



Technical Requirements for the Interconnection of Customer-Owned Generation Facilities to the We Energies Distribution System- Supplement to PSC 119

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1. INTRODUCTION

This document describes the technical requirements for interconnection of Customer-Owned Generation Facilities to the We Energies Distribution System. This includes third party and other power producers. This document is meant to supplement Wisconsin PSC 119 “Rules for Interconnecting Distributed Generation Facilities” and to clarify any items that are not directly addressed by PSC 119. Distributed generation (DG) is defined as any device producing electrical energy such as rotating generators driven by steam turbines, internal combustion engines, hydraulic turbines, microturbines, windmills; photovoltaics, fuel cells, battery arrays; other energy sources utilizing a DC to AC inverter, or any other electric generating device.

This document defines the minimum requirements for safe and effective operation of the Customer/We Energies parallel interconnection. These requirements apply to those generation systems that have the capability to operate in parallel with We Energies’ Distribution System, and that will not be intentionally operated in an islanded condition with the We Energies Distribution System. Exceptions may be made, following review by We Energies, for infrequent momentary parallel operation of emergency stand-by generation¹.

It is in the best interest of the Customer to identify We Energies’ requirements early in the design stage to avoid any unnecessary expenses or delays.

We Energies does not assume responsibility for the protection of the Customer’s generating equipment or for damage to any other Customer equipment, and does not assume any liability or responsibility for Customer-owned equipment through the generation approval process. The Customer is solely responsible for protecting its equipment to prevent damage due to faults, line

¹PSC 119 currently defines “Parallel operation” as the operation for longer than 100 milliseconds of an on-site DG facility while the facility is connected to the energized distribution system. This could be interpreted as implying that soft start emergency generators which may operate for short periods of time (less than five minutes) but longer than 100 milliseconds must follow all the provisions outlined in PSC 119. The Wisconsin Public Service Commission has subsequently stated that PSC 119 was not intended for these types of soft loading backup generators in spite of the 100 ms definition. Although these types of installations are not required to follow PSC 119; they still must be reviewed and approved by We Energies.

reclosing, imbalances or disturbances on the We Energies Distribution System, as well as assuring that generation equipment is paralleled in synchronism with the We Energies Distribution System. The Customer is responsible for damage to property and/or injury to personnel of We Energies or others when caused by Customer's generation facility because of malfunction, improper design, improper operation, human error, or other negligence of the Customer or derived from the generation facility or controls.

2. POINT OF SERVICE REQUIREMENTS

All services must meet all applicable requirements of the "Electric Service and Metering Manual". Additionally all services above 600V must meet all applicable "Customer Substation Manual" requirements. Both manuals are available by request from We Energies or on the internet at: <http://www.we-energies.com/builders-contractors/electricians/electricians.htm>

2.1 Electric Service:

The electric service will be sized to meet the maximum load demand. The Customer shall reimburse We Energies for any additional capacity or metering necessary to accommodate generation. Generation in excess of 300 kW may require service from a higher voltage distribution system, or line upgrades including reconductoring and conversion from single phase to three phase service. The total single phase generation at a site shall not exceed 150 kW. Standard line extension costs will apply.

2.2 Overvoltages:

Due to the possibility of potentially damaging overvoltages during distribution system fault conditions when generation is present, steps must be taken in the design phase of a generation project to assure that overvoltages are limited to acceptable levels. The utility side of the Customer's interface transformer must be effectively grounded to limit We Energies system and other Customers' overvoltages if the generator interconnected to the distribution system is temporarily islanded from the We Energies substation source. The preferred method to meet this requirement is through the use of an interface transformer connected grounded wye on the utility side. This is in addition to the standard requirement that all transformers smaller than 3000kVA be wye-wye triplex core. Distribution systems inherently operate with some system voltage imbalance, therefore, a generator with a grounded neutral connection may require an additional level of transformation between the generator and the point of service to limit generator neutral currents.

