California Interconnection Guidebook:
A Guide to Interconnecting Customer-owned Electric Generation Equipment to the Electric Utility Distribution System Using California's Electric Rule 21

CONSULTANT REPORT

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California Interconnection Guidebook

1 Introduction

1.1 Purpose of the Guidebook

This guidebook is intended to help customers interconnect electric generators (distributed generation) to their investor-owned electric utility Distribution System under the California Public Utilities Commission (CPUC) approved utility interconnection Rule 21. Rule 21 applies only to electric utilities in California that are under jurisdiction of the CPUC, and have filed this tariff Rule. Rule 21 is identical for these utilities, except for specific information, such as the utility name and references to other tariffs. Exporting for sale is not addressed under Rule 21. See Section 1.3.3.2.4 for details. Rule 21 does not specify every detail of implementation of the requirements it describes; where it is not specific, implementation by the utilities may vary. Section 9.2 contains links to all the documents you'll need from each electric utility.

Several California municipal utilities have also adopted interconnection rules similar to Rule 21. Section 1.3 below discusses which municipal utility rules are similar to Rule 21 at time of issuance of this guidebook. Section 9.2 also contains links for additional materials from these municipal utilities. This guidebook does not describe the various municipal utility interconnection rules. If you plan to interconnect with a municipal utility's Distribution System, you will need to contact the utility for information.

The tariff Rule 21 states in formal language the requirements for interconnection at the Distribution System level. This guidebook steps you though the process involved in actual interconnection and provides information resources for each step. The guidebook does not assume previous experience in interconnecting electric generators; however, interconnecting a new Generator to an existing electrical network can be a complicated technical task, and can be dangerous if not performed correctly. You can help ensure a successful interconnection by retaining the services of an electrical engineer who has experience in interconnection of electric Generators and who specializes in Distribution System protection.

As you go through the guidebook and apply for interconnection, please bear in mind that the practice of using small generating facilities for distributed generation purposes has not been the norm, and that utility engineers have historically been concerned primarily with larger Generators interconnected to transmission lines at high voltages. Consequently, the experience level for all parties is increasing as the number of distributed generation interconnections grows. Many of the processes in Rule 21 are in their infancy; some questions remain to be resolved. The utility engineer's first priority must always be the safety and reliability of the transmission and Distribution System that supplies millions of customers with vital electric power. Many distributed generation and interconnection technologies such as microturbines and fuel cell systems are new and still evolving. Until significantly more experience is gained on how distributed generation impacts the system, utilities may require detailed information on the design and performance of the system and will err on the side of caution.

1.2 Structure of the Guidebook

This guidebook gives an overall understanding of the process of interconnection, first as an overview, then in details. Sections 1-2 give an overview of Rule 21. Sections 3-7 give the technical details for interconnecting. Section 8 covers what to do if there is a dispute with the electric utility. Section 9 contains links to further information.

For best results when planning to interconnect your Generator to the Distribution System:

1. Read Rule 21 (see Sections 9.2.1.1, 9.2.2.1, and 9.2.3.1 for web links to the utility implementations of the rule);
2. Read any utility interconnection guide or handbook your utility may have developed (see Section 9.2 for links to all necessary documents);
3. Read this entire guidebook;
4. Then, when you actually plan to interconnect, return to this guidebook and work through the following sections in order:
    a. Section 4: to help fill out the application;
    b. Section 5: to help understand what happens during the Utility Review;
    c. Section 6: to help fill out the proper agreements;
    d. Section 7: to help with Installation and Commissioning.

1.2.1 Terminology

Rule 21 uses language in a very exact way to define terms necessary for interconnection. When you read the text of the rule, you'll find many capitalized words.[1] Please see the Glossary in Appendix D for definitions of any capitalized words used in this guidebook. A few very common words defined in Rule 21 are not capitalized in this guidebook to avoid cluttering the text. These words were chosen because they are in common usage with identical meanings outside of Rule 21. They include:[2]

> **application**: A Commission[3]-approved form submitted to the utility for Interconnection of a Generating Facility.
>
> **customer:** The entity that receives or is entitled to receive Distribution Service through the Distribution System.
>
> **interconnection agreement:** An agreement between the utility and the Producer that gives certain rights and obligations to effect or end Interconnection.
>
> **interconnection; interconnected:** The physical connection of a Generating Facility in accordance with the requirements of this Rule so that Parallel Operation with the utility's Distribution System can occur (has occurred).

All other Rule 21-defined terms are capitalized in this guidebook.

[1] Section H of Rule 21 contains the complete Glossary of terms used in Rule 21.
[2] In this guidebook, all text presented indented in Arial 10 point font is Rule 21 text, such as these definitions.
[3] Rule 21 uses "Commission" to mean California Public Utilities Commission, not the California Energy Commission. In this guidebook, these two different names are always spelled out, except when quoting verbatim from Rule 21.

