Interconnection Requirements

For

Distributed Generation

Arizona Public Service Company

Effective October 2013
Rev 7.2

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1 INTRODUCTION

This document specifies the minimum requirements for safe and effective operation of Distributed Generation electrically interconnected (or paralleled) with the Arizona Public Service Company (APS) radial distribution system (21 kV or less). Application for interconnection is made by completing and submitting to APS the applicable Interconnection Application (Static Inverters or Rotating Machinery) along with the required Supplementary Information specified in Appendix A (Static Inverter) or Appendix B (Rotating Machinery) at the back of this document.

Installations that are directly connected to the transmission system or sell power for resale except in limited circumstances described later, have additional APS requirements. In such cases an interconnection application may need to be made in accordance with APS' Open Access Transmission Tariff ("OATT"). Further information can be obtained by accessing the following website: http://www.oatioasis.com/azps/index.html and clicking on the link entitled Applications.

If a generator interconnects to the APS transmission system (greater than 21 kV), and is not subject to APS' OATT, such interconnection may be performed in accordance with this document. APS will work with the Customer and advise of additional requirements.

Note, the term "Customer" as defined in Section 2 refers to any distributed generator, cogenerator or small power producer, even though they may not actually be purchasers of power from APS, and includes any independent party or entity that either invests in, owns or operates a distributed generator or generation facility.

Customers applying for the interconnection of certain static inverter based systems in conjunction with making an application to participate in a distributed generation incentive program being offered by APS may need to complete a different interconnection application other than that included in Appendix A. Additional information is available in Section 14 of this document. However, it is important to note that regardless of the interconnection application submitted, the interconnection technical requirements outlined in this document govern.

APS customers and APS personnel shall use this document when planning the installation of any Backup Generator or Generating Facility. Note that these requirements may not cover all details in specific cases. The Customer should discuss project plans with APS before designing the facility or purchasing and installing equipment. This document must be applied in conjunction with the following APS documents that pertain to the parallel operation of Customer-owned Distributed Generation with the APS System:

- Schedule #1, Terms and Conditions for the Sale of Electric Service
- Schedule #2, Terms and Conditions for Energy Purchases from Qualified Cogenerators and Small Power Production Facilities
- Schedule #4, Totalized Metering of Multiple Service Entrance Sections at A Single Site for Standard Offer and Direct Access Service.
- Schedule #5, Guidelines for Electric Curtailment.
- Schedule #6, Interconnection Services and Fees for Non-FERC Wholesale Generation Facilities
- APS Electric Service Requirements Manual ("ESRM")

The Service Schedules listed above are available on the following website link:

http://www.aps.com/en/ourcompany/ratesregulationsresources/serviceplaninformation/Pages/business-sheets.aspx

and the ESRM is available at:

http://www.aps.com/ESRM

The minimum required protective relaying and/or safety devices and requirements specified in this document, are for protecting only APS facilities and the equipment of other customers from damage or disruptions caused by a fault, overcurrent condition, malfunction or improper operation of the Generating Facility. These requirements are also necessary to ensure the safety of utility workers and the public. Minimum protective relaying and interconnection requirements do not include additional relaying, protective or safety devices as may be required by industry and/or government codes and standards, equipment manufacturer requirements and prudent engineering design and practice to fully protect Customer's Generating Facility; those are the sole responsibility of the Customer.

The information contained in this document contains general information about the APS interconnection requirements for Customer-owned Distributed Generation Facility. In addition to all applicable regulatory, technical, safety, and electrical requirements and codes, which are not contained in their entirety in this document, Customers will also be subject to contractual and other legal requirements, which are only summarized in this document. Those regulations, requirements, contracts and other materials contain complete information concerning interconnection and govern over the general provisions in this document.

The technical interconnection requirements outlined in this document shall also apply to any interconnected utility-owned or operated Distributed Generation Facility.

This document, as well as the various Agreements and rate schedules, is subject to revision from time to time. Please check with APS for the latest revision prior to commencing your project.

APS is committed to making sure that interconnection applications are handled promptly, and to do everything possible to complete the interconnection process in a safe and timely manner. At APS, we look forward to working with you to ensure a successful generation project.

2 DEFINITIONS

The following terms, as used in this document, shall have the meanings specified:

AHJ: or Authority Having Jurisdiction, the organization, office, or individual responsible for enforcing the requirements of a code or standard or for approving equipment, materials, an installation, or a procedure.

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

Application: The standard form for applying to interconnect a Generating Facility with the Utility system also referred to as the "Interconnection Application".

APS: Arizona Public Service Company.

APS Interconnection Requirements: The requirements set forth herein entitled "Interconnection Requirements for Distributed Generation Arizona Public Service Company" and all additional requirements that are referenced in this document.

APS System: Refers to APS' electric Transmission or Distribution System. Also referred to as APS' System.

Arizona Corporation Commission ("ACC" or "Commission"): The regulatory agency of the State of Arizona having jurisdiction over public service corporations, including APS, operating in Arizona.

Backfeed: To energize any section of the APS system from an electric source other than the normal utility source.

Backup Generator: An independent power generation source or sources located at a Customer's facility installed for the sole purpose of supplying on site generated power to selected loads upon failure or outage of the normal Utility source. A Backup Generator shall be understood to include a Standby Power System and an Emergency Power System as defined in IEEE Std. 446.

Behind the Meter: A term used to describe a power generation application in which the Generating Facility generation is not directly interconnected to the APS System but rather, to a Customer-owned electric system that is itself electrically connected to the APS electric system via an APS retail billing meter.

Bi-directional Meter: A meter having two separate metering registers, one to record electricity delivered to the Customer and the other to record electricity received from the Customer.

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

Clearance: A Clearance is a statement by one having complete authority over all parts of a circuit or piece of electrical equipment that said circuit or equipment is disconnected from all known

sources or power. It is assurance that all proper precautionary measures have been taken and workers may proceed with grounding the circuit.

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

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

Continuous Parallel: A Generating Facility that electrically parallels with the APS System for more than 15 seconds.

Customer: A Customer is considered to be an APS account holder or APS "Customer of Record" that receives electric service from APS and which may also generate electricity at the property receiving electric service. A Customer shall be understood to include any independent party or entity that either invests in, owns or operates the Generating Facility including without limitation its grantees, lessees or licensees.

Dedicated Feeder: A Distribution System feeder placed into service with the sole purpose of serving a single Customer. Note that a non-Dedicated Feeder (sometimes referred to as a "Shared Feeder") serves multiple Customers.

Disconnect Switch: A visible open disconnect device that the Customer is 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 APS System, including the Utility metering equipment located at the SES.

Distributed Generation (DG): Any type of electrical generator, static inverter or Generating Facility interconnected with the APS System that either (a) has the capability of being operated in electrical parallel with the APS distribution system, or (b) can feed a customer load
that can also be fed by the APS System. A Distributed Generation Facility is also referred to as a "Generating Facility" in this document.

Distribution System: The infrastructure constructed, maintained, and operated by APS to deliver electric service at the distribution level (21 kW or less) to retail customers. Also referred to as APS' System or the APS System.

ESRM: APS Electric Service Requirements Manual. See http://www.aps.com/ESRM.

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

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

FERC: Federal Energy Regulatory Commission.

Generator: A Rotating Machine or Static Inverter used to produce electrical power.

Generating Facility (GF): All or part of the electrical generator(s) or inverter(s) together with all protective, safety, and associated equipment and improvements associated with the interconnection to the APS System. A Generating Facility also includes any Qualifying Facility (QF), and is sometimes referred to as a Distributed Generation Facility.

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.

IEEE: The Institute of Electrical and Electronic Engineers. See http://www.ieee.org/index.html .

Interconnection: The physical connection of the Customer's Generating Facility to the APS System.

Interconnection Agreement: An agreement, together with appendices, signed between APS and the Customer, covering the terms and conditions governing the Interconnection and parallel operation of the Generating Facility with APS.

Interconnection Application: An application form and all supplementary information specified therein attached as Appendix A or Appendix B to this document.

Interconnection Generation Design Review Agreement: An agreement signed between APS and the Customer covering the terms for APS to proceed with a detailed study of the impact of the Customer's DG on APS' System.

Interconnection Study: A study or studies that may be undertaken by APS (or an APS designated third party) in response to its receipt of a completed Application for Interconnection and parallel operation with the APS system. Interconnection studies may include, but are not limited to, Interconnection Feasibility Studies, System Impact Studies, and Facilities Studies.

Island: A condition in which a portion of a Utility electric power system is energized solely by one or more local electric power systems throughout the associated Point of Interconnection while that portion of the Utility electric power system is electrically separated from the rest of the Utility electric power system.

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

Minimum Protective Devices, Relays, and Interconnection Requirements: The minimum required protective relaying and/or safety devices or requirements specified in this document, as may be revised from time to time, for the purpose of protecting only APS and its other customer facilities from damage or disruptions caused by a fault, malfunction or improper operation of the Customer's GF. Minimum Protective Relaying and Interconnection Requirements do not include relaying, protective 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 GF or facilities; those are the sole responsibility of the Customer.

Momentary Parallel System: A Momentary Parallel System is one that transfers electrical load between the Utility grid and the Customer's Generating Facility by means of a "make-before break" transfer scheme. Momentary Parallel Systems synchronize the Generating Facility with the Utility grid for a period not to exceed ten cycles for the purpose of uninterrupted load transfer.

NEC: National Electric Code. See www.necdirect.org.

NEMA: National Electrical Manufacturers Association. See http://www.nema.org.

NERC: North American Electric Reliability Corporation. See http://www.nerc.com.

Net Metering: A billing process whereby an electric "net metering" rate allows energy delivered by a Customer into the electric grid to be netted with energy received by the Customer from the grid over the billing period. A Bi-directional meter is required to be installed in the SES in order to effect Net Metering.

NFPA: National Fire Protection Association. See http://www.nfpa.org

Non-Parallel Connection Agreement: An agreement, together with appendices, signed between APS and the Customer, covering the terms and conditions governing the non-parallel connection and operation of the Generation Facility with APS.

OSHA: Occupational Safety and Health Administration. See http://www.osha.gov.

Parallel System: A Generating Facility that is electrically interconnected to a bus common with the Utility's electric distribution system, and operates in parallel either on a momentary or continuous basis.

Partial Requirements Service: Electric service provided to a customer that has on-site interconnected generation whereby the output from its electric Generator(s) first supplies its own electric load requirements with any excess generation (over and above the customers own load requirements at any point in time) then being backfed into the APS System. APS supplies any supplemental electric load requirements of customer (those not met by the customer's own generation.

Point of Interconnection (POI): The physical location where APS' service conductors are connected to a Customer's conductors, bus, and/or service equipment.

Primary Network: An AC power distribution system that uses two or more dedicated primary voltage feeders, connected in parallel, to simultaneously supply power to one customer. The system includes automatic protective devices intended to isolate faulted primary feeders, while maintaining uninterrupted service to the customer served from the other primary feeder circuit(s).

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.

Radial Line: A 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.

Readily Accessible: Capable of being reached quickly and conveniently on a 24 hour basis without requiring climbing over or removing obstacles, obtaining special permission, keys or security clearances.

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

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.

Rotating Machine: An induction or synchronous machine used to generate alternating current (AC) electric power.

Secondary Spot Network System: An AC power distribution system in which a Customer is simultaneously served from three-phase, four-wire low-voltage (typically 480V) circuits supplied by two or more network transformers whose low-voltage terminals are connected to the low-voltage circuits through network protectors. The low voltage circuits do not have ties to adjacent or nearby secondary network systems. The secondary spot network system has two or more high-voltage primary feeders. These primary feeders are either dedicated network feeders that serve only other network transformers, or a non-dedicated network feeder that serves radial transformers in addition to the network transformer(s), depending on network size and design. The system includes automatic protective devices and fuses intended to isolate faulted primary feeders, network transformers, or low-voltage cable sections while maintaining uninterrupted service to the customers served from the low-voltage circuits.

Separate System: The operation of a Generating Facility that has no possibility of operating in parallel with, or backfeeding onto, APS' system.

Service Entrance Section (SES): The Customer-owned main electrical panel or equipment located at its premises to which the Utility delivers electric energy via the Utility service drop or service lateral.

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

Static Inverter: An electronic device used to convert direct current (DC) power into alternating current (AC) power.

Totalized Metering: The measurement for billing purposes on the appropriate rate, through one meter, of the simultaneous demands and energy consumption of a Customer who receives electric service at more than one SES at a single site in accordance with APS Service Schedule 4.

Transfer Switch: An automatic or manually operated device for transferring one or more load conductor connections from one power source to another (e.g. Generating Facility).

Transfer Trip Scheme: A form of remote trip in which a communication channel is used to transmit a trip signal from the relay location (e.g. utility substation) to a remote location (e.g. Generating Facility).

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.

UL: Underwriters Laboratories Inc. See http://www.ul.com.

UL Listed: Distributed Generation equipment identified herein as required to be tested and certified to an applicable UL Standard shall also be listed and labeled according to section 110.3 of the NEC.

Utility: The electric power company (in this case APS) that constructs, operates and maintains its electrical power system for the receipt and/or delivery of electric power.

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

(a) ANSI/IEEE C37.90-1989 (R1994), IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.

(b) ANSI/IEEE C37.9.01-1989 (R1994), IEEE Standard Surge Withstand (SWC) Tests for Protective Relays and Relay Systems.

(c) ANSI/IEEE C37.90.2-1995, IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.

Wholesale Generation: A Generating Facility (GF) connected directly to the APS electric distribution or transmission network that sells energy and capacity directly to a utility under a power purchase contract.

3 APS POLICY ON CUSTOMER-OWNED GENERATION

Any Customer qualifying as a QF under the Public Utility Regulatory Policies Act (PURPA) of 1978, may operate its GF in parallel with the APS radial distribution system provided the Customer provides equipment that will:

(a) not present any hazards to APS personnel, other customers or the public,
(b) minimize the possibility of damage to APS and other customer equipment,
(c) not adversely affect the quality of service to other customers, and
(d) minimally hamper efforts to restore a feeder to service (specifically when a clearance is required).

In addition, the Customer must comply with the following prior to paralleling a GF with APS:

(a) The Generating Facility must meet all the minimum interconnection, safety, and protection requirements outlined in this document or as otherwise determined by APS,
(b) Customer must sign an Interconnect Agreement, as well as an Electric Supply /Purchase Agreement, as applicable, with APS,
(c) Customer must comply with and is subject to all applicable service and rate schedules and requirements, rate tariffs and other applicable requirements as filed with and approved by the Arizona Corporation Commission, and
(d) The Generating Facility must be inspected by APS and written permission to parallel must be obtained from APS.