2.3 Disconnect Device:

A utility accessible disconnect device must be provided which will separate the Customer generation from the We Energies Distribution System. The contacts of the disconnect device must provide a visible separation between the generation and the We Energies System when in the open position. The disconnect operating mechanism must be lockable in the open and closed positions. Doors or panels providing access to live parts must be secured with a lock. Most services already include such a device. For small single phase services this may be the meter. For

large primary services this may be the main loadbreak. A draw out type circuit breaker which is racked out and has We Energies locks on the compartment doors may also be an acceptable disconnect device even though it does not necessarily provide a visible disconnect. Typically this device will completely disconnect the service from the utility. If the Customer does not want its service completely disconnected from the utility in the event that the utility deems it necessary to lock out its generation it must supply a separate visible, lockable, utility accessible switch that disconnects its generation from the We Energies Distribution System. This switch must be clearly marked and its location must be approved by We Energies.

2.4 Metering

New metering may be required in order to accurately measure energy flow in both directions. The type of metering needed is dependent on the Customer's tariffed rate or contract and the size of the generation. The Customer shall be responsible for all costs associated with upgrading existing and/or installing new metering (in compliance with all applicable rules and regulations) to accommodate the generation.

3. INTERCONNECTION PROTECTION REQUIREMENTS

Protection of the We Energies-Customer Generation interconnection is necessary to avoid unintentional islanding of the We Energies Distribution System during abnormal system conditions. Unintentional islanding of Customer owned generation where it supports a portion of the We Energies Distribution System must be avoided to ensure that other We Energies Customers are supplied with a safe, reliable, and stable supply of electricity. Customer generation supporting only its own load under non-paralleled conditions is acceptable.

3.1 Interconnection Protective Relay Requirements:

The purpose of interconnection relays is to (a) sense faulted conditions on, or the loss of, the We Energies Distribution System and (b) automatically disconnect the Customer owned generation from the We Energies Distribution System.

The Customer shall be responsible for the purchasing, setting, testing, operation and maintenance of all interconnection relays.

The interconnection relaying package must be reviewed and approved by We Energies before the DG source may be operated in parallel with the We Energies Distribution System.

As a minimum, We Energies requires the following interconnection relays and settings be installed whenever Customer owned generation is capable of being operated in parallel with the We Energies Distribution System. Other schemes must provide the equivalent protection characteristics of these relays, and must be accepted by We Energies:

**Table 3-1,
Minimum Interconnection Relay Requirements**

Relay	IEEE Device No.	Pickup Setting	Time Delay (at pickup)
Under Voltage	27	90% of nominal	1.0 Seconds
Over Voltage	59	110% of nominal	0.1 Seconds
Under Frequency	81U	59.5 Hz	0.5 seconds
Over Frequency	81O	60.5 Hz	Instantaneous

We Energies must approve any deviation from the specific relay type or settings identified in Table 3-1.

The relays identified in Table 3-1 reflect the minimum relay requirements which are satisfactory for most Customer owned DG installations. However, during the application process, We Energies may determine that additional interconnection relaying requirements are necessary to ensure protection of the distribution system due to specific concerns associated with the type or location of the generator as well as the distribution system at the point of interconnection. Any additional interconnection relaying requirements will be identified by We Energies during the Interconnection Study. The Customer shall be responsible for the cost of any additional equipment.

Synchronism Check and Transfer Trip Protection

The relays identified in Table 3-1 may not guarantee against anti-islanding for all DG interconnections in all situations². If We Energies were to reclose on that section of the energized islanded distribution system; it is likely that this would be out of synchronization with the customer DG, which could damage the customer’s generation equipment. The likelihood of the customer generation becoming islanded will vary greatly depending on: the type of generator; its control system; and the loading profile of the We Energies feeder to which the DG is connected. It is the responsibility of the customer to evaluate this risk and determine whether or not the addition of utility relaying such as synchronism check or transfer trip relays to prevent an out of synchronism reclosing operation is warranted. During the application process, We Energies will inform the customer of situations where the feeder load could closely match the DG output (i.e. where there is a greater chance of islanding) and provide the customer with the option of installing transfer trip and/or synchronous check functionality on the upstream We Energies line protection device(s) at the customer’s expense.

² During non-faulted conditions (1) if the feeder load were to closely match the output of the DG, and (2) if that feeder were to become isolated from the We Energies system; it is possible that the generator’s voltage and frequency output could remain relatively constant and therefore not cause the under / over voltage and frequency interconnection relays to operate and isolate the DG from the islanded utility system.

