



Interconnection Manual

For

Distributed Generation

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1. INTRODUCTION

This manual specifies the minimum requirements for safe and effective operation of distributed generation interconnected (or paralleled) with the Navopache Electric Cooperative, Inc. (“NEC” or “the Utility”) radial distribution system, in conjunction with the interconnection rules promulgated in the Arizona Administrative Code, Title 14, Article 26 Interconnection of Distributed Generation Facilities. Interconnection requirements outlined here are for those installations that will be connected to the NEC distribution system and do not backfeed onto the transmission system. This document shall be used when planning for the installation of a distributed generation facility. **Note that these requirements may not cover all details in specific cases.** The Customer should discuss project plans with NEC before designing the facility or purchasing and installing equipment.

The term "Customer" will be used herein to refer to any distributed generator, cogenerator or small power producer, even though they may not actually be purchasers of power from NEC, and includes any independent party or entity that either invests in, owns or operates a distributed generator or generation facility.

The information contained in this manual contains general information about the interconnection requirements for Customer-owned distributed generation. In addition to all applicable regulatory, technical, safety, and electrical requirements and codes, which are not contained in their entirety in this manual, Customers will also be subject to contractual and other legal requirements, a summary of which are in this manual. The complete regulations, requirements, contracts and other materials contain additional information concerning interconnection and govern over the general provisions in this manual.

The technical interconnection requirements outlined in this manual shall also apply to any interconnected utility-owned or -operated distributed generation facility.

NEC 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. We look forward to working with you to ensure a successful generation project.

2. DEFINITIONS

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

- 2.1 AC: Alternating current.
- 2.2 Backfeed: To energize a section of the NEC electric system with a Generating Facility.
- 2.3 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.

- 2.4 Customer: An electric consumer applying to connect a Generating Facility on the consumer's side of the utility meter, whether an Exporting System, a Non-Exporting System, or an Inadvertent Export system; also refers to a non-NEC consumer or entity who invests in, owns or operates a generator or generation facility.
- 2.5 DC: Direct Current
- 2.6 Distributed Generation: Any type of Customer electrical generator, solid-state or static inverter, or Generating Facility interconnected with the Distribution System that either (a) can be operated in electrical parallel with the NEC Distribution System, or (b) can feed a Customer load that can also be fed by the NEC Distribution System. Distributed Generation is sometimes referred to simply as "generator" in this manual.
- 2.7 Distribution System: The infrastructure constructed, maintained and operated by NEC to deliver electric service at the distribution level (25 kV or less) to retail consumers.
- 2.8 Electric Supply/Purchase Agreement: The agreement, together with appendices, signed between NEC, wholesale power suppliers to NEC (if applicable), and the Customer covering the terms and conditions under which electrical power is supplied to and/or purchased from NEC.
- 2.9 Exporting System: Any type of Generating Facility that is designed to regularly backfeed the Distribution System.
- 2.10 Generating Facility: All or part of a Customer's electrical generator(s), energy storage system(s), or any combination of electrical generator(s), energy storage system(s), together with all inverter(s) and protective, safety, and associated equipment necessary to produce electric power at the Customer's facility; this includes solid-state or static inverters, induction machines and synchronous machines.
- 2.11 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.
- 2.12 IEEE: Institute of Electrical and Electronic Engineers, Inc.
- 2.13 Inadvertent Export: The unplanned, uncompensated transfer of electric energy from a Generating Facility to the Distribution System across the Point of Interconnection.
- 2.14 Interconnection: The physical connection of a Generating Facility to the Distribution System.

- 2.15 Interconnection Agreement: An agreement, together with appendices, signed between NEC and the Customer covering the terms and conditions governing the Interconnection and operation of the Generating Facility with NEC.
- 2.16 Interconnection Facilities: The electrical wires, switches and related equipment that are required, in addition to the facilities required to provide electric distribution service to a Customer, to allow Interconnection. Interconnection Facilities may be located on either side of the Point of Interconnection as appropriate to their purpose and design.
- 2.17 Interconnection Study: A study that may be undertaken by NEC (or an NEC-designated third party) in response to NEC's receipt of a completed application. An Interconnection Study may include a) a feasibility study, b) a system impact study, c) a facilities study, and d) any additional analysis required by NEC.
- 2.18 Islanding: A condition in which a portion of the Distribution System is energized solely by one or more local electric power systems throughout the associated Point of Interconnection while that portion of the Distribution System is electrically separated from the rest of the Distribution System; islanding can be either intentional (planned) or unintentional (unplanned).
- 2.19 kW: Kilowatt
- 2.20 Maximum Capacity: Is a) the nameplate AC capacity of a Generating Facility, or b) only the power transferred across the Point of Interconnection to the Distribution System if the operating characteristics of the Generating Facility limit the power transferred across the Point of Interconnection to the Distribution System.
- 2.21 Minimum Protective Devices, Relays, and Interconnection Requirements: The minimum required protective relaying and/or safety devices and requirements specified in this manual, as may be revised from time to time, are for the purpose of protecting only NEC and its other NEC consumer facilities from damage or disruptions caused by a fault, malfunction or improper operation of the Customer's Generating Facility. Minimum Protective Relaying and Interconnection Requirements do not include relaying, 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 Generating Facility or facilities; those are the sole responsibility of the Customer.
- 2.22 MW: Megawatt
- 2.23 Network System: A system which may be fed from multiple sources.
- 2.24 Non-Exporting System: A system in which there is no designed, regular export of power from the Generating Facility to the Distribution System.

- 2.25 Operating Characteristics: The mode of operation of a Generating Facility (Exporting System, Non-Exporting System, or Inadvertent Exporting System) that controls the amount of power delivered across the Point of Interconnection to the Distribution System.
- 2.26 Parallel Operation: The operation of a Generating Facility that is electrically interconnected to a bus common with the Distribution System, either on a momentary or continuous basis.
- 2.27 Point(s) of Interconnection: The physical location(s) where NEC's service conductors are connected to the Customer's service conductors to allow parallel operation of the Customer's Generating Facility with NEC's Distribution System.
- 2.28 Protective Functions: The equipment, hardware or software in the Generating Facility that protects against unsafe operating conditions.
- 2.29 Qualifying Facility: 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.
- 2.30 Relay: An electric device that is designed to interpret input conditions in a prescribed manner and, after specified conditions are met, to respond and cause contact operation or similar abrupt change in associated electric control circuits.
- 2.31 Small Power Production Facility: A facility that uses primarily biomass, waste or renewable resources, including wind, solar, and water, to produce electric power.
- 2.32 Unsafe Operating Conditions: Conditions, which if left uncorrected, could result in any of the following: a) harm to personnel; b) damage to equipment; c) an adverse effect on the safe operation of the Distribution System; or d) operation of the Generating Facility outside pre-established parameters required by the Interconnection Agreement.
- 2.33 Utility: An electric distribution company that constructs, operates and maintains its distribution system for the receipt and delivery of electricity and that is a public service corporation under Arizona Constitution, Article 15, Section 2.