It is the policy of APS to also permit Customer generating equipment with an aggregate generation nominal nameplate AC rating of less than 1 MW that is not qualified as a QF under PURPA to operate in parallel with the APS radial distribution system provided that all of the conditions outlined above are complied with and customer does not fall under FERC jurisdiction.

APS requires any GF (other than a Backup Generator) interconnecting with APS' System, with an aggregate nominal AC nameplate rating of greater than 1 MW to provide documentation acceptable to APS (including FERC Form 556), that confirms the GF has achieved Qualifying Facility status under 18 CFR, Chapter 1, Part 292, Subpart B, including, without limitation, §292.207 of the FERC's regulations, as amended.

This self-certification will be required from all QF's, regardless of the voltage at the Point of Interconnection.

An exception to the self-certification requirement in the paragraph above is granted for GFs that are: 1) installed in Behind the Meter installations, and 2) not expected to ever produce more energy from the GF than is consumed by the host Customer's facility on any 12 month calendar basis.

The links to FERC for "Frequently Asked Questions" and "Form 556" are listed below:

http://www.ferc.gov/help/faqs/qf-faqs.asp

http://www.ferc.gov/docs-filing/forms/form-556/form-556.pdf

Due to relay coordination and potential backfeed problems, APS cannot permit any distributed generation with an AC nameplate output rating of greater than 10 kW to be connected to a Primary or Secondary Spot Network System, without a detailed Interconnection Study being undertaken at Customer's expense to determine, among other things, special relaying, communication channels and other operational constraints that will need to be implemented. A DG connected to either a Primary or Secondary Spot Network system will nonetheless not be permitted to backfeed any power into the APS system.

The minimum protective and safety devices (relays, circuit breakers, disconnect switch, etc.) specified in this document must be installed and placed into service before allowing parallel operation of Customer's generation facilities with the APS system. The purpose of these devices is to isolate the Customer's generating equipment from the APS system whenever faults, over-current conditions, or disturbances occur, and also for maintenance purposes. Modifications to the APS electrical system configuration or protective equipment may also be required at the expense of the Customer in order to accommodate parallel generation.

APS will not assume any responsibility for the protection of the Customer's generator(s), or of any other portion of the Customer's electrical equipment. The Customer is fully and solely responsible for protecting its equipment in a manner to prevent any faults or other disturbances from damaging, or otherwise adversely affecting, the operation of the Customer's equipment.

In addition to complying with any other required codes, ordinances and statutes, Customer must obtain an electrical permit and inspection indicating that the Customer's generating facility complies with the NEC. In the event that a Customer's GF is located in a locality where there is no AHJ, or the AHJ does not issue a permit or perform an inspection of the GF, then the Customer will be required to sign a "Letter-in-Lieu of Electrical Clearance". APS will forward such letter for Customer's signature.

APS can disallow the interconnection of a Customer's GF if, upon review of the Customer's design, or as the result of a site inspection, it determines that the proposed design is not in compliance with applicable safety codes, or is such that it could constitute a potentially unsafe or hazardous condition.

If APS believes that there may be a potential safety issue or code violation then APS reserves the right to forward the GF diagrams to, and/or discuss same with, the AHJ.

4 DISTRIBUTED GENERATION TYPES

Distributed generators include induction and synchronous electrical generators as well as any type of electrical inverter capable of producing A/C power. A **Separate System** is designed so as to never electrically interconnect or operate in electrical parallel with APS' system. A **Parallel System** is any generator or generation system that can parallel, or has the potential to be paralleled via design or normal operator control, either momentarily or on a continuous basis, with APS' system.

The Customer may elect to run its generator as a separate system with non-parallel load transfer between the two independent power systems, or they may run it in parallel with the APS system. A description and the basic requirements for these two methods of operation are outlined below.

4.1 Separate System

A Separate System is one in which there is no possibility of electrically connecting or operating the Customer's generation in parallel with the utility's 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 a Separate System, APS may require verification that the transfer scheme meets the non-parallel requirements.

Emergency or standby generators used to supply part or all of the Customer's load during a utility power outage must be connected to the Customer's wiring through a true double throw, "break-before-make" transfer switch specifically designed and installed for that purpose in order to qualify as Separate System. The transfer switch must be of a fail-safe mechanical throw over design, which will under no circumstances allow the generator to electrically interconnect or parallel with APS' system. The transfer switch must always disconnect the Customer's load from APS' power system prior to connecting it to the generator. Conversely, the transfer switch must also disconnect the load from the generator prior to re-connecting it back to the APS system. These requirements apply to both actual emergency operations as well as to testing the generator. The normal source (utility) electrical conductors and the emergency (generator) electrical conductors feeding the transfer switch shall not be routed in the same conduit or raceway or in any way share a common enclosure. Transfer switches tested and certified to UL *Standard for Transfer Switch Equipment* UL 1008 will qualify as a Separate System as defined herein.

Portable generators are not designed to be connected 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 and the installation is inspected by the AHJ.

Failure to use a transfer switch can result in backfeed into the APS system – the generator voltage can backfeed through the APS 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 utility equipment.

Other than the requirements outlined above in this section, APS has no further technical interconnection requirements for a separate system.

4.2 Parallel System

A parallel, or interconnected, generator is connected to a bus common with the utility'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 generator must be considered in the electrical protection and operation of the utility system.

Parallel generators encompass any type of distributed generator or generating facility that can electrically parallel with, or potentially backfeed the utility system. Additionally, any generator system using a "closed transition" type transfer switch or any multi-breaker or multi-switch transfer scheme not tested and certified to UL 1008, or an electrical inverter that can be configured or programmed to operate in a "utility interactive mode" constitutes a potential backfeed source to the APS system, and is classified as a Parallel System.

APS has specific interconnection, inspection and contractual requirements, as outlined in this document that must be complied with and information that needs to be submitted for all interconnected generators. These requirements include a "visible open" disconnect switch meeting certain requirements to isolate the Customer's system from APS' system, as well as protective relaying, metering, special rate schedules, and other safety and information requirements. The Customer will be responsible for having the generation system protective schemes tested by a qualified testing/calibration company. APS personnel will inspect the system and the Customer will be required to sign an Interconnect Agreement and, as applicable, an Electric Supply/Purchase Agreement with APS.

In certain instances, APS and the Customer will need to sign a "Non-Parallel Connection Agreement" and/or an "Operating Agreement". APS will advise the Customer of any such requirements after reviewing the proposed design.

APS does not extend "blanket approval" to any specific type of generator or generator scheme since each project is site specific and needs to be reviewed on a case-by-case basis.

In addition to the various other requirements specified in this document, Parallel Systems shall specifically comply with the technical requirements outlined in the Interconnection Technical Requirements section (Section 8) of this document.

5 CUSTOMER RESPONSIBILITIES

The Customer is responsible for all facilities required to be installed solely to interconnect the Customer's generation facility to the APS system. This includes connection, transformation, switching, protective relaying, metering and safety equipment, including a visibly-open Disconnect Switch and any other requirements as outlined in this document, the ESRM and applicable rate schedules as well as any other special items specified by APS. All such Customer facilities are to be installed by the Customer at the Customer's sole expense. In the event that additional facilities are required to be installed on the APS system to accommodate the Customer's generation, APS will install such facilities at the Customer's expense. APS may also charge the Customer for any administrative costs and/or the costs of studies required to interconnect the Customer's generation.

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) Control and protective devices, in addition to minimum 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. Such protective devices must promptly disconnect the generating facility from APS' system in the event of a power outage on APS system.
(c) Interconnection facilities on the Customer's premises which may be required to deliver power from the Customer's generating facility to the APS system at the Point of Interconnection.

Due to risks associated with interconnecting and operating a GF with the APS System, such as serious bodily injury, death or property damage, it is recommended that every Customer protect itself with insurance or other suitable financial instrument sufficient to meet its construction, operating and liability responsibilities. A Customer should consult with its insurance advisor to determine what issues may be posed by the installation of the GF, since current policies may not have contemplated its addition, and changes may need to be made to the existing insurance policy to include coverage of the GF itself and the consequences of its operation. APS does not require that the Customer negotiate any policy or renewal of any policy covering any liability through a particular insurance provider, agent, solicitor or broker.

Any Customer operating a static inverter based GF with an aggregate nominal AC output rating of greater than 2 MW, or operating a Rotating Machine(s) with an aggregate nominal AC output rating of greater than 50 kW shall, at its own expense, maintain in force general liability insurance without any exclusion for liabilities related to the interconnection undertaken pursuant to the Interconnection Agreement. The amount of such insurance shall be sufficient to insure against all reasonably foreseeable direct liabilities given the size and nature of the GF being interconnected, the interconnection itself, and the characteristics of the system to which the interconnection is made. The Customer shall obtain additional insurance only if necessary as a function of owning and operating a GF. Such insurance shall be obtained from an insurance provider authorized to do business in Arizona. Certification that such insurance is in effect shall be provided upon APS' request, except that the Customer must show proof of the insurance to APS no later than ten (10)

business days prior to the date upon which the GF commences interconnected operation with the APS System. If the Customer is determined by APS to be of sufficient credit-worthiness, the Customer may propose to self-insure for such liabilities.

All interconnected Customers will be required to sign, in addition to any other purchase, supply or other standby or special agreements as may be applicable, an Interconnection Agreement with APS. Customers that connect a static inverter to the utility, and which will be programmed so as not to backfeed into the utility system (i.e. non-utility interactive mode), will need to sign a Non-Parallel Connection Agreement with APS, since such an arrangement can constitute a potential backfeed source. Customers that purchase power from, or sell power to, APS may be required to sign an Electric Supply/Purchase Agreement with APS.

In the event that the Customer's facility is fed by more than one APS electrical service, then Customer shall (a) have suitable controls and/or operating procedures in place that are acceptable to APS to ensure that the APS services will under no circumstances ever be paralleled; and (b) ensure that the GF is never connected to an electrical service other than the one specified in Customer's Interconnection Application and/or Interconnection Agreement.

6 MUTUAL UNDERSTANDINGS

6.1 Interconnections

APS will not install or maintain any lines or equipment on a Customer's side of the Point of Interconnection, except it may install electric meters and at times research equipment. Only authorized APS employees (with credentials to identify their company affiliation) may make and energize the service connection between the APS system and the Customer's service entrance conductors.

Normally, the interconnection will be arranged to accept only one type of standard service at one Point of Interconnection. If a Customer's generating facility requires a special type of service, or if sales to APS will be at a different voltage level, the services will only be provided according to additional specific terms that are outlined in the Electric Supply/Purchase Agreement, applicable rate schedules, or other terms and conditions governing the service.

6.2 Easements and Rights of Way

Where an easement or right of way is required to accommodate the interconnection, the Customer must provide to APS suitable easements or rights of way, in APS' name, on the premises owned, leased or otherwise controlled by the Customer. If the required easement or right of way is on another's property, the Customer must obtain and provide to APS a suitable easement or right of way, in APS' name, at Customer's sole cost and in sufficient time to meet the Interconnect Agreement requirements. All easements or rights of way must be on terms and conditions acceptable to APS.

6.3 Rate Schedules

The rate applicable to the interconnection of a Customer's generating facility will depend on the system size, type and configuration. Please refer to section 10 of this document for the rate schedules applicable to Distributed Generation. Because of varied and diverse requirements and operating modes associated with the interconnection, the Customer must evaluate and determine which system configuration and electric rate is most appropriate for it and whether or not it qualifies for the particular rate. APS will provide information to assist the Customer to assess the available options. The Customer remains fully responsible for such matters, however, and no APS assistance or information should be taken as constituting any representation or warranty about any particular option.

Any energy purchases from the Customer's facility will be in accordance with the rate schedule and Electric Supply/Purchase Agreement as applicable, any changes required by law or regulation, and such applicable rates authorized by law. Generating facilities with requirements of unusual size or characteristics may require additional or special rate and contract arrangements.

If the purchase of electric energy or capacity would result in greater cost to APS than if APS generated the energy itself or purchased it from another source, APS will not be obligated to buy such energy or capacity from a Customer. When that occurs, APS will

give reasonable notice to the Customer so that the Customer may discontinue deliveries or elect to sell to APS at a lower rate.

6.4 ACC Jurisdiction

The rates, terms or other contract provisions governing the electric power sold to a Customer or purchased from the Customer by APS are subject to the jurisdiction of the Arizona Corporate Commission. APS retains at all times and without restriction the right to file a unilateral ACC application for a change in requirements, charges, classification, or service, or any rule, regulation or agreement as allowed by law.

7 DESIGN CONSIDERATIONS AND DEFINITION OF CLASSES

Protection requirements are influenced by the size and characteristics of the parallel generator along with the nature and operational characteristics of the associated APS system. Therefore, similar units connected to different lines could have different protection requirements based on varying load conditions, as well as on utility feeder and transformer characteristics.

7.1 Synchronous Units

Synchronous generators are generally capable of supplying sustained current for faults on the APS system. These units can also supply isolated APS load providing the load is within the units' output capability.

Reclosing of the utility onto synchronous units must be blocked to prevent out-of-synch paralleling and must also be prevented from energizing a de-energized utility line. Automatic reclosing by APS is time-delayed which allows for automatic Customer generator separation prior to utility circuit re-energization.

7.2 Induction Units

Induction generators are basically induction motors that are mechanically 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 utility system. Such units are generally not capable of supplying isolated load when separated from the utility 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. APS and its other customers must be protected from out-of-phase closing and over-voltages that can occur whenever an induction generator becomes self-excited. Induction units must therefore be designed to automatically separate from the utility system upon loss of utility voltage and prior to reclosing of the utility feeder.

7.3 Static Inverters

Static inverters convert DC power to AC by means of electronic switching. Switching can be controlled by the AC voltage of the utility's supply system (line-commutated) or by internal electronic circuitry (forced-commutated).

Line-commutated inverters are generally not capable of operating independently of the utility's AC supply system and, as such, cannot normally supply any appreciable fault current, or continue to energize isolated loads, provided proper protective functions are

in place. To accommodate such protective functions, any line-commutated inverter that is electrically paralleled with the utility system shall be tested and certified to UL *Standard for Inverters, Converters and Controllers for use in Independent Power Systems*, UL1741 by a Nationally Recognized Testing Laboratory (NRTL) certified by OSHA to perform the UL1741 test standard.

Forced-commutated, or self-commutated, inverters are capable of energizing load independently of the utility system. Any forced-commutated inverter, the output of which is to be directly interconnected with the utility, would need to be specifically designed for that purpose, i.e. it would need to be designed to accommodate parallel interfacing and operation. However, it is not anticipated at this time that any forced-commutated inverters will be interconnected to the utility system. APS would consider any such interconnection on a case-by-case basis. Under no circumstance shall the self-commutated output of a "battery backup" inverter which is normally designed to energize a subpanel independently of the utility, be connected to the utility system.

