Technical Requirements

For Generating Facilities Interconnecting

To The Distribution System

Salt River Project

Effective June 6, 2012
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1. NOTICE OF DISCLAIMER AND USE OF REFERENCES
NOTICE OF DISCLAIMER: All information contained in this document is made available for the sole and limited purpose of providing general information regarding utility interactive Customer generation connected to the Salt River Project Agricultural Improvement and Power District (SRP) electric distribution system. Nothing stated in this material should be construed as a promise, assurance, or warranty by SRP regarding the obligations of SRP with respect to Customer generation connected to the SRP system. Any promises, assurances, warranties or obligations between SRP and Customer generation connected to the SRP system shall be in writing and executed by all appropriate parties.

USE OF REFERENCES: There are numerous documents and standards that were used in developing these guidelines. Many of these documents are modified and updated over time; the equipment of an interconnected generator shall conform to the most recent versions of these documents. A partial list of documents used is included below:

- National Electrical Code (NEC)
- National Electric Safety Code (NESC)
- SRP Electric Service Specifications
- SRP Rules & Regulations
- UL1741
2. **SCOPE**

This document specifies the SRP technical requirements for safe and effective interconnection of a Generating Facility (GF) to the SRP electric distribution system (connections below 69 kV). This document is made available on the internet at: [http://www.srpnet.com](http://www.srpnet.com).

Connections to the SRP transmission system (69kv and above) are controlled by SRP’s Open Access Transmission Tariff (OATT). Further information can be obtained by accessing the following website: [http://www.oatioasis.com/SRP/index.html](http://www.oatioasis.com/SRP/index.html) and clicking on the link entitled applications.

The devices specified are intended to address the protection of SRP’s electrical distribution facilities and SRP Customers from damage or disruptions caused by a failure, malfunction or improper operation of the GF facility. These specified devices are also necessary to address the safety of SRP workers and the public. The requirements specified herein do not address any additional relaying, or other protective and/or safety devices as may be required by industry or government codes and standards, equipment manufacturer requirements and prudent engineering design and practice to fully protect the Customer’s GF. Contractual agreements between SRP and the Customer take precedence over the general provisions of this document.

Customers and SRP personnel shall use this document when planning the installation of a GF. This document may not be all inclusive. Therefore, please discuss project plans with SRP before designing the facility or purchasing and installing the equipment.
3. DEFINITIONS

The following terms, as used in this manual, shall have the meaning specified:

3.1 ANSI: American National Standards Institute. See www.ansi.org

3.2 Backfeed: To energize a section of a Utility electric system from a source other than its normal source.

3.3 Business Day: Monday through Friday, excluding Federal and Arizona State Holidays.

3.4 Clearance Point: The physical location on a section of a power line or equipment that is to be visibly disconnected from all known sources of power.

3.5 Cogeneration Facility: Any facility that sequentially produces electricity, steam, or forms of useful energy (e.g., heat) from the same fuel source and is used for industrial, commercial, heating, or cooling purposes.

3.6 Customer: Anyone connected to the SRP electrical system that installs, owns or operates a Generating Facility.

3.7 Disconnect Switch: A visible open disconnect device that the Customer may be required to install and maintain in accordance with the requirements set forth in this document. It will completely isolate the Customer’s Generating Facility from the Utility grid.

3.8 Distributed Generator (DG): Any type of electrical generator, static inverter or generating facility interconnected with the Distribution System that (a) has the capability of being operated in electrical parallel with the SRP’ Distribution System, or (b) can feed a customer load that can also be fed by the SRP electrical system. A Distributed Generator is often referred to as a “Generator Facility” or “generator” in this document.

3.9 Distribution System: The infrastructure constructed, maintained, and operated by SRP to deliver electric service to retail Customers. This system consists of all voltages below 69 kV.

3.10 Electric Service Specifications (ESS): An SRP set of standards and specifications a Customer must follow in order to connect to the SRP system. The ESS is not a complete set of rules, and more complex systems (including GFs) are subject to additional requirements.

3.11 Electric Supply/Purchase Agreement: An agreement signed between SRP and the Customer covering the terms and conditions under which electrical power is supplied to, or purchased from, SRP.

3.12 Fault Current: The level of current that can flow if a short circuit is applied to a voltage source.

3.13 Fast Transition: A switch that parallels the generator with the utility for less than 500 milliseconds, when transferring the load to or from the utility source.
3.14 **Generating Facility**: All or part of the Customer’s electrical generator(s) or inverter(s) together with all protective, safety, and associated equipment necessary to produce electric power at the Customer’s facility. A Generating Facility (GF) also includes any Qualifying Facility (QF).

