Exporting and the method used (reverse power or underpower); and

(8) If the equipment is Certified as Non-Islanding.
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GENERATING FACILITY INTERCONNECTIONS

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Continued)

2. Certified and Non-Certified Interconnection Equipment (Continued)
   a. Certified Equipment (Continued)

   It is the responsibility of the equipment manufacturer to ensure that Certification
   information is made publicly available by the manufacturer, the testing laboratory,
   or by a third party.

   b. Non-Certified Equipment

   For non-Certified equipment, some or all of the tests described in this Rule may
   be required by Distribution Provider for each Generating and/or Interconnection
   Facility. The manufacturer or a laboratory acceptable to Distribution Provider may
   perform these tests. Test results for non-Certified equipment must be submitted
   to Distribution Provider for the Supplemental Review. Approval by Distribution
   Provider for equipment used in a particular Generating and/or Interconnection
   Facility does not guarantee Distribution Provider’s approval for use in other
   Generating and/or Interconnection Facilities.

3. Type Testing
   a. Type Tests and Criteria for Interconnection Equipment Certification

   Type testing provides a basis for determining that equipment meets the
   specifications for being designated as Certified equipment under this Rule. The
   requirements described in this Section cover only issues related to
   Interconnection and are not intended to address device safety or other issues.

   Table L.1 defines the test criteria by Generator or inverter technology. While UL
   1741(1) and UL 1741 – Supplement SA were written specifically for inverters, the
   requirements are readily adaptable to synchronous Generators, induction
   Generators, as well as single/multi-function controllers and protection relays.
   Until a universal test standard is developed, Distribution Provider or NRTL shall
   adopt the procedures referenced in Table L.1 as appropriate and necessary for a
   Generating Facility and/or Interconnection Facilities or associated equipment
   performance and its control and Protection Functions. These tests shall be
   performed in the sequence shown in Table L.2.
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L. CERTIFICATION AND TESTING CRITERIA (Continued)

3. Type Testing (Continued)

  g. Paralleling Device Withstand Test

  The di-electric voltage withstand test specified in Section L.1 shall be performed on
  the paralleling device to ensure compliance with those requirements specified in
  Section H.1.c (IEEE 1547-5.1.3.3).

4. Production Testing

At a minimum, each interconnection system shall be subjected to Distribution Provider
Voltage and Frequency Variation Test procedure described in UL1741 under
Manufacturing and Production Tests, Section 68 and the Synchronization test specified in
Section L.3.f. Interconnection systems with adjustable set points shall be tested at a
single set of set points as specified by the manufacturer. This test may be performed in
the factory or as part of a Commissioning Test (Section L.5).

5. Commissioning Testing

  a. Commissioning Testing

  Commissioning Testing, where required, will be performed on-site to verify
  protective settings and functionality. Upon initial Parallel Operation of a Generating
  Facility, or any time interface hardware or software is changed that may affect the
  functions listed below, a Commissioning Test must be performed. An individual
  qualified in testing protective equipment (professional engineer, factory–certified
  technician, or licensed electrician with experience in testing protective equipment)
  must perform Commissioning Testing in accordance with the manufacturer's
  recommended test procedure to verify the settings and requirements per this Rule.

  Distribution Provider may require written Commissioning test procedure be
  submitted to Distribution Provider at least 10 working days prior to the performance
  of the Commissioning Test. Distribution Provider has the right to witness
  Commissioning Test. Distribution Provider may also require written certification by
  the installer describing which tests were performed and their results. Protective
  Functions to be tested during commissioning, particularly with respect to non-
  Certified equipment, may consist of the following:

(Continued)
L. CERTIFICATION AND TESTING CRITERIA (Continued)

7. Type Testing Procedures Not Defined in Other Standards (Continued)

a. Non-Exporting Test Procedures (Continued)

iii) Tests for Inverters and Controllers with Integrated Functions (Continued)

Method 2: If external secondary current or voltage signals are not used, then unit-specific tests must be conducted to verify that power cannot be exported across the PCC for a period exceeding two seconds. These may be factory tests, if the measurement and control points are integral to the unit, or they may be performed in the field.

Inverters and controllers designed to provide reverse or underpower functions shall be tested to certify the intended operation of this function. Two methods are acceptable:

Method 1: If the inverter or controller utilizes external current/voltage measurement to determine the reverse or underpower condition, then the inverter or controller shall be functionally tested by application of appropriate secondary currents and potentials as described in the Discrete Reverse Power Relay Test, Section L.7.a.i of this Rule.

Method 2: If external secondary current or voltage signals are not used, then unit-specific tests must be conducted to verify that power cannot be exported across the PCC for a period exceeding two seconds. These may be factory tests, if the measurement and control points are integral to the unit, or they may be performed in the field.
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GENERATING FACILITY INTERCONNECTIONS

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Continued)

7. Type Testing Procedures Not Defined in Other Standards (Continued)

b. In-rush Current Test Procedures

This test will determine the maximum In-rush Current drawn by the Generator.

(i) Locked-Rotor Method

Use the test procedure defined in NEMA MG-1 (manufacturer’s data is acceptable if available).

(ii) Start-up Method

Install and setup the Generating Facility equipment as specified by the manufacturer. Using a calibrated oscilloscope or data acquisition equipment with appropriate speed and accuracy, measure the current draw at the Point of Interconnection as the Generating Facility starts up and parallels with Distribution Provider’s Distribution or Transmission System. Startup shall follow the normal, manufacturer-specified procedure. Sufficient time and current resolution and accuracy shall be used to capture the maximum current draw within 5%. In-rush Current is defined as the maximum current draw from Distribution Provider during the startup process, using a 10-cycle moving average. During the test, Distribution Provider source, real or simulated, must be capable of maintaining voltage within +/- 5% of rated at the connection to the unit under test. Repeat this test five times. Report the highest 10-cycle current as the In-rush Current. A graphical representation of the time-current characteristic along with the certified In-rush Current must be included in the test report and made available to Distribution Provider.