7.4 Definition of Generator Size Classes

The following generator size classifications are used in determining specific minimum protective requirements for distributed generation facilities. Specified ratings are for each connection to the APS system. Customers must satisfy, in addition to the general requirements specified in this document, the minimum relaying requirements given in this document (Section 8.7) for each generator class.

(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

8 INTERCONNECTION TECHNICAL REQUIREMENTS

The requirements and specifications outlined in this section are applicable to distributed generation interconnected for parallel operation (continuous or momentarily) with APS' distribution system, unless otherwise specified. The protection and safety devices and other requirements specified in the following sections are intended to provide protection for the APS system and its workers, other APS 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.

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

(a) ensure if a fault on the APS system persists, the fault current supplied by the Customer's generator is interrupted;
(b) prevent the possibility of reclosing into an out-of-sync isolated system composed of the utility distribution system, or a section thereof, and the Customer's generator;
(c) prevent reclosing into the Customer's generation system that may be out of synchronization or stalled;
(d) prevent unintentional islanding.

The protection requirements are minimal for smaller installations, but increase as the size of the Customer's generation increases. Small installations usually ensure that the generator is small compared with the magnitude of any load with which it might be isolated. Thus, for any fault on the utility system, utility protective devices will operate and normally isolate the generation with a large amount of load, causing voltage collapse and automatic shutdown of the generator.

Section 8.8, Additional Requirements for GFs with an Aggregate AC Generation ≥ 1 MW, contains additional requirements that apply to any GF that is nominally rated to generate 1 MW or more and is interconnected with the APS System for continuous parallel operation.

For larger installations the probability of isolated operation is higher since the available generation may be sufficient to carry the entire load, or part thereof, of the local APS circuit. In instances where the APS system arrangement is such that it is possible that the generators will not always be isolated with comparatively large amounts of load, additional protection and generator shutdown schemes are required.

The Customer is solely responsible for the protection of its equipment from automatic reclosing by the utility. APS normally applies automatic reclosing to overhead distribution circuits. When the APS source breaker trips, the Customer must ensure that its generator is disconnected from the utility circuit prior to automatic reclosing by the utility (the automatic reclosing on APS distribution feeders is normally delayed by at least 2 seconds). Automatic reclosing out-of-sync with the Customer's generator may cause severe damage to Customer equipment and could also pose a serious hazard to Customer or Utility personnel.

8.1 General Technical Requirements

8.1.1 Customer is responsible for obtaining and maintaining all required permits and inspections indicating that Customer's generating facility complies with all applicable codes, ordinances and statutes relating to safety, construction and operation.

8.1.2 Multiple Generator connections on the same utility service are permitted subject to APS approval; however, a single Disconnect Switch for the facility will generally be required (normally located at the service entrance section).

8.1.3 In the event that a generator, or aggregate of generators, are of sufficient size to carry the (minimum) load of the APS 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, and in certain instances a dedicated utility feeder, will be required at the Customer's expense. If a transfer trip is required, or the Customer's aggregate generation is one megawatt or greater, a communication channel and telemetering will also be required, at the Customer's expense, to facilitate proper parallel operation. Refer to Section 8.8 for additional information. In such instances, APS will need to perform an Interconnection Study to determine the required facilities.

Should an Interconnection Study be required, technical equipment submittals shall be provided by the GF Developer. Interconnection Studies will dictate project specific technical requirements of the GF. Should a GF developer install any equipment that is deviant from the initial submittal and the equipment fails to meet project specific technical requirements, it shall be understood that the Interconnection Project may be delayed until APS deems the equipment acceptable. The GF shall not be allowed to interconnect with APS until it is determined said modifications comply with the project specific technical requirements. The cost for additional Interconnection Studies or necessary equipment changes shall be borne by the GF Developer.

8.1.4 For synchronous generators, the Customer shall ensure that any potential open points such as breakers, fused disconnect switches, etc, located between the generator breaker and utility service are appropriately equipped with either (1) keyed or other suitable mechanical interlocks to prevent them from being inadvertently opened when the generator breaker is closed, or (2) electrical contacts that will instantaneously trip the generator breaker if any such switch were opened while the generator breaker was closed. This is to prevent the opening and subsequent (inadvertent) re-closing of such a breaker or switch onto an un-synchronized generator.

8.1.5 In the event that the utility is required to install electric meter(s) to record the output of the generator(s), Customer shall ensure that the design is such that the meter(s) are located on the utility-side of any generator breaker on a normally energized bus. Electronic meters are not designed to be de-energized for any length of time.

8.1.6 In the case that a Generator is connected or tapped to the line (utility) side of an SES service disconnecting means, as may be permitted by the NEC, the following requirements apply:

a) A supply (or line) side tap (commonly referred to as a supply side connection or SSC) constitutes a new service as defined by the NEC and is subject to all applicable NEC requirements and/or requirements adopted by the Authority Having Jurisdiction. The required SSC service disconnecting means shall also be in accordance with the APS ESRM and the APS Supply (or Line) Side Connection Guidelines available at www.aps.com/dg.

b) Any SSC shall be made without any modifications to any factory installed and/or factory listed equipment or components, unless such connection is expressly authorized by the manufacturer and/or listing agency, and performed in strict accordance with the manufacturer's directions and specifications. In order for APS to approve a SSC interconnection, the following may be required:

- Documentation from the AHJ and the electric service manufacturer approving the SSC.
- Detailed manufacturer instructions as to how to perform the SSC
- A test report provided by the listing agency (see NOTE below)
- Interconnection drawings shall stamped by a professional electrical engineer licensed in the state of Arizona (refer to section 13 of these requirements for further details).

NOTE: In the absence of manufacturer approval, the customer may hire an authorized Nationally Recognized Testing Laboratory (NRTL) to perform a field evaluation. The field evaluation shall assess if the SSC compromises the safety and/or integrity of the electric service.

c) No Customer connections or equipment are permitted in the Utility sealed metering compartment or pull-section of the SES. Any line side tap shall be made only in the applicable Customer accessible section of the SES panel, and a label shall be placed at the SES in accordance with section 8.6.4 of this document.

d) APS secondary electrical service conductors are not fused and can only be de-energized by APS personnel. As such Customer will need to contact APS to arrange for the electrical service to be de-energized prior to performing a line side tap. Since APS will not re-energize the service following completion of the tap, unless an electrical clearance ("green tag") has been issued by the AHJ, it is important that the Customer coordinate this work very closely with APS and the AHJ.

e) The maximum output current nameplate rating of the Generator(s) shall not exceed the 100% continuous duty rating of the APS transformer or service run. Note that the ratings of the APS transformer and service run do not necessarily match the SES rating. APS will notify Customer if any APS equipment is over-dutied following APS review of the Interconnection Application. Any required equipment upgrades shall be performed at Customer's sole expense.

8.1.7 The Customer is responsible for the design, installation, operation and maintenance of all equipment on the Customer's side of the Point of Interconnection. It is strongly recommended that the Customer submit specifications and detailed plans as specified in the Interconnection Application (refer to section 14) for the installation to APS for review and written approval prior to ordering any equipment. Written approval by APS does not indicate acceptance by other authorities.

8.1.8 While APS recommends the use of copper conductors, if the Customer nonetheless elects to use aluminum conductors to connect any equipment either owned by, or placed under operational jurisdiction of APS (GF metering, Utility Disconnect Switch, etc.), then the Customer must comply with the following requirements:

(a) An oxidation inhibitor must be applied to the cleaned aluminum conductor.
(b) A UL Listed lug, compression type terminal, must be used for the terminations of the aluminum conductors.
(c) Compression terminal shall clearly indicate the conductor and the die to be used on the crimping tool, and the connection shall be made in strict accordance with manufacturer specifications.
(d) Locations of aluminum conductors must be clearly identified on the Interconnection Diagrams submitted to APS for review.

APS will not assume any responsibility for any maintenance or inspection of conductors within an APS sealed portion of the GF. It shall be the sole responsibility of the Customer to schedule and arrange for any such inspection.

8.2 Disconnect Switch

The Customer shall install and maintain a stand-alone visible open, manually- operated load-break disconnect switch ("Disconnect Switch") capable of being locked in a visibly "open" position by a standard APS padlock with a 3/8" shank that will completely open and isolate all ungrounded conductors of the Customer's Generating Facility from the APS system. The Disconnect Switch hasp shall not be field modified in any way. For multi-phase systems, the switch shall be gang-operated.

The Disconnect Switch shall be connected so that the blades (and any fuses if present) are de-energized when the switch is in the "open" position in accordance with NFPA 70E and NEC 404.6(C) for phase to phase voltages 600V and less or NEC 490.21(E)(4) for phase to phase voltages over 600V. For example, the blades (load side) will be connected to the inverter side of a static inverter based circuit and the switch jaws (line side) to the utility source side. The Disconnect Switch blades, jaws and the air-gap between them shall all be clearly visible when the switch is in the "open" position and the front cover of the switch box is opened. It is not acceptable to have any of the "visible open" 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 to by APS in order to meet fault current requirements per NEC 110.9 and 110.10. APS 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 APS' system could

adversely affect APS' system or endanger life or property, or upon termination of the Interconnect Agreement.

The Disconnect Switch shall be installed in a Readily Accessible place (available on a 24 hour basis) so as to provide safe (no tripping hazards, domesticated animals or other obstructions, etc.) and easy, unrestricted and unimpeded access to APS personnel and must be installed adjacent to the Customer's electrical service entrance section; however, it may be located in the immediate vicinity of the Customer's generator or inverter, provided that APS' access to the Disconnect Switch is not impeded, and subject to APS approval.

The Disconnect Switch must normally be located on the utility source side of any meter installed to measure the output of the GF.

The Disconnect Switch will be placed under the operational jurisdiction of APS for systems with a line voltage of 600V or less, and the cover of such switch will be locked closed with a standard 3/8" shank APS padlock. The Disconnect Switch shall be a stand-alone device, and electrical conductors and/or cables entering into and exiting from the Disconnect Switch shall be kept physically separated and shall not be routed in the same raceway or in any way share a common enclosure. If a second service disconnecting means is installed as in the case of a supply side connection (SSC), the second service disconnect cover shall be locked closed with a customer provided lock.

The Disconnect Switch must be rated for the voltage and current requirements of the Generating Facility, and must be listed and conform to all applicable UL, ANSI and IEEE standards. The switch shall be installed in accordance with the National Electric Code, (NEC) and APS requirements, and shall be located between 36" and 60" measured from final grade to the center of the disconnect switch and include a minimum clear workspace of 36" by 36" in front of the switch. Please note minimum clear workspace may be greater than 36" by 36" based on NEC Article 110 requirements. The Disconnect Switch shall not be (1) located behind an electrically operated gate or door unless the electric operator is backed up by an uninterruptible power source to ensure that it can be operated in the event of a utility power outage, (2) installed under a breezeway, patio, porch or any area that can be enclosed, (3) installed behind a gate, fence, wall or other barrier unless expressly agreed to by APS. In the event that a lock-box is required to be installed by the Customer for APS to gain access to the disconnect switch or any other APS equipment, the lock-box needs to be installed within 36" of the door or gate, etc., and it shall be located no less than 36" above grade and no more than 60" above grade. Note: Indoor equipment locations require access from the exterior of the building.

The switch enclosure shall be properly grounded via an equipment ground wire attached to a factory provided grounding lug or an appropriately UL listed grounding lug or terminal. Under no circumstances shall the disconnect switch enclosure be used as a conduit or raceway for any conductors other than those phase conductors being switched and the associated grounded conductor (neutral) and grounding conductor (equipment ground).

In cases where the Disconnect Switch will be installed on a line at a voltage above 600V, APS has specific grounding requirements that will need to be incorporated into the Disconnect Switch. APS also has certain requirements that will need to be adhered to for

the purpose of obtaining electrical clearances, including the establishment of an "Operating Agreement" which must be signed with the Customer.

In instances where a visible open switch is not commercially available, APS may accept a Customer installed rack-out breaker, along with a racking tool and grounding breaker (to ground the utility side) as may be required, in order to effect an electrical clearance. In these cases, APS will work with the Customer to determine the best option and ensure that all appropriate safety requirements are met.

8.3 Dedicated Transformer

Customer generators with a combined total rating of over 10 kW, as measured at the service entrance, may be required to be isolated from other customers fed off the same utility transformer by a dedicated power transformer connecting to the utility distribution feeder. The primary purpose of the dedicated transformer is to ensure that (a) the generator cannot become isolated at the secondary voltage level with a small amount of other-customer load, and (b) the generator does not contribute any significant 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. APS will specify the transformer winding connections and any grounding requirements based on the specific Customer site location and generator type.

8.4 Power Quality

In order to minimize interference on the utility system the Customer must ensure that the electrical characteristics of its load and generating equipment meet, as a minimum, the specifications outlined below.

8.4.1 Current Imbalance

The phase current imbalance for a three-phase system as measured at the Customer's service entrance section shall not be greater than ten percent (10%) at any time.

8.4.2 Harmonics

The electrical output of the Customer's Generating Facility shall not contain harmonic content which may cause disturbances on or damage to APS electrical system, or other customer's systems, such as but not limited to computer, telephone, communication and other sensitive electronic or control systems. Harmonics, as measured at the Point of Interconnection, shall not exceed the limits promulgated in IEEE 519-1992.

8.4.3 Power Fluctuations

The Customer must exercise reasonable care to assure that the electrical characteristics of its load and generating equipment, such as deviation from sine wave form or unusual short interval fluctuations in power demand or production, shall not be such as to result in impairment of service to other customers or in interference with operation of computer, telephone, television or other communication systems or facilities.

8.4.4 Voltage Flicker

If Customer utilizes the APS system to facilitate start-up of its generating facility, the voltage flicker level shall not exceed APS standards. (Refer to IEEE 519-1992).

8.4.5 Service Voltage Ranges

Customer shall ensure its GF does not cause the RMS voltage at the Point of Interconnection to vary beyond the Favorable Voltage Service Range (Range A) of +/- 5% as specified in ANSI standard C84.1. APS will not be responsible for voltage excursions outside of this range caused by the GF.

8.5 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 DG shall follow, and not attempt to oppose or regulate changes in the voltage at the Point of Interconnection, unless otherwise required by Section 8.9 of this document.