3.15 **Good Utility Practice**: Any of the practices, methods, and acts engaged in or approved by a significant portion of the electric industry during the relevant time period, or any of the practices, methods, and acts which, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, could have been expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety, and expedition. Good Utility Practice is not intended to be limited to the optimum practice, method, or act to the exclusion of all others, but rather to be acceptable practices, methods, or acts generally accepted in the region.

3.16 **Hold Tag**: The method used as an aid in protection of personnel working on or near energized equipment, whereby Reclosing of a line is disabled until the system operator receives a release from the person to whom the hold was issued. As it relates to distributed generation, circuits with hold tags shall have all potential sources of backfeed removed by opening, locking and tagging the appropriate disconnect switch.

3.17 **IEEE**: The Institute of Electrical and Electronic Engineers. See [www.ieee.org](http://www.ieee.org)

3.18 **Integrated Distributed Resources (IDR)**: GFs with protective functions built into the unit’s control system for operating interconnected with the utility

3.19 **Interconnection**: The physical connection of the Customer’s Generating Facility to the Utility system.

3.20 **Interconnection Agreement**: The agreement, together with appendices, signed between SRP and the Customer covering the terms and conditions governing the interconnection and operation of the Generating Facility with SRP.

3.21 **Island**: A condition occurring when a generator and a portion of the SRP electrical distribution system separates from the remainder of the SRP system and continues to operate in an energized state. At present, SRP electrical distribution has no systems designed to intentionally Island. When the condition is unintentional, Islanding may pose a safety threat or cause equipment problems.

3.22 **Islandable System**: A Generating Facility interconnected to a bus common with the Utility’s system, where the Generating Facility is designed to serve part of the Utility grid that has become or is purposefully separated from the rest of the grid.

3.23 **Metering**: The function related to measuring the transfer of electric power and energy.

3.24 **Minimum Protective Devices, Relays, and Interconnection Requirements**: The minimum required protective relaying and/or safety devices or requirements specified in this manual are for the purpose of protecting only SRP electrical distribution facilities and its other Customer facilities from damage or disruptions caused by a fault, malfunction, or improper operation of the Customer’s Generating facility. Minimum Protective Relaying and Interconnection Requirements do not include relaying, or other protective, and/or safety devices as may be required by industry and/or government codes and standards, equipment manufacturing and prudent engineering design
and practice to fully protect the Customer’s Generating Facility; those are the sole responsibility of the Customer. These requirements may be revised from time to time.

3.25 **NEMA:** National Electrical Manufacturers Association. See [www.nema.org](http://www.nema.org)

3.26 **NFPA:** National Fire Protection Association. See [www.nfpa.org](http://www.nfpa.org)

3.27 **Non-Parallel Connection Agreement:** The agreement for the non-parallel connection of the Customer’s Generation Facility with SRP Distribution System.

3.28 **OSHA:** Occupational Safety and Health Administration. See [www.osha.gov](http://www.osha.gov)

3.29 **Parallel System:** A Generating Facility that is electrically interconnected to a bus common with the SRP electrical distribution system, and operates in parallel either on a momentary or a continuous basis.

3.30 **Point of Common Coupling:** See Point of Interconnection.

3.31 **Point of Interconnection:** The physical location where the SRP’s electric service conductors are connected to the Customer’s service conductors to allow parallel operation of the Customer’s Generating Facility with SRP’s electric distribution system.

3.32 **Qualifying Facility (QF):** Any Cogeneration or Small Power Production Facility that meets the criteria for size, fuel use, efficiency, and ownership as promulgated in 18 CFR, Chapter I, Part 292, Subpart B, of the Federal Energy Regulatory Commission’s Regulations.

3.33 **Radial Line:** An electrical distribution line that originates from a substation and is normally not connected to another substation or another circuit sharing the common supply of electric power.

3.34 **Reclosing:** The act of automatically re-energizing a line in an attempt to restore power.

3.35 **Relay:** An electric device that is designed to interpret input conditions in a prescribed manner and after specified conditions are met to respond to cause contact operation or similar abrupt change in associated electric control circuits.

3.36 **Separate System:** The operation of a Generating Facility that has no possibility of operating in parallel with the SRP’s electrical distribution system.

3.37 **Small Power Production Facility:** A facility that uses primarily biomass, waste or renewable resources, including wind, solar, and water to produce electric power.

3.38 **SRP:** The Salt River Project Agricultural Improvement and Power District.

3.39 **Transfer Switch:** An automatic or manual device for transferring one or more load conductor connections from one power source to another.

3.40 **Transfer Trip Scheme:** A form of remote trip in which a communication channel is used to transmit a trip signal from the relay location to a remote location.
3.41 **Transmission System:** Utility-owned high-voltage lines (69 kV or higher) and associated equipment for the movement or transfer of electric energy between power plants and the distribution system.