3. NEC POLICY ON CUSTOMER-OWNED GENERATION

Any Customer qualified under the Public Utility Regulatory Policies Act (PURPA) of 1978 may operate their generating equipment in parallel with the NEC radial distribution system provided the Customer provides equipment that in the judgment of NEC will:

- (a) Not present any hazards to NEC personnel, other NEC consumers or the public;
- (b) Minimize the possibility of damage to NEC and other NEC consumer equipment;
- (c) Not adversely affect the quality of service to other NEC consumers; and
- (d) Minimally hamper efforts to restore a feeder to service (specifically when a clearance is required).

In addition, the Customer will also need to comply with the following to the satisfaction of NEC:

- (a) The Generating Facility meets all the minimum interconnection, safety, and protection requirements outlined in this manual;
- (b) Customer signs an Interconnection Agreement, as well as an Electric Supply/Purchase Agreement, as applicable, with NEC, or any successor supplier; and
- (c) Customer complies 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 appropriate state regulatory body.

NEC's policy is to also allow Customer generating equipment that does not qualify under PURPA to operate in parallel with the NEC radial Distribution System provided that all of the conditions outlined above are complied with. Due to relay coordination and potential backfeed problems, NEC cannot permit any distributed generation to be connected to a network system.

The minimum protective and safety devices (relays, circuit breakers, disconnect switches, etc.) specified in this manual must be installed and placed into service before allowing parallel operation of Customer's Generating Facility with the NEC system. The purpose of these devices is to isolate the Customer's generating equipment from the NEC system whenever faults or disturbances occur and for maintenance purposes. Modifications to the NEC Distribution System configuration or protective equipment may also be required at the expense of the Customer in order to accommodate parallel generation.

NEC 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 their equipment in a manner to prevent any faults or other disturbances from damaging the Customer's equipment.

The Customer must obtain, to the satisfaction of NEC, all required permits and inspections indicating that the Customer's Generating Facility complies with local and other applicable safety codes. NEC can disallow the interconnection of a Customer's Generating Facility if, upon review of the Customer's design, NEC 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 or threaten the reliability of the NEC system.

This manual is not a complete description or listing of all laws, ordinances, rules and regulations, nor is this manual intended to be an installation or safety manual. The Customer requesting interconnection shall follow where applicable, the current *IEEE 1547 Standard Guide for Distributed Generation Interconnection*, other IEEE standards, ANSI standards, current National Electrical Code, National Electrical Safety Code, governmental and regulatory laws, rules, ordinances or requirements.

4. DISTRIBUTED GENERATION TYPES

Distributed generation is any type of generator or generating facility which has the potential (a) for feeding a Customer load, where this load can also be fed by or connected to the NEC Distribution System, or (b) for electrically paralleling with or for feeding power back into NEC's Distribution System.

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** (an Emergency or Standby Generation System) is designed to never electrically interconnect or operate in electrical parallel with NEC's system. A **Parallel System** (an Interconnected Generation 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 NEC's system.

The Customer may elect to run their generator as a separate system with non-parallel load transfer between the two independent power systems, or he may run it in parallel with the NEC 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 NEC'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, NEC 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 double throw, "break-before-make" transfer switch specifically designed and installed for that purpose. The transfer switch must be of a visible and fail-safe mechanical throw over design, which will under no circumstances allow the generator to electrically interconnect or parallel with NEC's system. The transfer switch must always disconnect the Customer's load from NEC's 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 NEC system. These requirements apply to both actual emergency operations as well as testing operations. All transfer switches and transfer schemes must be inspected and approved by the jurisdictional electrical inspection agency.

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. Failure to use a transfer switch can result in backfeed into the NEC system; the generator voltage can backfeed through the NEC 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, NEC 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 NEC'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 becomes an integral part of the utility system that 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 a multi-breaker transfer scheme, or an electrical inverter that can be configured or programmed to operate in a "utility interactive mode" constitutes a potential backfeed source to the NEC system, and is classified as an interconnected generator.

NEC has specific interconnection and contractual requirements, as outlined in this Interconnection Manual, that must be complied with and information that needs to be submitted for all interconnected generators. These include a "visible open" disconnect switch meeting certain requirements to isolate the Customer's system from NEC's 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's protective schemes tested by a qualified testing/calibration company, subject to NEC approval. NEC personnel will inspect the system and the Customer will be required to sign an Interconnection Agreement and, if applicable, an Electric Supply/Purchase Agreement with NEC, and NEC's wholesale power supplier(s). NEC 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.

With respect to the above protection objectives, it is necessary for NEC to be enabled with equipment to disconnect the parallel generator when trouble occurs. This is to:

- (a) Ensure if a fault on the NEC system persists, the fault current supplied by the Customer's generator is interrupted;
- (b) Prevent the possibility of reclosing into an out-of-synch isolated system composed of the Distribution System, or a section thereof, and the Customer's generator;
and
- (c) Prevent reclosing into the Customer's generation system that may be out of synchronization or stalled.

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. 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 NEC circuit. In instances where the NEC 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 their equipment from automatic reclosing by NEC. NEC normally applies automatic reclosing to overhead distribution circuits. When the NEC source breaker trips, the Customer must ensure that their generator is disconnected from the NEC circuit prior to automatic reclosure by NEC. The automatic reclosing time on the NEC distribution system varies from feeder to feeder. Automatic reclosing out-of-synch with the Customer's generator may cause severe damage to Customer equipment and could also pose a serious hazard to Customer or utility personnel. The design of the facilities is the Customer's responsibility and at the Customer's expense.

