

CHAPTER 25. SUBSTANTIVE RULES APPLICABLE TO ELECTRIC SERVICE PROVIDERS

Subchapter I. Transmission and Distribution.

DIVISION 2. TRANSMISSION AND DISTRIBUTION APPLICABLE TO ALL ELECTRIC UTILITIES.

§25.212. Technical Requirements for Interconnection and Parallel Operation of On-Site Distributed Generation.

- (a) **Purpose.** The purpose of this section is to describe the requirements and procedures for safe and effective connection and operation of distributed generation.
- (1) A customer may operate 60 Hertz (Hz), three-phase or single-phase generating equipment, whether qualifying facility (QF) or non-QF, in parallel with the utility system pursuant to an interconnection agreement, provided that the equipment meets or exceeds the requirements of this section.
 - (2) This section describes typical interconnection requirements. Certain specific interconnection locations and conditions may require the installation and use of more sophisticated protective devices and operating schemes, especially when the facility is exporting power to the utility system.
 - (3) If the utility concludes that an application for parallel operation describes facilities that may require additional devices and operating schemes, the utility shall make those additional requirements known to the customer at the time the interconnection studies are completed.
 - (4) Where the application of the technical requirements set forth in this section appears inappropriate for a specific facility, the customer and utility may agree to different requirements, or a party may petition the commission for a good cause exception, after making every reasonable effort to resolve all issues between the parties.
- (b) **General interconnection and protection requirements.**
- (1) The customer's generation and interconnection installation must meet all applicable national, state, and local construction and safety codes.
 - (2) The customer's generator shall be equipped with protective hardware and software designed to prevent the generator from being connected to a de-energized circuit owned by the utility.
 - (3) The customer's generator shall be equipped with the necessary protective hardware and software designed to prevent connection or parallel operation of the generating equipment with the utility system unless the utility system service voltage and frequency is of normal magnitude.
 - (4) Pre-certified equipment may be installed on a company's utility systems in accordance with an approved interconnection control and protection scheme without further review of their design by the utility. When the customer is exporting to the utility system using pre-certified equipment, the protective settings and operations shall be those specified by the utility.
 - (5) The customer will be responsible for protecting its generating equipment in such a manner that utility system outages, short circuits or other disturbances including zero sequence currents and ferroresonant over-voltages do not damage the customer's generating equipment. The customer's protective equipment shall also prevent unnecessary tripping of the utility system breakers that would affect the utility system's capability of providing reliable service to other customers.
 - (6) For facilities greater than two megawatts (MW), the utility may require that a communication channel be provided by the customer to provide communication between the utility and the customer's facility. The channel may be a leased telephone circuit, power line carrier, pilot wire circuit, microwave, or other mutually agreed upon medium.
 - (7) Circuit breakers or other interrupting devices at the point of common coupling must be capable of interrupting maximum available fault current. Facilities larger than two MW and exporting to the utility system shall have a redundant circuit breaker unless a listed device suitable for the rated application is used.

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- (8) The customer will furnish and install a manual disconnect device that has a visual break that is appropriate to the voltage level (a disconnect switch, a draw-out breaker, or fuse block), and is accessible to the utility personnel, and capable of being locked in the open position. The customer shall follow the utility's switching, clearance, tagging, and locking procedures, which the utility shall provide for the customer.
- (c) **Prevention of interference.** To eliminate undesirable interference caused by operation of the customer's generating equipment, the customer's generator shall meet the following criteria:
- (1) **Voltage.** The customer will operate its generating equipment in such a manner that the voltage levels on the utility system are in the same range as if the generating equipment were not connected to the utility's system. The customer shall provide an automatic method of disconnecting the generating equipment from the utility system if a sustained voltage deviation in excess of +5.0 % or -10% from nominal voltage persists for more than 30 seconds, or a deviation in excess of +10% or -30% from nominal voltage persists for more than ten cycles. The customer may reconnect when the utility system voltage and frequency return to normal range and the system is stabilized.
 - (2) **Flicker.** The customer's equipment shall not cause excessive voltage flicker on the utility system. This flicker shall not exceed 3.0% voltage dip, in accordance with Institute of Electrical and Electronics Engineers (IEEE) 519 as measured at the point of common coupling.
 - (3) **Frequency.** The operating frequency of the customer's generating equipment shall not deviate more than +0.5 Hertz (Hz) or -0.7 Hz from a 60 Hz base. The customer shall automatically disconnect the generating equipment from the utility system within 15 cycles if this frequency tolerance cannot be maintained. The customer may reconnect when the utility system voltage and frequency return to normal range and the system is stabilized.
 - (4) **Harmonics.** In accordance with IEEE 519 the total harmonic distortion (THD) voltage shall not exceed 5.0% of the fundamental 60 Hz frequency nor 3.0% of the fundamental frequency for any individual harmonic when measured at the point of common coupling with the utility system.
 - (5) **Fault and line clearing.** The customer shall automatically disconnect from the utility system within ten cycles if the voltage on one or more phases falls below -30% of nominal voltage on the utility system serving the customer premises. This disconnect timing also ensures that the generator is disconnected from the utility system prior to automatic re-close of breakers. The customer may reconnect when the utility system voltage and frequency return to normal range and the system is stabilized. To enhance reliability and safety and with the utility's approval, the customer may employ a modified relay scheme with delayed tripping or blocking using communications equipment between customer and company.
- (d) **Control, protection and safety equipment requirements specific to single phase generators of 50 kilowatts (kW) or less connected to the utility's system.** Exporting to the utility system may require additional operational or protection devices and will require coordination of operations with the host utility. The necessary control, protection, and safety equipment specific to single-phase generators of 50 kW or less connected to secondary or primary systems include an interconnect disconnect device, a generator disconnect device, an over-voltage trip, an under-voltage trip, an over/under frequency trip, and a synchronizing check for synchronous and other types of generators with stand-alone capability.