3.42 **UL:** Underwriters Laboratories Inc. See [www.ul.com](http://www.ul.com)

3.43 **Utility:** The electric utility entity (SRP) that constructs, operates, and maintains the electrical distribution system for the receipt and/or delivery of power. Also referred to as the Utility Distribution Company (UDC).

3.44 **Utility Grade Relays:** Relays specifically designed to protect and control electric power apparatus, tested in accordance with the following ANSI/IEEE standards:


4. DISTRIBUTED GENERATION TYPES

This Document applies to all Distributed Generating Facilities operating (or applying to operate) within the SRP electric distribution system. This Document establishes technical requirements that will promote the safe and effective parallel operation of Customer Generating Facilities. This Document includes provisions for interconnecting the three distinct types of generators: (a) solid-state or static inverter, (b) induction machine, and (c) synchronous machine.

The total capacity of an individual Customer’s Generating Facility may exceed 10 MW; however, no more than 10 MW of a facility’s capacity may be connected through a single Point of Interconnection.

4.1 Separate System (Emergency or Standby Generation System)

A separate system is one in which there is no possibility or intent of electrically connecting or operating the Customer’s GF in parallel with the SRP electric distribution system. The Customer’s equipment must transfer load between the two power systems in an open transition or non-parallel mode. If the Customer claims to have a separate system, SRP may require verification that the transfer scheme meets the non-parallel requirements.

Emergency or standby GFs used to supply part or all of the Customer’s load during SRP power outages, are required by the National Electrical Code to have transfer equipment designed and installed to prevent the inadvertent interconnection of normal and emergency sources of supply in any operation of the transfer equipment.

As such, these GFs must be connected to the Customer’s wiring through a double throw, break-before-make transfer switch specifically designed and installed for that purpose. The transfer switch must be of a fail-safe mechanical throw over design, which will under no circumstances allow the GF to electrically interconnect or parallel with the SRP electric distribution system. The transfer switch must always disconnect the Customer’s load from the SRP power system prior to connecting it to the GF. Conversely, the transfer switch must also disconnect the load from the GF prior to reconnecting it to the SRP electric distribution system. These requirements apply to both actual emergency operations as well as to testing the GF. All transfer switches and transfer schemes must be inspected and approved by the governmental bodies that exercise legal jurisdiction over electrical installations.

Portable generators are not designed for connection to a building’s permanent wiring system, and are not to be connected to any such wiring unless a permanent and approved transfer switch is used. Failure to use a transfer switch can result in back-feed into the SRP electric distribution system – the generator voltage can back-feed through the SRP transformer and be stepped up to a very high voltage. This can pose a potentially fatal shock hazard to anyone working on the power lines or on SRP equipment.

4.2 Parallel System (Interconnected Generation Systems)

A parallel, or interconnected, GF is connected to a bus common with SRP’s system, and a transfer of power between the two systems is a direct result. A consequence of such interconnected
operation is that the Customer’s GF becomes an integral part of the SRP electric distribution system that must be considered in the electrical protection and operation of the SRP electric distribution system.

Parallel generators encompass any type of GF that can electrically parallel with, or potentially back-feed to, the SRP electric distribution system. Additionally, any generator system using a “closed transition” type transfer switch or a multi-breaker transfer scheme, or an electrical inverter that can be configured or programmed to operate in a “utility interactive mode” constitutes a potential back-feed source to the SRP electric distribution system, and is classified as an interconnected GF.

4.3 Fast Transition System (Interconnected Generation Systems)

SRP does not require, the installation of additional separate protection at sites employing fast-transition switching with the following conditions:

- The customer signs an interconnection agreement with SRP
- The switch meets UL1008 requirements for Automatic Transfer Switches
- The customer demonstrates to SRP’s System Protection Department that the transfer switch can switch from utility source to generator and back.
- The customer demonstrates that the switch will not parallel the customer’s GF with the SRP Distribution system for more than 500 milliseconds. If the switch gets stuck while transferring to or from generator, the device back-trips to isolate the generator from SRP (typically in 0.8 seconds).

The technical requirements for interconnected GFs are detailed in Section 7. SRP will inspect and review the design of each GF on a case-by-case basis.
5. GENERAL INFORMATION AND REQUIREMENTS

The Customer will own and be responsible for designing, installing, operating and maintaining:

(a) The generating facility in accordance with the requirements of all applicable electric codes, laws and governmental agencies having jurisdiction.

(b) Any control and protective devices, in addition to protective relays and devices specified in this document, to protect its facilities from abnormal operating conditions such as, but not limited to, electric overloading, abnormal voltages, and fault currents.

(c) Interconnection facilities, not owned by SRP, on the Customer’s premises may be required to deliver power from the Customer’s generating facility to the SRP system at the Point of Interconnection.