The Customer shall adequately design and protect the Generating Facility against the impact of switching operations and contingencies on NEC's system. Some examples are as follows: (This is not to be considered an all-encompassing list.)

1. Load rejection on the Generating Facility will cause overspeed and overvoltages in the Generating Facility.
2. Self-excitation can occur where an islanded Distribution System, left connected to the Generating Facility, represents a capacitive load in excess of the generator's capability to absorb it. The Generating Facility and NEC equipment could be damaged by the resulting overvoltage if the Generating Facility is not quickly disconnected from the Distribution System.
3. Acceleration of the Generating Facility during faults on nearby NEC distribution feeders could cause the Generating Facility to slip out of synchronism with NEC's system.
4. Broken conductors on NEC feeders could cause high levels of negative sequence current in the Customer's generator.
5. Voltage unbalance at the Point of Interconnection can cause negative sequence heating in the generator and/or the interconnecting transformer.

5. CUSTOMER RIGHTS AND RESPONSIBILITIES

A Customer has the following rights:

1. To designate a representative to act on the Customer's behalf;
2. To submit an Application to interconnect a Generating Facility with NEC;
3. To expect prompt and professional responses from NEC during the Interconnection process;
4. To receive detailed and itemized good faith estimates of costs from NEC;
5. To expect documentation for proposed work before NEC undertakes any studies or system upgrades to accommodate the Generating Facility;
6. To sign documents using an electronic (e-signature) method if the Customer and NEC have the technical capability to sign electronically, and to submit the documents electronically;
7. To request a one-time 90-day extension from NEC using a simple notification process, and not to have an extension unreasonably withheld for circumstances beyond the Customer's control.

A Customer shall be responsible to ensure that:

1. The Generating Facility meets or exceeds all minimum Interconnection, safety and protection requirements outlined in NEC's Interconnection Manual;
2. The Generating Facility meets all applicable construction codes, safety codes, electric codes, laws and requirements of government agencies having jurisdiction;
3. The Generating Facility IEEE equipment is installed and operated in a manner that protects the Generating Facility, NEC personnel, the public, and the Distribution System from harm;
4. The Generating Facility design, installation, maintenance and operation minimize the likelihood of causing a malfunction in, damaging or otherwise impairing the Distribution System;
5. The Generating Facility does not adversely affect the quality of service to other NEC consumers;
6. The Generating Facility does not hamper efforts to restore a feeder to service when a clearance is required;
7. The Generating Facility is maintained in accordance with applicable manufacturer's maintenance schedules; and
8. NEC is notified of any emergency or hazardous condition or occurrence involving the Generating Facility that could affect safe operation of the Distribution System.

The Customer shall pay for, lease or own, and be responsible for designing, installing and operating all Interconnection Facilities on the Customer's side of the Point of Interconnection. The Customer shall ensure that the Interconnection Facilities are located on the Customer's premises, and are enabled to deliver power from the Generating Facility to the Distribution System at the Point of Interconnection. This includes connection, transformation, switching, protective relaying, metering, communication and safety equipment, including a visibly-open Disconnect Switch and any other requirements as outlined in this manual or other special items specified by NEC. In the event that, in the judgment of NEC, additional facilities are required to be installed on the NEC system to accommodate the Customer's generation, NEC will install

such facilities at the Customer's expense. NEC may also charge the Customer for any administrative costs and/or the costs of studies required to interconnect the Customer's generation, and the Customer shall pay said costs.

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 which shall include but not be limited to the current *IEEE 1547 Standard Guide for Distributed Generation Interconnection*, other IEEE standards, ANSI standards, current National Electrical Code requirements and current National Electrical Safety Code as applicable.
- (b) Control and protective devices, in addition to minimum protective relays and devices, specified in this manual, 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 NEC's system in the event of a power outage on NEC's system.
- (c) Interconnection facilities on the Customer's premises as may be required to deliver power from the Customer's Generating Facility to the NEC system at the Point of Interconnection.

A Customer interconnecting a Generating Facility with the Distribution System will be required to sign an Interconnection Agreement with NEC, in addition to any other applicable purchase, supply or other standby or special agreements.

Customers that purchase power from, or sell power to, NEC or NEC's wholesale power supplier(s) will be required to sign an Electric Supply/Purchase Agreement with NEC and/or NEC's wholesale power supplier(s) as circumstances may require.

6. MUTUAL UNDERSTANDINGS

- 6.1** NEC shall interconnect a Generating Facility to the Distribution System, subject to the requirements of the Arizona Administrative Code, Title 14. Public Service Corporations, Chapter 2. Fixed Utilities, Article 26. Interconnection of Distributed Generation Facilities, and this Interconnection Manual.
- 6.2** NEC has the right to expect prompt, reasonable, and professional responses from a Customer during the interconnection process.
- 6.3** NEC requires that an interconnected Generating Facility:
- 6.3.1 Does not present any hazards to NEC personnel, other NEC consumers, or the public;
 - 6.3.2 Minimize the possibility of damage to NEC's and other NEC consumers' equipment;
 - 6.3.3 Not adversely affect the quality of service to the other NEC consumers; and
 - 6.3.4 Not hamper efforts to restore a feeder to service when a clearance is required.
- 6.4** NEC shall notify a Customer if there is a reason to believe that operation of the Customer's Generating Facility has caused disruption or deterioration of service to other NEC consumers or to the Distribution System.
- 6.5** NEC shall make its Interconnection Manual, standard Application, and Interconnection Agreements readily available to an Applicant in print and online formats.
- 6.6** NEC has two levels of service standards for interconnection of a Generating Facility, based on the proposed system size and characteristics:
- 6.6.1 Expedited Interconnection process: Maximum capacity of 20 kW, with the following characteristics from either 6.6.1.1 or 6.6.1.2:
 - 6.6.1.1 Non-Exporting Inverter-Based Energy Storage Generating Facility
 - a. The Generating Facility shall utilize only UL 1741 and UL 1741SA listed equipment.
 - b. The Generating Facility shall meet all applicable codes and standards required by and referenced in this document.
 - c. The Generating Facility shall comply with NEC's Interconnection and contractual requirements.
 - d. The Generating Facility shall be a Non-Exporting inverter-based energy storage device with an aggregate maximum nameplate rating no greater than 500 kW.