1.3 Your local electric utility

1.3.1 Who is your local electric utility?

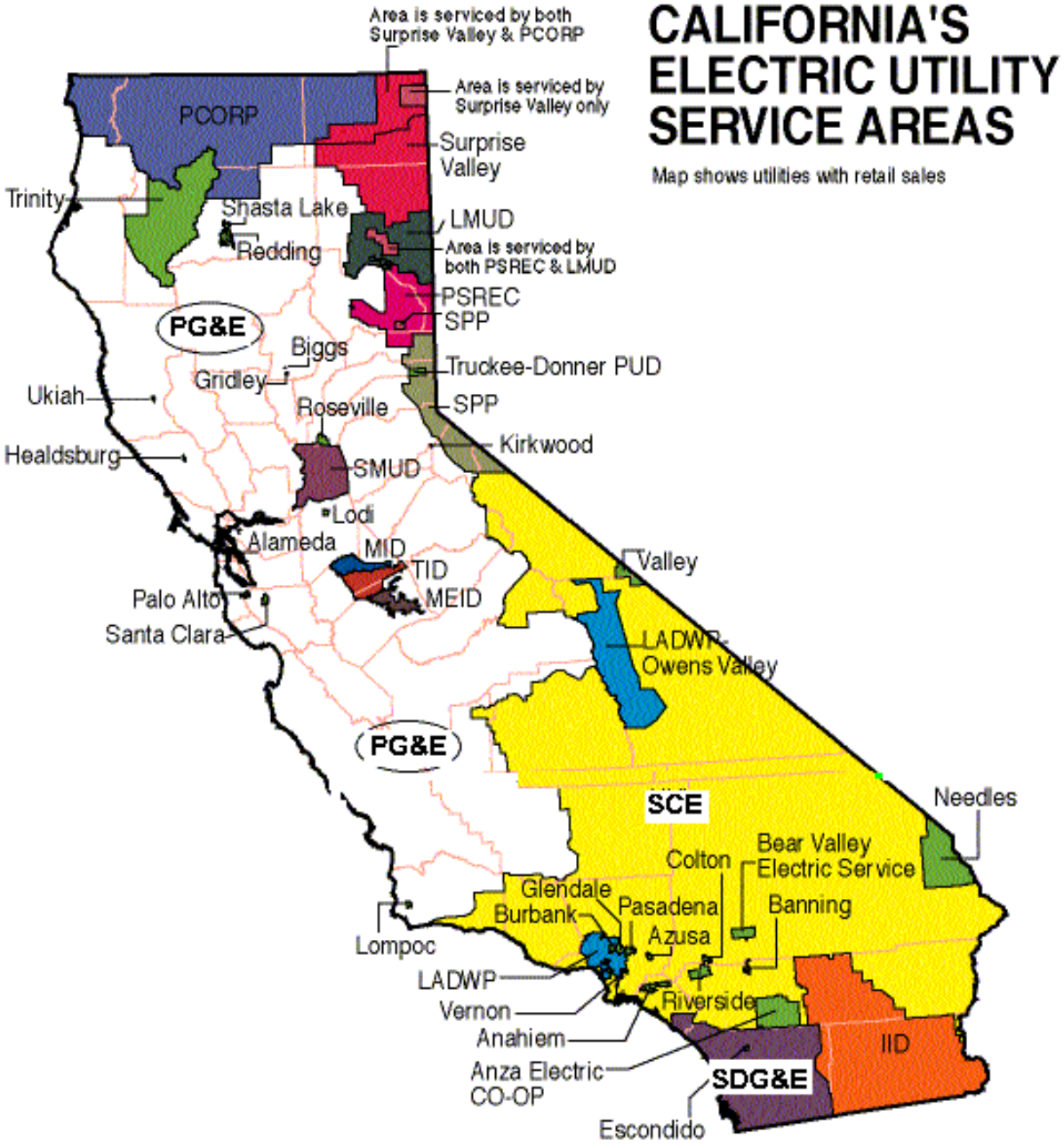
The location of the site where you plan to install an electricity Generating Facility will determine which utility you work with to interconnect. Unless you plan to operate your Generator and load isolated from the grid such that the load is never powered from the grid, you should advise the utility of your Generating Facility plans. (See Section 1.3.1 below for more about isolated operation.)

Even if you plan to sell power to another entity, as allowed by Section 218 of the California Public Utility Code,[4] for example—you will still interconnect to the local electric utility Distribution System.

Figure 1-1 shows all investor-owned utilities and municipal utilities, cooperatives and irrigation districts that between them are responsible for providing electric service in California. Electric utilities have a franchise for providing electric service in an area; each area is served by one (and only one) utility.