Reactive metering is required for all GF installations greater than 50 kW. Smaller units will be reviewed on a case-by-case basis. If the Customer intends to sell energy back to SRP or others, then additional metering equipment is required. Contact SRP for design requirements and installation details.
6. DESIGN CONSIDERATIONS AND DEFINITION OF CLASSES

The size and characteristics of the parallel generator along with the nature and operational characteristics of SRP’s electric distribution system influence protection requirements. Therefore, similar units connected to different lines could have different protection requirements based on varying load conditions, as well as on SRP feeder and transformer characteristics.

The Customer is responsible for designing the GF system to automatically separate from the SRP system upon loss of SRP voltage.

6.1 Synchronous Units

A synchronous generator is an alternating-current machine in which the rotational speed of normal operation is constant, and when interconnected, is in synchronism with the frequency and in step with the voltage of the electric utility system. Synchronous generators are generally capable of supplying sustained current for faults on the SRP electric distribution system.

6.2 Induction Units

Induction generators are basically induction motors that are driven above synchronous speed to produce electric power. These units do not have a separate excitation system and, as such, require that their output terminals be energized with AC voltage and supplied with reactive power to develop the magnetic flux. Induction generators are therefore normally not capable of supplying sustained fault current into faults on the SRP electric distribution system. Such units are generally not capable of supplying isolated load when separated from the SRP electric distribution system; however, it is possible for an induction generator to become self-excited if a sufficient amount of capacitance exists at its output terminals. Under conditions of self-excitation, an induction generator will be capable of supplying isolated load, providing the load is within the units' output capability. In most cases when self-excitation occurs, it will be accompanied by a sudden increase in terminal voltage. SRP and its other Customers must be protected from out-of-sync closing and over-voltages that can occur whenever an induction generator becomes self-excited.

6.3 Static Inverters

Static inverters convert DC power to AC by means of electronic switching. Switching can be controlled by the AC voltage of the SRP supply system (line-commutated) or by internal electronic circuitry (forced-commutated). Line-commutated inverters are generally not capable of operating independently of the SRP AC supply system and, as such, cannot normally supply fault current or isolated loads. Forced-commutated, or self-commutated, inverters are capable of supplying fault current and load independently of the AC supply system. The KW rating for a system using a static inverter is determined from the AC output name plate rating of the inverter regardless of the DC rating of the input source.

6.4 Definition of Generator Size Classes

The following generator size classifications are used in determining specific minimum protective requirements for GF’s. Specified ratings are for each connection to the SRP system.
(a) Class I -- 50 kW or less, single or three phase
(b) Class II -- 51 kW to 300 kW, three phase
(c) Class III -- 301 kW to 5,000 kW, three phase
(d) Class IV -- over 5,000 kW, three phase
7. INTERCONNECTION TECHNICAL REQUIREMENTS

The requirements and specifications outlined in this section are applicable to GF interconnected for Parallel Operation (continuous or momentarily) with the SRP electric distribution system. The protection and safety devices and other requirements specified in the following sections are intended to provide protection for the SRP electric distribution system, SRP workers, other SRP customers, and the general public. They are not intended to provide protection for the Customer’s generation equipment or personnel; this is the sole responsibility of the Customer.

With respect to the above protection objectives, it is necessary to disconnect the parallel generator when trouble occurs. This is to:

a) Limit the fault current supplied by the Customer’s generator.

b) Limit the possibility of reclosing into an out of synchronization isolated system composed of the Customer’s generator and SRP’s electric distribution system or a section thereof.

c) Limit the possibility of reclosing into the Customer’s generator system that may be out of synchronization or stalled.

d) Limit the possibility of unintentional islanding.

The Customer is solely responsible for the protection of his equipment from Reclosing by SRP. SRP normally applies instantaneous (0.1 seconds) Reclosing to distribution circuits. The Customer must ensure that when the SRP source breaker trips, the GF is disconnected from the SRP circuit. Reclosing out of synchronism with the Customer’s generator, may cause severe damage to Customer equipment and could also pose a serious hazard to Customer or SRP personnel.

7.1 General Technical Requirements

7.1.1 The Customer is responsible for obtaining and maintaining all required permits and inspections to indicate that the Customer’s generating facilities comply with all applicable codes, ordinances and statutes relating to safety, construction, and operation.

7.1.2 The connection of multiple generators to the same SRP service may be permitted subject to SRP approval; however, a single disconnect switch for the facility will generally be required (normally located at the service entrance section).

7.1.3 In the event that a generator, or aggregate of generators, are of sufficient size to carry the minimum load of the SRP distribution feeder, or if a generator size and physical location on a feeder is such that it could support an isolated (islanded) section of the feeder, then a transfer trip scheme is required at the Customer’s expense. A transfer trip scheme includes a communication channel and telemetering. In certain instances, a dedicated SRP feeder may be required, also at the Customer’s expense.