- e. No other Generating Facilities, other than isolated backup Generating Facilities, may be at the same Point of Interconnection as the Generating Facility.
- f. The Generating Facility shall comply with Section 8.8.6 of this document.
- g. The Generating Facility shall comply with one of the following:
 - The system capacity shall be less than 25% of the electrical service entrance ampere rating, and less than 50% of the service transformer rating, or
 - The system output rating shall be less than 50% of the verifiable Customer minimum load as measured over the past 12 months

6.6.1.2 Inadvertent Exporting Generating Facility

- a. The Generating Facility shall utilize only UL 1741 and UL 1741SA listed equipment.
- b. The Generating Facility shall meet all applicable codes and standards required by and referenced in this document.
- c. The Generating Facility shall comply with NEC's Interconnection and contractual requirements.
- d. The Generating Facility shall utilize control functions that limit the export of electrical power to the Distribution System.
- e. The Generating Facility shall have a duration of Inadvertent Export of power of less than 30 seconds for any single event.
- f. The Generating Facility shall monitor that its total energy export per month is maintained to be no more than its Maximum Capacity multiplied by 0.1 hours per day over a rolling 30-day period (e.g. a 100kVA gross nameplate capacity Generating Facility would have a maximum energy export per 30-day month of 300kWh).
- g. The Generating Facility shall disconnect from the Distribution System in the event of an Inadvertent Export, ceasing to energize the Distribution System or halting energy production, within two seconds after the period of uninterrupted export exceeds 30 seconds or the magnitude of export exceeds 100kVA.
- h. The Generating Facility shall enter a safe operation mode, where Inadvertent Export events cannot occur, upon failure of the control or inverter system for more than 30 seconds, whether from loss of control signal, loss of control power, or a single component failure or related control sensing of the control circuitry.
- i. No other Generating Facilities, other than isolated backup Generating Facilities or Generating Facilities that are already subject to an executed Interconnection Agreement, may be at the same Point of Interconnection as the Generating Facility.
- j. The Generating Facility shall comply with Section 8.8.5 and 8.8.6 of this document.

6.6.2 Fast Track Process: for proposed Generating Facilities ranging in size from 21 kW up to 2 MW, provided that the proposed facility meets the criteria in Section 8.8.

- 6.7** For any potential new interconnected Generating Facility greater than 2 MW, NEC is required to provide notice to, and receive approval from, its wholesale power supplier per the terms of the Balancing Authority Services Agreement.
- 6.8** Following receipt of an Application, NEC shall review the Generating Facility to ensure it complies with the applicable screening provisions of Arizona Administrative Code, Chapter 2, Article 26, Section 15 (see Section 8.8). If the proposed Generating Facility design does not comply with the applicable screening provisions, an Interconnection Study may be required. Prior to commencing such study, NEC will provide written notice to the Applicant of the cost of such study that the applicant will be responsible for paying. If the results of the Interconnection Study indicate additional Interconnection Facilities or upgrades, NEC shall provide written notice to the Applicant, and the Applicant shall pay NEC for the Interconnection Facilities or upgrades identified in the Interconnection Study, except for those unrelated to the Generating Facility installation. NEC shall provide the results of the Interconnection Study to the Applicant.
- 6.9** NEC may not disapprove Interconnection of a Generating Facility that satisfies the requirements of the Arizona Administrative Code and this Interconnection Manual, provided that the distributed generation provisions of NEC's contract with its wholesale power provider are not triggered by the size of the proposed Generating Facility.
- 6.10** If additional Interconnection Facilities or upgrades are needed to accommodate a Generating Facility and the Interconnection Facilities or upgrades will benefit the grid, NEC shall reduce the charge of the Interconnection Facilities or upgrades to the Customer by the amount of benefits to the grid that are readily quantifiable by NEC. NEC shall not reject an application on the basis of deficient existing Distribution System conditions or charge a Customer for Interconnection Facilities or upgrade that are overdue or that will soon be required to ensure compliance with Good Utility Practice.
- 6.11** NEC will process all Applications on a nondiscriminatory basis.

6.12 Interconnections

NEC will not install or maintain any lines or equipment on a Customer's side of the Point of Interconnection, except for a meter and potentially, research equipment. Only authorized NEC employees (with credentials to identify their company affiliation) may make and energize the service connection between the NEC 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 NEC's wholesale power supplier(s) 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.

6.13 Easements and Rights-of-Way

Where an easement or rights-of-way is required to accommodate the interconnection, the Customer must provide NEC with a suitable easement or rights-of-way, in NEC's name, on the premises owned, leased or otherwise controlled by the Customer. If the required easement or rights-of-way is on property not owned by the Customer, the Customer must obtain and provide to NEC a suitable easement or rights-of-way, in NEC's name, at Customer's expense and in sufficient time to comply with the Interconnection Agreement requirements. All easements or rights-of-way must be on terms and conditions acceptable to NEC. NEC will use reasonable efforts to utilize existing easements to accommodate interconnections, and will use reasonable efforts to assist a Customer in securing necessary easements at the Customer's expense.

6.14 Purchase Rates

Where applicable, any energy purchases from the Customer's facility will be in accordance with the applicable Electric Supply/Purchase Agreement, 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.

6.15 Regulatory Commissions

The rates, terms or other contract provisions governing the electric power sold to a Customer by NEC are subject to the jurisdiction of the appropriate state regulatory commissions. NEC retains, at all times and without restriction, the right to file a unilateral 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 NEC 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 NEC system. These units can also supply isolated NEC 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 NEC is time-delayed to allow 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 and 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. NEC 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 fault current or isolated loads. Forced-commutated, or self-commutated, inverters are capable of supplying fault current and load independently of the AC supply system. Any forced-commutated inverter that is to be interconnected with

the utility must be specifically designed for that purpose, i.e., it must be designed to accommodate parallel interfacing and operation.

Reclosing of the utility onto inverter units must be blocked to prevent out-of-synch closing and to prevent the energizing of a de-energized NEC line.

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 NEC system. Customers must satisfy, in addition to the general requirements specified in this manual, the minimum relaying requirements given in this document for each generator class, as described in Section 8.7.2.

- (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 all classes of distributed generation, unless otherwise specified. The minimum protection and safety devices and other requirements imposed in the following sections are intended to provide protection for the NEC system and its other consumers. They are not imposed to provide protection for the Customer's generation equipment; this is the sole responsibility of the Customer. These requirements are in addition to requirements outlined in other sections of this Interconnection Manual.