[4] See Section 6.1.1.1 and Section 4.4.3, page 34.

Figure 1-1: Map of California's Electric Utilities



A growing number of California municipal utilities have interconnection rules modeled after Rule 21: Riverside Utilities Department (RUD), Sacramento Municipal Utility District (SMUD) the Los Angeles Department of Water and Power (LADWP), Mountain Utilities, Bear Valley Electric (SWC), and Sierra Pacific. If you plan to site a Generating Facility in one of these franchise areas (or any other), you must interconnect with the Distribution System of the utility in accordance with their rules. Do not assume that CPUC-approved Rule 21 is identical to any municipal utility, cooperative or irrigation district interconnection rule. A listing of electric utilities with links to websites is included in Section 9.2. Individual utilities may also offer their own interconnection guidebook—check to see if one is available from your utility

If you have any question about who your local electric utility is, look at the utility bill for the meter behind which you plan to site the Generating Facility. You will need to submit a copy of this bill with your application, and much of the information contained on it will be useful in filling out your application.

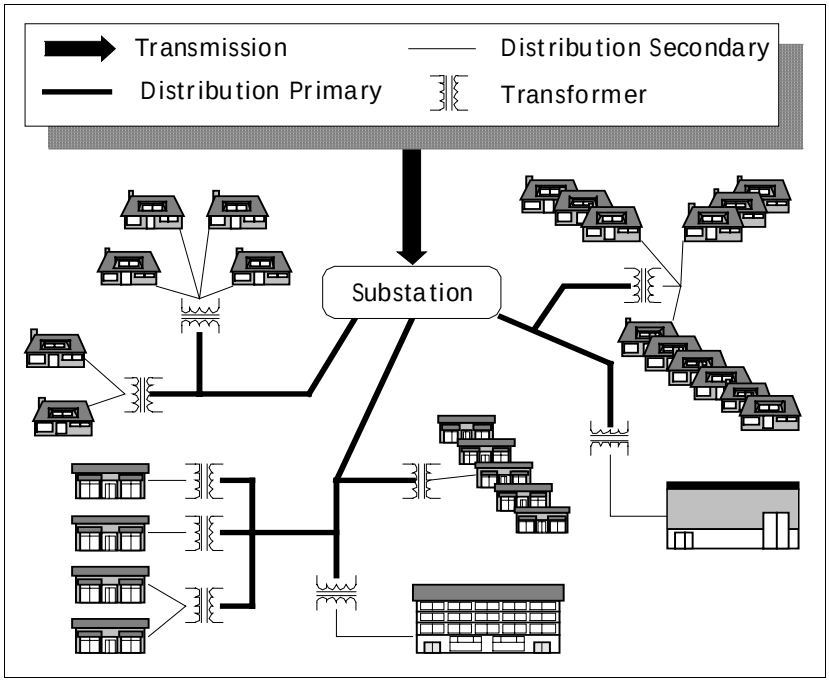
While this guidebook is specifically for Generators planning to interconnect to the investor-owned utilities, it will also be useful to Generators connecting to other electric utility Distribution Systems.

1.3.2 What is the Electric Grid?

The electric grid is broadly divided into two systems: the transmission system that transfers bulk power at high voltages, from power plants to utility-owned substations and a few very large customers, and the Distribution System that delivers power at medium and low voltages from the substation to the majority of customers. Both state and federal governments regulate use of these systems. In general, the Federal Electricity Regulatory Commission (FERC) regulates transactions that are "wholesale" in nature and require the use of the Transmission System. "Retail" transactions, which normally take place at the Distribution System level, are under the jurisdiction of the CPUC.

Rule 21 applies to interconnection of generation used only to supplement a customer's retail electric service. Generators used to generate electric energy to be sold in wholesale (sale for resale) transactions must follow separate Federal Energy Regulatory Commission requirements and are outside the scope of Rule 21 and this guidebook.

