



TECHNICAL REQUIREMENTS FOR DISTRIBUTED GENERATION

A. General

1. This document describes typical technical interconnection requirements. CPS Energy may determine that certain specific interconnection locations and conditions require the installation of more sophisticated protective devices and operating schemes, especially when the facility is exporting power to CPS Energy.
2. If CPS Energy determines an application for parallel operation describes facilities that require additional devices and operating schemes, CPS Energy shall make those additional requirements known to the Customer at the time the interconnection studies are completed.
3. *Point of Interconnection.* If the Point of Interconnection (POI) is defined in the Interconnection Agreement between CPS Energy and Customer, that definition overrides the following definition:

The Point of Interconnection is defined as the terminals of the Power Station Isolating Switch on the Customer's facility side.

B. Design Considerations

1. The Customer's equipment shall be designed in accordance with but not limited to UL Standards, Institute of Electrical and Electronics Engineers (IEEE) Standards, the National Electrical Code (NEC), the National Electrical Safety Code (NESC), the ERCOT Operating Guides, CPS Energy Electric Service Standards and any other applicable local, state or federal codes or standards.
2. The Customer's DG shall be equipped with protective hardware and software designed to prevent the DG from being connected to a de-energized CPS Energy circuit.
3. The Customer's DG shall be equipped with the necessary protective hardware and software designed to prevent connection or parallel operation of the DG equipment with CPS Energy's distribution system unless the CPS Energy voltage and frequency is of normal magnitude.
4. Pre-certified equipment may be installed on CPS Energy's distribution system in accordance with a CPS Energy approved interconnection control and protection scheme without further review of the Customer's design by CPS Energy. When the Customer is exporting to CPS Energy using pre-certified equipment, the protective settings and operations shall be those specified by CPS Energy.



5. The Customer shall be responsible for protecting its DG equipment in such a manner that CPS Energy system outages, short circuits or other disturbances including zero sequence currents and ferroresonant over-voltages do not damage the Customer's DG equipment. The Customer's protective equipment shall also prevent unnecessary tripping of CPS Energy breakers that would affect CPS Energy's capability of providing reliable service to other customers.
6. If the DG is 2 MW or larger or CPS Energy determines (based on studies or reviewing test results) that a DG may not trip properly when isolated from CPS Energy's system, CPS Energy shall provide (at the Customer's expense) a communication channel to support communication between CPS Energy and the Customer's facility. The channel may be a leased telephone circuit or other mutually agreed upon medium.
7. Circuit breakers or other interrupting devices at the Point of Interconnection must be capable of interrupting maximum available fault current from either direction. Facilities larger than 2 MW and exporting to CPS Energy shall have a redundant circuit breaker unless a listed device suitable for the rated application is used.
8. The Customer shall 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 CPS Energy personnel, and capable of being locked in the open position. The Customer shall follow CPS Energy's switching, clearance, tagging, and locking procedures, which CPS Energy shall provide for the Customer.

C. Prevention of interference.

The DG Facility operating requirements are described below and summarized in Table C-1.

1. **Voltage.** The Customer will operate its DG equipment in such a manner that the voltage levels on CPS Energy are in the same range as if the DG equipment were not connected to CPS Energy's system. The Customer shall provide an automatic method of disconnecting the DG equipment from CPS Energy if a sustained voltage deviation in excess of +5.0 % or -10% from nominal voltage persists for more than 2 seconds, or a deviation in excess of +10% or -30% from nominal voltage persists for more than 10 cycles. The Customer may reconnect when CPS Energy voltage and frequency return to normal range and the system is stabilized. Note that for non-inverter installations, the Customer shall use 3-phase, 4-wire wye connected PT's for monitoring voltage and the monitoring point shall be at the point of interconnection.



2. **Flicker.** The Customer's equipment shall not cause excessive voltage flicker on CPS Energy's distribution system. This flicker shall not exceed 3.0% voltage dip, in accordance with IEEE 519 as measured at the Point of Interconnection.
3. **Frequency.** The operating frequency of the Customer's DG 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 DG equipment from CPS Energy within 15 cycles if this frequency tolerance cannot be maintained. The Customer may reconnect when CPS Energy 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 Interconnection.
5. **Fault and line clearing.** The Customer shall automatically disconnect from CPS Energy within 10 cycles if the voltage on one or more phases falls below -30% of nominal voltage on CPS Energy serving the Customer premises. This disconnect timing also ensures that the DG is disconnected from CPS Energy prior to automatic re-close of breakers. The DG may reconnect when CPS Energy voltage and frequency return to normal range and the system is stabilized.

Note: For non-inverter installations, the Customer shall use 3-phase, 4-wire wye connected PT's for monitoring voltage and the monitoring point shall be at the point of interconnection.

6. **Direct Current Injection.** The DR Facility should not inject direct current (DC) greater than 0.5% of rated output current into CPS Energy's distribution system.

Table C-1. Summary of DG Facility Operating Requirements

CPS Energy DG Operating Variable	Trigger Point for Disconnect	Maximum Time to Disconnect (seconds)
1. Voltage @ Point of Interconnection (POI)		
Over Voltage Set point #1	+5% of nominal voltage	2 sec
Under Voltage Set point #1	-10% of nominal voltage	2 sec
Over Voltage Set point #2	+10 % of nominal voltage	0.167 sec
Under Voltage Set point #2	-30% of nominal voltage	0.167 sec
2. Flicker	Voltage at the POI must be less than 3% voltage dip as defined by the "Maximum Borderline of Irritation Curve" in IEEE 519.	
3. Frequency		



Over Frequency Set point	+0.5 Hz from base frequency	0.25 sec
Under Frequency Set point	-0.7 Hz from base frequency	0.25 sec
4. Harmonics		IEEE 519 requirement
Total Harmonic Distortion	<5.0% of fundamental frequency	
Individual Harmonics	<3.0% of fundamental frequency	
5. Fault and Line Clearing for Loss of Voltage on any phase of CPS circuit	-30% of nominal voltage	0.167 sec
6. Direct Current Injection	< 0.5% of DG Facility rated output current.	