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- (e) **Control, protection and safety equipment requirements specific to three-phase synchronous generators, induction generators, and inverter systems.** This subsection specifies the control, protection, and safety equipment requirements specific to three phase synchronous generators, induction generators, and inverter systems. Exporting to the utility system may require additional operational or protection devices and will require coordination of operations with the utility.
- (1) **Three phase synchronous generators.** The customer's generator circuit breakers shall be three-phase devices with electronic or electromechanical control. The customer is solely responsible for properly synchronizing its generator with the utility. The excitation system response ratio shall not be less than 0.5. The generator's excitation system(s) shall conform, as near as reasonably achievable, to the field voltage versus time criteria specified in American National Standards Institute Standard C50.13-1989 in order to permit adequate field forcing during transient conditions. For generating systems greater than two MW the customer shall maintain the automatic voltage regulator (AVR) of each generating unit in service and operable at all times. If the AVR is removed from service for maintenance or repair, the utility's dispatching office shall be notified.
- (2) **Three-phase induction generators and inverter systems.** Induction generation may be connected and brought up to synchronous speed (as an induction motor) if it can be demonstrated that the initial voltage drop measured on the utility system side at the point of common coupling is within the visible flicker stated in subsection (c)(2) of this section. Otherwise, the customer may be required to install hardware or employ other techniques to bring voltage fluctuations to acceptable levels. Line-commutated inverters do not require synchronizing equipment. Self-commutated inverters whether of the utility-interactive type or stand-alone type shall be used in parallel with the utility system only with synchronizing equipment. Direct-current generation shall not be operated in parallel with the utility system.
- (3) **Protective function requirements.** The protective function requirements for three phase facilities of different size and technology are listed below.
- (A) Facilities rated ten kilowatts (kW) or less must have an interconnect disconnect device, a generator disconnect device, an over-voltage trip, an under-voltage trip, an over/under frequency trip, and a manual or automatic synchronizing check (for facilities with stand alone capability).
- (B) Facilities rated in excess of ten kW but not more than 500 kW must have an interconnect disconnect device, a generator disconnect device, an over-voltage trip, an under-voltage trip, an over/under frequency trip, a manual or automatic synchronizing check (for facilities with stand alone capability), either a ground over-voltage trip or a ground over-current trip depending on the grounding system if required by the company, and reverse power sensing if the facility is not exporting (unless the generator is less than the minimum load of the customer).
- (C) Facilities rated more than 500 kW but not more than 2,000 kW must have an interconnect disconnect device, a generator disconnect device, an over-voltage trip, an under-voltage trip, an over/under frequency trip, either a ground over-voltage trip or a ground over-current trip depending on the grounding system if required by the company, an automatic synchronizing check (for facilities with stand alone capability) and reverse power sensing if the facility is not exporting (unless the facility is less than the minimum load of the customer). If the facility is exporting power, the power direction protective function may be used to block or delay the under frequency trip with the agreement of the utility.

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- (D) Facilities rated more than 2,000 kW but not more than 10,000 kW must have an interconnect disconnect device, a generator disconnect device, an over-voltage trip, an under-voltage trip, an over/under frequency trip, either a ground over-voltage trip or a ground over-current trip depending on the grounding system if required by the company, an automatic synchronizing check and AVR for facilities with stand alone capability, and reverse power sensing if the facility is not exporting (unless the facility is less than the minimum load of the customer). If the facility is exporting power, the power direction protective function may be used to block or delay the under frequency trip with the agreement of the utility. A telemetry/transfer trip may also be required by the company as part of a transfer tripping or blocking protective scheme.
- (f) **Facilities not identified.** In the event that standards for a specific unit or facility are not set out in this section, the company and customer may interconnect a facility using mutually agreed upon technical standards.
- (g) **Requirements specific to a facility paralleling for sixty cycles or less (closed transition switching).** The protective devices required for facilities ten MW or less which parallel with the utility system for 60 cycles or less are an interconnect disconnect device, a generator disconnect device, an automatic synchronizing check for generators with stand alone capability, an over-voltage trip, an under-voltage trip, an over/under frequency trip, and either a ground over-voltage trip or a ground over-current trip depending on the grounding system, if required by the utility.
- (h) **Inspection and start-up testing.** The customer shall provide the utility with notice at least two weeks before the initial energizing and start-up testing of the customer's generating equipment and the utility may witness the testing of any equipment and protective systems associated with the interconnection. The customer shall revise and re-submit the application with information reflecting any proposed modification that may affect the safe and reliable operation of the utility system.
- (i) **Site testing and commissioning.** Testing of protection systems shall include procedures to functionally test all protective elements of the system up to and including tripping of the generator and interconnection point. Testing will verify all protective set points and relay/breaker trip timing. The utility may witness the testing of installed switchgear, protection systems, and generator. The customer is responsible for routine maintenance of the generator and control and protective equipment. The customer will maintain records of such maintenance activities, which the utility may review at reasonable times. For generation systems greater than 500 kW, a log of generator operations shall be kept. At a minimum, the log shall include the date, generator time on, and generator time off, and megawatt and megavar output. The utility may review such logs at reasonable times.
- (j) **Metering.** Consistent with Chapter 25, Subchapter F of this title (relating to Metering), the utility may supply, own, and maintain all necessary meters and associated equipment to record energy purchases by the customer and energy exports to the utility system. The customer shall supply at no cost to the utility a suitable location on its premises for the installation of the utility's meters and other equipment. If metering at the generator is required in such applications, metering that is part of the generator control package will be considered sufficient if it meets all the measurements criteria that would be required by a separate stand alone meter.