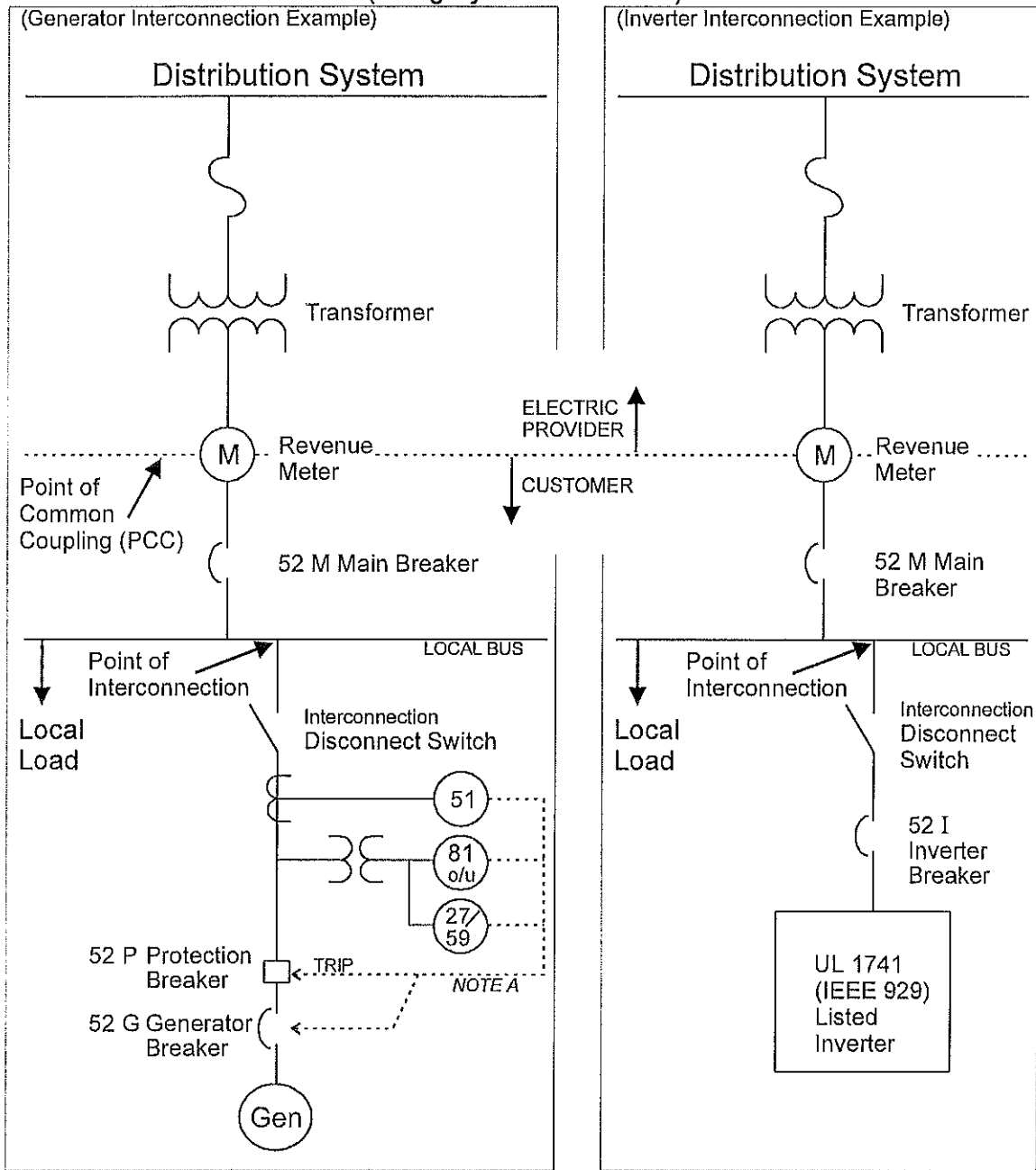


## Appendix V Sample One-line Schematic Diagram (Category 1: 20 kW or less)



**Relay Key:**

- 27 / 59 under/over voltage relay
- 51 over current relay
- 52 circuit breaker
- 81 o/u over/under frequency relay

*Indicate grounding configuration of generator or inverter transformer, if present, e.g.*



**Notes:**

- A) Trip of either breaker is acceptable.

