

Section II. Interconnection Requirements

A. Design Requirements

1. Common

The generator-owner shall provide appropriate protection and control equipment, including a protective device that utilizes an automatic disconnect device that will disconnect the generation in the event that the portion of the utility system that serves the generator is de-energized for any reason or for a fault in the generator-owner's system. The generator-owner's protection and control equipment shall be capable of automatically disconnecting the generation upon detection of an islanding condition and upon detection of a utility system fault.

The generator-owner's protection and control scheme shall be designed to ensure that the generation remains in operation when the frequency and voltage of the utility system is within the limits specified by the required operating ranges. Upon request from the utility, the generator-owner shall provide documentation detailing compliance with the requirements set forth in this document.

The specific design of the protection, control and grounding schemes will depend on the size and characteristics of the generator-owner's generation, as well the generator-owner's load level, in addition to the characteristics of the particular portion of the utility's system where the generator-owner is interconnecting.

The generator-owner shall have, as a minimum, an automatic disconnect device(s) sized to meet all applicable local, state, and federal codes and operated by over and under voltage and over and under frequency protection. For three-phase installations, the over and under voltage function should be included for each phase and the over and under frequency protection on at least one phase. All phases of a generator or inverter interface shall disconnect for voltage or frequency trip conditions sensed by the protective devices. Voltage protection shall be wired phase to ground for single phase installations and for applications using wye grounded-wye grounded service transformers.

The settings below are listed for single-phase and three-phase applications using wye grounded-wye grounded service transformers or wye grounded-wye grounded isolation transformers. For applications using other transformer connections, a site-specific review will be conducted by the utility and the revised settings identified in Step 6 of the Application Process.

⁶ See Section III: Glossary of Terms for definition.

⁷ See Section III: Glossary of Terms for definition.

⁸ See Section III: Glossary of Terms for definition.

¹⁰ See Section III: Glossary of Terms for definition

generators:

- a) Solid grounding
- b) High- or low-resistance grounding
- c) High- or low-reactance grounding
- d) Ground fault neutralizer grounding

Synchronous generators shall not be permitted to connect to secondary network systems without the approval of the utility.

3. Induction Generators

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 at the PCC is acceptable based on current inrush limits. The same requirements also apply to induction generation connected at or near synchronous speed because a voltage dip is present due to an inrush of magnetizing current. The generator-owner shall submit the expected number of starts per specific time period and maximum starting kVA draw data to the utility to verify that the voltage dip due to starting is within the visible flicker limits as defined by IEEE 519, Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.

Starting or rapid load fluctuations on induction generators can adversely impact the utility's system voltage. Corrective step-switched capacitors or other techniques may be necessary. These measures can, in turn, cause ferroresonance. If these measures (additional capacitors) are installed on the customer's side of the PCC, the utility will review these measures and may require the customer to install additional equipment.

4. Inverters

Direct current generation can only be installed in parallel with the utility's system using a synchronous inverter. The design shall be such as to disconnect this synchronous inverter upon a utility system interruption.

It is recommended that equipment be selected from the "Certified Equipment" list maintained by the PSC. Non-certified equipment must have dynamic anti-islanding protection as defined by IEEE 929, conform to the maximum harmonic limits delineated in IEEE 519, and be protected by utility grade relays (as defined in these requirements) using settings approved by the utility and verified in the field. The field verification test must demonstrate that the equipment meets the frequency requirements detailed in this section.

Synchronization or re-synchronization of an inverter to the utility system shall not result

in a voltage deviation that exceeds the requirements contained in Section II.E, Power Quality. Only inverters designed to operate in parallel with the utility system shall be utilized for that purpose.

A line inverter can be used to isolate the customer from the utility system provided it can be demonstrated that the inverter isolates the customer from the utility system safely and reliably.

5. Minimum Protective Function Requirements

Protective system requirements for distributed generation facilities result from an assessment of many factors, including but not limited to:

- Type and size of the distributed generation facility
- Voltage level of the interconnection
- Location of the distributed generation facility on the circuit
- Distribution transformer
- Distribution system configuration
- Available fault current
- Load that can remain connected to the distributed generation facility under isolated conditions
- Amount of existing distributed generation on the local distribution system.

As a result, protection requirements can not be standardized according to any single criteria.

Minimum protective function requirements shall be as detailed in the table below. ANSI C37.2, Electric Power System Device Function Numbers, are listed with each function.