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 local and other applicable construction and safety codes, and making copies thereof available to NEC.
- 8.1.2 Multiple generator connections on the same Point of Interconnection are permitted subject to NEC approval; however, a single Disconnect Switch for the facility will be required (normally located at the service entrance section).
- 8.1.3 A communication channel and telemetering may be required, at the Customer's expense, to facilitate proper parallel operation.
- 8.1.4 In the event that the generator MVA rating, or aggregate of generators ratings, exceed 50% of the expected minimum load that could be isolated with the generation, Direct Transfer Trip ("DTT") will be required at the Customer's expense. In certain instances, a dedicated utility feeder may be required. One exception to the DTT requirement would be in the case for a generator that does not export power onto the Distribution System, load displacement only. In this case a reverse power relay could be used to detect power flowing onto the NEC system and trip the unit.
- 8.1.5 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 Point of Interconnection are appropriately equipped with either (a) Kirk key interlocks to prevent them from being inadvertently opened when the generator breaker is closed, or (b) 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) reclosing of such a breaker or switch onto an unsynchronized generator.
- 8.1.6 In the event that NEC is required to install (at Customer's expense) 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 the generator

breaker on a normally energized bus. Electronic meters are not designed to be de-energized for any length of time.

- 8.1.7 Customer is responsible for the design, installation, operation and maintenance of all equipment for connection to the NEC system, and all associated costs thereof. The Customer is also required to submit specifications and detailed plans for the installation as specified in Appendix A of this Interconnection Manual, for review and written approval from NEC, **prior to the purchase and installation of the system**. Written approval by NEC does not indicate acceptance by other authorities.

8.2 **Disconnect Switch**

The Customer shall install and maintain a visible open, manually and gang-operated load-break disconnect switch (“Disconnect Switch”) capable of being locked in a visibly “open” position by a standard NEC padlock that will completely isolate the Customer’s Generating Facility from the NEC system.

The Disconnect Switch blades, jaws and the air-gap between them shall all be clearly visible when the switch is in the “open” position. It is not acceptable to have any of the “visible open” components obscured by the switch case or an arc-shield, etc. Only switches specifically designed to provide a true “visible open” are acceptable. Such Disconnect Switch shall be installed in a place so as to provide easy and unrestricted accessibility to NEC personnel on a 24-hour basis. NEC 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 NEC system could adversely affect NEC system or endanger life or property, or upon termination of the Interconnection Agreement.

The Disconnect Switch will normally be required to be installed at the Customer’s electrical service entrance section; however it may be located in the immediate vicinity of the generator, subject to NEC approval.

The Disconnect Switch must be rated for the voltage and current requirements of the Generating Facility and must meet all applicable UL, ANSI and IEEE standards. The switch enclosure shall be properly grounded per the requirements of the National Electric Code.

In cases where the Disconnect Switch will be installed on a line at a voltage above 500V, NEC has specific grounding requirements that will need to be incorporated into the Disconnect Switch. Under certain circumstances (above 500V, switch located outdoors and underground fed), NEC may require the Customer to install a rack-out breaker, along with a racking tool and grounding breaker, in lieu of a Disconnect Switch. In these cases, NEC will work with the Customer to determine the best option and ensure that the 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, must be isolated from other Customers fed off the same utility transformer by a dedicated power transformer connecting to the utility distribution feeder. The purpose of the dedicated transformer is to ensure that the generator cannot become isolated at the secondary voltage level with a small amount of other Customer load. It also helps to confine any voltage fluctuation or harmonics produced by the generator to the Customer's own system. NEC will specify the transformer winding connections and any grounding requirements.

8.4 **Power Quality**

In order to minimize interference on NEC's system the Customer should ensure that the electrical characteristics of its load and generating equipment meet, at a minimum, the specifications promulgated in the latest version of IEEE Standard 519.

8.4.1 **Power Factor**

The power factor of the Customer's facility shall not be less than ninety percent (90%) lagging, but shall not be leading, unless agreed to by NEC.

8.4.2 **Current Imbalance**

The 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.

8.4.3 **Harmonics**

The electrical output of the Customer's Generating Facility shall not contain harmonic content which may cause disturbances on or damage to NEC's Distribution System, or other Customer's systems, such as but not limited to computer, telephone, communication and other sensitive electronic or control systems.

8.4.4 **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.

8.4.5 **Voltage Flicker**

The Customer facilities shall not cause Voltage Flicker at the Point of Interconnection that exceeds generally accepted practice or NEC standards.

8.4.6 **Monitoring Requirements**

NEC shall have the option to install, at the Customer's expense, power quality monitoring equipment at the Customer's facility to investigate any power quality problems that may be caused by the operation of the Customer's generator.

8.5 **Voltage Requirements**

Customer generating equipment must deliver, at the Point of Interconnection, 60 Hertz, either single or three-phase power at one standard voltage: (normally three-phase 24,940/14,400; 480/277; 208/120 volts or single-phase 120/240 volts as may be selected by the Customer subject to availability at the premises). Interconnections at other voltage levels will be handled on a case-by-case basis.

8.6 **Labeling Requirements**

8.6.1 **Disconnect Switch**

The Customer shall label the Disconnect Switch "Interconnected Utility Disconnect Switch" (or "Photovoltaic Inverter, Wind Turbine, etc., Utility Disconnect Switch", as the case may be) by means of a permanently attached placard with clearly visible and permanent letters.

8.6.2 **Breaker Panels**

The Customer is responsible for ensuring that all electrical devices such as panel boxes, etc., which are or can be back-fed by the Customer's generator(s) are clearly identified/labeled as such in accordance with the requirements of the National Electrical Code. NEC will assume responsibility for labeling any utility equipment.

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 their generator(s) with the NEC system.

8.7.1.2 Customer facility shall include a UL approved automatic interrupting device that is rated to interrupt available fault (short circuit) current. The interrupting device shall be tripped, as a minimum, by all protective

devices required herein.