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## Chapter PSC 119

### RULES FOR INTERCONNECTING DISTRIBUTED GENERATION FACILITIES

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#### Subchapter I — General

**PSC 119.01 Scope.** This chapter implements s. 196.496, Stats. It applies to all DG facilities with a capacity of 15 MW or less that are interconnected, or whose owner seeks to have interconnected, to an electric public utility's distribution system. It also applies to all electric public utilities to whose distribution systems a DG facility is interconnected, or to which interconnection is sought. These rules establish uniform statewide standards for the interconnection of DG facilities to an electric distribution system.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.02 Definitions.** In this chapter:

- (1) "ANSI" means American National Standards Institute.
- (2) "Applicant" means the legally responsible person applying to a public utility to interconnect a DG facility to the public utility's distribution system.
- (3) "Application review" means a review by the public utility of the completed standard application form for interconnection, to determine if an engineering review or distribution system study is needed.
- (4) "Category 1" means a DG facility of 20 kW or less.
- (5) "Category 2" means a DG facility of greater than 20 kW and not more than 200 kW.
- (6) "Category 3" means a DG facility of greater than 200 kW and not more than 1 MW.
- (7) "Category 4" means a DG facility of greater than 1 MW and not more than 15 MW.
- (8) "Certified equipment" means a generating, control or protective system that has been certified by a nationally recognized testing laboratory as meeting acceptable safety and reliability standards.
- (9) "Commission" means the public service commission of Wisconsin.
- (10) "Commissioning test" means the process of documenting and verifying the performance of a DG facility so that it operates in conformity with the design specifications.
- (11) "Customer" means any person who is receiving electric service from a public utility's distribution system.
- (12) "DG" means distributed generation.
- (13) "DG facility" has the meaning given in s. 196.496 (1), Stats.
- (14) "Distribution feeder" means an electric line from a public utility substation or other supply point to customers that is operated at 50 kV or less, or as determined by the commission.

(15) "Distribution system" means all electrical wires, equipment, and other facilities owned or provided by a public utility that are normally operated at 50 kV or less.

(16) "Distribution system study" means a study to determine if a distribution system upgrade is needed to accommodate the proposed DG facility and to determine the cost of any such upgrade.

(17) "Engineering review" means a study that may be undertaken by a public utility, in response to its receipt of a completed standard application form for interconnection, to determine the suitability of the installation.

(18) "Fault" means an equipment failure, conductor failure, short circuit, or other condition resulting from abnormally high amounts of current from the power source.

(19) "IEEE" means Institute of Electrical and Electronics Engineers.

(20) "Interconnection" means the physical connection of a DG facility to the distribution system so that parallel operation can occur.

(21) "Interconnection disconnect switch" means a mechanical device used to disconnect a DG facility from a distribution system.

(22) "Inverter" means a machine, device, or system that converts direct current power to alternating current power.

(23) "Islanding" means a condition on the distribution system in which a DG facility delivers power to customers using a portion of the distribution system that is electrically isolated from the remainder of the distribution system.

(24) "kV" means kilovolt.

(25) "kW" means kilowatt.

(26) "Material modification" means any modification that changes the maximum electrical output of a DG facility or changes the interconnection equipment, including:

(a) Changing from certified to non-certified devices.

(b) Replacing a component with a component of different functionality or UL listing.

(27) "MW" means megawatt.

(28) "Nationally recognized testing laboratory" means any testing laboratory recognized by the U.S. Department of Labor Occupational Safety and Health Administration's accreditation program.

Note: A list of nationally recognized testing laboratories is available at [www.osh-sa.gov/dts/otpc/nrtl/index.html](http://www.osh-sa.gov/dts/otpc/nrtl/index.html).

(29) "Network service" means 2 or more primary distribution feeders electrically connected on the low voltage side of 2 or more transformers, to form a single power source for any customer.

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(30) "Parallel operation" means the operation, for longer than 100 milliseconds, of an on-site DG facility while the facility is connected to the energized distribution system.

(31) "Paralleling equipment" means the generating and protective equipment system that interfaces and synchronizes a DG facility with the distribution system.

(32) "Point of common coupling" means the point where the electrical conductors of the distribution system are connected to the customer's conductors and where any transfer of electric power between the customer and the distribution system takes place.