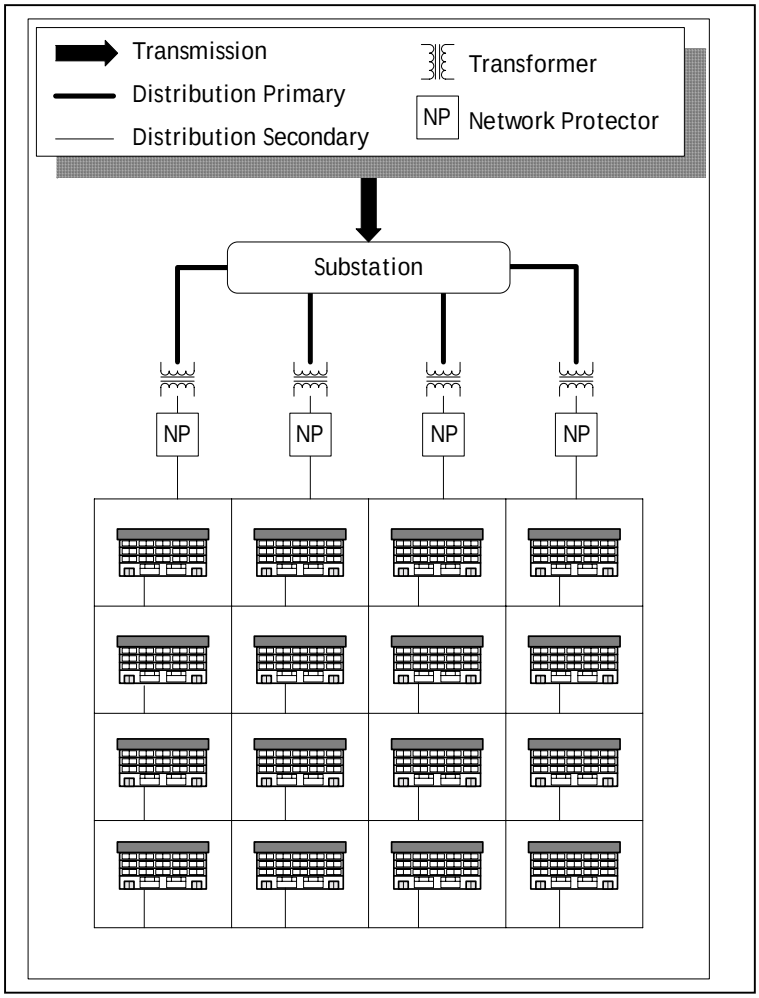
Figure 1-2: Typical Radial Distribution System



A distribution substation typically draws power from the high voltage (60 kilovolts (kV) to 500kV) transmission system and converts it to medium voltage (4 kV to 60 kV). From the substation, Distribution System "feeders" carry power to individual customers. While the transmission system is usually designed for bi-directional power flow (for example, power may flow from Southern California to Northern California or vice versa on the same transmission line), the Distribution System is usually designed for uni-directional power flow: from the

distribution substation to the customer load. Most often, this is accomplished through a Radial Distribution System with the substation at the hub and feeders acting as the spokes carrying power to the customers (see Figure 1-2: Typical Radial Distribution System). The equipment in the Distribution System is generally designed with the assumption that power flows one-way from the substation outward to the customers.

Figure 1-3: Typical Network Distribution System



In very high-density load areas, typically major metropolitan areas such as Los Angeles and San Francisco, a Network Secondary Distribution System may be used. Here, multiple paths and multiple sources increase reliability and reduce outages in the event of a fault on the system, either on one of the supplying feeders, or within the Network itself (see Figure 1-3). Within a Network system, bi-directional power flow is anticipated and is, in fact, a key reason for its improved reliability. However, power flow out of the Network back to the radial feeder(s) is expressly prohibited, a function provided by the Network Protector. Network systems are characterized as either Grid Networks, which may supply several city blocks of high-rise office buildings, as suggested in Figure 1-3, or Spot Networks, which supply only one or two buildings. Thus Networks present more complications to the interconnection of customer generation than do Radial systems. The criteria and requirements for interconnecting customer Generators within Network systems are still being debated within the technical community.

The Distribution System is a highly complex maze of transformers, wires, switches, and protective and control equipment. It must serve each customer reliably at all times. Electric utilities are charged with this responsibility. No two distribution lines are identical, and no two customers have the same consumption pattern. Furthermore, systems and customer loads are constantly changing. Even those systems that are similar when installed change over time and become unique. Some businesses grow while others close their doors. Power consumption patterns vary from morning till night and from summer to winter. The power from your

Generator will likely be fed into such a dynamic system that was not originally designed to receive such power. (Sections 1.3.3.2.3 and 1.3.3.2.4 discuss power export.) Maintaining and operating the Distribution System is a major function of the electric utility, accounting for nearly 1/3 of the average electric utility bill, at a cost roughly equal to that of the energy itself. As your utility evaluates your interconnection application, it must consider not just the impact of your Generator to your service, but the effect the Generator may have on the rest of the system during normal and abnormal conditions, on your neighbors, on power quality and other parameters, even while the system may change in the future.

1.3.3 What mode of operation are you planning for your Generator?

If you plan to install a Generator to produce electricity, you'll have several interconnection options. Each one is described in the following sections in order:

1. Isolated operation, not interconnected to the utility's Distribution System (see Section 1.3.3.1);
2. Interconnected, but never exporting power to the utility's Distribution System (see Section 1.3.3.2.1);
3. Interconnected to the utility's Distribution System and incidentally exporting power;
4. Net energy metering per utility tariffs (see Section 1.3.3.2.2);
5. Exporting power for sale (see Section 1.3.3.2.4).