7.1.4 To prevent the opening and subsequent closing of equipment into an un-synchronized generator, the Customer shall ensure that any potential open points such as breakers or fused disconnect switches, located between the generator breaker and SRP service, are
appropriately equipped. This is accomplished with either keyed or other suitable mechanical interlocks to prevent the open points from being inadvertently closed when the generator breaker is closed, or by using contacts that will instantaneously trip the generator breaker if any such switch or breaker is closed while the generator breaker is closed.

7.1.5 The Customer shall ensure that the design and installation of electric meter(s) meet SRP’s requirements in the SRP Electric Service Specifications. This includes the assurance that the meter(s) are located on the utility-side of the generator breaker on a normally energized bus and that any electronic meter(s) are not de-energized for any length of time.

7.1.6 The Customer is responsible for the design, installation, operation and maintenance of all equipment for connection to the SRP electrical distribution system. It is also the Customer’s responsibility to submit for SRP’s review and written approval the specifications and detailed plans as required in this manual prior to purchase and installation. Written approval by SRP does not indicate acceptance by other authorities.

7.2 Disconnect Switch

The Customer shall install and maintain a single stand alone, visible open, manually-operated load-break disconnect switch capable of being locked in a visibly open position by a standard SRP padlock with a 3/8” shank. This switch shall completely open and isolate all ungrounded conductors of the GF from the SRP system. For multi-phase systems, the switch shall be gang-operated.

The disconnect switch blades, jaws and the air-gap between them shall be clearly visible when the switch is in the open position and the front cover of the switch box is open. It is not acceptable to have any of the visible components obscured by a switch “dead front” or an arc-shield, etc. Only switches specifically designed to provide a true “visible open” are acceptable, and shall not be fused, unless expressly agreed by SRP. The disconnect switch shall be installed in a place to provide easy and unrestricted accessibility to SRP personnel on a 24-hour basis. SRP shall have the right to lock open the disconnect switch without notice to the Customer, when interconnected operation of the Customer’s generating facility with the SRP system could adversely affect the SRP system or endanger life or property, or upon termination of the Interconnection Agreement. In the event that SRP locks open the disconnect switch, the Customer shall not remove or tamper with the lock.

The disconnect switch will normally be required to be installed at the Customer’s electrical service entrance section. It may be located in the immediate vicinity of the Customer’s generator or inverter, provided that SRP accessibility to the Disconnect is not impeded and is subject to SRP’s approval. The disconnect switch must be a standalone device or share a common enclosure. Electrical conductors entering into and exiting from the disconnect switch shall not be routed in the same conduit or raceway. The Disconnect Switch will be placed under the operational jurisdiction of SRP for systems with a line voltage of 500V or less, and the cover of such switch will have the ability to be locked closed with a standard 3/8” shank SRP padlock.
The disconnect switch must be rated for the voltage and current requirements of the generation facility, and must meet all applicable UL, ANSI and IEEE standards, including a 36” by 36” clear working space in front of the switch. The switch shall meet the requirements of the National Electrical Code, and the switch enclosure shall be properly grounded, via a ground wire attached to a factory provided grounding lug or an appropriately UL listed grounding lug.

Under no circumstances shall the disconnect switch enclosure be used as a conduit or raceway for any conductors other than those phase neutral and ground conductors associated with the GF.

In situations where the GF is in a remote location, the GF generation exceeds 1 MW, or there are several GFs on the same SRP circuit, SRP may require that a special remote-controlled switch be installed, or that SRP be compensated for a troubleshooter’s time to travel to and from the site and open the disconnect switch during Hold Tag or clearance conditions.

In cases where the Disconnect Switch will be installed on a line at a voltage above 500V, SRP will work with the Customer to determine the best option and ensure that the safety requirements are met.

7.3 Dedicated Transformer

GF’s with a combined total rating of over 10 kW, as measured at the service entrance, may require a dedicated distribution transformer. To limit the possibility of a secondary voltage island and the generator does not contribute fault current to other customer’s electrical systems. It also helps to confine any voltage fluctuation or harmonics produced by the generator to the Customer’s own system. SRP will specify the transformer winding connections and any grounding requirements based on the specific Customer site location and generator type.

7.4 Power Quality

The Customer shall ensure that the electrical characteristics of its load and generating equipment will maintain SRP’s normal power quality requirements. Any deviation from sine waveform or unusual short interval fluctuations in power demand or production shall not be such as to result in impairment of service to other customers. Power factor and quality issues are defined in SRP Rules and Regulations documents. Harmonics and voltage flicker shall not exceed the limits promulgated in IEEE 519-1992.