(33) "Public utility" has the meaning given in s. 196.01 (5), Stats.

(34) "Standard application form" means PSC Form 6027 for Category 1 DG facilities or PSC Form 6028 for Category 2 to 4 DG facilities.

(35) "Standard interconnection agreement" means PSC Form 6029 for Category 1 facilities or PSC Form 6030 for Category 2 to 4 DG facilities.

Note: A copy of PSC Forms 6027 to 6030 can be obtained at no charge from your local electric utility or from the Public Service Commission, PO Box 7854, Madison, WI 53707-7854.

(36) "Telemetry" means transmission of DG operating data using telecommunications techniques.

(37) "UL" means Underwriters Laboratory.

(38) "Working day" has the meaning given in s. 227.01 (14), Stats.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

## Subchapter II — General Requirements

**PSC 119.03 Designated point of contact.** Each public utility shall designate one point of contact for all customer inquiries related to DG facilities and from which interested parties can obtain installation guidelines and the appropriate standard commission application and interconnection agreement forms. Each public utility shall have current information concerning its DG point of contact on file with the commission.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.04 Application process for interconnecting DG facilities.** Public utilities and applicants shall complete the following steps regarding interconnection applications for all classes of DG facilities, in the order listed:

(1) The public utility shall respond to each request for DG interconnection by furnishing, within 5 working days, its guidelines and the appropriate standard application form.

(2) The applicant shall complete and submit the standard application form to its public utility.

(3) Within 10 working days of receiving a new or revised application, the public utility shall notify the applicant whether the application is complete.

(4) Within 10 working days of determining that the application is complete, the public utility shall complete its application review. If the public utility determines, on the basis of the application review that an engineering review is needed, it shall notify the applicant and state the cost of that review. For Categories 2 and 3, the cost estimate shall be valid for one year. For Category 4, the time period shall be negotiated but may not exceed one year. If the application review shows that an engineering review is not needed, the applicant may install the DG facility and need not complete the steps described in subs. (5) to (9).

(5) If the public utility determines on the basis of the application review that an engineering review is needed, upon receiving from the applicant written notification to proceed and receipt of applicable payment from the applicant, the public utility shall complete an engineering review and notify the applicant of the results within the following times:

(a) Category 1 DG application, 10 working days.

(b) Category 2 DG application, 15 working days.

(c) Category 3 DG application, 20 working days.

(d) Category 4 DG application, 40 working days.

(6) If the engineering review indicates that a distribution system study is necessary, the public utility shall include, in writing, a cost estimate in its engineering review. The cost estimate shall be valid for one year and the applicant shall have one year from receipt of the cost estimate in which to notify the public utility to proceed, except for a Category 4 DG application, in which case the time period shall be negotiated, but may not extend beyond one year. Upon receiving written notification to proceed and payment of the applicable fee, the public utility shall conduct the distribution system study.

(7) The public utility shall within the following time periods complete the distribution system study and provide study results to the applicant:

(a) Category 1 DG application, 10 working days.

(b) Category 2 DG application, 15 working days.

(c) Category 3 DG application, 20 working days.

(d) Category 4 DG application, 60 working days unless a different time period is mutually agreed upon.

(8) The public utility shall perform a distribution system study of the local distribution system and notify the applicant of findings along with any distribution system construction or modification costs to be borne by the applicant.

(9) If the applicant agrees, in writing, to pay for any required distribution system construction and modifications, the public utility shall complete the distribution system upgrades and the applicant shall install the DG facility within a time frame that is mutually agreed upon. The applicant shall notify the public utility when project construction is complete.

(10) (a) The applicant shall give the public utility the opportunity to witness or verify the system testing, as required in s. PSC 119.30 or 119.31. Upon receiving notification that an installation is complete, the public utility has 10 working days, for a Category 1 or 2 DG project, or 20 working days, for a Category 3 or 4 DG project, to complete the following:

1. Witness commissioning tests.

2. Perform an anti-islanding test or verify the protective equipment settings at its expense.

3. Waive its right, in writing, to witness or verify the commissioning tests.

(b) The applicant shall provide the public utility with the results of any required tests.