In each of the last four relationships, the Generator operates "in parallel' with the utility's Distribution System, generating power while interconnected, and thus having to match the utility power characteristics.

1.3.3.1 Isolated Operation

Some generating facilities power the customer's partial or entire load isolated from the utility. One example would be a hospital emergency Generator intended to provide power only when the utility is not available. Isolated operation involves no interaction with the utility's Distribution System, since the Generator does not operate in parallel with the utility. In some isolated systems, the generator is sized for a specific load that is always powered from the generator and never from the utility. While no interconnection agreement is required for permanently wired[5] isolated operation or some temporary installations, if there is a switch to "transfer" load from the utility to the generator and back, utility approval is usually necessary. There are two ways of transferring load to isolated operation:

[5] A motor home with a generator has loads that can be powered by the utility "shore power". These systems, for example, do not require utility notification or approval, nor does the use of a portable generator on construction site. However, even temporarily wiring a portable generator into a building service panel to provide emergency power can present an equipment and personnel safety hazard and should only be installed by trained technicians using proper equipment with utility consent.

- With a Break-before-make transfer switch (also known as open transition switching), manual or automatic—a switching device disconnects the load from the utility prior to making the new connection with the on-site electric Generating Facility;
- With a Momentary-Parallel (or closed transition) switch, a control system starts the customer's Generator and parallels it with the utility's Distribution System, quickly ramps the Generator output power to meet the customer's load demand and then disconnects the load from the utility, all within 60 cycles (1 second) or less.

Both of these ways have different potential impacts on the electric utility Distribution System and neighboring customers.

Electric utility requirements for isolated operation are currently not addressed in Rule 21; however, the utility notification requirements are covered in the application form. Section 4.2 of this guidebook specifies which parts of the interconnection application you will need to fill out if you are planning isolated operation. If you have further questions about isolated operation, please contact your local utility. Because these Generators are momentarily or not parallel operated, interconnection requirements are different than for Generators that are operated in parallel continuously.

Interconnection in parallel with the utility's Distribution System gives a customer the flexibility to serve its electric loads *either* with its own Generator *or* with the utility electric service *or* both. While isolated operation reduces or eliminates interconnection requirements, it does not for parallel operation. In isolated operation, the Generator (with load following or load shedding scheme) must be sized to supply the entire load or specific loads must be transferred between the Generator and the utility supply.

1.3.3.2 Parallel Operation

Rule 21 and this guidebook are aimed primarily at parallel operation, which means the Generating Facility produces alternating-current power while electrically interconnected with the local utility generating equipment. Under parallel operation, the Generator must match the prevailing voltage magnitude and frequency of the utility's Distribution System. It also must meet minimum power quality requirements and not interfere with electric utility protective and reliability functions. Parallel operation is divided into cases where all of the generated power is consumed by the customer's load (called Non-Export) and those where some of that power is exported to the utility's Distribution System (called export). Export is defined relative to the Point of Common Coupling (PCC) where the electric utility equipment connects to the customer's equipment. In most cases it is demarked by the revenue meter, but it may be associated with a service transformer, a disconnect switch, or some other piece of equipment, as defined by the electric utility. The following sections discuss increasing levels of export and possible interconnection complexity.

1.3.3.2.1 Non-Export

As stated above, Non-Exporting generating facilities have all power consumed by the customer's load. From the local utility's perspective, the power provided by turning on a Non-Exporting

Generator should be equivalent to turning off electric load.[6] Interconnection requirements for a non-exporting Generating Facility are simplified because there is less risk of reverse power flow to the Distribution System and of unintended "islanding". Islanding is a condition where part of the electric utility's system (generation and load) becomes disconnected from the rest of the system and continues to operate. Utility operators may do this intentionally with their own generating equipment, for example, to keep one section of the system operating while another is being serviced. Unintended islanding is a specific case where one or more generating facilities operate a section of the utility's Distribution System without utility oversight and control. Unintended islanding represents a potential safety hazard to utility personnel working on what they believe to be an isolated section of line, unaware that current is flowing (i.e., the line is energized). Additionally, unless proper steps are taken to ensure the two systems are "synchronized", equipment damage and personal injury can occur the instant an unintended islanded section is reconnected to the rest of the Distribution System. The potential for unintended islanding depends on many factors including the type of Generating Facility, the size and type of loads that might be isolated with the Generator(s), and the effectiveness of controls and protective functions used to mitigate its possibility.