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 generator Classes II and above (>50 kW) that require both voltage and frequency relay protection, separate and independent voltage and frequency relays and associated trip paths to the generator breaker (automatic interrupting device) are required. This is to ensure a redundant trip function in the event of a single relay failure or out-of-tolerance condition. It is acceptable however, for the over/under (“O/U”) voltage functions to be integrated into a single O/U voltage relay, and for the O/U frequency functions to be integral to a single O/U frequency relay. Multifunction relays are allowed if the relay has self-test capability and the relay failure contacts are connected to trip the generator. Digital fault recorder (DFR) facilities are required to be installed in the interconnecting equipment. DFR in relays would be acceptable.

8.7.1.5 The generator protective scheme shall be of a fail-safe design such that loss of the protection scheme control power will immediately cause the generator breaker to open. The relays provided shall be equipped with NEC approved test switches to provide isolation for CT’s, VT’s and Outputs and to facilitate testing.

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 is an under-voltage contactor.
2. For all synchronous generators and forced commutated inverters, a synchronizing scheme, either manual with synch check relay, or an automatic synchronizer is required.

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

1. Relays for overvoltage, undervoltage, overfrequency, and underfrequency are required.
2. For all synchronous generators and forced commutated inverters, a synchronizing scheme, either manual with synch check relay, or an automatic synchronizer is required.
3. For installations interconnected to NEC's system 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. NEC will advise Customer of any such requirements after a preliminary review of the Customer's proposed installation.

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

1. For this class of installation, utility grade protection devices and equipment will be required.
2. Relays for overvoltage, undervoltage, overfrequency, and underfrequency are required. Generators in this range may require additional relays and DTT. This requirement will be determined during the Interconnection Study.
3. For all synchronous generators and forced commutated inverters, a synchronizing scheme, either manual with synch check relay, or an automatic synchronizer is required.
4. For installations interconnected to NEC's system 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. NEC 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. NEC will advise Customer of any communications requirements after a preliminary review of the proposed installation.

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

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

1. For this class of installation, utility-grade protective devices and equipment will be required.
2. Relays for overvoltage, undervoltage, overfrequency, and underfrequency are required.
3. For all synchronous generators and forced commutated inverters, a synchronizing scheme, either manual with synch check relay, or an automatic synchronizer is required.
4. A ground time overcurrent and instantaneous overcurrent relay, or for installations interconnected to NEC's system 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 relays are also required:
 - (a) Voltage-controlled time overcurrent relays, one per phase
 - (b) Negative sequence time overcurrent relay
 - (c) Overexcitation relay
 - (d) Loss of excitation relay
6. Other equipment such as supervisory control and alarms, telemetering, and associated communications channel may be necessary. NEC will advise Customer of any communications requirement after a preliminary review of the proposed installation.

The minimum protective relaying requirements for parallel operation of distributed generation are summarized in the following table:

Summary of Minimum Protective Relaying Requirements

	Induction Generator/ Line Commutated Inverter	Synchronous Generator/ Forced Commutated Inverter
Class I 50 kW or less	Undervoltage contactor	Undervoltage contactor Synchronizing
Class II 51 to 300 kW	Oversvoltage, Undervoltage Overfrequency, Underfrequency	Oversvoltage, Undervoltage Overfrequency, Underfrequency Synchronizing
Class III 301 to 5,000 kW	Oversvoltage, Undervoltage Overfrequency, Underfrequency	Oversvoltage, Undervoltage Overfrequency, Underfrequency Synchronizing
Class IV Greater than 5,000 kW	No induction generators of this size anticipated	Oversvoltage, Undervoltage Overfrequency, Underfrequency Synchronizing Ground Time Overcurrent Ground Instantaneous Overcurrent Voltage-controlled Time Overcurrent Loss of Excitation Overexcitation Negative Sequence Time Overcurrent

8.7.3 Relay Settings

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

8.7.3.1 Undervoltage relays will operate at no less than 90% of the nominal voltage level (108 volts on a 120V base) and will have a maximum time delay of 1.0 seconds.

8.7.3.2 Oversvoltage relays will operate at no greater than 110% of nominal voltage (132 volts on a 120V base) and will have a maximum time delay of 1.0 seconds.

8.7.3.3 Overfrequency relays will operate at no greater than 60.5 Hz and will have a maximum time delay of 0.1 seconds.

8.7.3.4 Underfrequency relays will operate at no less than 59.5 Hz and have a maximum time delay of 0.1 seconds.

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

8.8 Criteria For Review And Screening of Each Proposed Generation Facility

Generating Facility interconnection applications may, at NEC's discretion, be reviewed against some or all of the below criteria, depending on system size. The specific criteria screens used by NEC will vary based on the specifications, size, and features of individual projects and Generating Facilities.

- 8.8.1 For interconnection of a proposed Generating Facility to a distribution circuit, the aggregated generation on the circuit, including the proposed Generating Facility, shall not exceed 15% of the total circuit annual peak load as most recently measured at the substation or on the line section (if available), or the circuit hosting capacity limit, whichever is greater. Non-Exporting Systems, regardless of system size, and Inadvertent Export systems with a Maximum Capacity of 20 kW and under shall not be subject to this subsection.
- 8.8.2 A proposed Generating Facility shall not contribute more than 10% to a distribution circuit's maximum fault current at any point on the Distribution System, including during normal contingency conditions that may occur due to reconfiguration of the feeder or the distribution substation.
- 8.8.3 The proposed Maximum Capacity of a Generating Facility, in aggregate with the Maximum Capacity of other generation on a distribution circuit, shall not cause any distribution protective devices and equipment (including, but not limited to, substation breakers, fuse cutouts, and line reclosers), or consumer equipment on the system, to exceed 90% of the short circuit interrupting capability. Interconnection shall not be proposed for a circuit that already exceeds 90% of the short circuit interrupting capability.
- 8.8.4 NEC employs a three-phase, four-wire, primary Distribution System. Interconnection to NEC shall be line-to-neutral for both three-phase and single-phase Generating Facilities.
- 8.8.5 If a proposed Generating Facility is to be interconnected on a single-phase shared secondary, the aggregate generation capacity on the shared secondary, including the Maximum Capacity of the Generating Facility, shall not exceed 75% of the service transformer rating (see Section 8.3 regarding a dedicated transformer). Non-Exporting Systems and Inadvertent Export systems shall not be subject to this subsection.
- 8.8.6 If a proposed Generating Facility is single-phase and is to be interconnected on a transformer center tap neutral of a 240-volt service, its addition shall not create an imbalance between the two sides of the 240-volt service of more than 20% of the nameplate rating of the service transformer.