8.6 Labeling Requirements

8.6.1 General Requirements

The Customer shall conform to the National Electric Code (NEC), as adopted by the local Authority Having Jurisdiction, for labeling of all GF equipment, including the service entrance section. APS will assume responsibility for labeling any utility-owned equipment. All APS-required labels shall consist of a permanently attached weatherproof/UV resistant placard, letters shall be engraved or embossed/raised, and letters will be a minimum of 1/4 inch tall. If applicable, any adhesive backing shall be rated for outdoor applications in the Arizona environment with UV inhibitors. It is also acceptable to rivet labels to the applicable equipment as long as the attachment means does not violate the UL Listing of the equipment. Labels shall be made of (a) aluminum, brass or other approved corrosive resistant metal, or (b) a high density polyethylene material 55 mils thick comprised of a 35 mil black polyethylene base film capped (co-extruded) with a 20 mil color polyethylene. Labels should follow the ANSI Z535.1 -1998 color codes when applicable.

8.6.2 Disconnect Switch

The Customer shall label the Disconnect Switch “Generator Utility Disconnect Switch” or “Photovoltaic System, Wind Turbine, etc, Utility Disconnect Switch”, as the case may be. In the event APS grants approval to install the Disconnect Switch at a location other than the electrical service entrance section (SES), Customer shall install a placard at the SES giving concise directions to, and the location of, the Disconnect Switch.

In the event APS allows more than one Disconnect Switch to be installed at a Customer’s facility, the switches shall be labeled 1/x, 2/x, etc. where x is the total number of Disconnect Switches.

In addition, a warning label shall be mounted on the Disconnect Switch front cover with the following words: "Warning: Electric Shock Hazard. Do Not Touch Terminals. Terminals On Both The Line And Load Sides May Be Energized In The Open Position".

8.6.3 **Generator Meter**

The Customer shall label any meter installed to meter the electrical output of a Generator as "Generator Meter" or "Photovoltaic System, Wind Turbine, etc, Meter", as the case may be.

In the event APS allows more than one Generator Meter to be installed at a Customer's facility, the meters shall be labeled 1/x, 2/x, etc. where x is the total number of Generator Meters.

8.6.4 **Service Entrance Section**

When a photovoltaic system is connected on the supply (utility) side of the SES main breaker, in accordance with the NEC and requirements specified in this document, a label shall be placed adjacent to the main service breaker stating:
"Warning: A Generation Source is connected to the Supply (Utility) Side of the Service Disconnecting Means. Follow proper Lock-Out/Tag-Out Procedures to ensure the Photovoltaic System Utility Disconnect Switch is opened prior to performing work on this device".

8.7 Protective Relaying Requirements

8.7.1 General Requirements

8.7.1.1 The Customer shall be solely responsible for properly protecting and synchronizing its generator(s) and/or static inverter(s) with the APS system.

8.7.1.2 For generators, Customer facility shall include an automatic interrupting device (normally the generator breaker) that is rated to interrupt available fault (short circuit) current and is tested and certified to applicable UL standards. The interrupting device shall be directly tripped (and not via a programmable logic controller, etc.), as a minimum, by all protective devices required herein. If a Local/Remote control selector switch or any other component is wired in series with the trip and/or close circuit, said component(s) shall not impede or bypass any of the protective devices required herein, or the ability to trip/close the automatic interrupting device.

8.7.1.3 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.

8.7.1.4 For rotating generator classes II and above (>50 kW) utilizing discrete relays that require both voltage and frequency relay protection, separate and independent voltage and frequency relays and associated trip paths to the 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 o/u voltage relay, and for the over/under frequency functions to be integral to a single o/u frequency relay.

Microprocessor-based protective relays may be used, provided that the required functionality and redundancy described is demonstrated.

8.7.1.5 For rotating generator and GFs utilizing static inverter based technology (with an aggregate nominal nameplate rating of 1000 kW and greater) protective schemes that utilize microprocessor based, multi-function relays, the protective relay failure alarm contacts will be configured to trip the automatic interrupting device.

8.7.1.6 The generator protective scheme shall be of a fail-safe design such that loss of the protection scheme control power will immediately cause the automatic interrupting device to open.

8.7.1.7 With the addition of generation at a Customer site, ground fault current magnitude might increase to level where the existing 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.

8.7.1.8 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.

8.7.1.9 A GF utilizing a Momentary Parallel Transition transfer scheme shall install an independent back up timer that directly trips the main breaker(s) feeding the SES. The trip circuit shall not be routed through any circuit or logic scheme that could inhibit or block the trip signal, and not via a programmable logic controller, etc.

8.7.1.10 A GF comprised of one or more generators with an AC continuous nameplate rating of 10 MW or greater will be required to be equipped with Automatic Voltage Regulating (AVR) capability, the capability to operate in Power Factor Control (PFC) mode, and the capability to operate in MVAR Control mode as specified in Section 8.9.

8.7.1.11 Any GF comprising static inverters with an aggregate generator nominal nameplate rating of 10MW or less and interconnecting with a non-Dedicated Feeder, shall utilize inverters that have been tested and certified to UL *Standard for Inverters, Converters and Controllers for use in Independent Power Systems,* UL1741, by a Nationally Recognized Testing laboratory (NRTL) certified by OSHA to perform the UL1741 test standard.

8.7.1.12 Any GF comprising static inverters with an aggregate generator nominal nameplate rating of 10 MW or less, and interconnecting with a Dedicated Feeder, shall utilize inverters that have been tested and certified as specified in Section 8.7.1.11, or Customer shall ensure, at a minimum, that the inverter performance tests specified below are performed and certified by a NRTL to ensure compliance with the following sections of IEEE 1547-2003 (per section 40.1 of UL 1741-2010):

Section 4.3 Power Quality

- Section 4.3.1 Limitation of DC injection
- Section 4.3.2 Limitation of flicker induced by the DR
- Section 4.3.3 Harmonics

Customer shall provide APS with a copy of the test results and certification from the NRTL, for APS review and approval.

8.7.1.13 Any GF comprising static inverters with an aggregate generator nominal nameplate rating of greater than 10 MW and interconnecting with a

Dedicated Feeder, shall be equipped to support the options specified as per Section 8.9. However, Customer shall ensure, at a minimum, that the inverter performance tests specified below are performed and certified by a NRTL to ensure compliance with the following sections of IEEE 1547-2003 (per section 40.1 of UL 1741-2010):

Section 4.3 Power Quality
- Section 4.3.1 Limitation of DC injection
- Section 4.3.2 Limitation of flicker induced by the DR
- Section 4.3.3 Harmonics

Customer shall provide APS with a copy of the test results and certification from the NRTL, for APS review and approval.

8.7.2 Minimum Relaying Requirements

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

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

2. Synchronous generators require a synchronizing scheme, either manual with a synch check relay, or an automatic synchronizer.

3. Static inverters shall be tested and certified to UL *Standard for Inverters, Converters and Controllers for use in Independent Power Systems,* UL1741, by a Nationally Recognized Testing Laboratory (NRTL) certified by OSHA to perform the UL1741 test standard.

8.7.2.2 Class II (Three Phase: 51-300 kW)

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

2. Synchronous generators require a synchronizing scheme, either manual with a synch check relay, or an automatic synchronizer.

3. Inverters shall be tested and certified 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 UL1741 test standard, unless otherwise provided for in Section 8.7.1.

4. For installations interconnected to the utility through a transformer with connections that will not supply current to a ground fault on the utility system, a ground fault detector may be necessary. APS will advise

Customer of any such requirements after a preliminary review of the Customer's proposed installation.

5. Other equipment such as supervisory control and alarms, telemetering and associated communications channel 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 thereof. APS will advise Customer of any communications requirements after a preliminary review of the proposed installation. Refer to Section 8.8 for additional details.

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

1. For this class of installation, utility grade protection devices and equipment are required.

2. The minimum protection required for induction and synchronous generators is overvoltage, undervoltage, overfrequency, underfrequency, and negative sequence time overcurrent.

3. Synchronous generators require a synchronizing scheme, either manual with synch check relay, or an automatic synchronizer.

4. Static inverters shall be tested and certified to UL Standard for Inverters, Converters and Controllers for use in Independent Power Systems, UL1741, by a Nationally Recognized Testing Laboratory (NRTL) certified by OSHA to perform the UL1741 test standard, unless otherwise provided for in Section 8.7.1. In addition, a redundant over/under voltage relay will be required for inverters with an AC output nominal rating of ≥1000 kW, or whenever the aggregate inverter AC output nominal rating of a GF ≥1000 kW.

5. For installations interconnected to the utility through a transformer with connections that will not supply current to a ground fault on the utility system, a ground fault detector may be necessary. The utility will advise Customer of any such requirements after a preliminary review of the Customer's proposed installation.

6. Other equipment such as supervisory control and alarms, telemetering, and associated communications channel may be necessary. APS will advise Customer of any such requirements after a preliminary review of the proposed installation. Refer to Section 8.8 for additional details.

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

Note: Induction Generators or Line Commutated Inverters in this size range are not anticipated.

1. For this class of installation, utility-grade protective devices and equipment are required.

2. Relays for overvoltage, undervoltage, overfrequency, and underfrequency are required.

3. Synchronous generators require a synchronizing scheme, either manual with synch check relay, or an automatic synchronizer.

4. A ground time overcurrent and ground instantaneous overcurrent relay, or for installations interconnected to the utility through a transformer with connections that will not supply current to a ground fault on the utility system, a ground fault detection scheme is required.

5. The following additional protective functions are also required:

   (a) Voltage-controlled time overcurrent
   (b) Loss of excitation
   (c) Overexcitation
   (d) Negative sequence time overcurrent

6. Other equipment such as supervisory control and alarms, telemetering, and associated communications channel are generally required. APS will advise Customer of any such requirements after a preliminary review of the proposed installation. Refer to Section 8.8 for additional details.

The minimum protective relaying requirements for parallel operation of distributed generation are summarized in the table below. Note that depending on the specific application of the GF, a Reverse Current relay may be required. APS will advise the Customer of any such requirement after a preliminary review of the proposed installation.

Summary of Minimum Protective Relaying Requirements

	Induction Generator	Synchronous Generator	Static Inverter
Class I 50 kW or less	Undervoltage	Undervoltage, Synchronizing	UL 1741*
Class II 51 to 300 kW	Overvoltage, Undervoltage Overfrequency, Underfrequency	Overvoltage, Undervoltage, Overfrequency, Underfrequency Synchronizing	UL 1741*
Class III 301 to 5,000 kW	Overvoltage, Undervoltage Overfrequency, Underfrequency Negative Sequence Time Overcurrent	Overvoltage, Undervoltage, Overfrequency, Underfrequency Synchronizing Negative Sequence Time Overcurrent	*UL 1741 with redundant Over/Under voltage for > 1000 kW
Class IV Greater than 5,000 kW	No induction generators of this size anticipated	Overvoltage, Undervoltage, Overfrequency, Underfrequency, Synchronizing, Ground Time Overcurrent, Ground Instantaneous Overcurrent, Voltage-controlled Time Overcurrent, Loss of Excitation, Overexcitation, Negative Sequence Time Overcurrent	**No individual inverters of this size anticipated. Refer to Sections 8.7.1 and 8.9 for additional GF aggregate requirements.

*Inverters shall be tested and certified to UL1741 unless the requirements specified in Sections 8.7.1 and 8.9 apply. Redundant O/U voltage protection is required for individual inverters with an AC output nominal rating of ≥1000 kW, or whenever the aggregate inverter AC output nominal rating of a GF is ≥1000 kW. Such protection shall be applied to one or more breakers external to the inverter(s).

**For utility scale installations utilizing static inverters with an aggregate AC output nominal rating of ≥10 MW will require redundant O/U voltage and O/U frequency protection. Such protection shall be applied to one or more breakers external to the inverter(s) (i.e. the main GF breaker(s)). Please reference section 8.8 of this document for further details.

8.7.3 Relay Settings

Voltage and frequency relays needed for minimum interface protection for all classes will have setting limits as specified below with exception to Generating Facilities subject to Low Voltage Ride Through (LVRT) requirements, Section 8.10.

8.7.3.1 Undervoltage relays will operate at no less than 80% of the nominal voltage level and will have a maximum time delay of 1.0 seconds.

8.7.3.2 Overvoltage relays will operate with a maximum time delay of 1.0 seconds for a voltage range of greater than 110% and less than 120% of nominal voltage. The relay will operate instantaneously at 120% or greater of nominal voltage to provide a maximum clearing time of 10 cycles.

8.7.3.3 Underfrequency relays will operate at no less than 58 Hz and have a maximum time delay of 1.0 seconds.

8.7.3.4 Overfrequency relays will operate instantaneously at any frequency greater than 60.5 Hz to provide a maximum clearing time of 10 cycles.

Additional settings for Class IV installations and/or any other relays that may be required due to unusual circumstances will be handled on an individual basis.

8.8 Additional Requirements for GF with Aggregate AC Generation ≥ 1MW.

The requirements outlined in this Section apply to any Generating Facility that is nominally rated to generate 1 MW or more and is interconnected with the APS System for continuous parallel operation. APS will identify the actual requirements, and the optimum method of implementing these as part of the Interconnection Study (refer to Section 8.1.3). APS can also assist the Customer during the preliminary stages of the project to implement the identified requirements into the Customer's design drawings.

Note that this Section applies to generation of 1 MW or more interconnected behind any single APS metered point of electric service delivery, and up to 1 MW will normally be allowed to be connected behind such a metered point without having to implement the requirements outlined in this Section unless determined otherwise by APS.

8.8.1 Transfer Trip

(a) A Transfer Trip scheme will normally comprise a relay located at the APS substation feeder breaker which communicates via fiber optic cable with a relay located at the GF along with associated control circuits. Whenever the APS substation breaker opens, a trip signal is sent to the GF to automatically trip the generation off line.

If the GF is fed from a Dedicated Feeder, and it is determined during the interconnection review process that a transfer trip scheme is needed, APS will require the Customer to install a relay and communication link that interfaces with

the APS substation relay. In lieu of a transfer trip scheme, it may be acceptable, as determined by APS, to install a Hot-Bus/Dead-Line permissive scheme at the substation for static inverter based systems.

(b) In the event that a Transfer Trip is required, Customer will need to install and maintain a Schweitzer SEL 351-7 relay for transfer trip control of the Generator breaker along with the associated instrumentation transformers and circuitry. APS will install, at Customer's expense, a SEL 351-7 relay at the APS substation.

In accordance with the APS ESRM, APS will provide Customer with the overcurrent relay settings (50, 50N, 51, and 51N) for the SEL 351-7 relay located at the GF for coordination with the SEL 351-7 relay at the APS substation. Additionally, Customer will activate device functions 27 (Undervoltage), 59 (Overvoltage), and 81 O/U (Over/Under Frequency) in the SEL 351-7 relay located at the GF. Additionally, Customer shall incorporate Relay Failure scheme in accordance with 8.7.1.5 per this document. Trip settings for these functions will be in accordance with the APS Interconnection Requirements. Customer will submit settings for APS review and approval.