There are several methods that are used to ensure a Generating Facility is non-exporting. Rule 21 describes the following methods:

- Reverse Power Function – The Generating Facility must take corrective action (decrease or drop generation, increase load or a combination) if power flows to the utility's Distribution System, exceeds a set threshold, called "reverse power", for a defined period of time;
- Under Power Function – The Generation Facility must take corrective action (decrease or drop generation, increase load or a combination) if power flows from the utility's Distribution System is less than a set threshold, called "under power", for a defined period of time;
- The Generating Facility output capacity is a fraction of customer's verifiable minimum load, assuring that the customer load will always exceed the generation.

1.3.3.2.2 Inadvertent and Incidental Export

Customer-sited generation is sometimes used to reduce both energy and peak demand charges. In some instances the Generator may be operated at a level very close to the customer's load to minimize the power drawn from the utility. Unless the Generator is able to respond quickly, a sudden reduction in the customer's load may result in Inadvertent Export while the Generator throttles back. Neither the customer nor the utility desires this inadvertent power export because there is no compensation for the customer and the utility's system may not be designed for it. Therefore, the interconnection should be designed to minimize the power and energy exported. By allowing inadvertent export, the Generator can continue operation normally without the need to respond to momentary changes in load.

[6] Assuming, that is, the generator has no adverse power quality emissions onto the grid.

Alternatively, a Generator that is small relative to the customer's facility load and utility service capacity will be unlikely to export, and will have minimal impact if it does (Incidental Export). Additional requirements may be needed to specifically address the potential for islanding.

1.3.3.2.3 Exporting - Net Energy Metering

Some generating facilities, including wind and solar Generators, intentionally export power to accommodate the non-dispatchability[7] of their energy sources. Net energy metering is a specific tariff term used for Generators that may export surplus power to the grid, and where the energy exported to the utility is subtracted from the energy drawn from the utility, so that the customer pays only for the net amount of energy used from the utility. Net Energy Metering is usually reconciled (total energy exported is subtracted from the total energy drawn from the utility) on a monthly or yearly basis. Net Energy metering in California is available only for certain renewable energy Generators, such as solar and wind up to 1 MW capacity, and has recently been expanded to include certain dairy digesters. It is measured either by allowing the revenue meter to spin backwards when exporting and forwards when buying or importing, or by using separate meters for import and for export.

The interconnection approval process must address the export of power from these Generators. The applicant is not charged a fee for the application, any interconnection studies, or some interconnection facilities. This guidebook will restrict discussion to the interconnection process. Consult your utility, the California Energy Commission, and the CPUC for updated information related to fees, tariffs and rebates.

1.3.3.2.4 Exporting for Sale

One option for generated electricity is to sell it. At this time, power from a Generator connected to the Distribution System may be sold only to a utility, unless you apply for the FERC wholesale tariff and sign a Wholesale Distribution Access Tariff (WDAT) agreement with the utility. "Direct Access", the tariff that allowed certain power sales from one private entity to another using the utility system for delivering the power and that was a key feature of California's electric utility deregulation law, has been suspended for new entrants. On a technical basis, exporting for sale—regardless of the buyer —is the same as Net Energy Metered export and has the same technical requirements. However, it differs significantly on a contractual and jurisdictional basis. Thus, as mentioned above, exporting for sale is not addressed under Rule 21.

For tariff purposes, export for resale, other than to the utility, is considered a wholesale transaction by the utilities, and therefore under the jurisdiction of FERC. Section 9.4.3 contains links to FERC for those wishing to export for resale.

[7] Unlike fossil-fueled generation, renewable energy resources such as wind and solar do not have control over their fuel. These systems are able to generate power when the wind is blowing or the sun is shining and are therefore called non-dispatchable. Customers utilizing these resources typically generate excess power during peak resource conditions (i.e., daytime, for solar) and consume energy during periods of low resource, using the electric utility as a virtual storage medium.

One concern with exporting Generators is the increased potential for unintended islanding. Another concern is the potential impact of power flowing backwards through the Distribution System as the level of export increases, resulting in the need for more detailed engineering review. For example, the proper operation of electric utility voltage control systems (voltage regulators and switched capacitors) typically assumes that the voltage decreases with distance from the substation as power flows towards the customers. Power from exporting Generators flowing towards the substation can cause the voltage to *increase* with increasing distance from the substation, causing voltage control equipment to operate incorrectly. In some situations, it is possible that power flowing towards substations could defeat protection schemes and coordination, potentially resulting in damage to distribution system equipment.

1.4 A Brief Overview of Rule 21

This Section of the guidebook will give a brief overview of each Section of Rule 21. This overview will not elaborate on the use of technical terms; explanation and elaboration of these terms will be contained in Section 3 of this guidebook.

1.4.1 Section A: Applicability

This Section states that Rule 21 covers the interconnection, operating and metering requirements for generating facilities to be connected with the Distribution System of the named electric utility.