(11) The public utility may review the results of the on-site tests and shall notify the applicant within 5 working days, for a Category 1 DG project, or within 10 working days, for a Category 2 to 4 DG project, of its approval or disapproval of the interconnection. If approved, the public utility shall provide a written statement of final acceptance and cost reconciliation. Any applicant for a DG system that passes the commissioning test may sign a standard interconnection agreement and interconnect. If the public utility does not approve the interconnection, the applicant may take corrective action and request the public utility to reexamine its interconnection request.

(12) A standard interconnection agreement shall be signed by the applicant and public utility before parallel operation commences.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.05 Insurance and indemnification.** (1) An applicant seeking to interconnect a DG facility to the distribution system of a public utility shall maintain liability insurance equal to or greater than the amounts stipulated in Table 119.05-1, per occurrence, or prove financial responsibility by another means mutually agreeable to the applicant and the public utility. For a

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DG facility in Category 2 to 4, the applicant shall name the public utility as an additional insured party in the liability insurance policy.

Category	Generation Capacity	Minimum Liability Insurance Coverage
1	20 kW or less	\$300,000
2	Greater than 20 kW to 200 kW	\$1,000,000
3	Greater than 200 kW to 1 MW	\$2,000,000
4	Greater than 1 MW to 15 MW	Negotiated

(2) Each party to the standard interconnection agreement shall indemnify, hold harmless and defend the other party, its officers, directors, employees and agents from and against any and all claims, suits, liabilities, damages, costs and expenses resulting from the installation, operation, modification, maintenance or removal of the DG facility. The liability of each party shall be limited to direct actual damages, and all other damages at law or in equity shall be waived.

History: CR 03-003: cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.06 Modifications to the DG facility.** The applicant shall notify the public utility of plans for any material modification to the DG facility by providing at least 20 working days of advance notice for a Category 1 DG facility, 40 working days for Category 2 DG facility, and 60 working days for a Category 3 or 4 DG facility. The applicant shall provide this notification by submitting a revised standard application form and such supporting materials as may be reasonably requested by the public utility. The applicant may not commence any material modification to the DG facility until the public utility has approved the revised application, including any necessary engineering review or distribution system study. The public utility shall indicate its written approval or rejection of a revised application within the number of working days shown in the table below. Upon completion of the application process, a new standard interconnection agreement shall be signed by both parties prior to parallel operation. If the public utility fails to respond in the time specified in Table 119.06-1, the completed application is deemed approved.

Category	Generation Capacity	Application Review Fee	Engineering Review Fee	Distribution System Study Fee
1	20 kW or less	None	None	None
2	Greater than 20 kW to 200 kW	\$250	Max. \$500	Max. \$500
3	Greater than 200 kW to 1 MW	\$500	Cost based	Cost based
4	Greater than 1 MW to 15 MW	\$1000	Cost based	Cost based

(2) The public utility may recover from the applicant an amount up to the actual cost, for labor and parts, of any distribution system upgrades required. No public utility may charge a commissioning test fee for initial start-up of the DG facility. The utility may charge for retesting an installation that does not conform to the requirements set forth in this chapter.

(3) Costs for any necessary line extension shall be assessed pursuant to s. PSC 113.1005.

History: CR 03-003: cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.09 Disconnection.** A public utility may refuse to connect or may disconnect a DG facility from the distribution

Category	Generation Capacity after Modification	Working Days for Utility's Response to Proposed Modifications
1	20 kW or less	20
2	Greater than 20 kW to 200 kW	40
3	Greater than 200 kW to 1 MW	60
4	Greater than 1 MW to 15 MW	60

History: CR 03-003: cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.07 Easements and rights-of-way.** If a public utility line extension is required to accommodate a DG interconnection, the applicant shall provide, or obtain from others, suitable easements or rights-of-way. The applicant is responsible for the cost of providing or obtaining these easements or rights of way.

History: CR 03-003: cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.08 Fees and distribution system costs.**

(1) Upon receiving a standard application form, the public utility shall specify the amount of any engineering review or distribution system study fees. Application fees shall be credited toward the cost of any engineering review or distribution system study. The applicant shall pay the fees specified in Table 119.08, unless the public utility chooses to waive the fees in whole or in part.

system only under any of the following conditions:

(1) Lack of approved standard application form or standard interconnection agreement.