In the event that there is a loss of Mirrored Bits communication between the APS Substation relay(s) and GF relay(s), the GF breaker(s) shall trip open via the GF relay(s) settings. It is acceptable to add a 15 cycle delay for loss of Mirrored Bits within the GF relay(s) settings to avoid nuisance trips.

8.8.2 Remote Trip

(a) A Remote Trip is a manual trip signal issued by the APS Control Center to trip the generation off line and isolate it from the APS Distribution System. This signal will normally be communicated via fiber optic cable originating at the APS substation or communicated via a VG36 leased telephone line provided by the local telephone company. It will generally trip the generator breaker(s) via a Customer installed breaker control circuit. Any GF that is 1 MW or greater shall be equipped for Remote Trip capability.

A GF with an aggregate generator nominal nameplate rating less than 1 MW will not typically require remote trip capability as specified above. However, depending upon the GF's impact on the APS System, APS may require remote trip and remote monitoring capability.

The Remote Trip function will be accomplished via a Remote Terminal Unit (RTU) provided by APS at Customer's expense and installed by Customer at Customer's Facility.

(b) For a GF comprising static inverters located on a non-dedicated feeder, should APS need to switch the section of the normal feeder on which the GF is located, to another feeder for line/breaker maintenance, feeder sectionalizing/switching, and/or load transfer operations, APS reserves the right, without liability, to remotely trip the GF off-line for the duration of any such operation. If adverse

operating conditions occur on the APS system due to the GF, APS reserves the right to open the Generator breaker without notice until such conditions are addressed. Additionally Customer will assume full responsibility for the inverters shutting down in accordance with UL1741/IEEE1547 in the event of a utility outage or system fault.

(c) For a GF located behind a primary meter on a dedicated feeder, an exception to the remote trip requirements may be granted by the Energy Delivery Compliance Committee (EDCC). APS Planning, Operations and Interconnection Engineering shall mutually agree to submit the exception request to EDCC prior to the request submittal. Remote monitoring or GF production data in 15 minute intervals may still be required.

8.8.3 Remote Monitoring

(a) Any GF rated at 1MW or greater shall be equipped for remote monitoring by the APS Control Center. APS will install, at Customer's expense, a bi-directional EMS meter (in addition to the billing meter) along with communication wiring in the SES incoming metering section to provide instantaneous Watts, VARS, Volts and cumulative kWh readings to the RTU. For all installations, Customer must provide two meter sockets and two sets of test switches at the SES metering compartment in accordance with the APS ESRM – one set for the EMS meter and the other for the billing meter. APS may elect to install, on a temporary basis, and at APS' expense, transducers in lieu of the EMS meter, in the event such meter is not available at the time of the GF start-up. Once the EMS meter becomes available, APS will coordinate with Customer to install it and remove the transducers.

(b) In the event that a meter is required to be installed to monitor the Generator output, Customer will provide a metering section in accordance with the APS ESRM. APS will install, at Customer's expense, an EMS meter along with communication wiring in the metering section to provide instantaneous Watts, VARS, Volts and cumulative kWh readings to the RTU.

(c) Customer will provide hard-wired open/close contact (b contact) status points and control wiring to the RTU for any breaker with Remote Control capability by APS so that APS can monitor the status of this breaker remotely.

8.8.4 Technical Details

(a) At Customer's expense, APS will provide, operate and maintain an RTU. Customer shall install the RTU enclosure as provided by APS, and APS will install and program the RTU. Customer shall provide a 120 VAC, 15 Amp (minimum) power supply to the RTU, and shall install 2" rigid metallic conduits for all required circuits associated with the RTU. The 120VAC/15A circuit must be from a dedicated feed upstream from the Generator breaker, so it remains energized in the event the Generator breaker is open. The RTU and associated equipment installed at the GF must be accessible by APS personnel on an

unrestricted 24 hour basis. For all PPA/Customer Owned GF, the dedicated 120 VAC circuit shall not be backed up via customer provided UPS.

(b) The RTU will be housed in an enclosure along with an appropriate communication device (e.g. fiber converter, or modem as specified by APS), and battery back-up system. The RTU enclosure typically measures 36"X30"X10", and is a Nema 3R outdoor rated cabinet. Additional RTUs may be required if a single RTU cannot be located in the immediate vicinity of the SES and any required metering on the generation output. The top of the RTU cabinet shall not exceed more than 6' from final grade.

(c) The Customer is responsible for securing a communication path back to the APS communication system (e.g. fiber optic back to APS Substation or VG36 leased line via the local telephone company). Any VG36 leased line shall be a Class B, Type 3, Full Duplex Data Circuit with sealing current, 1200 Baud. Customer shall provide a leased data quality VG36 phone line from the RTU through the Telco Point of Presence (POP) network to APS designated location. Customer is responsible for paying the monthly service fee for the communication path. In the event the communication path is disrupted for any reason, Customer is responsible for remedying the issue.

In the case the communication system located at the APS Substation (or designated APS location) communicating back to the APS EMS system cannot support the additional data points, the Customer will be responsible for upgrading the communication path. The cost of any communication upgrades, and the monthly service fee will be passed on to the customer. Equipment and means of completing the communication path will be determined by APS and communicated to the customer during the interconnection study process.

(d) Customer will provide, install and maintain Generator breaker control circuitry ("Breaker Control Scheme") that will accept two remotely initiated control functions from the APS EMS system through the APS RTU (for each generation breaker). If a Local/Remote control selector switch or any other component is installed and wired in series with the trip and/or close circuit associated with the Generator Breaker, the APS remote trip & block close/close permissive control circuit must not be impeded. APS must be able to remotely trip the Generator breaker open regardless of the position of the Local/Remote control switch.

i. Trip Function: Contacts will close momentarily when APS issues a trip command through the RTU.

The trip function contacts within the APS RTU are "dry" (not powered). Maximum ratings for the contacts on the trip relay in the APS RTU are as follows:

- 10A, 120VAC
- 3A, 125 VDC
- 10A, 28VDC

ii. Block Close / Close Permissive Function: Contacts will latch in the open position when APS issues a block close command. Contacts will latch in the closed position when APS removes the block close, i.e. issues a close permissive.

The generator breaker control logic will allow the Customer to operate associated breaker, however it will be necessary for APS to first enable the close permissive to allow the Customer to close the breaker. NOTE: The only acceptable means by which the GF breaker(s) is permitted to be closed shall be via the breaker control circuitry (locally or remotely). Circumventing the breaker control circuitry by manually closing the GF breaker(s) for the purposes of energizing the GF is not allowed by APS. Customer shall disable manual closure of the GF breaker(s) by installing a mechanical blocking accessory or other means acceptable to APS.

The block close function contacts within the APS RTU are "dry" (not powered). Maximum ratings for the contacts on the block close relay in the APS RTU are as follows:

- 10A, 120VAC
- 0.5A, 125 VDC
- 10A, 28VDC

Customer is responsible for providing an interposing relay and any associated power source if needed to ensure that the APS RTU contact ratings are not exceeded.

Depending on the GF system configuration, these functions may be applied to either individual Generator breaker(s) within the Customer gear, or to a single main Generator breaker for the GF in order to isolate the Generator(s) from the APS System.

Note that APS will provide a "wetting" voltage of 24 VDC for the Customer generation breaker status contacts.

APS will require an AC/DC schematic diagram for the Breaker Control Scheme as part of the final interconnection diagram submittal showing the terminal connections and sequence of operations of the Trip and Block Close/Close Permissive functions.

(e) APS can provide upon request sample diagrams showing typical RTU/Communication requirements. These requirements must be incorporated on the final Electrical One-Line Diagram required for APS interconnection review.

(f) Customer shall include an Uninterruptable Power Supply (UPS) or battery bank with a DC to AC inverter for any required Breaker Control Scheme and any SEL

351-7 relay to be operational if the normal power source should fail. The UPS shall be capable of supplying backup power for at least six continuous hours and shall be hard-wired (a "plug in" UPS is not acceptable). Customer will perform periodic maintenance on the UPS batteries to ensure that it remains in operational condition at all times. Documentation shall be provided that the UPS has been tested and is operational as part of the APS final inspection.

8.8.5 Project Details

(a) Circuit requirements are dependent on generation size and all system additions and system improvements to meet the needs of the Customer for its DG installation. Any additions/improvements to the APS system as a result of the DG installation will be expensed to the Customer. A cost summary will be provided to the customer as part of the Interconnection Study.

(b) Please be advised that the materials required for the RTU and specialized metering are long lead time items that can take as long as 4 months to receive. Please note that APS cannot allow the Customer to place the Generating Facility (GF) on-line until after all APS and Customer required work outlined in the Interconnection Study has been completed in addition to all applicable requirements being implemented as delineated in the APS Interconnection Requirements. The customer is advised to communicate need dates to APS as soon as practically possible so as to avoid project delays.

(c) A communication shelter may be required (specifically for APS owned projects) to house the Supervisory Control and Data Acquisition (SCADA), communication, and any security equipment. At the Customer's option, a second service can be provided at the applicable retail rate and system voltage for the communication shelter electrical service. In such cases, APS will coordinate the RTU and associated communication equipment arrangement and installation details with the Customer. The communication shelter will be provided and installed by the Customer. All conduits, wiring, and components related to the SCADA, communication, and any security system shall be installed prior to final commissioning. It is suggested that if a communication shelter is required that ample time be allotted for ordering, delivering, and installation of the communication shelter and associated equipment.

8.9 Dynamic Response Requirements.

For any GF with an aggregate generator nominal nameplate rating of 10 MW or larger, Customer shall ensure that the GF is equipped and capable of meeting all of the following requirements at the Point of Interconnection:

(a) Capability to operate in Power Factor Control (PFC) mode at a fixed power factor within plus or minus 0.95 pf at the maximum continuous nameplate rated MW output of the generator(s). Power Factor shall be measured at the high side of the transformer or at

the POI subject to APS' discretion. NOTE: APS default GF setting shall be 0.98 leading (absorbing VARS at the GF) unless informed otherwise by APS.

(b) Capability to operate at any MVAR output at any power level within the MVAR range calculated in item (a) above while the generator is on line.

(c) Capability to operate in Automatic Voltage Regulator (AVR) mode and shall regulate the voltage at a fixed value within plus or minus 0.95 pf and within 0.95 to 1.05 pu voltage range.

(d) When the GF acts as a net load to the APS System, the power factor of the net load shall not be less than 90% lagging.

APS will specify, dependent upon the results of the interconnection study and/or changes to APS' System, whether Customer will operate the GF in modes (a), (b) or (c) above, and APS will specify the set point.

A GF with an aggregate generator nominal nameplate rating less than 10 MW will not typically require power factor or voltage regulation as specified above. However, depending upon the GF's impact on the APS System, APS may require one or more of (a), (b) and (c) above.

(e) Additional requirements:

- The GF Developer/Customer shall select a controller (Human Machine Interface or Dynamic Reactive Device) capable of operating in all modes (a), (b) and (c) above.
- For AVR operating mode, voltage regulation attained by the controller shall be within 0.25% of the voltage set point value.
- Voltage change shall not exceed 0.50% during capacitor bank step change/switching.
- The controller shall accept a step of change reference and drive the plant output to 90% of the new reference point within 2-4 seconds of the step input, and shall settle/damp out to a final value within 8 seconds of step input irrespective of operating mode.
- The GF Developer/Customer shall provide a written performance testing procedure as part of the drawing and application submittal. A sample procedure, checklist, maybe provided upon request.
- Once the Customer's GF is on-line at full power output, the Customer shall be ready to complete performance testing of the GF within ten (10) business days. APS will coordinate scheduling the performance testing with the Customer on mutually agreed upon date(s). In the event APS personnel are not available to witness any/all performance testing, Customer shall provide a certified test report demonstrating conformance to the requirements noted herein for APS' review and acceptance.
- Upon control system failure (i.e. loss of comm.) the control system shall be programmed to revert to the default setting as specified in 8.9(a) above.

Irrespective of the operating mode, the control system's performance may be evaluated by a step of reference input into the controller. In the case of AVR mode, the step of reference is just a change in the plant's desired output voltage setpoint. **Figure 1** documents the generalized response of a plant control system to a step of refernce into the control at time $\mathbf{t_1}$. The top trace documents the step input and the bottom trace is the controlled plant output (voltage, power factor or VARs). Note that there may be a time delay until $\mathbf{t_2}$ when the the plant output begins to respond to the step input. The time $\mathbf{t_3}$ to reach 90% of the final output value is noted on the plot as well. After the output has attained 90% of its final value, there may be some overshoot and oscillatory response until the plant output settles out to its final value at $\mathbf{t_4}$. Note that there will be a small difference between the final value attained by the control system and the desired value specified by the setpoint. This difference is expressed as a percent error band referenced to the desired setpoint verses the actual final value.

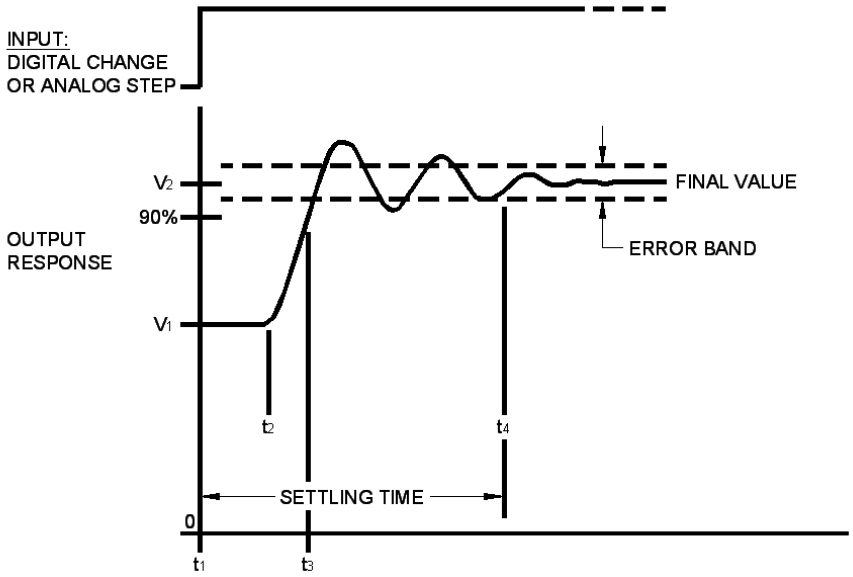

Figure 1 – Generalized Plant Response to a Reference Step Input

(f) In the event APS contacts Customer to change the operating mode or set point, Customer will implement such request within four (4) hours. If the request is made between the hours of 6:00 am to 4:00 pm. If the request is made outside these hours, the request must be implemented by 8:00 am the following morning. This is dictated by APS Energy Control Center (ECC).