1.4.2 Section B: General Rules, Rights and Obligations

This Section states the general requirements of a Generating Facility that plans to operate in parallel with (that is, electrically interconnected to) the utility Distribution System. The general requirements include: necessity of a written agreement, necessity of complying with all applicable laws, rules, and tariffs, the right of the utility to perform design reviews and inspections and to have access to facilities necessary under its other tariffs, confidentiality of customer information, and events justifying curtailment and disconnection of generating facilities.

1.4.3 Section C: Generating Facility Application and Interconnection Process

Section C covers the Generating Facility application process for interconnection. This entails the legal description of the interconnection application process, including: the applicant initiating contact with the utility, the applicant completing the application, the structure of the interconnection fee, the utility initial and supplemental review, the utility detailed study (when required), installation of interconnection facilities or modification of Distribution System (where applicable), commissioning testing, utility authorization for parallel operation, and utility reconciliation of costs and payments.

1.4.4 Section D: Generating Facility Design and Operating Requirements

Section D of Rule 21 contains the interconnection system design and operating requirements. It contains three major subsections, including general interconnection project requirements,

prevention of interference with the normal operation of the Distribution System, and control, protective function and safety equipment requirements.

1.4.5 Section E: Interconnection Facility and Distribution System Improvement Ownership and Financing

Section E addresses the additions that may be required to the Generating Facility or to the Distribution System (or both) in order to be able to interconnect safely and reliably.

This section describes the ownership and cost limits of Interconnection Facilities and exemptions for certain solar and Net Energy Metered Generating Facilities, the responsibilities of each party for study and review costs, and the maintenance of a separation of utility-incurred costs for Distribution System improvements serving other customers are not billed to the entity that signs the interconnection agreement with the utility (called the Producer).

The Producer and the utility may have to execute additional agreements to the interconnection agreement. Such agreements could cover ownership of Distribution System improvements installed to accommodate the interconnection, or if the Producer may, with utility approval, build interconnection facilities on the utility's side of the PCC, (which will be owned and operated by the utility), power purchase by the utility, etc.

1.4.6 Section F: Metering, Monitoring and Telemetering

Section F covers metering, monitoring and Telemetering. The utility may require under certain circumstances the installation of meters at the customer's Generator (called "Net generation metering"). These meters are for the purposes of assessing certain charges such as exit fees and standby charges. (See Section 9.7 for links to regulatory and legislative activity and information on these tariffs.) The CPUC and the legislature have been active in this area, and have limited in certain cases the utilities' ability to require such metering. There are unresolved issues relative to the cost, ownership, access to, and operation of such Net Generation Meters. For larger Generators, the utility may require that the metered data be telecommunicated to the utility, in order to allow the utility to monitor such large Generators for their impact on the Distribution System. See Section 9.5 for further information on metering issues.

The current conditions of Net Generation Metering and Telemetering expire December 31, 2004. The cost for metering required by this Section is to be paid by the Producer.

1.4.7 Section G: Dispute Resolution Process

Section G outlines the process for resolving disputes under Rule 21. Disputes unresolved for 45 days may be appealed to the CPUC.

1.4.8 Section H: Definitions

This section covers definitions used specifically for Rule 21. As noted earlier, words defined in Rule 21 are capitalized, both in the Rule and in this guidebook, with the exception of the four

very common terms listed in Section 1.2.1. All Rule 21-defined terms used in this guidebook are listed in Appendix D.

1.4.9 Section I: Review Process for Applications to Interconnect Generating Facilities

Section I describes the process that the electric utility uses to determine the level of review necessary for interconnection. All applications for interconnection receive Initial Review (i.e., they are screened) with the goal of passing those that can be approved quickly without an Interconnection Study. Those that do not pass the Initial Review have a second chance of passing quickly following a Supplemental Review. There are thus three levels of review, in order of increasing costs and complexity:

- Initial Review (Screening);
- Supplemental Review;
- Interconnection Study.