Relays required as part of PSC 119.25 that are not identified above are to be set based on the Customer's facility specifics. The Customer is responsible for the determination of these settings.

The Interconnection relay requirements discussed above are separate from and in addition to relays required for the protection of the Customer's generation and electrical equipment. The Customer is solely responsible for the design, installation, setting, operation, and maintenance of any relays necessary to protect its equipment.

3.2 Other Interconnection Design Considerations:

The Customer shall not energize a de-energized We Energies circuit. The Customer shall install the necessary sensing³ and control devices required to monitor voltage on all phases of the We Energies supply circuit and prevent energizing where any phase voltage is outside the range specified in Section 4.1 System Voltages.

The Customer must install a method of synchronizing its generation to the We Energies Distribution System. Connection of its generation to the We Energies system may only be accomplished via synchronization. It is highly recommended that automatic synchronizing be used to minimize the potential for damage to Customer owned equipment.

We Energies normally applies automatic reclosing to all distribution lines. The Customer must ensure that its generation is automatically disconnected from the We Energies Distribution System prior to reclosing.

- We Energies shall assume no responsibility for damage to Customer's equipment due to out-of-phase reclosing
- Typically, We Energies devices may have one or more recloses with the first set at a minimum of 1.0 second.

There may be single phase protection devices installed between the We Energies source substation and the Customer. It is the responsibility of the Customer to protect its three phase equipment for potentially damaging effect of the loss of one or two phases supplying that equipment.

We Energies system voltage may vary at the interconnection point. The Customer's generation and protective scheme must be able to operate at the normal and short term voltage variation outlined in Section 4.

³ Sensing devices may be installed on either the high or low side of the interface transformer but must be able to sense a loss of phase condition on the We Energies source. High side sensing will be required where the interface transformer connection is grounded wye (on the utility side)- delta (on the DG side).

It is the responsibility of the Customer to ground the generator as necessary to protect its equipment.

If the installation of generation equipment causes the We Energies system design fault current limits to be exceeded, the Customer must install equipment, at its expense, to limit the fault current on the We Energies Distribution System.

4. DESIGN AND OPERATING REQUIREMENTS

The nature of the We Energies Distribution System is dynamic; therefore, source conditions may change. The Customer should be aware that changes made to the local utility system, or addition of other Customers with generation, may require that modifications be made to the Customer interconnection protective devices to properly coordinate with the utility supply. If changes are necessary, the Customer may be subject to future charges to facilitate the modifications. Operation of the Customer generation system shall not adversely affect other Customers or interfere with proper operation of the utility system. If the generation system adversely affects other Customers, the Customer generation equipment may be required to be disconnected until the problem is resolved. The DG system owner must resolve the problem internally, if possible. We Energies may make distribution system modifications to resolve the problem at the generation owner's expense, or We Energies may disconnect service to the generation facility.

4.1 Operating Conditions:

System Voltages

We Energies' Distribution System operates at a nominal system steady-state voltage of plus 5% (plus 10% for 34.5kV) through minus 5% or 10% depending on actual service voltage. Customer's generation should be capable of operating within this range. The generation equipment should have the ability to ride through short-term system disturbances and operate without interruption to avoid excessive nuisance tripping. Inverters should sense abnormal voltages and respond to track and trip as appropriate.

System Voltage Imbalance

Due to constantly changing Customer loads, We Energies' voltage and voltage imbalance varies continuously. The Customer's equipment must be capable of operating within the imbalance range at the location where the generation is being applied.

Reclosing

We Energies normally applies automatic reclosing to distribution lines. Refer to section 3.2 for details.

4.2 Generation System Operating Requirements:

Power Factor

The Customer power factor must be maintained between .90 leading and .90 lagging. If the generation facilities impose unusual reactive burden on the utility system (usually resulting from induction machines), the Customer may have to install power factor correction equipment. We Energies must be consulted prior to addition of power factor correction equipment, and must accept the power factor correction method or design. If the generation facilities cause an unacceptable increase in the We Energies Distribution System voltage, the Customer may be required to operate at a specific power factor to reduce distribution system voltage. We Energies will work with the Customer to determine the specific power factor requirement.