8.10 Low Voltage Ride Through (LVRT).

Applies to generating systems interconnected to the APS system at 69kV with an aggregate generator nominal nameplate rating of 10MW or larger. Please reference the NERC Standard PRC-024 for more details. Systems subject to this NERC standard shall submit documentation depicting individual systems' Frequency Capability Curves, Trip Times, Voltage Ride Through Time Duration Curves and any other information explaining how the generating system(s) meets the NERC PRC-024 standard. In the event a GF is interconnected at a voltage class less than 69kV (i.e. 12kV) and the generator equipment is able to meet the

requirements of NERC PRC-024 standard, the LVRT features may be activated at APS' option.

9 METERING REQUIREMENTS

This section applies to Customer owned generation that electrically parallels with the APS distribution system.

The Customer must provide and install, at Customer's expense, meter sockets and metering cabinets in accordance with APS service standards, in Readily Accessible locations acceptable to APS to accommodate any meter(s) that are required by rate schedule(s) or other applicable APS agreement(s). Such standards are specified in the APS document titled "Electric Service Requirements", which can be accessed at the following website:

http://www.aps.com/esrm

Please reference the Metering Installation section 300 for further details.

APS will furnish, own, install and maintain billing meter(s) at the point of delivery to the Customer's facility, and any meter(s) that may be required by the applicable electric rate schedule to measure the output of the generator(s). The responsibility for the costs of providing and maintaining any required meters will be specified in the applicable rate schedule or other APS agreement.

Under no circumstances shall any metering enclosure be used as a raceway for any conductors other than those phase conductors being metered and the associated grounded conductor (neutral) and grounding conductor (equipment ground).

In the event Customer needs to install third party metering for a data logger, performance monitoring, current and/or voltage sensing equipment, CTs and/or PTs associated with the GF any wiring terminations shall not be made inside of any APS sealed compartments, subject to APS approval. In addition, connections that require overcurrent protection shall be made in accordance with the National Electric Code, and shall be of negligible load so as to not affect the production output of the Generating Facility. Power circuits for third party metering shall originate at a dedicated circuit that does not impact the production output of the Generating Facility.

All Generating Facilities other than those comprising a Backup Generator must include a system dedicated kWh meter, or meters, (the "Production Meter"), which measures the energy production of the Generator(s). The Production Meter must be installed in compliance with the APS Electric Service Requirements Manual (ESRM) Section 300, which is available on APS' website, and must be installed so as to record the AC energy output produced by the Generator. Please note a valid neutral may be required for APS production metering to work properly.

For Current Transformer (CT) rated installations (greater than 200A), APS will install the production meter, CTs, PTs, test switches and wiring as required. The Customer shall be responsible for installing, in accordance with APS' Requirements a production metering enclosure with meter socket. The customer shall adhere to the following additional requirements regarding production metering enclosures:

- For Secondary Voltage systems of 200A and less (phase to phase voltage less than 600V), Customer shall provide a ring type self contained metering enclosure with safety test blocks and a meter per the APS ESRM.
- For Secondary Voltage systems greater than 200A (with phase to phase voltage less than 600V), Customer shall provide a ring type CT rated enclosure per the APS ESRM.
- For Medium Voltage Systems (phase to phase voltage greater than 600V), Customer shall provide medium voltage lineup with grounding provisions per the APS ESRM.

The location of the Production Meter shall be approved by APS and shall be located so that APS has unassisted 24/7 access to the meter in accordance with APS requirements, including but not limited to Section 300 of the APS ESRM ("Electric Service Requirements Manual") and Service Schedule 1 ("Terms and Conditions for Standard Offer and Direct Access Services"). Please note, customer provided production metering enclosures shall be listed, tested and marked to withstand the available short circuit current. Additionally, all CT rated metering enclosures shall have the bus identified with reference to the generation source side prior to metering installation with a temporary tag labeled "Generation Source/Polarity".

APS may, at its discretion and expense, replace a Customer-installed Production Meter and associated equipment with an APS-owned Production Meter for system monitoring purposes.

In cases where the applicable rate schedule (e.g. E-56 and E-56 R) or other APS agreement requires billing meter(s) to be installed on the output of the facility generators, Customer must provide a dedicated analog dial tone phone line to each such generator meter and also to the GF service entrance section utility meter(s) and/or sub meters if necessary. Each dedicated phone line is to be landed on the APS-provided telephone interface module, normally located within two feet of the meter. The phone line is referred to as a Single Business Line, Type 1FB, and should be ordered with NO additional features such as Call Waiting, Call Transfer, Call Hold, Message Waiting, etc., and no long distance service. For network systems with IPBX or VoIP, an IP to analog (or gateway) device with modem pass through capabilities shall be installed by the customer and shall support analog modem service of 56kBps and higher. The IP to analog device shall also support CCITT V.90 and CCITT V.92 standards, and lower.

Customer is responsible for paying the monthly service fee for the dedicated analog dial tone phone line. In the event the phone line service is disrupted for any reason, Customer is responsible for remedying the issue. Cell phone technology maybe provided by APS in the event the GF is located within an Advanced Metering Infrastructure (AMI) deployed area In lieu of customer providing a dedicated phone line.

Note: The customer will be advised at the time of application if APS has any additional requirements for production metering and communication circuitry if required (i.e. dedicated phone line for non-program installations in a non-AMI area).

Customer must provide a suitable visual-open disconnecting means, subject to APS' approval, to electrically isolate any Current Transformer (CT) rated meter from all potential sources of power. Additionally, for meters installed on systems with a phase to phase voltage of 600V or greater, suitable grounding provisions shall also be required in accordance with the APS ESRM (Section 1100) and subject to APS approval.

Exception: For static inverter based systems certified to UL1741, all CT Rated Production Metering systems with phase to phase voltage less than 600V may, in lieu of a visual open switch, utilize circuit breaker(s) or disconnect switch(es) with locking provisions in order to isolate the GF side of the CT Rated Metering Equipment subject to APS review and approval. APS will not accept electronic disconnect devices (i.e. push-button type). Please note the exception does not preclude the need for a visual open disconnect switch on the Utility side of the CT Rated Production Metering Equipment required per section 8.2. If the GF side AC isolation device is not located within the same work space as the GF CT Rated Production Metering, Customer shall provide a placard with explicit directions as to the location of the GF side isolation device.

All CT rated metering enclosures shall be submitted by Customer to the APS Meter Shop for review and approval in accordance with the APS ESRM. Such submittal shall clearly indicate the points of connection of the utility and generation sources and shall be submitted along with a copy of the Electrical One-Line Diagram of the GF duly accepted by APS. Please submit shop drawings of the metering enclosure to submittals.metershop@apsc.com. Please reference the Type of System and the APS Reservation or Install ID in the subject line (e.g. Photovoltaic System, Reservation #12345 Shop Drawings).

Generator output meters and APS billing meters shall be installed in a Readily Accessible place so as to provide safe (no tripping hazards, domesticated animals or other obstructions, etc.) and easy, unrestricted and unimpeded access to APS personnel and must be installed adjacent to the Customer's SES unless otherwise approved by APS.

10 RATE SCHEDULES APPLICABLE TO DISTRIBUTED GENERATION

The rate schedules shown below are applicable to Customer owned generation that electrically parallels with the APS electric distribution system. Note that participation under a particular rate schedule is subject to the Generating Facility qualifying for that schedule.

- EPR-6, “Rates for Renewable Resource Facilities for Partial Requirements”

  This rate schedule requires a bi-directional meter to be installed at the SES to effect Net Metering. Bi-directional metering is currently not available to Customers participating in Totalized Metering under Service Schedule 4.

- EPR-2, "Purchase Rates for Qualified Cogeneration and Small Power Production Facilities under 100kW Receiving Partial Requirements or Interruptible Service."

- E-56, “Partial Requirements Service”

  Rate schedule E-56 is applicable to Customers installing generation equipment with a nameplate A/C output rating of greater than 100 kW. (Customer should consider qualifications for the EPR-6 and E-56 R rates before selecting the E-56 rate).

- E-56 R, “Partial Requirements-Renewable”

  Rate Schedule E-56 R is applicable to Customers installing solar/photovoltaic, wind, geothermal, biomass and biogas generation systems with a nameplate A/C output rating of greater than 100 kW. (Customer should consider qualifications for the EPR-6 rate before selecting the E-56 R rate).

The above rates can be accessed at the following website:

http://www.aps.com/en/ourcompany/ratesregulationsresources/serviceplaninformation/Pages/business-sheets.aspx

The rates specified above do not apply to backup or standby generation that is used solely for emergency purposes, and that parallels with the utility for brief periods in order to effect a power transition from the utility to the backup generation and vice versa.

11 TESTING AND START-UP REQUIREMENTS

11.1 Following APS approval of the Customer's Generating Facility and associated minimum interconnection requirements, the Customer shall, at a minimum, have all specified interface equipment, shutdown and associated protective devices tested and calibrated at the time of installation by qualified personnel and shall also perform functional trip testing of these relays and associated Generator breaker. Calibration must include on-site bench testing of pickup and timing characteristics of the relays. Functional testing must demonstrate that each protective relay trip function as required herein, upon a (simulated) out of tolerance input signal will trip the generator breaker, and shall also include a simulated loss of control power to demonstrate that the generator breaker will open.

A trip timing test (simulated loss of voltage) will suffice for static inverters tested and certified to UL1741.

11.2 The Customer shall provide APS with a certified copy of calibration and functional test results for all GF's comprising of Rotating Machines and for any GF comprising of Static Inverters with an aggregate AC nameplate rating of 10MW or larger performed at the time of commissioning of the GF. Customer must also notify APS at least ten (10) business days in advance that such tests are to be performed and allow APS personnel to witness the tests.

11.3 In addition to having the protective devices tested by a qualified testing firm at the time of installation, the Customer shall also have such tests performed for rotating generator protective schemes at intervals not to exceed four (4) years by qualified test personnel. The Customer shall provide APS with a certified copy of such test results upon request by APS.

11.4 The Customer is required to have a signed Interconnection Agreement with APS, and must also provide APS with any other required documentation, prior to electrically paralleling the GF with APS' system. The Customer must provide APS with a copy of the Final Electrical Clearance ("Green Tag") for the GF as provided by the AHJ, or provide APS with a duly signed and notarized Letter-in-Lieu of Electrical Clearance if no AHJ electrical inspection is required, before APS will schedule the site inspection.

11.5 Customer shall not commence interconnected operation of the GF with the APS System until (a) the GF has been inspected by an authorized APS representative and written notification is received from APS allowing the GF to commence parallel operation with APS' System; and (b) Customer provides, for any GF (other than a Backup Generator) with an aggregate generation nominal nameplate AC rating of 1MW or greater, documentation acceptable to APS (including FERC Form 556), that confirms the GF has achieved Qualifying Facility (QF) status under 18 CFR, Chapter I, Part 292, Subpart B, including, without limitation §292.207 of the FERC's regulations, as amended, unless the exception to the self-certification specified in Section 3 of this document applies.

11.6 The Customer shall give APS at least ten (10) business days prior notice of when initial startup of a rotating generator or any static inverter based GF with an aggregate generator

rating of 1 MW or greater is to begin, and APS will have the right to have a representative present during initial energizing and testing of the GF.

11.7 For all GF's comprising of Rotating Machines and for any GF comprising of Static Inverters with an aggregate AC nameplate rating of 10MW or larger Customer shall submit a pre-test calibration and functional test check list, prior to witnessing calibration and functional testing of the GF protective devices (relays) associated with the Generating Facility breaker(s), at APS' request. The customer shall also provide documentation/certification to APS ensuring that the control wiring (along with CT and PT circuitry) has been completed and verified, relay settings have been applied, and any internal trip path testing has been performed (i.e. dry run). Customer shall also provide relay test report(s), equipment test reports (transformers, inverters, generators, etc..) and any other required certification/documentation required by APS prior to granting full permission to parallel with APS.

11.8 For any GF comprising of Static Inverters with an aggregate AC nameplate rating of 10MW or larger, Customer shall hire a 3rd party testing firm to perform full plant trip timing test. Customer shall provide a test report performed by a qualified testing firm. APS may, at its option, require any such report to be stamped by a professional electrical engineer licensed in the state of Arizona. Test report shall provide trip time, voltage and frequency profile graphs with all inverters on-line (recommend at low power output). Any communication latency between plant equipment at t=0 shall be communicated within the test report. Customer must also notify APS at least ten (10) business days in advance that such tests are to be performed and allow APS personnel to witness the tests. APS, at its option, may elect to connect its test equipment along with, or in lieu of, Customer's test equipment for the purpose of performing the trip timing test. For the purposes of the trip timing test Customer may be required to disable the Mirrored Bits Receive function at the GF relay(s) for APS DTT (Direct Transfer Trip).

12 OPERATIONAL AND MAINTENANCE REQUIREMENTS

12.1 The Customer will be responsible for operating and maintaining the generator facility in accordance with the requirements of all applicable safety and electrical codes, laws and governmental agencies having jurisdiction.

12.2 The Customer shall protect, operate and maintain the generating facility in accordance with those practices and methods, as they are changed from time-to-time, which are commonly used in prudent engineering and electric utility operations and shall operate and maintain the generating facility lawfully in a safe manner and non-hazardous condition.

12.3 The Customer will allow APS and its authorized agents access to the protective relaying and control facilities to conduct whatever startup or periodic tests APS deems necessary. APS will provide the Customer with advance notice of such tests, so that the Customer's representatives may be in attendance when such tests are performed.

12.4 In the event APS or its authorized agents lock open the Disconnect Switch, the Customer shall not remove or tamper with such lock.

12.5 APS will be allowed to install on Customer's premises any instrumentation equipment for research purposes. Such equipment shall be owned, furnished, installed and maintained by APS.

12.6 APS (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 APS may install, provided that as reasonably as possible, notice is given to the Customer prior to entering its premises; (b) maintain, replace or repair APS equipment, and which may require APS personnel to open the Disconnect Switch without notice; (c) immediately and without prior notice disconnect or cause Customer to immediately disconnect, the GF or otherwise render the GF disconnected from the APS system (including by opening the Disconnect Switch) if, in APS' opinion, a hazardous condition exists and such immediate action is necessary to protect persons, APS facilities or other customers' or third parties' property and facilities from damage or interference, or if, in APS' opinion, any of the protective devices is not or does not appear to be operating properly; (d) open the Disconnect Switch without notice if an operating clearance is required by APS personnel; (e) close the Disconnect Switch upon completion of APS work performed under an operating clearance.