Synchronous Generators	Induction Generators	Inverters
Over/Under Voltage (Function 27/59)	Over/Under Voltage (Function 27/59)	Over/Under Voltage (Function 27/59)
Over/Under Frequency (Function 81O/81U)	Over/Under Frequency (Function 81O/81U)	Over/Under Frequency (Function 81O/81U)
		Anti-Islanding Protection

The need for additional protective functions shall be determined by the utility on a case-by-case basis. If the utility determines a need for additional functions, it shall notify the generator-owner in writing of the requirements. The notice shall include a description of the specific aspects of the utility system that necessitate the addition, and an explicit justification for the necessity of the enhanced capability. The utility shall specify and provide settings for those functions that the utility designates as being required to satisfy protection practices. Any protective equipment or setting specified by the utility shall not be changed or modified at any time by the generator-owner without written consent from the utility.

The generator-owner shall be responsible for ongoing compliance with all applicable local, state, and federal codes and standardized interconnection requirements as they pertain to the interconnection of the generating equipment.

Protective devices shall utilize their own current transformers and potential transformers and not share electrical equipment associated with utility revenue metering.

A failure of the generator-owner's protective devices, including loss of control power, shall open the automatic disconnect device, thus disconnecting the generation from the utility system. A generator-owner's protection equipment shall utilize a non-volatile memory design such that a loss of internal or external control power, including batteries, will not cause a loss of interconnection protection functions or loss of protection set points.

All interface protection and control equipment shall operate as specified independent of the calendar date.

6. Metering

The need for additional revenue metering or modifications to existing metering will be reviewed on a case-by-case basis and shall be consistent with metering requirements adopted by the Commission.

Net metering customer-generators shall be afforded the option of selecting a single meter with bi-directional capability or two meters measuring consumption and generator output

separately. For photovoltaic, net metering residential applicants, at least one meter in a two meter arrangement may be, at the customer's option, non-demand, non-time of use. The generator-owner is responsible for the cost of installing any necessary meter box and socket.

The single bi-directional meter option is not available to demand billed applicants. For non-demand billed applicants, a single bi-directional meter may be employed as approved by the Commission.

B. Operating Requirements

The generator-owner shall provide a 24-hour telephone contact. This contact will be used by the utility to arrange access for repairs, inspection or emergencies. The utility will make such arrangements (except for emergencies) during normal business hours.

Voltage and frequency trip set point adjustments shall be accessible to service personnel only.

Any changes to these settings must be reviewed and approved by the utility.

The generator-owner shall not supply power to the utility during any outages of the system that serves the PCC. The generator-owner's generation may be operated during such outages only with an open tie to the utility. Islanding will not be permitted. The generator-owner shall not energize a de-energized utility circuit for any reason.

The disconnect switch specified in Section II.D, Disconnect Switch, may be opened by the utility at any time for any of the following reasons:

- a. to eliminate conditions that constitute a potential hazard to utility personnel or the general public;
- b. pre-emergency or emergency conditions on the utility system;
- c. a hazardous condition is revealed by a utility inspection;
- d. protective device tampering;
- e. parallel operation prior to utility approval to interconnect

The disconnect switch may be opened by the utility for the following reasons, after notice to the responsible party has been delivered and a reasonable time to correct (consistent with the conditions) has elapsed:

⁸ See Section III: Glossary of Terms for definition.

¹⁶ In the event that no disconnect has been provided as required in Section II.D, the utility shall disconnect the generation utilizing an alternate method. The utility shall make a reasonable attempt to assure that the generation is disconnected in a manner so as not to interrupt any on-site customer load.

- a. A generator-owner has failed to make available records of verification tests and maintenance of its protective devices;
- b. A generator-owner's system adversely impacts the operation of utility equipment or equipment belonging to other utility customers;
- c. A generator-owner's system is found to adversely affect the quality of service to adjoining customers.

The utility will provide a name and telephone number so that the generator-owner can obtain information about the utility lock-out.

The generator-owner shall be allowed to disconnect from the utility without prior notice in order to self generate.

Under certain conditions a utility may require direct transfer trip (DTT). The utility shall provide detailed evidence as to the need for DTT.

If a generator-owner proposes any modification to the system that has an impact on the interface at the PCC after it has been installed and a contract between the utility and the generator-owner has already been executed, then any such modifications must be reviewed and approved by the utility before the modifications are made.

C. Dedicated Transformer

The utility reserves the right to require a power-producing facility to connect to the utility system through a dedicated transformer. The transformer shall either be provided by the connecting utility at the generator-owner's expense, purchased from the utility, or conform to the connecting utility's specifications. The transformer may be necessary to ensure conformance with utility safe work practices, to enhance service restoration operations or to prevent detrimental effects to other utility customers. The transformer that is part of the normal electrical service connection of a generator-owner's facility may meet this requirement if there are no other customers supplied from it. A dedicated transformer is not required if the installation is designed and coordinated with the utility to protect the utility system and its customers adequately from potential detrimental net effects caused by the operation of the generator.