7.5 Voltage Requirements

Customer generating equipment must be rated at 60 Hertz, and be either a single or three-phase system connected at a standard utility voltage that may be selected by the Customer subject to utility availability at the premises. The GF shall follow and not attempt to oppose or regulate changes in the voltage at the Point of Interconnection.

7.6 Labeling Requirements

The Customer shall conform to the NEC for labeling of generation equipment, switches, breakers, etc. See SRP’s ESS book, Miscellaneous Contractor Supplied Material.

7.7 Protective Requirements
7.7.1 General Requirements

7.7.1.1 The Customer shall be solely responsible for properly protecting and synchronizing the GF with the SRP system.

7.7.1.2 Customer facility shall include an automatic interrupting device that is listed with Underwriters Laboratories, and is rated to interrupt available fault (short circuit) current. The interrupting device shall be tripped, as a minimum, by all protective devices required herein.

7.7.1.3 For rotating generator classes II and above (>50 kW), utilizing discrete relays, separate and independent voltage and frequency relays and associated trip paths to the generator breaker (automatic interrupting device) are required. This is to ensure a redundant trip function in the event of a single relay failure or out-of-tolerance condition. It is acceptable however, for the over/under voltage functions to be integrated into a single over/under voltage relay, and for the over/under frequency functions to be integral to a single over/under frequency relay.

7.7.1.4 Protective relays or microprocessor-based devices may be used provided that the required functionality and redundancy described above is demonstrated. For generator protective schemes that utilize microprocessor based, multi-function relays, the protective relay failure condition will generate an alarm and will also trip the generator breaker or contactor.

7.7.1.5 Inherent characteristics of induction disk type voltage and frequency relays render their use unsuitable for some generator interface protection applications. Therefore, relays with definite level and timing characteristics (e.g., solid state type relays) will be necessary to meet the minimum requirements established herein.

7.7.1.6 With the addition of generation at a Customer site, the ground fault current magnitude might increase to the level where the grounding grid is insufficient to protect personnel from step or touch potentials. The Customer shall ensure the adequacy of the facility grounding grid to keep any step and touch potentials at a safe level.

7.7.1.7 The Customer shall ensure that the GF protective relaying and controls are adequately protected from electrical surges that may result from lightning, utility switching or electrical faults.

7.7.2 Generator Class Protective Requirements

7.7.2.1 Class I (Single or Three Phase: 50 kW or less) Requirements

(a) The minimum protection required for induction and synchronous generators is an under-voltage relay.

(b) A synchronizing scheme is also required for synchronous generators. A manual synchronizing scheme shall require a synchronizing check relay.
(c) Static inverters shall be tested to UL Standard for Inverters, Converters, and Controllers for Use in Independent Power Systems, UL 1741 by a Nationally Recognized Testing Laboratory (NRTL) certified by OSHA to perform the UL 1741 test standard.

7.7.2.2 Class II (Three Phase: 51-300 kW) Requirements

(a) The minimum protection required for induction and synchronous generators is overvoltage, undervoltage, overfrequency, and underfrequency.

(b) A synchronizing scheme is also required for synchronous generators.

(c) For installations interconnected to SRP through a transformer with connections that will not supply current to a ground fault on the SRP system, a special ground fault detection scheme may be necessary. SRP will advise Customer of any such requirements after a preliminary review of the Customer’s proposed installation.

(d) Other equipment such as supervisory control and alarms, transfer-tripping schemes, telemetering and associated communications channels may be necessary. This is especially the case when the generator or an aggregate of generators is large relative to the minimum load on a feeder or sectionalized portion of the feeder; the GF is involved in power transactions requiring the grid; or the GF are remotely controlled by, or dispatched by SRP. SRP will advise the Customer of any communications requirements after a preliminary review by SRP Engineering and Operations departments of the proposed installation.

(e) Static inverters shall be tested to UL Standard for Inverters, Converters, and Controllers for Use in Independent Power Systems, UL 1741 by a Nationally Recognized Testing Laboratory (NRTL) certified by OSHA to perform the UL 1741 test standard.

7.7.2.3 Class III (Three Phase: 301-5,000 kW)

(a) Utility Grade protection devices and equipment will be required.

(b) Protection for overvoltage, undervoltage, overfrequency, and underfrequency and a synchronizing scheme.

(c) For installations interconnected to SRP through a transformer with connections that will not supply current to a ground fault on the SRP system, a special ground fault detection scheme may be necessary. SRP will advise Customer of any such requirements after a preliminary review of the Customer’s proposed installation.

(d) Other equipment such as supervisory control and alarms, transfer-tripping schemes, telemetering and associated communications channels may be necessary. This is especially the case when the generator or an aggregate of
generators is large relative to the minimum load on a feeder or sectionalized portion of the feeder; the GF is involved in power transactions requiring the grid; or the GF are remotely controlled by, or dispatched by SRP. SRP will advise Customer of any such requirements after a preliminary review by SRP Engineering and Operations departments of the proposed installation.