Flicker

Customer shall not cause flicker in excess of 2% at the high side of the distribution transformer. If a dedicated transformer is not present, voltage flicker shall not exceed 3% at the low side of the transformer. If flicker complaints arise from other Customers as a result of the generating equipment, the Customer generation equipment may be required to be disconnected until the problem is resolved.

Frequency

All Customer generating equipment shall maintain an output frequency of 60-hertz. The operating frequency of the Customer's generating equipment shall not deviate more than 0.5 hertz from a 60-hertz base.

Harmonics

The Customer's generating equipment shall not introduce excessive harmonics to the We Energies system voltage and current waveforms per the latest revision of IEEE 519, "Recommended Practices and Requirements for Harmonic Control in Electric Power Systems". If harmonics complaints arise from other Customers as a result of the generating equipment, the Customer generation equipment may be required to be disconnected until the problem is resolved. IEEE 519 will be used as a guide in resolving harmonic issues.

Voltage Transients (Impulses)

The magnitude of sub-cycle voltage transients (anywhere on the voltage waveform) caused by activation, deactivation, or operation of the Customer generation shall not exceed twice the normal peak of the nominal voltage sine wave (e.g. 350 volts for a 120 volt rms system). No repetitive sub-cycle voltage transients causing false zero crossings of the voltage waveform will be allowed.

High Frequency Noise

The level of high frequency noise between 20kHz and 1MHz should not be increased by more than 0.5% of the nominal system voltage (e.g. 0.6 volts on a 120 volt system) when the DG is operated.

Reconnection after outage

After an outage, generation should cease to operate until continuous system normal voltage and frequency has been maintained for a minimum of 5 minutes. Reconnection may be either automatic or manual.

Transfer Schemes

This paragraph applies to standby-by generation that is not operated in parallel with the We Energies distribution system. Typically transfer between sources is accomplished through the use of an open transition (Break-Before-Make) transfer scheme. Closed transition (Make-Before-Break) transfer schemes are permitted only between two energized sources, which are in synchronism with each other. The transfer device shall be equipped with sensing to verify presence and adequacy of both sources before allowing the transfer to be made. If either source falls outside the synchronism requirements specified by the DG manufacturer, the transfer shall be prevented. The maximum allowable closed transition transfer time shall be no greater than 100 milliseconds. All other transfers shall be performed with open transition type (Break-Before-Make) equipment.

Access

Once the generation facility is interconnected with the We Energies Distribution System the Customer grants We Energies the right to inspect the facility at We Energies' discretion.

Maintenance

All interconnection protective devices, including circuit breakers, relays, control batteries and communication equipment, owned by the Customer shall be periodically maintained, tested and calibrated by qualified personnel at intervals specified by the device manufacturer, or in accordance with accepted industry practice. Copies of maintenance, testing and calibration logs and reports shall be made available to We Energies upon request. The Customer grants We Energies the right to witness or verify on demand the calibration and operation of all interconnection protective equipment.

Supply System Modifications

Changes or additions to the We Energies Distribution System, or addition of other generation facilities may require modifications to the Customer's interconnection protective devices. The cost of these modifications will be borne entirely by the owner of the affected generation facility.

5. DEFINITIONS

AUTOMATIC: Self acting, operated by its own mechanism when actuated by some impersonal influence as, for example, a change in current magnitude; not manual; and without personal intervention.

AUTOMATIC RECLOSING: A device has automatic reclosing when means are provided for closing without manual intervention after it has tripped under abnormal conditions.

AUTOMATIC TRIPPING, OPENING, OR DISCONNECTING: The opening of a circuit breaker under predetermined conditions without the intervention of an operator.

CIRCUIT BREAKER: A device designed to operate by automatic or non-automatic means, utilized for interruption of a circuit under normal or fault conditions.

COGENERATION: The production of electricity from another fuel or energy source (wind, heat, steam, photovoltaics, gas, water, etc.) that is intentionally or unintentionally connected to (paralleled with) the utility distribution system.

CLOSED TRANSITION TRANSFER: In this scheme, a Customer's source of power is transferred from Source 1 to Source 2 and vice-versa with momentarily connecting the two sources together. Here, the Customer's load is not interrupted at all during the transfer process. Also referred to as "Make-Before-Break".