(2) Termination of interconnection by mutual agreement.

(3) Non-compliance with the technical or contractual requirements.

(4) Distribution system emergency.

(5) Routine maintenance, repairs, and modifications, but only for a reasonable length of time necessary to perform the required work and upon reasonable notice.

History: CR 03-003: cr. Register January 2004 No. 577, eff. 2-1-04.

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#### PSC 119.10 One-line schematic diagram.

(1) The applicant shall include a one-line schematic diagram with the completed standard application form. ANSI symbols shall be used in the one-line schematic diagram to show the following:

- (a) Generator or inverter.
- (b) Point where the DG facility is electrically connected to the customer's electrical system.
- (c) Point of common coupling.
- (d) Lockable interconnection disconnect switch.
- (e) Method of grounding, including generator and transformer ground connections.
- (f) Protection functions and systems.

(2) The applicant shall include with the schematic diagram technical specifications of the point where the DG facility is electrically connected to the customer's electrical system, including all anti-islanding and power quality protective systems. The specifications regarding the anti-islanding protective systems shall describe all automatic features provided to disconnect the DG facility from the distribution system in case of loss of grid power, including the functions for over/under voltage, over/under frequency, overcurrent, and loss of synchronism. The applicant shall also provide technical specifications for the generator, lockable interconnection disconnect switch, and grounding and shall attach the technical specification sheets for any certified equipment. The applicant shall include with the schematic diagram a statement by the manufacturer that its equipment meets or exceeds the type tested requirements for certification.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.11 Control schematics.** For equipment not certified under s. PSC 119.26, the applicant shall include with the application a complete set of control schematics showing all protective functions and controls for generator protection and distribution system protection.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.12 Site plan.** For all categories, the applicant shall include with the application a site plan that shows the location of the interconnection disconnect switch, adjoining street name, and the street address of the DG facility. For Category 2, 3, or 4 DG facilities, the site plan shall show the location of major equipment, electric service entrance, electric meter, interconnection disconnect switch, and interface equipment.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

### Subchapter III — Design Requirements

**PSC 119.20 General design requirements.** (1) The applicant shall install protection devices to ensure that the current supplied by the DG facility is interrupted if a fault or other potentially dangerous event occurs on the distribution system. If such an event occurs and the public utility's distribution system is de-energized, any DG facility that is connected to this distribution system shall automatically disconnect. All DG facilities shall utilize protection devices that prevent electrically closing a DG facility that is out of synchronization with the distribution system.

(2) All installations shall include equipment circuit breakers, on the DG facility side of the point where the DG facility is electrically connected to the customer's electrical system, that are capable of interrupting the maximum available fault current. Equipment circuit breakers shall meet all applicable UL, ANSI, and IEEE standards.

(3) The public utility may require that the applicant furnish and install an interconnection disconnect switch that opens, with a visual break, all ungrounded poles of the interconnection circuit. The interconnection disconnect switch shall be rated for the voltage and fault current requirements of the DG facility, and shall meet all applicable UL, ANSI, and IEEE standards. The switch

enclosure shall be properly grounded. The interconnection disconnect switch shall be accessible at all times, located for ease of access to public utility personnel, and shall be capable of being locked in the open position. The applicant shall follow the public utility's recommended switching, clearance, tagging, and locking procedures.

Note: Provisions of the Wisconsin Electrical Safety Code, Volume 2, ch. Comm 16 also apply to these installations.

(4) The applicant shall label the interconnection disconnect switch "Interconnection Disconnect Switch" by means of a permanently attached sign with clearly visible and permanent letters. The applicant shall provide and post its procedure for disconnecting the DG facility next to the switch.

(5) The applicant shall install an equipment grounding conductor, in addition to the ungrounded conductors, between the DG facility and the distribution system. The grounding conductors shall be available, permanent, and electrically continuous, shall be capable of safely carrying the maximum fault likely to be imposed on them by the systems to which they are connected, and shall have sufficiently low impedance to facilitate the operation of overcurrent protection devices under fault conditions. All DG transformations shall be multi-grounded. The DG facility may not be designed or implemented such that the earth becomes the sole fault current path.

Note: Grounding practices are also regulated by the Wisconsin Electrical Safety Code Volumes 1 and 2, as found in chs. Comm 16 and PSC 114.