(e) Static inverters shall be tested to UL Standard for Inverters, Converters, and Controllers for Use in Independent Power Systems, UL 1741 by a Nationally Recognized Testing Laboratory (NRTL) certified by OSHA to perform the UL 1741 test standard with redundant over/under voltage relay.

7.7.2.4 Class IV (Three Phase: Greater than 5,000 kW)

(a) Units of this size will be reviewed on a case-by-case basis.

(b) The minimum protective relaying requirements for Parallel Operation of GF are summarized in the following table:

**Summary of Minimum Protective Relaying Requirements**

<table>
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<tr>
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<th>Induction Generator</th>
<th>Synchronous Generator</th>
<th>Static Inverter</th>
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<tbody>
<tr>
<td><strong>Class I</strong></td>
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<tr>
<td>50 kW or less</td>
<td>Undervoltage</td>
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<td>UL 1741</td>
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<tr>
<td><strong>Class II</strong></td>
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<td>51 to 300 kW</td>
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<td>Overvoltage, Undervoltage</td>
<td>UL 1741</td>
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<td></td>
<td>Overfrequency, Underfrequency</td>
<td>Overvoltage, Underfrequency</td>
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<td>Overvoltage, Underfrequency</td>
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<td><strong>Class IV</strong></td>
<td>Case by case basis</td>
<td>Case by case basis</td>
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<td>Greater than</td>
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<td>5,000 kW</td>
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7.7.3 Relay Settings

Voltage and frequency relays needed for minimum interface protection for all classes will have setting ranges as specified by SRP. The Customer should discuss these ranges with SRP prior to designing or installing a GF. For class III and IV units, there may be additional frequency setting requirements to accommodate grid load shedding in accordance with practices of the Western System Coordinating Council.

7.7.3.1 Voltage and frequency relays needed for minimum interface protection for all classes will have setting limits as specified below.

7.7.3.2 Under-voltage relays will agree with the latest IEEE 1547 standard. (Reference IEEE 1547 section 4.2.3 Table 1.)
7.7.3.3 Over-voltage relays will agree with the latest IEEE 1547 standard. (Reference IEEE 1547 section 4.2.3 Table 1.)

7.7.3.4 Over-frequency relays will agree with the latest IEEE 1547 standard. (Reference IEEE 1547 section 4.2.4 Table 2.)

7.7.3.5 Under-frequency relays will agree with the latest IEEE 1547 standard. (Reference IEEE 1547 section 4.2.4 Table 2.)
8. TESTING REQUIREMENTS

8.1 Relay Testing Prior to the Witness/Commissioning Tests:

The Customer shall have all associated protective devices field-tested and calibrated by qualified personnel. Calibration shall include on-site testing of trip set points and timing characteristics of the protective functions. Written copies of the results shall be sent to SRP at least five days prior to the witness testing described below. If there are differences in the original design settings and the field settings, SRP requires additional time to review those differences prior to witness testing.

8.2 Witness/Commissioning Test Requirements:

On the day of witness testing, the Customer shall demonstrate, in the presence of SRP personnel that:

(a) Relay settings are consistent with the written calibration tests previously provided by the Customer.

(b) Operation of each protective output contact results in the desired operation of the appropriate protective device (usually a breaker or contactor). For static inverters rated less than 50 kW, a trip-timing test with simulated loss of voltage will be sufficient.

(c) The GF is capable of synchronizing with the SRP grid.

(d) The GF properly disconnects from the SRP system under simulated disturbance conditions.

(e) SRP remote visibility or control of any devices associated with the GF function properly, if applicable.

(f) Settings of programmable logic devices are correct, if applicable.
9. OPERATIONAL AND MAINTENANCE REQUIREMENTS

9.1 The Customer shall be responsible for operating and maintaining the GF in accordance with the requirements of all applicable safety and electrical codes, laws and governmental agencies having jurisdiction.

9.2 SRP may request witnessing of functional trip tests on an annual basis. When requested, the Customer shall notify SRP when such tests are to be performed at least five working days prior to such tests, and shall allow SRP personnel to witness the testing. In addition, SRP may annually request that all protective devices be field tested and calibrated by qualified personnel, and that written copies of the results be provided to SRP.

9.3 SRP, including its employees, agents and representatives, shall have the right to enter the Customer’s premises to:

(a) Inspect the Customer’s generating facility, protective devices, and to read or test instrumentation equipment that SRP may install, provided that reasonable advance notice is given to the Customer prior to entering its premises.

(b) Maintain or repair SRP equipment.