12.7 Upon termination of the Interconnect Agreement, the Customer shall be responsible for ensuring that the Disconnect Switch is immediately opened, and that the electric conductors connecting the Customer's generator(s) to the Disconnect Switch are lifted and permanently removed, so as to preclude any possibility of interconnected operation in the future. APS reserves the right to inspect the Customer's facility to verify that the generator is permanently disconnected.

13 APPLICATION PROCESS AND GENERAL REVIEW REQUIREMENTS

13.1 For a static inverter-based GF with an aggregate nominal AC nameplate output rating of less than 1 kW that interconnects with the APS System, the Customer is not required to submit an Interconnection Application to APS, and APS will not inspect the installation or prepare an Interconnection Agreement for Customer signature. However, it remains the Customer's responsibility to (i) have the system properly permitted and inspected by the AHJ; (ii) ensure that the inverters are tested and certified to UL1741 in accordance with section 8.7.1.11; and (iii) conform with all applicable APS interconnection requirements as specified in this document.

13.2 Customers wishing to interconnect a static inverter-based GF with a nameplate rating of greater than 1 kW are required to submit a copy of the Building Permit issued by the AHJ along with the completed APS Interconnection Application and diagrams specified therein. The Building Permit shall be the permit issued by the AHJ following AHJ approval of the GF diagrams and not the "permit application" form. The applicable "Interconnection Application" form must be completed and all supplementary information requested therein must be provided. Refer to Appendices A and B for further requirements and instructions. The required drawings shall be prepared and submitted in accordance with the requirements specified in this document and in a format depicted on the APS Sample Drawings located at www.APS.com/dg. APS may accept a set of the required diagrams (normally one-line, three-line, array, plant location and site plan) approved by the AHJ provided these diagrams have been prepared in accordance with APS' Sample Drawings and contain the necessary information show therein and as otherwise specified in this Interconnection Requirements manual and its Appendices.

13.3 Depending on the GF type and size, APS will review the Interconnect Application along with the required diagrams for consistency with the APS Interconnection Requirements, and will provide comments back to the Customer or Customer's designee. It is APS' expectation that the Customer-provided diagrams are in compliance with all NEC, APS, and AHJ requirements. APS generally will not require re-submittal of the Interconnection Application or drawings unless the drawings or system design is revised prior to scheduling the APS site inspection, or APS requests a re-submittal. As a part of the APS Site Inspection, APS will inspect to ensure all applicable diagram comments made by APS have been incorporated.

If there is no plan review or permit requirement imposed by the AHJ where the GF is located, then APS will require drawings submitted per Appendix A or B of the Interconnection Requirements, as well as a notarized copy of APS' Letter-in-Lieu of Electrical Clearance form. APS may require drawings to be stamped by a Professional Engineer (Electrical) in the State of Arizona, and APS will provide comments to the Customer if applicable and as required. A re-submittal of drawings may be required in this case depending on compliance issues identified during the APS drawing review process. Diagram review by APS does not relieve the Customer of the responsibility of full compliance with the APS Interconnection Requirements and all applicable building and safety codes, and local permitting requirements.

13.4 APS' review of documentation submitted by Customer or Customer's designee shall not be construed as any warranty or representation to Customer or any third party regarding the safety, durability, reliability, performance or fitness of Customer's generation and service facilities, its control or protective devices, or the design, construction, installation or operation thereof.

13.5 APS strongly encourages the Customer to contact and work closely with APS at the conceptual stages of the design to ensure that the project proceeds smoothly. APS will generally require a single point of contact with which to coordinate the interconnection process.

13.6 Following receipt of the Customer's Interconnection Application, APS may perform an engineering review to determine if an Interconnection Study (Study) is required. Generally, systems rated at 1 MW or greater nominal generator AC nameplate rating will require a Study (Schedule 6 may apply).

The Study will determine, among other things, whether any modifications, upgrades or additional facilities are required on the APS System, and will also provide the Customer with the estimated costs. The Study may take 90 days or longer to complete, so it is important for the Customer to submit the Interconnection Application as soon as practically possible.

13.7 Should it be necessary for APS to upgrade its system or install additional facilities, (including but not limited to a dedicated feeder, control or protective devices, remote terminal unit (RTU) capability, etc) in order to accommodate or protect the Customer's Generation Facility or APS equipment, APS will provide the Customer with the estimated costs and construction schedule. The Customer will be responsible for all costs incurred to the extent they exceed those normally incurred by APS for customers who do not have self generation facilities, and which must be paid prior to the commencement of any such work.

13.8 Following APS' final site inspection of the Customer's Generating Facility, Customer shall not remove, alter or otherwise modify or change the equipment specifications, including, without limitation, the plans, control and protective devices or settings, and in general the Generating Facility system configuration or any facilities appurtenant thereto that are subject to the APS Interconnection Requirements. If the Customer desires to make such changes or modifications, the Customer must resubmit to APS revised plans describing the changes or modifications for review by APS. No change or modification may be made without the prior written acceptance of APS.

13.9 Following APS' review of the Customer's Interconnection Application and associated diagrams, APS will prepare the Interconnection Agreement, as well as any other applicable agreements (e.g. Electric Supply/Purchase Agreement, Construction Agreement, Line Extension Agreement, and/or Operating Agreement) and/or other required documents for Customer's review and signature.

14 INTERCONNECTION APPLICATION INSTRUCTIONS

A Customer wishing to interconnect a GF with the APS Distribution or Transmission System and not subject to FERC jurisdiction must do the following:

1) Complete the appropriate Interconnection Application (refer to table 14-1 of this section). If Appendix A for Static Inverter installations or Appendix B for Rotating Machinery installations is to be completed, be sure to provide all required Supplementary Information referenced in the relevant Appendix.
2) Provide a copy of the AHJ Building Permit along with the Interconnection Application. If the AHJ, as a matter of policy, does not review diagrams or approve and grant permits for Generating Facilities, then provide a notarized copy of APS' Letter-in-Lieu of Electrical Clearance for the GF. Call or email APS for the form.
3) Forward all required items above to APS via the contact information below.
4) If general liability insurance is required per Section 5 of the Interconnection Requirements manual, then proof of insurance must be provided to APS prior to the date of interconnected operation in accordance with Section 5.
5) If the GF aggregate nominal nameplate rating is 1 MW or greater, and the exception specified in Section 3 of the Interconnection Requirements manual does not apply, then documentation as specified in Section 3 must be provided to APS prior to the date of interconnected operation.

Once received, APS will review the documentation to determine if the design appears to be in conformance with APS' requirements. APS reserves the right to require diagrams submitted to APS to be stamped by a Professional Engineer (Electrical) registered in the State of Arizona.

APS notification that the system design appears to be in conformance with APS' Interconnection Requirements does not represent APS' approval of system's design, nor is it an assurance that the system complies with all applicable electric codes, laws, regulations and requirements applicable to its installation and operation.

Note that the APS Interconnection Site Inspection is in addition to, not in lieu of, an AHJ inspection. Final drawings shall be provided by the Customer per section 13 of this document prior to APS scheduling and performing the APS Interconnection Site Inspection.

It is important that GF not be interconnected or operated in parallel with APS' grid until APS has inspected the system and issues written notification that the system design conforms to APS' requirements.

If you have any questions please call 602-371-6160 for assistance.

Please submit all documentation electronically in .pdf format to:
Commercial-Renewables@aps.com

Include Customer name in subject line of email.

Table 14-1 below shows the appropriate interconnection application to be completed for the GF being contemplated.

Non-Residential Applications	Wholesale Generation	For FERC interconnections use the application located at APS' Oasis Website at: http://www.oatioasis.com/azps/index.html For Non-FERC interconnections, Use the appropriate application (Appendix A or B) available at: http://www.aps.com/dg
	Behind the Meter 1 kW or larger	Use the appropriate application (Appendix A or B) available at: http://www.aps.com/dg
	Behind the Meter less than 1 kW	No APS application is required. Customer must still follow all code and local permitting requirements. Refer to section 13.1.
Residential Applications	APS Renewable Energy Incentive Program 1 kW or larger	Use the application located at: http://www.aps.com/GoSolar
	Non Incentive-Interconnect Only Process 1 kW or larger	Use the application located at: http://www.aps.com/GoSolar
	Relocating system and participated in the APS Incentive Program 1 kW or larger	Send email for transfer packet renewables@aps.com – Subject Line: Transfer
	Relocating system and participated in the Non Incentive – Interconnect Only Process 1 kW or larger	Send email for transfer packet renewables@aps.com – Subject Line: Transfer – Interconnect Only
	Systems less than 1 kW	No APS application is required. Customer must still follow all code and local permitting requirements. Refer to section 13.1.

Table 14-1

APPENDIX A

INTERCONNECTION APPLICATION FOR STATIC INVERTERS ONLY

For APS use

APS Reservation # (if applicable)	
APS Installation #	

CUSTOMER OF RECORD AND SITE SPECIFIC INFORMATION

APS Customer Account Holders Name(s): _____

Customer Contact Person's Name:_____

Telephone (day): _____ E-mail:_____

Generating Facility Address: _____

_____

Customer Contact Mailing Address: _____

_____

APS Account Number: _____ APS Meter #:_____

Is there an existing Generator interconnected behind this meter? (Yes or No): _____

If Yes, please provide kW size and type of existing Generator: _____

Is there an existing Generator connected behind a different meter at this site? (Yes or No): _____

If Yes, please provide kW size and type of existing Generator: _____

Is this GF being interconnected behind a sub-meter constituting a Totalized Metering arrangement?

(Yes or No): _____ If Yes, provide the APS sub-meter # feeding the GF: _____

STATIC INVERTER INFORMATION

A. Manufacturer: _____Model #: _____

B. Inverter nameplate continuous AC power output rating [kW] _____

No. of Units: _____ Total System Nameplate AC rating [kW]:_____

C. Tested and Certified to UL1741? (Yes or No): _____

If No, explain: _____

D. Energy Source (photovoltaic, thermal solar, wind, etc.): _____

E. Prime Mover for Thermal Solar (concentrating dish, solar trough, with Sterling Engine, etc): _____

_____

APPENDIX A: INTERCONNECTION APPLICATION FOR STATIC INVERTERS (cont'd)

PHOTOVOLTAIC SYSTEM INFORMATION - complete only for photovoltaic systems

A. PV Module Manufacturer: _____ Model #: _____ # of Modules _____

B. Utility Disconnect Switch Manufacturer: _____ Model #: _____

C. If one or more dedicated (analog) metering phone line(s) are required by the applicable APS incentive program or rate schedule, verify that any such phone line will be a Single Business Line, Type 1FB, and should be ordered with NO additional features.

(Yes or No):_____ If No, explain: _____

PROPOSED OPERATION

A. Specify whether the inverter will be programmed to operate in parallel with the utility or in backup ("battery charger") mode only:

_____ Parallel mode

_____ Backup mode

B. If the inverter will operate in parallel with the utility, specify which one of the following options you desire (refer to Section 10):

_____ Net metering in accordance with the EPR-6 rate

_____ Partial Requirements Service under the E-56 R rate (> 100 kW)

_____ Sell excess energy to APS in accordance with the EPR-2 rate (≤ 100kW)

_____ Sell excess energy to APS under a Power Purchase Agreement (PPA)

_____ None of the above. Specify:_____

C. Provide the anticipated project in-service date: _____

D. Is an electrical permit and/or inspection required by the Authority Having Jurisdiction?

(Yes or No):_____ If No, explain:_____

E. Is access by APS personnel to the Utility Disconnect Switch, the facility SES and any utility-required inverter production metering in any way restricted or impeded (e.g. fences, locks, gates, walls, animals, etc.)?

(Yes or No):_____ If Yes, explain how APS will have 24/7 unrestricted access:_____

_____

F. If the GF aggregate generation nominal nameplate AC rating is 1MW or greater, and the GF is not installed in a Behind the Meter application, is documentation (including FERC Form 556) confirming the GF has achieved QF status included with this Interconnection Application? (Refer to Section 3 of the APS Interconnection Requirements).

(Yes or No):_____ If No, explain:_____

_____

APPENDIX A: INTERCONNECTION APPLICATION FOR STATIC INVERTERS (cont'd)

G. If the GF aggregate generation nominal nameplate AC rating is 1 MW or greater, and the GF is installed in a Behind the Meter application, does Customer warrant that, to the best of Customer's knowledge, even when considering the expected degradation of the GF's power rating over its expected life and future potential increased electrical load needs of the Customer, the GF is not expected to produce more energy over the 12 month period between January 1 and December 31 of any given year than what the Customer consumes behind the APS bi-directional billing meter.

(Yes or No): _____ If No, explain _____

_____

H. Is general liability insurance required per Section 5 of the Interconnect Requirements manual?

(Yes or No): _____ If Yes, explain when proof of such insurance will be provided to APS:_____

_____

I. Have you applied for an APS Renewable Energy Incentive?

(Yes or No): _____

If Yes, does all of the system equipment (eg. number, type, size of photovoltaic modules, inverters, etc.) specified in this application exactly match the system equipment specified in the Incentive Reservation Application you submitted?

(Yes or No): _____

If No, please complete the "**Request to Amend kWh Production or System Equipment Information"** form in its entirety and submit to commercial-incentives@aps.com.

- **Failure to submit the amendment form may delay incentive payment processing and/or reduce the amount of incentive reserved for your project.**

J. Will you proceed with this project if you are not awarded an APS incentive?

(Yes or No): _____

APPENDIX A: INTERCONNECTION APPLICATION FOR STATIC INVERTERS (cont'd)

IMPORTANT NOTE:

APS requires disclosure about the transaction that the Customer is undertaking with the installation of the interconnected GF on its premises.

SYSTEM OWNER

If the GF is owned by a person or entity, including Customer's grantee or lessee, other than the Customer, complete the following:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

SYSTEM LESSEE

If the GF is not owned by the Customer, but is instead leased, identify the lessee and the lessor:

Lessee:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

Lessor:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

SYSTEM OPERATOR

If the GF is to be operated and/or maintained by a person or entity other than the Customer, including the System Owner or Lessee, complete the following:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

PROPERTY OWNER

If the Customer does not own the property upon which the GF is located, please complete the following:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

LANDLORD

If the Customer is a tenant upon the property at which the GF is located, please provide the following information on the landlord:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

INTERCONNECTION PROCESS PRIMARY CONTACT

If the Primary Contact for coordinating the interconnection process is a person or entity other than the Customer, complete the following:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

INSTALLER INFORMATION

If the installer is not the Primary Contact for the interconnection process, complete the following:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

SYSTEM DESIGN OR ENGINEERING FIRM INFORMATION

If the system is being designed by an entity or person other than the installer, please complete the following:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

CUSTOMER CERTIFICATION

This Application is complete and accurate to the best of my knowledge, and as the APS Customer of Record, I hereby grant APS permission to coordinate the interconnection process with the person or entity specified as the Primary Contact in the Interconnection Process Primary Contact Section above, if such section is completed.