(6) (a) Certified paralleling equipment shall conform to UL 1741 (January 17, 2001 Revision) or an equivalent standard as determined by the commission.

(b) Non-certified paralleling equipment shall conform to the requirements of IEEE 1547.

Note: The UL standards are available at <http://ulstandardsinfo.net.ul.com>, and IEEE standards are available at <http://iee.org>. They may also be viewed at the PSCW Library, 610 N. Whitney Way, Madison, WI.

(7) (a) All Category 1 and 2 DG facilities shall be operated at a power factor greater than 0.9.

(b) All Category 3 and 4 DG facilities shall be operated at unity power factor or as mutually agreed between the public utility and applicant.

(8) The DG facility shall not create system voltage or current disturbances that exceed the standards listed in subch. VII of ch. PSC 113.

(9) The applicant shall protect and synchronize its DG facility with the distribution system.

(10) Each DG facility shall include an automatic interrupting device that is listed with a nationally recognized testing laboratory and is rated to interrupt available fault current. The interrupting device shall be tripped by any of the required protective functions.

(11) An applicant for interconnection of a Category 3 or Category 4 facility shall provide test switches as specified by the public utility, to allow for testing the operation of the protective functions without unwiring or disassembling the equipment.

(12) The public utility may require a DG facility to be isolated from other customers by installation of a separate power transformer. When a separate transformer is required, the utility may include its actual cost in the distribution system upgrade costs. The applicant is responsible for supplying and paying for any custom transformer. This requirement does not apply to an induction-type generator with a capacity of 5 kW or less, or to other generating units of 10 kW or less that utilize a line-commutated inverter.

(13) The owner of a DG facility designed to operate in parallel with a spot or secondary network service shall provide relaying or control equipment that is rated and listed for the application and is acceptable to the public utility.

(14) For a Category 3 or Category 4 DG facility, the public utility may require that the facility owner provide telemetry equipment whose monitoring functions include transfer-trip function-

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ality, voltage, current, real power (watts), reactive power (vars), and breaker status.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.25 Minimum protection requirements.**

(1) Each DG facility shall include protection and anti-islanding equipment to prevent the facility from adversely affecting the reliability or capability of the distribution system. The applicant shall contact the public utility to determine any specific protection requirements.

(2) The protective system functions, which may be met with microprocessor-based multifunction protection systems or discrete relays, are required. Protective relay activation shall not only alarm but shall also trip the generator breaker/contactors.

(3) In addition to anti-islanding protection, a DG facility shall meet the following minimum protection requirements:

(a) A Category 1 DG facility shall include:

1. Over/under frequency function.
2. Over/under voltage function.
3. Overcurrent function.
4. Ground fault protection.

(b) A Category 2, 3, or 4 DG facility shall include:

1. Over/under frequency function.
2. Over/under voltage function.
3. Overcurrent function.
4. Ground fault protection.
5. Synchronism check function.

6. Other equipment, such as other protective devices, supervisory control and alarms, telemetry and associated communications channel, that the public utility determines to be necessary. The public utility shall advise the applicant of any communications requirements after a preliminary review of the proposed installation.

(4) A DG facility certified pursuant to s. PSC 119.26 shall be deemed to meet the requirements of this section.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

**Subchapter IV — Equipment Certification**

**PSC 119.26 Certified paralleling equipment.** DG paralleling equipment that a nationally recognized testing laboratory certifies as meeting the applicable type testing requirements of UL 1741 (January 17, 2001 revision) is acceptable for interconnection, without additional protection systems, to the distribution system. The applicant may use certified paralleling equipment for interconnection to a distribution system without further review or testing of the equipment design by the public utility, but the use of this paralleling equipment does not automatically qualify the applicant to be interconnected to the distribution system at any point in the distribution system. The public utility may still require an engineering review to determine the compatibility of the distributed generation system with the distribution system capabilities at the selected point of common coupling.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.27 Non-certified paralleling equipment.**

(1) Any DG facility that is not certified under s. PSC 119.26 shall be equipped with protective hardware or software to prevent islanding and to maintain power quality. The applicant shall provide the final design of this protective equipment. The public utility may review and approve the design, types of protective functions, and the implementation of the installation. The applicant shall own the protective equipment installed at its facility.