(c) Disconnect the generating facility without notice if, in SRP’s opinion, a hazardous condition exists and such immediate action is necessary to protect persons, SRP facilities or other Customers’ or third parties’ property and facilities from damage or interference caused by the Customer’s generating facility, or improperly operating protective devices.

(d) Open the Disconnect Switch without notice if SRP personnel require an operating clearance or Hold Tag.

9.4 SRP Hold Tags

Hold Tags are used to protect equipment as well as personnel who are working on or near energized equipment, whereby Reclosing of a line is disabled. When a Hold Tag for a circuit is in effect, if the circuit trips open, it will not be re-closed until it is verified that all personnel are in the clear. As it relates to GFs, circuits with hold tags may have all potential sources of back-feed removed by opening, locking and tagging the appropriate disconnect switch. The number of hold tags at any given time varies from a handful on weekends and holidays, to more than 50 on weekdays (SRP has approximately 1,000 12 kV feeders). Only in extreme conditions are Hold Tags kept overnight; typically they are taken in the morning and released in the afternoon. Although Hold Tags are only issued to SRP personnel, they can be taken as a result of conditions outside of SRP’s control, at the request of City personnel, the fire department, or other utilities.

Following the release of an SRP Clearance or Hold Tag, where it was necessary for SRP to open the Disconnect Switch, SRP personnel will not normally close the switch. It will normally be the Customer’s responsibility to close the switch after ensuring that all generation sources are synchronized with the utility.
The Hold Tag procedure is included below in flowchart form:

1. Hold tag is requested by SRP personnel
2. SRP Distribution Operations makes a courtesy phone call to Customer (if conditions allow), informing them that SRP is about to open and lock disconnect switch
3. SRP disables Reclosing on substation feeder and directs a troubleshooter to the disconnect switch
4. Troubleshooter opens, locks and tags the disconnect switch
5. Hold Tag is released (when work is completed, which can take several hours)
6. SRP directs the troubleshooter to the disconnect switch to remove the tag and lock.
7. SRP places courtesy call to customer and inform them that the Hold Tag is no longer in effect, and the customer can proceed to close the disconnect switch at their discretion.
8. Substation reclosing is re-enabled

STOP
APPENDIX A
SAMPLE SYSTEM ONE LINE DIAGRAMS

NOTES:
(1) DISCONNECT SWITCH MUST BE RATED SO THAT IT CAN BREAK LOAD CURRENT, MUST BE LOCKABLE, AND BE VISUALLY VERIFIABLE IN THE OPEN POSITION.
(2) TRANSFORMER MAY BE REQUIRED IF GENERATOR IS RATED GREATER THAN 10 kW.

81O OVERFREQUENCY
81U UNDERFREQUENCY

TYPICAL MINIMUM REQUIREMENTS
CLASS I GENERATOR WITH INVERTER
(UP TO 50 kW)
TYPICAL MINIMUM REQUIREMENTS
CLASS II SYNCHRONOUS GENERATOR
(51-300 kW, NO TRANSFER TRIPPING REQUIRED)
TYPICAL MINIMUM REQUIREMENTS
CLASS III SYNCHRONOUS GENERATOR
(301- 5,000 kW; WITH TRANSFER TRIPPING )
APPENDIX B  
DISTRIBUTED GENERATOR  
INTERCONNECTION TECHNICAL REQUIREMENTS  
FOR GENERATORS OVER 5 MEGA-WATTS

The requirements and specifications outlined in this section are applicable to GF systems that are rated to generate over 5MWs that are interconnected for Parallel Operation (continuous or momentarily) with the SRP distribution system and are in addition to and not replacing the requirements and specifications in section 7 of this document. The protection and safety devices and other requirements specified in the following sections are intended to provide protection for the SRP system, SRP workers, other SRP customers, and the general public. They are not imposed to provide protection for the Customer’s generation equipment or personnel; this is the sole responsibility of the Customer.

A. A GF must be rated for 20 MWs or less to interconnect to voltages less than 69 kV.

B. All class 3 protection specifications are required in addition to what the assigned SRP system protection engineer requires. This may include a transfer tripping scheme that is communicated via fiber, an accepted low voltage ride through capability, and a remote controlled disconnect that enables SRP to isolate the generator from the system.

1. The GF shall operate with a power factor of .95 leading or lagging when interconnected with the SRP electrical distribution system.

2. A GF that is rated for 5 MWs and above shall provide Low Voltage Ride Through during disturbances and faults. Voltage Ride Through characteristics must meet the latest IEEE 1547 standard.

C. Circuit requirements are dependent on generation size and all system additions and system improvements to meet the needs of the Customer for its GF installation is expensed to the Customer.

1. No more than 3 MWs on a shared circuit.
2. No more than 10 MWs on a dedicated circuit.
3. SRP limits the number of dedicated circuits to one per substation transformer for a GF facility.