Note: The above limits apply at the Point of Interconnection. Disconnect set points are based on nominal frequency of 60 Hz.

D. Control, protection and safety equipment requirements specific to single phase DG of 50 kilowatts (kW) or less connected to CPS Energy's system.

Exporting to CPS Energy may require additional operational or protection devices and will require coordination of operations with CPS Energy. The necessary control, protection, and safety equipment specific to single-phase DG of 50 kW or less connected to secondary or primary systems include an interconnect disconnect device, a DG 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.

E. Control, protection and safety equipment requirements specific to 3-phase synchronous generators, induction generators, and inverter systems.

This section specifies the control, protection, and safety equipment requirements specific to 3-phase synchronous generators, induction generators, and inverter systems. Exporting to CPS Energy may require additional operational or protection devices and will require coordination of operations with CPS Energy.

- 1. Three-phase synchronous generators.** The Customer's circuit breakers shall be 3-phase devices with electronic or electromechanical control. The Customer is solely responsible for properly synchronizing its generator with CPS Energy. 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 2 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, CPS Energy's System Operator 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 CPS Energy side at the point of common coupling is within the visible flicker stated in paragraph C.2 of this document. 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 CPS Energy-interactive type or stand-alone type shall be used in parallel with CPS Energy only with synchronizing equipment. Direct-current generation shall not be operated in parallel with CPS Energy.

3. **Protective function requirements.** The protective function requirements for 3-phase facilities of different size and technology are listed below.
 - a) Facilities rated 10 kilowatts (kW) or less must have an interconnect disconnect device, a DG 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 10 kW but not more than 500 kW must have an interconnect disconnect device, a DG 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 CPS Energy, and reverse/under power sensing if the facility is not exporting (unless the DG is less than the minimum load of the Customer's facilities).

 - c) Facilities rated more than 500 kW but not more than 2,000 kW must have an interconnect disconnect device, a DG 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 CPS Energy, an automatic synchronizing check (for facilities with stand alone capability) and reverse/under 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 CPS Energy.

 - d) Facilities rated more than 2,000 kW but not more than 10,000 kW must have an interconnect disconnect device, a DG 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 CPS Energy, an automatic synchronizing check and AVR for facilities with stand alone capability, and reverse/under 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 CPS Energy. A telemetry/transfer trip may also be required by CPS Energy as part of a transfer tripping or blocking protective scheme.

F. Requirements specific to a facility paralleling for 60 cycles or less (closed transition switching).

The protective devices required for facilities 10 MW or less which parallel with CPS Energy for 60 cycles or less are an interconnect disconnect device, a DG 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 CPS Energy. For DR's that wish to parallel for longer than 60 cycles but not continuously, a reverse-power or under-power function is likely to be required and the typical time delay would be 1 to 2 seconds. These DRs shall be required to have a function to limit the amount of time that the DR can stay in parallel with the utility.

G. System Acceptance and Commissioning

1. **Inspection and start-up testing.** The Customer shall provide CPS Energy with notice at least two weeks before the initial energizing and start-up testing of the Customer's DG equipment and CPS Energy 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 CPS Energy distribution system. Within thirty (30) days of testing, the Customer shall submit a summary report containing the test procedures used and the results of the tests. The report shall be submitted to the CPS Energy project manager on file. Customer may be required to retest the system protection elements upon any reasonable request by CPS Energy, thereafter.
2. **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 DG and interconnection point. Testing will verify all protective set points and relay/breaker trip timing. CPS Energy may witness the testing of installed switchgear, protection systems, and DG. The Customer is responsible for routine maintenance of the DG and control and protective equipment. The Customer will maintain records of such maintenance activities, which CPS Energy may review at reasonable times. For DG systems greater than 500 kW, a log of DG operations shall be kept. At a minimum, the log shall include the date, DG time on, and DG time off, and megawatt and megavar output. CPS Energy may review such logs at reasonable times.



F. Metering.

CPS Energy shall supply (this may be at the Customer's expense depending on the applicable CPS Energy tariff), own, and maintain all necessary meters and associated equipment to record energy purchases by the Customer and energy exports to CPS Energy. The Customer shall supply at no cost to CPS Energy a suitable location on its premises for the installation of CPS Energy's meters and other equipment.

DGs delivering 50kW or greater at the point of interconnect to the CPS Energy grid will require ERCOT metering. ERCOT metering will be designed and installed by CPS Energy at customer expense, and will be located at the point of interconnect. Communications will be required at the meter point for remote meter access. Routine dial up through a POTS line or sharing existing communications paths will be provided at customer expense.

Multiple generators behind one meter point for larger DGs (10MW) may require realtime MW and MVAR telemetry from each generator point. Relay accuracy data is acceptable.

ERCOT metered installations will require Customer registration with ERCOT as a Resource, and will utilize CPS Energy as the "Qualifying Scheduling Entity" for scheduling the market resource.

CPS Energy shall supply, own, and maintain all RTU (remote terminal unit) and associated equipment to remotely control and/or monitor status and analog data deemed necessary by CPS Energy. All serial connected devices providing these reads to the RTU must be capable of communicating DNP 3.0 protocol or provide a 4-20ma input to the RTU. The Customer shall supply at no cost to CPS Energy a mutually agreed upon location on its premises for the installation of CPS Energy's SCADA equipment.