CUSTOMER: For the purposes of this document a Customer is identified as the owner/operator of parallel generation, including independent power producers, even if not technically a Customer of We Energies.

DELTA CONNECTED CIRCUIT: A three-phase circuit with three source windings connected with a closed delta (triangle). A closed delta is a connection in which each winding terminal is connected to the end (terminal) of another winding.

DISCONNECT: A device used to isolate a piece of equipment. A disconnect may be gang operated (all poles switched simultaneously) or an individually operated device in series with a gang operated load-breaking device.

GROUND: A conducting connection between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth. The term is often used in electrical work in referring to the earth, or the earth connection, or as zero voltage (potential) when measuring to energized components.

GROUND, PROTECTIVE OR SAFETY: For safety purposes, circuits are grounded; i.e. normally energized conductors are connected directly to known grounded conductors, while any work is being done on or near a circuit or piece of equipment in the circuit.

INTERCONNECTION: The physical system of electrical connection for power transmission between the Customer's generation and the utility.

INDEPENDENT POWER PRODUCER; IPP. An organization, which is not a utility, that operates a power plant, produces energy, and then sells it to a utility.

ISLAND (ISLANDING): A part of an interconnected system may be isolated during a system disturbance and start operating as a subsystem with its own generation, transmission and distribution capability. Then the subsystem becomes an island to the main interconnected system without a tie. In such a case, the islanded system and the main interconnected system may operate at different frequencies and voltages.

LAGGING POWER FACTOR: Occurs when reactive power flows in the same direction as real power. Also defined as the case when current lags the applied voltage.

LEADING POWER FACTOR: Occurs when reactive power flows in the opposite direction of real power. Also defined as the case when current leads the applied voltage.

ONE-LINE DIAGRAM: A diagram in which several conductors are represented by a single line and in which all devices and pieces of equipment are denoted by simplified symbols. The purpose of such a diagram is to present an electrical circuit or circuits in a simplified manner so that its function(s) can be readily understood.

OPEN TRANSITION TRANSFER: In this scheme, a Customer's source of power is transferred from Source 1 to Source 2 and vice-versa without momentarily connecting the two sources together. Here, the Customer's load is interrupted momentarily during the transfer. Also referred to as "Break-Before-Make".

PARALLEL OPERATION: The operation of a Customer-owned generator while connected to the utility system. Parallel operation may be required solely for the Customer's operating convenience or for the purpose of delivering power to the utility system.

POINT OF INTERCONNECTION: The point where the Customer's conductors meet We Energies' conductors (point of ownership change).

POINT OF METERING: The point where metering equipment (meters, transducers, current transformers, potential transformers, etc.) is installed to measure the power flow and energy exchange between We Energies and the Customer.

POWER FACTOR: The ratio of actual power (kW) to apparent power (kVA).

PROTECTION: All of the relays and other equipment which are used to open the necessary circuit breakers to clear lines or equipment when trouble develops or outages occur.

RECLOSE: The automatic return of a protective device (recloser or circuit breaker) to its closed position after it has opened by relay or other action.

RELAY: A device that is operative by a variation in the condition of one electric circuit to affect the operation of another device in the same or in another electric circuit.

SELF-EXCITED: An electric machine in which the field current is secured from its own armature current.

SEPARATELY EXCITED: Use of an exciter for sending current through the field windings of an electric machine in place of taking the field current from its own armature current.

SYNCHRONISM: Expresses the condition across an open circuit wherein the voltage sine wave (measured between phases or phase to ground) on one side matches the voltage sine wave on the other side in frequency and amplitude without phase angle difference.

TRIPLEX CORE TRANSFORMER: A transformer consisting of three single phase assemblies in a single tank with essentially no magnetic coupling between phases.

VOLTAGE IMBALANCE: A method to compare voltages within a circuit, and measure of how closely the magnitude of phase to phase voltages of a circuit match. It is described as the ratio of the maximum deviation, from the average voltage, to the average voltage.

WE ENERGIES: The name under which Wisconsin Electric Power Company, a Wisconsin corporation and public utility, is doing business.

WYE or “Y” CONNECTED CIRCUIT (STAR CONNECTED): A three-phase circuit in which windings of all three phases have one common connection.