If the utility determines a need for a dedicated transformer, it shall notify the generator-owner in writing of the requirements. The notice shall include a description of the specific aspects of the utility system that necessitate the addition, the conditions under which the dedicated transformer is expected to enhance safety or prevent detrimental

¹⁷ See Section III: Glossary of Terms for definition

effects, and the expected response of a normal, shared transformer installation to such conditions.

D. Disconnect Switch

Generating equipment shall be capable of being isolated from the utility system by means of an external, manual, visible, gang-operated, load break disconnecting switch. The disconnect switch shall be installed, owned, and maintained by the owner of the power-producing facility, and located between the power-producing equipment and its interconnection point with the utility system.

The disconnect switch must be rated for the voltage and current requirements of the installation.

The basic insulation level (BIL) of the disconnect switch shall be such that it will coordinate with that of the utility's equipment. Disconnect devices shall meet applicable UL, ANSI, and IEEE standards, and shall be installed to meet all applicable local, state, and federal codes. (New York City Building Code may require additional certification.)

The disconnect switch shall be clearly marked, "Generator Disconnect Switch," with permanent 3/8 inch letters or larger.

The disconnect switch shall be located within 10 feet of the utility's external electric service meter. If such location is not possible, the customer-generator will propose, and the utility will approve, an alternate location. The location and nature of the disconnect shall be indicated in the immediate proximity of the electric service entrance. The disconnect switch shall be readily accessible for operation and locking by utility personnel in accordance with Section II.B, Operating Requirements.

The disconnect switch must be lockable in the open position with a standard utility padlock with a 3/8-inch shank.

For installations above 600V or with a full load output of greater than 960A, a draw-out type circuit breaker with the provision for padlocking at the draw-out position can be considered a disconnect switch for the purposes of this requirement.

E. Power Quality

The maximum harmonic limits for electrical equipment shall be in accordance with IEEE 519 to limit the maximum individual frequency voltage harmonic to 3% of the fundamental frequency and the voltage total harmonic distortion (THD) to 5% on the utility side of the PCC. In addition, any voltage fluctuation resulting from the connection of the customer's energy producing equipment to the utility system must not exceed the limits defined by the maximum permissible voltage fluctuations border line of visibility curve identified in IEEE 519. This requirement is necessary to minimize the adverse voltage effect upon other customers on the utility system.

F. Power Factor

If the average power factor, as measured at the PCC, is less than 0.9 (leading or lagging), the method of power factor correction necessitated by the installation of the generator will be negotiated with the utility as a commercial item.

Induction power generators may be provided VAR capacity from the utility system at the generator-owner's expense. The installation of VAR correction equipment by the generator-owner on the generator-owner's side of the PCC must be reviewed and approved by the utility prior to installation.

G. Islanding

Generation interconnection systems must be designed and operated so that islanding is not sustained on utility distribution circuits. The requirements listed in this document are designed and intended to prevent islanding.

H. Equipment Certification

In order for the equipment to be acceptable for interconnection to the utility system without additional protective devices, the interface equipment must be equipped with the minimum protective function requirements listed in the table in Section II.A.5 and be tested in compliance with Underwriter's Laboratories (UL) 1741, Inverters, Converters and Controllers for Use in Independent Power Systems.

Equipment rated less than 1000 V shall be tested in accordance with the Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits, ANSI/IEEE C62.45, to confirm that the surge withstand capability is met for the product's surge level rating as defined in Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits, ANSI/IEEE C62.41.2.

Equipment rated greater than 1000 V shall be tested in accordance with manufacturer or system integrator designated applicable standards. For equipment signal and control circuits use Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems, IEEE C37.90.1.

The acceptance criteria for both of these testing protocols shall be as detailed in IEEE C37.90.1. If, during the performance of any of the tests prescribed above, the equipment ceases to export power and in the judgement of the independent testing laboratory fails in a safe manner, this will be considered an acceptable result for the purposes of these requirements.

Utility grade relays need not be certified per the requirements of this section.

Documentation indicating compliance with the requirements of this section shall be submitted to the contacts listed on the Department web site (<http://www.dps.state.ny.us/distgen.htm>). A list of “Certified Equipment” shall be maintained for posting at this location.

I. Verification Testing

All interface equipment must include a verification test procedure (except for single phase inverters and inverter systems rated 15 kW and below) as part of the documentation presented to the utility. Except for the case of small single-phase inverters as discussed later, the verification test must establish that the protection settings meet the SIR requirements. The verification testing may be site-specific and is conducted periodically to assure continued acceptable performance.

Upon initial parallel operation of a generating system, or any time interface hardware or software is changed, the verification test must be performed. A qualified individual must perform verification testing in accordance with the manufacturer’s published test procedure. Qualified individuals include professional engineers, factory-trained and certified technicians, and licensed electricians with experience in testing protective equipment. The utility reserves the right to witness verification testing or require written certification that the testing was successfully performed.