- 8.8.7 A proposed Generating Facility's Point of Interconnection shall not be on a transmission line.
- 8.8.8 A proposed Generating Facility shall not exceed the capacity of the Customer's existing electrical service unless there is a simultaneous request for an upgrade to the Customer's electrical service or the Generating Facility is configured never to inject on to the feeder power that exceeds the capacity of the electrical service.
- 8.8.9 If a proposed Generating Facility is non-inverter based, the Generating Facility must comply with the Protective Relaying Requirements in Section 8.7 of this Interconnection Manual.

9. METERING REQUIREMENTS

The Customer must provide and install at Customer's expense, and in accordance with NEC service standards, meter sockets and metering cabinets in a suitable location.

NEC will furnish, own, install and maintain all meters that register the flow of all energy from the Customer. The Customer will be invoiced, or billed as specified in the Electric Supply/Purchase Agreement, for the cost of the required meter(s) and maintenance costs.

10. APPLICATION PROCESS AND DOCUMENTATION REQUIREMENTS

Note: NEC approvals given pursuant to the review and approval process and the Interconnection Agreement shall not be construed as any warranty of, or representation regarding the safety, durability, reliability, performance or fitness of Customer's generation and service facilities, its control or protective device or the design, construction, installation or operation thereof, to Customer or any third party.

10.1 Application Review Considerations

During the Application process, NEC will make all practical efforts to follow the schedule and timelines set out in the Application Process Timeline. However, NEC's review, study, and processing of each Application will be subject to the number of Applications received and the availability of NEC staff. Depending on the size, specifications, and features of a Generating Facility and/or project, NEC may require that a third-party engineering consulting firm(s) be involved, which may add time to the review process.

10.2 Application Process:

The Customer must submit written equipment specifications and plans for the installation and operation of its Generating Facility, Interconnection Facilities, control and protective devices and facilities for NEC review and advance written approval prior to actual equipment installation. The "Application for Operation of Consumer-Owned Generation" attached to this document as Appendix A must be completed and all supplementary information requested therein must be provided.

10.2.1 NEC strongly encourages each Customer to contact and work closely with NEC at the conceptual stages of the design to ensure that the project proceeds smoothly. Upon request from the Applicant, NEC will provide a sample diagram to indicate the level of detail and type of information required for a typical system.

10.3 Timeline:

10.3.1 Once an application has been submitted to the department specified on the application, NEC will ensure that any individual in the specified department will be able to coordinate with the Applicant. NEC will generally require a single point of contact from the Applicant to coordinate the interconnection process.

10.3.2 NEC will provide the application packet to a member or their representative within seven (7) days of their request for the application.

10.3.3 Upon receipt of the completed application, NEC will contact the member or their representative within seven (7) days to review NEC's programs and tariffs, and address any questions the member or representative has.

10.3.4 Within fourteen (14) days of receipt of the completed application, NEC will inform the member or representative as to the sufficiency and completeness of their application; if there are deficiencies in the application, the member or representative will be notified in writing of the outstanding requirements.

Generating Facilities of Maximum Capacity greater than 2 MW (as a single system or several close proximity systems in aggregate) NEC is required to provide notice to, and receive approval from, its wholesale power supplier per the terms of the Balancing Authority Services Agreement. These applications will be processed under Max Study Track. The components of this process are listed below and elaborated upon thereafter.

- a. Pre-application Meeting
- b. Application Submittal
- c. Application Review
- d. Scoping Meeting
- e. Feasibility Study
- f. System Impact Study
- g. Facilities Study
- h. Interconnection Agreement

The pre-application meeting is optional and is an opportunity for the Customer to discuss the proposed project with NEC and ask any questions.

For NEC review, the application for Max Study Track includes an application form, electrical one-line and three-line diagrams, AC and DC control schematics, a location map, a site plan, and Generating Facility equipment information (e.g. data sheets, product bulletins, etc.).

In response to NEC's receipt of a completed Application, NEC (or an NEC-designated third party) may undertake an Interconnection Study. An Interconnection Study may include:

- a. Feasibility Study
- b. System Impact Study
- c. Facilities Study
- d. Additional Analysis/Study Required

Following the initial review by NEC and within 30 calendar days, NEC will notify the applicant of one of the following determinations:

- a) Generating Facility meets all requirements, and no additional equipment or system modifications are necessary, the application will be approved for Interconnection.

- b) Generating Facility does not meet one or more of the Interconnection requirements, and NEC determines that more study is necessary. Within 21 calendar days after notice of Generating Facility not meeting interconnection requirements, the member may request an optional Scoping Meeting. The Scoping Meeting purpose is for NEC to explain the studies needed and the costs and timelines associated with each.

Following the Scoping Meeting and if Feasibility Study is required, an agreement outlining the scope of the study and a good faith estimate of the cost of the materials and labor needed to perform the study will be provided to the Customer within 14 days.

The Feasibility Study evaluates short circuit currents and existing circuit protection equipment in an effort to determine whether further studies are necessary.

After Customer executes agreement, provides all requested information necessary to complete the Study, and pays the estimated cost, NEC shall complete the Study within 60 calendar days.

If deemed necessary by NEC, NEC shall undertake a System Impact Study. NEC shall provide Customer, within 14 calendar days after completing the previous study or meeting, an agreement including an outline of the scope of the study and a good faith estimate of the cost of the materials and labor needed to perform the study.

System Impact Study involves modeling the NEC circuit to which the Generating Facility will interconnect in Distribution System modeling software and evaluating the impact of the Generating Facility based on the following studies:

- a. Load Flow Study
- b. Short Circuit Study
- c. Voltage Regulation Study
- d. Circuit Protection and Coordination Study
- e. Islanded Operation Potential

After Customer executes agreement, provides all requested information necessary to complete the Study, and pays the estimated cost, NEC shall complete the Study within 60 calendar days.

If the outcome of the System Impact Study determines the need for additional NEC facilities to accommodate the Interconnection, a Facilities Study will be required. NEC shall provide Customer, within 14 calendar days after completing the previous study or meeting, an agreement including an outline of the scope of the study and a good faith estimate of the cost of the materials and labor needed to perform the study.