I further understand that APS will not accept any drawings that are copyrighted, proprietary, or contain confidential material. APS reserves the right to reject any Interconnection Application which it deems illegible or does not meet the mandatory requirements set forth in the APS Interconnection Requirements or the APS sample drawings.

Name: _____

Signature: _____ Date: _____

SUPPLEMENTARY INFORMATION

Diagrams specified below must be submitted along with a copy of the Building Permit issued by the AHJ for non-residential Static Inverter based systems with an aggregate generator nominal AC nameplate rating of less than 1 MW and interconnecting at less than 12 kV, and are to be submitted in pdf format for all projects. Refer to Section 13.2 & 13.3 of the APS Interconnection Requirements for additional information. **APS will not accept any copyrighted, proprietary or confidential drawings. These must be site specific regarding the information requested below, without extraneous information and must be prepared for APS' use. All diagrams are to be professionally drawn, using only black print on white paper; and are not to be in color or shaded.** Free hand drawn, faxed diagrams and drawings that are otherwise difficult to read will not be accepted by APS. All diagrams must include the project name and street address and include any updated diagram revision numbers and dates. If the required information is not provided on the drawings, application and/or supplemental information, then APS will require clarifying information. Such clarifying information may include requesting manufacturers cut sheet(s) or the UL certification documents for the device/equipment in question.

APS has prepared several sample diagram sets that indicate the general layout, the level of detail, the necessary information, and the quality required by APS for typical inverter-based systems. These diagrams are located at: www.aps.com/dg

Standard industry electrical symbols shall be used on the diagrams, and the required size for drawings is 11"x17".

(a) Electrical One-Line Diagram: Note (1)

Diagram(s) must show all generation sources (e.g. photovoltaic panels, wind generator, etc.) and any associated DC electrical components, inverter(s), any combiner panels, metering, Utility Disconnect Switch, as well as the electric service entrance. In addition, the utility meter, connection points of facility loads, and all other associated electrical components must be shown including any required dedicated metering phone lines, transfer trip communication path(s) along with the associated relaying and trip circuits, and any APS required Remote Terminal Unit (RTU) with associated communication channels and trip/block close/close permissive circuitry (please refer to section 8.8.4 of the APS Interconnection Requirements). The electrical ratings of the wire and equipment including all backfed breakers or fuses and any subpanels, including any required dedicated metering phone lines must be indicated.

(b) Electrical Three-Line Diagram: Note (2)

Diagram(s) must show detailed phase wiring of all electrical equipment as specified in the Electrical One-Line Diagram, as well as all neutral, equipment ground and grounding electrode equipment (G.E.C.) conductors and connections.

(c) AC & DC Control Schematics:

For systems greater than 1MW only (unless required otherwise by APS), Diagram(s) must show the detailed phase wiring of all electrical equipment as specified above for the Electrical One-Line Diagram, including protective relaying, associated instrument transformers, breaker control circuitry, and additional control schemes. Include control power source and all associated AC and DC connections.

(d) Plant Location Diagram: Note (3)

Diagram must show major cross streets and location of facility. Include a North arrow.

(e) Site Plan:

Diagram must clearly show the major GF equipment individual components and their locations, including the electric service entrance section and utility meter, location of the inverter(s), Utility Disconnect Switch and any lock-boxes, etc. Include building structure location and any walls, fences and gates etc, to clearly indicate unobstructed access to APS equipment, including any required special metering and the Utility Disconnect Switch. Include a North arrow.

(f) Relay Setting Sheet(s):

For systems greater than 1MW only (unless required otherwise by APS), setting sheet(s) for the APS-required minimum protective relay functions must show the trip setpoints and times. Settings may be provided after the initial APS review, once the final system configuration has been determined.

APPENDIX A: INTERCONNECTION APPLICATION FOR STATIC INVERTERS (cont'd)

Note 1: An Electrical One-Line Diagram is required for multiple inverter-based residential systems, or single inverter-based residential systems 12 kW or greater. Additionally, a One-Line is required for all battery backup based systems.

Note 2: A Three-Line Diagram is required for residential inverter-based systems that meet any of the following criteria:

(a) The AC nominal nameplate output rating of the inverter(s) is greater than 12 kW.
(b) The system consists of more than one inverter.
(c) The system backfeeds a breaker located in subpanel rather than one located in the SES.
(d) The system is connected as a supply side tap.
(e) The installation is an expansion or addition to an existing system operating in parallel with APS' system.
(f) The installation is a battery backup type inverter system.

Note 3: A Plant Location Diagram will not be required for residential systems.

APPENDIX B

INTERCONNECTION APPLICATION FOR ROTATING MACHINERY ONLY

	For APS use
APS Reservation # (if applicable)	
APS Installation #	

CUSTOMER OF RECORD AND SITE SPECIFIC INFORMATION

APS Customer Account Holders Name(s): _____

Customer Contact Person's Name: _____

Telephone (day): _____ E-mail: _____

Generating Facility Address: _____

_____

Customer Contact Mailing Address: _____

_____

APS Account Number: _____ APS Meter #: _____

Is there an existing Generator interconnected behind this meter? (Yes or No): _____

If Yes, please provide kW size and type of existing Generator: _____

Is there an existing Generator connected behind a different meter at this site? (Yes or No): _____

If Yes, please provide kW size and type of existing Generator: _____

Is this GF being interconnected behind a sub-meter constituting a Totalized Metering arrangement?

(Yes or No): _____ If Yes, provide the APS sub-meter # feeding the GF: _____

APPENDIX B: INTERCONNECTION APPLICATION FOR ROTATING MACHINERY (cont'd)

GENERATOR INFORMATION

A. Manufacturer: _____ Model #:_____

B. Generator Type (Synchronous, Induction): _____

C. Generator Nameplate Rating:

Voltage: _____ Single or Three Phases: _____

Power Factor: _____ Continuous Power kW: _____

No. of Units: _____ Total System kW: _____

D. Generator Electrical Characteristics (on the machine base, for above 50 kW):

Synchronous Reactance (Xd): _____

Transient Reactance (X'd): _____

Subtransient Reactance (X"d): _____

Stator Resistance (Ra): _____

Zero Sequence Reactance (X0): _____

Zero Sequence Resistance (R0): _____

Negative Sequence Reactance (X2): _____

Negative Sequence Resistance (R2): _____

E. Generator Neutral Grounding (for above 300 kW):

Specify whether the generator neutral will be solidly grounded or grounded through a neutral resistor:

_____

If grounded through a neutral resistor, specify the resistance: _____

PRIME MOVER

A. Manufacturer: _____ Model #: _____

B. Fuel Source (Natural Gas, Landfill Gas, etc.): _____

C. Is useful heat recovered from the prime mover (Yes or No): _____

D. Will the installation be certified as a Qualifying Facility (QF) (Yes or No): _____

INTERFACE EQUIPMENT AND PROTECTIVE RELAY INFORMATION
(Complete all applicable items; attach a separate sheet if necessary).

A. Synchronizer for Synchronous Generator:

Manufacturer: _____ Model #: _____

Automatic or Manual Synchronizer: _____

B. Manufacturer's name and model number for each protective device (Refer to section 8):

_____

_____

_____

_____

_____

C. Proposed settings (trip setpoint and time) for each protective device (Refer to section 8):

_____

_____

_____

_____

_____

APPENDIX B: INTERCONNECTION APPLICATION FOR ROTATING MACHINERY (cont'd)

PROPOSED OPERATION

A. Specify the mode in which the Generator will operate:

_____ Continuous Parallel

_____ Smooth Parallel Transition (normally 5-15 seconds)

_____ Momentary Parallel Transition (normally <10 cycles)

B. If the Generator will operate in continuous parallel with the utility, specify which one of the following options you desire (refer to section 10):

_____ Net metering in accordance with the EPR-6 rate

_____ Partial Requirements Service under the E-56 R rate (> 100 kW)

_____ Partial Requirements Service under the E-56 rate (> 100 kW)

_____ Sell excess energy to APS in accordance with the EPR-2 rate (≤ 100kW)

_____ Sell excess energy to APS under a Power Purchase Agreement (PPA)

_____ None of the above. Specify:_____

C. Provide the anticipated project in-service date: _____

D. Is an electrical permit and/or inspection required by the Authority Having Jurisdiction?

(Yes or No): _____ If No, explain: _____

_____

E. Is access by APS personnel to the Utility Disconnect Switch, the facility SES, and any utility-required generation metering in any way restricted or impeded (fences, locks, gates, walls, animals, etc.)?

(Yes or No): _____ If Yes, explain how APS will have 24/7 unrestricted access _____

_____

F. If the GF (other than Backup Generation) aggregate generation nominal nameplate AC rating is 1 MW or greater, and the GF is not installed in a Behind the meter application, is documentation (including FERC Form 556) confirming the GF has achieved QF status included with this Interconnection Application? (Refer to Section 3 of the APS Interconnection Requirements).

(Yes or No): _____ If No, explain: _____

_____

G. If the GF aggregate generation nominal nameplate AC rating is 1 MW or greater, and the GF is installed in a Behind the Meter application, does Customer warrant that, to the best of Customer's knowledge, even when considering the expected degradation of the GF's power rating over its expected life and future potential increased electrical load needs of the Customer, the GF is not expected to produce more energy over the 12 month period between January 1 and December 31 of any given year than what the Customer consumes behind the APS bi-directional billing meter.

(Yes or No): _____ If No, explain _____

_____

H. Is general liability insurance required per Section 5 of the Interconnect Requirements manual?

(Yes or No):_____ If Yes, explain when proof of such insurance will be provided to APS:_____

_____

APPENDIX B: INTERCONNECTION APPLICATION FOR ROTATING MACHINERY (cont'd)

IMPORTANT NOTE:

APS requires disclosure about the transaction that the Customer is undertaking with the installation of the interconnected GF on its premises.

SYSTEM OWNER

If the GF is owned by a person or entity, including Customer's grantee or lessee, other than the Customer, complete the following:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

SYSTEM LESSEE

If the GF is not owned by the Customer, but is instead leased, identify the lessee and the lessor:

Lessee:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

Lessor:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

SYSTEM OPERATOR

If the GF is to be operated and/or maintained by a person or entity other than the Customer, including the System Owner or Lessee, complete the following:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

PROPERTY OWNER

If the Customer does not own the property upon which the GF is located, please complete the following:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

LANDLORD

If the Customer is a tenant upon the property at which the GF is located, please provide the following information on the landlord:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

INTERCONNECTION PROCESS CONTACT INFORMATION

If the primary contact for interconnection process is to be coordinated by someone other than the Customer, complete the following:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

APPENDIX B: INTERCONNECTION APPLICATION FOR ROTATING MACHINERY (cont'd)

INSTALLER INFORMATION

If the installer is not the primary contact for interconnection process, complete the following:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

SYSTEM DESIGN OR ENGINEERING FIRM INFORMATION

If the system is being designed by an entity or person other than the installer, please complete the following:

Name: _____ Company: _____

Mailing Address: _____

_____

Phone: _____ E-mail: _____

CUSTOMER CERTIFICATION

This Application is complete and accurate to the best of my knowledge, and as the APS Customer of Record, I hereby grant APS permission to coordinate the interconnection process with the person or entity specified as the Primary Contact in the Interconnection Process Primary Contact Section above, if such section is completed.

I further understand that APS will not accept any drawings that are copyrighted, proprietary, or contain confidential material. APS reserves the right to reject any Interconnection Application which it deems illegible or does not meet the mandatory requirements set forth in the APS Interconnection Requirements or the APS sample drawings.

Name: _____

Signature: _____ Date: _____

APPENDIX B: INTERCONNECTION APPLICATION FOR ROTATING MACHINERY (cont'd)

SUPPLEMENTARY INFORMATION

Diagrams and information specified below are to be specifically prepared for APS' use, and to be submitted in pdf format for all rotating machinery based projects. **APS will not accept any copyrighted, proprietary or confidential drawings. These must be site specific regarding the information requested below, without extraneous information and must be prepared for APS' use. All diagrams are to be professionally drawn, using only black print on white paper; and are not to be in color or shaded.** Free hand drawn, faxed diagrams and drawings that are otherwise difficult to read will not be accepted by APS. All diagrams must include the project name and street address and include any updated diagram revision numbers and dates. If the required information is not provided on the drawings, application and/or supplemental information, then APS will require clarifying information. Such clarifying information may include requesting manufacturers cut sheet(s) or the UL certification documents for the device/equipment in question.

Standard industry accepted electrical symbols shall be used on the diagrams. The required size for all drawings is 11"x17".

(a) Electrical One-Line Diagram:

Diagram(s) must show generators and all major associated electrical components including protective relaying and associated trip paths, any interlocks and control functions, as well as the electric service entrance, utility meter, connection points of facility loads, any transformers, generator metering, and Utility Disconnect Switch including any required dedicated metering phone lines, transfer trip communication path(s) along with the associated relaying and trip circuits, and any APS required Remote Terminal Unit (RTU) with associated communication channels and trip/block close/close permissive circuitry (please refer to section 8.8.4 of the APS Interconnection Requirements). Any interlocks or permissive functions and / or control paths shall be clearly indicated on the drawing (e.g. as dashed lines).The electrical ratings of the equipment shall be shown.

(b) AC & DC Control Schematics:

Diagram(s) must show the detailed phase wiring of all electrical equipment as specified above for the Electrical One-Line Diagram, including protective relaying, associated instrument transformers, breaker control circuitry, and additional control schemes. Include control power source and all associated AC and DC connections.

(c) Plant Location Diagram:

Diagram must show major cross streets and location of facility. Include a North arrow.

(d) Site Plan:

Diagram must clearly show the individual major GF equipment components and their locations, including the electric service entrance section and utility meter, location of generator(s), interface equipment, Utility Disconnect Switch and location of any lock-boxes, etc. Include building structure location and any walls, fences and gates etc, to clearly indicate unobstructed access to APS equipment including any required special metering and the Utility Disconnect Switch. Include a North arrow.

(e) Relay Setting Sheet(s):

Setting sheet(s) for the APS-required minimum protective relay functions must show the trip set-points and times. Settings may be provided after the initial APS review, once the final system configuration has been determined.

(f) Sequence of Operations:

Customer shall submit a description of any sequence of operations or other operational controls of a particular system or control scheme. Customer may also provide a one-line block diagram depicting any/all parallel paths, breaker schemes (e.g. main-tie-tie-main or main-tie-main) as well as identifying any interlocks, normal open points, and transfer schemes.