(Continued)
M. INADVERTENT EXPORT

Under certain operating conditions, an Applicant may choose to completely offset their facility load by installing generation systems which are optimally sized to meet their peak demand with load following functionality on the Generator controls to ensure conditional export of electrical power from the Generating Facility to Distribution Provider's Distribution or Transmission System. In situations where the loading changes rapidly and/or the Generator cannot ramp down quickly enough, the Generating Facility may need to export small amounts of power for limited duration. The event of exporting uncompensated power for a short time is referred to as Inadvertent Export.

It is proposed that the following criteria be the minimum requirements for Inadvertent Export systems. It should be understood that other factors relevant to the interconnection study process (15% screen results, short circuit current ratio, etc.) may necessitate additional technical requirements (e.g. reclose block, transfer trip, ground bank, etc.) that are not explicitly noted here. Also, it should be noted that Inadvertent Export may not be available for interconnections to Networked Secondary Systems.

1) If a Generating Facility is proposed with Inadvertent Export, additional Protective Functions and equipment to detect Distribution or Transmission System faults (per Distribution Providers standard practices) may be required over and above the basic Protective Functions and equipment associated with the four options in the Export Screen. Protective Functions may include, but are not limited to, directional overcurrent/voltage-restraint overcurrent Protective Functions for line-to-line fault detection and overcurrent/overvoltage Protective Functions for line-to-ground detection. The addition of a ground bank or ground detector may also be necessary.

2) The effect on equipment ratings can be mitigated by limiting the amount of inadvertent export allowed. To a large degree, Voltage Regulation may be similarly handled. The amount of Inadvertent Export is dependent on specific Distribution Provider requirements and should be limited to the lesser of the following values:

   a. 50% of the Generating Facility Capacity, or
   b. 10% of the continuous conductor rating in watts at 0.9 power factor for the lowest rated feeder conductor upstream of the GF (i.e. 200kW @ 12kV), or
   c. 110% of the largest load block in the facility, or
2) (Continued)

d. 500kW or some other maximum level indicated by Distribution Provider

To govern this quantity, a reverse power Protective Function will be provided to trip the connected Generator(s) within two seconds if the proposed amount of Inadvertent Export is exceeded.

3) Similarly, to ensure limited impact to the Distribution or Transmission System, the expected frequency of Inadvertent Export occurrences should be less than two occurrences per 24-hour period. Additionally, a separate reverse power or underpower Protective Function will be required (in addition to the reverse power Protective Function described in 2) above) to trip the connected Generator(s) if the duration of reverse power or underpower (i.e. ANY export) exceeds 60 seconds.
N. EXPEDITED INTERCONNECTION PROCESS FOR NON-EXPORT ENERGY STORAGE GENERATING FACILITIES

Upon implementation by Distribution Provider, Applicants with Interconnection Requests for Non-Export Energy Storage Generating Facilities who meet the requirements outlined below are eligible for expedited interconnection, as provided herein, in accordance with the Fast Track Process technical review requirements of Section F.2.

1. Eligibility Requirements.

Applicants seeking to interconnect a Generating Facility under the provisions of this Section N must meet the following eligibility requirements.

a. Applicant must submit a completed Interconnection Request in which the expedited interconnection option is selected, including completing all application fields and submitting all supporting documentation necessary to facilitate the expedited review as required by Distribution Provider. Such documentation may include, but is not limited to, single line diagrams with specific details, manufacturer data sheets for proposed equipment, description of control systems, validation of the right to do business in the state, etc. Distribution Provider shall clearly communicate these requirements as part of the application process.

b. Applicant’s Generating Facility must meet the requirements outlined in Section N.2 below.

c. Applicant’s Interconnection Request must be eligible for and select the Fast Track Process.

d. Applicant’s Interconnection Request must pass Fast Track Initial Review and not require any Interconnection Facilities, Distribution Upgrades or Network Upgrades to remain eligible under this Section. As such, Interconnection Requests that select the Cost Envelope Option are not eligible.

2. Generating Facility Eligibility Criteria.

An Applicant’s Generating Facility must meet and adhere to the following criteria.

a. The Generating Facility must be comprised solely of the following specific categories of generation technology: Non-Exporting inverter-based energy storage.

b. The Generating Facility must have an aggregate maximum inverter nameplate rating of no greater than 500 kW. There is no limitation on an energy storage device’s kWh capacity rating.

1 Implementation is targeted for no later than the end of Q2 2017. In accordance with Advice 3493-E/E-A/E-B, the provisions provided for herein are being implemented under a pilot-like approach with a July 1, 2017 through June 30, 2018 reporting period. As such, the provisions may be continued, modified and/or withdrawn as determined by the Commission.
N. EXPEDITED INTERCONNECTION PROCESS FOR NON-EXPORT ENERGY STORAGE GENERATING FACILITIES (Continued)

3. Expedited Processing Provisions. (Continued)

c Any Interconnection Request that fails to meet the requirements specified in Section N is no longer eligible for processing under the provisions of this Section N. Such Interconnection Requests shall continue to be processed in accordance with the applicable provisions and timelines of Rule 21, unless the Applicant chooses to withdraw the Interconnection Request.