The Facilities Study identifies all NEC work necessary prior to Generating Facility Interconnection. It includes a list of tasks, cost estimates, and a schedule for construction completion. For any study work including but not limited to the Feasibility Study, System Impact Study, and Facilities Study, the Customer will be required to provide an up-front deposit for the study based on a good faith estimate by NEC. Actual costs incurred by NEC will be required to be paid upon completion of the study.

After Customer executes agreement, provides all requested information necessary to complete the Study, and pays the estimated cost, NEC shall complete the Study within 60 calendar days.

No Warranty from NEC

Approvals granted by NEC during the review and approval process (or any related process) 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 Facility, its control or protective devices or the design, construction, installation or operation thereof.

- 10.3.5 When the Customer or their representative notifies NEC that the installation is complete and a green tag inspection has been received from the appropriate oversight agency, NEC will contact its electrical installation inspector to schedule an on-site inspection.
- 10.3.6 Upon a satisfactory site inspection, NEC will notify the Customer in writing that the facility is ready for operation in accordance with the agreed-upon terms and conditions.
- 10.4 A Customer must reimburse NEC for the costs incurred, to the extent they exceed those normally incurred for Customers who do not have self-generation facilities, upon invoice, or as specified in the Electric Supply/Purchase Agreement, for Interconnection Facilities on its system (including but not limited to control or protective devices, or any other facilities), in order to accommodate or protect the Customer's Generating Facility or NEC's equipment
- 10.5 Following NEC approval of the Customer's proposed Generating Facility and associated facilities, any change, alteration or modification may not be made by the Customer without resubmitting plans to NEC and obtaining written approval from NEC. This includes the equipment specifications, the plans, control and protective devices or settings, and in general the Generating Facility system configuration or any facilities appurtenant thereto.

11. TESTING AND START-UP REQUIREMENTS

- 11.1 Following NEC 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 the associated generator or inverter breaker. Calibration must include on-site bench testing of pickup and timing characteristics of the relays. Functional testing must demonstrate that each (minimum) 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 rated 50 kW or less.
- 11.2 The Customer shall provide NEC with a copy of calibration and functional test results. Customer must also notify NEC in writing received by NEC at least five (5) working days in advance that such tests are to be performed and allow NEC personnel to witness such tests.
- 11.3 The Customer will be required to have a signed Interconnect Agreement with NEC, the preconditions for the effectiveness of which have been satisfied and completed, prior to electrically paralleling the Generating Facility with the NEC system.
- 11.4 The Customer will not commence interconnected operation of its Generating Facility until the installation has been inspected by an authorized NEC representative and final written approval is received from NEC to commence interconnected operation, which approval shall not be unreasonably withheld. The Customer shall give NEC at least five (5) working days' notice in writing prior to date when initial startup is to begin. NEC will have the right to have a representative present during initial energizing and testing of the Customer's system.
- 11.5 The Customer shall have all protective devices tested by a competent testing firm at the time of installation, prior to initial interconnection, and at intervals not to exceed four (4) years by qualified test personnel. The Customer shall (a) notify NEC as to when such tests are to be performed at least five (5) working days prior to such tests and allow NEC personnel to witness the test, and (b) provide NEC with a certified copy of the test results.

12. OPERATIONAL AND MAINTENANCE REQUIREMENTS

- 12.1 The Customer will be responsible for operating and maintaining the Generating 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 NEC and its authorized agents access to the protective relaying and control facilities to conduct whatever startup or periodic tests NEC deems necessary. NEC 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 NEC or its authorized agents lock open the Disconnect Switch, the Customer shall not remove or tamper with such lock.
- 12.5 NEC 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 NEC.
- 12.6 NEC (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 NEC may install, provided that as reasonably as possible, notice is given to the Customer prior to entering its premises; (b) maintain or repair NEC equipment; (c) disconnect the Generating Facility without notice if, in NEC's opinion, a hazardous condition exists and such immediate action is necessary to protect persons, NEC facilities or other Customers' or third parties' property and facilities from damage or interference caused by the Customer's Generating Facility, or improperly operating protective devices; (d) open the Disconnect Switch without notice if an operating clearance is required by NEC personnel; (e) close the Disconnect Switch upon completion of NEC work performed under an operating clearance. When the Customer has restored the Generating Facility to compliance, and notifies NEC of such, NEC will have the Generating Facility inspected within five (5) days, and upon verification of compliance, the Generating Facility will be reconnected as quickly as practicable.
- 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. NEC reserves the right to

inspect the Customer's facility to verify that the generator is permanently disconnected.

APPENDIX A

Supplementary Information

Application for Operation of Consumer-Owned Generation

System Facilities Upgrade Agreement

Consumer Guidelines for Electric Power Generation
Installation and Interconnection

SUPPLEMENTARY INFORMATION

Information below to be submitted for all projects. All diagrams are to be professionally and neatly drawn. Generally, free hand drawn and illegible diagrams will not be accepted by NEC.

- A. **Electrical One-Line Diagram:**
Provide 4 sets, including any and all revisions or changes as they are made.
Diagram(s) must also include project name and address, show generator size and all protective relaying and control equipment, as well as electric service entrance and utility meter.

- B. **Electrical Three-Line Diagram:**
Provide 4 sets, including any and all revisions or changes as they are made.
Diagram(s) must also include project name and address, show generator size and all protective relaying and control equipment, as well as electric service entrance and utility meter, and include all neutral and ground conductors and connections.

- C. **AC & DC Control Schematics:**
Provide 4 sets, including any and all revisions or changes as they are made, for all projects comprising rotating machinery. Diagram(s) must show the detailed wiring of all protective relays and control functions, and include control power source and wiring.

- D. **Detailed Map:**
Provide 4 sets of detailed maps, including any and all revisions or changes as they are made. Maps should show major cross streets and proposed plant location, and include the street address.

- E. **Site Plan:**
Provide 4 sets of site plans, including any and all revisions as they are made, showing the arrangement of the major equipment, including the electric service entrance section and utility meter, location of generator and interface equipment, and location of the Disconnect Switch. Include the street address, and location of the any lock-boxes, etc.

- F. **Testing Company:**
Provide the name of the company that will do the protective relay bench testing and the trip circuit functional tests and the anticipated start up date.

- G. **Point of Contact**
If the interconnection and start-up process is to be coordinated through a party or individual other than the Customer, provide the name, company, address and phone number of that individual or party with whom the utility is to coordinate the interconnection.