Verification testing shall be performed at least once every four years. All verification tests prescribed by the manufacturer shall be performed. If wires must be removed to perform certain tests, each wire and each terminal must be clearly and permanently marked. The generator-owner shall maintain verification test reports for inspection by the utility.

Single-phase inverters and inverter systems rated 15 kW and below shall be verified upon initial parallel operation and once per year as follows: the owner or his agent shall operate the load break disconnect switch and verify the power producing facility automatically disconnects and does not reconnect for five minutes after the switch is closed. The owner shall maintain a log of these operations for inspection by the connecting utility. Any system that depends upon a battery for trip power shall be checked and logged once per month for proper voltage. Once every four (4) years the battery must be either replaced or a discharge test performed.

Section III. Glossary of Terms

Automatic Disconnect Device: An electronic or mechanical switch used to isolate a circuit or piece of equipment from a source of power without the need for human intervention.

Cease to Energize: Cessation of energy flow capability

Coordinated Electric System Interconnection Review: Any studies performed by utilities to ensure that the safety and reliability of the electric grid with respect to the interconnection of distributed generation as discussed in this document.

Dedicated Transformer: A transformer with a secondary winding that serves only one customer.

Direct Transfer Trip: Remote operation of a circuit breaker by means of a communication channel.

Disconnect (verb): To isolate a circuit or equipment from a source of power. If isolation is accomplished with a solid-state device, "Disconnect" shall mean to cease the transfer of power.

Disconnect Switch: A mechanical device used for isolating a circuit or equipment from a source of power.

Draw-out Type Circuit Breaker: Circuit breakers that are disconnected by physically separating, or racking, the breaker assembly away from the switchgear bus.

Farm Waste, Net Meter, Farm Applicant: A farm applicant who is proposing to install a farm waste anaerobic digester generating system, not to exceed 400 kW, at a farm, per the requirements of New York State Public Service Law §66-j.

Generator-Owner: An applicant to operate on-site power generation equipment in parallel with the utility grid per the requirements of this document.

Islanding: A condition in which a portion of the utility system that contains both load and distributed generation is isolated from the remainder of the utility system. (Adopted from

Photovoltaic, Net Meter, Residential Applicant: A residential applicant who is proposing to install a photovoltaic generating system, not to exceed 10 kW, in an owner occupied residence per the requirements of New York State Public Service Law §66-j.

Point of Common Coupling : The point at which the interconnection between the electric utility and the customer interface occurs. Typically, this is the customer side of the utility revenue meter.

Preliminary Review: A review of the generator-owner's proposed system capacity, location on the utility system, system characteristics, and general system regulation to determine if the interconnection is viable.

Protective Device: A device that continuously monitors a designated parameter related to the operation of the generation system that operates if preset limits are exceeded

Required Operating Range: The range of magnitudes of the utility system voltage or frequency where the generator-owner's equipment, if operating, is required to remain in operation for the purposes of compliance with UL 1741 Excursions outside these ranges must result in the automatic disconnection of the generation within the prescribed time limits

Utility Grade Relay: A relay that is constructed to comply with, as a minimum, the most current version of the following standards for non-nuclear facilities:

<u>Standard</u>	<u>Conditions Covered</u>
<u>ANSI/IEEE C37.90</u>	Usual Service Condition Ratings - Current and Voltage Maximum design for all relay Ac and dc auxiliary relays Make and carry ratings for tripping contacts Tripping contacts duty cycle Dielectric tests by manufacturer Dielectric tests by user
<u>ANSI/IEEE C37.90.1</u>	Surge Withstand Capability (SWC) Fast Transient Test
<u>IEEE C37.90.2</u>	Radio Frequency Interference
<u>IEEE C37.98</u>	Seismic Testing (fragility) of Protective and Auxiliary
Relays	
<u>ANSI C37.2</u>	Electric Power System Device Function Numbers
<u>IEC 255-21-1</u>	Vibration
<u>IEC 255-22-2</u>	Electrostatic Discharge
<u>IEC 255-5</u>	Insulation (Impulse Voltage Withstand)

Verification Test: A test performed upon initial installation and repeated periodically to determine that there is continued acceptable performance.

Wind, Net Meter, Residential Applicant: A residential applicant who is proposing to install a wind electric generating system, not to exceed a combined rated capacity of 25 kW, located and used at the applicant's primary residence, per the requirements of New York State Public Service Law §66-1.

Wind, Net Meter, Farm Applicant: A farm applicant who is proposing to install a wind electric generating system, not to exceed a combined rated capacity of 125 kW, located and used at the applicant's primary residence, per the requirements of New York State Public Service Law §66-1.