(2) The applicant shall calibrate any protective system approved under sub.(1) to the specifications of the public utility. The applicant shall obtain prior written approval from the public utility for any revisions to specified protection system calibrations.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

**Subchapter V — Testing of DG Facility Installations**

**PSC 119.30 Anti-islanding test.** The public utility may perform an anti-islanding test or observe the automatic shutdown before giving final written approval for interconnection of the DG facility. The anti-islanding test requires that the unit shut down upon sensing the loss of power on the distribution system. This can be simulated by either removing the customer meter or opening a disconnection switch while the generator is operating. Voltage across the customer side of the meter or disconnection switch shall be measured and must be observed to reduce to zero within two seconds after disconnection. The test shall be conducted with the generation as close to its full output as possible. If a voltage is sustained after the disconnection, approval of the installation shall not be given until corrective measures are taken with a subsequent successful shutdown test.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.31 Commissioning tests for paralleling equipment in Categories 2 to 4.** The public utility shall provide the acceptable range of settings for the paralleling equipment of a Category 2, 3, or 4 DG facility. The applicant shall program protective equipment settings into this paralleling equipment. The public utility may verify the protective equipment settings prior to allowing the DG facility to interconnect to the distribution system.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.32 Additional test.** The public utility or applicant may, upon reasonable notice, re-test the DG facility installation. The party requesting such re-testing shall bear the cost of the re-tests.

History: CR 03-003; cr. Register January 2004 No. 577, eff. 2-1-04.

**PSC 119.40 Right to appeal.** The owner of a generating facility interconnected or proposed to be interconnected with a utility system may appeal to the commission should any requirement of the utility service rules filed in accordance with the provisions of this chapter be considered excessive or unreasonable. Such appeal will be reviewed and the customer notified of the commission's determination.

History: CR 03-003; renum. from PSC 113.0208 and am. Register January 2004 No. 577, eff. 2-1-04.

## Appendix IV Codes and Standards

This appendix is a partial list of codes and standards referenced in the guidelines.

### The National Fire Protection Association:

- *The National Electrical Code (NEC), (NFPA-70)*

### Institute of Electrical and Electronics Engineers (IEEE):

- ANSI/IEEE C37.90-1989, *IEEE Standard for Relay Systems Associated with Electric Power Apparatus.*
- ANSI/IEEE C37.95-1989, *IEEE Guide for Protective Relaying of Utility-Consumer Interconnections.*
- ANSI C62.1, *Surge Arresters for AC Power Circuits.*
- ANSI C84.1-1989, *American National Standards for Electric Power Systems and Equipment Ratings (60 Hertz).* Establishes nominal voltage ratings and operating tolerances for 60 Hz electric power systems from 100 V through 230 kV.
- IEEE Std 142-1991, *IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.*
- IEEE Std 242-1986, *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.*
- IEEE 519-1992, *IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.*
- ANSI/IEEE Std. 929-2000, *Recommended Practice for Utility Interface of Photovoltaic (PV) Systems.*
- IEEE 1547, *Standard for Distributed Resources Interconnected with Electric Power Systems*, October 2003.
- IEEE P1547.1 (IEEE P1589), *Draft Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems.*
- IEEE P1547.2 (IEEE P1608), *Draft Application Guide for IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems.*
- IEEE P1547.3, *Draft Guide for Monitoring Information Exchange and Control of DR Interconnected with Electric Power Systems.*
- IEEE P1561, *Draft Guide for Sizing Hybrid Stand-Alone Energy Systems*

### (Inter-) National Electrical Testing Association (NETA):

NETA promotes the independent electrical testing industry by establishing testing standards and specifications and training and certifying testing technicians.

### National Electrical Manufacturers Association (NEMA):

A nonprofit trade association supported by the manufacturers of electrical apparatus and supplies. NEMA is engaged in standardization to facilitate understanding between the manufacturers and users of electrical products.

### State of Wisconsin

- Wisconsin Electrical Safety Code, Volume 1 and Volume 2  
Volume 1: Department of Commerce - Comm 16 – State Electrical Code  
Volume 2: Public Service Commission - PSC 114
- PSC 119: Public Service Commission of Wisconsin – "Rules for Interconnecting Distributed Generation Facilities".