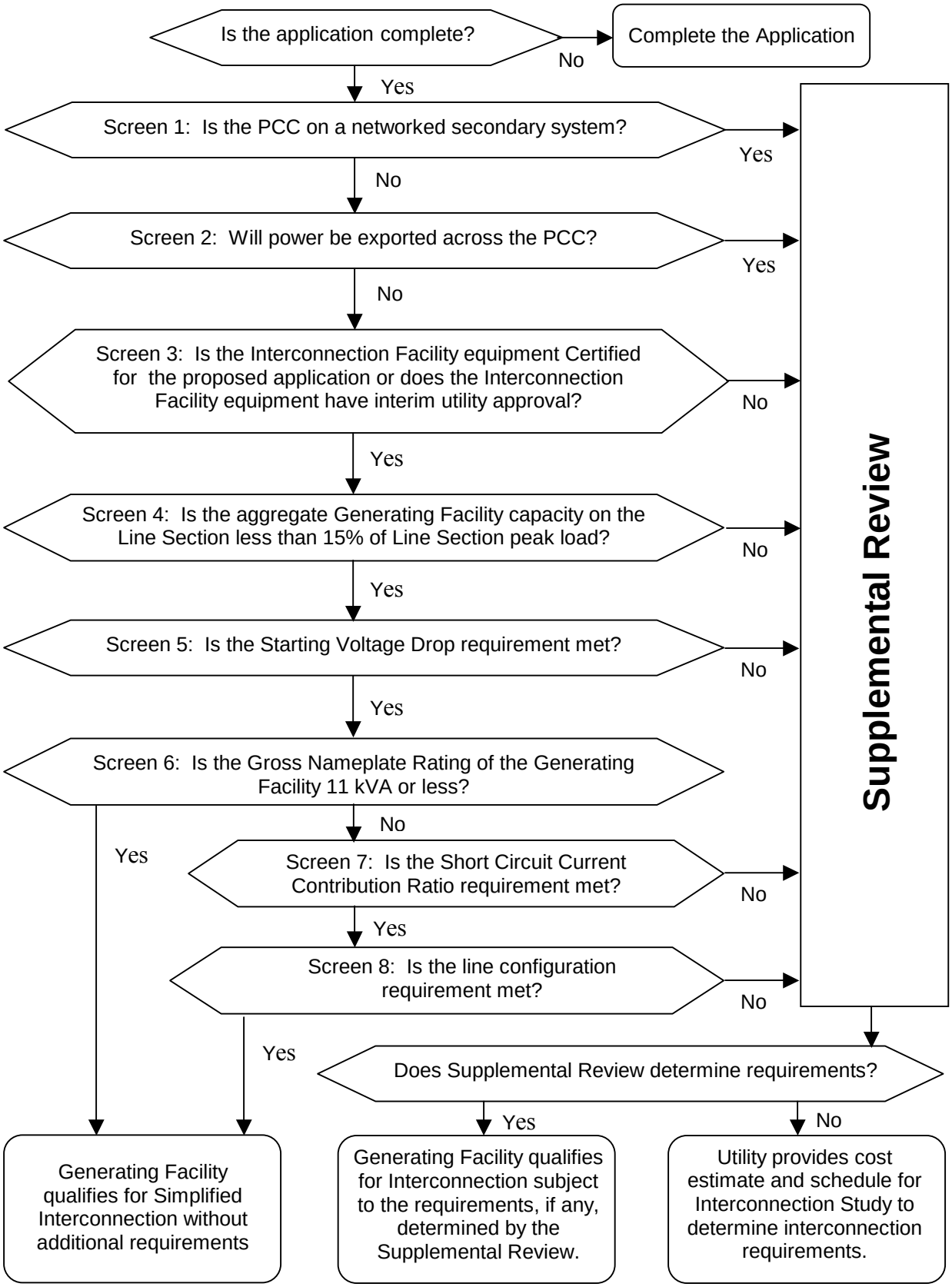
If the Generating Facility is approved for interconnection following the Initial Review, and in some cases following the Supplemental Review, it qualifies for Simplified Interconnection. If it requires an Interconnection Study, it probably won't qualify for Simplified Interconnection. There will likely be certain additional requirements imposed on the Generator or Interconnection facility prior to interconnection or modifications to the Distribution System are required to accommodate the interconnection.

Once the utility receives a completed application, it begins the review process. There are eight screens that make up the Initial Review, each in the form of a yes or no question. The answer to each of the eight screens determines whether the Generating Facility qualifies for Simplified Interconnection, or requires Supplemental Review.

In short, if your interconnection equipment has been Certified under Rule 21, and if you do not plan to export power, and the Generator capacity is small compared to your electrical consumption (i.e., "load"), you will likely qualify for Simplified Interconnection. Your chances of qualifying for Simplified Interconnection decrease the more you depart from these conditions.

Because the interconnection fees are fixed, they are a more significant part of the cost of a small Generating Facility than of a larger one. Providing a path to Certification of small Generators to achieve Simplified Interconnection was therefore made a priority in Rule 21. There are now several interconnection devices whose integral interconnection and protection equipment has been tested at independent laboratories, and whose test data has been approved by some California utilities, and are therefore Certified for Simplified Interconnection provided they pass the remaining screens. The screens of the Initial Review process are shown below. The Energy Commission maintains this list of Rule 21 Certified equipment on their website.

Figure 1-4: The Initial Review Flowchart



1.4.10 Section J: Rule 21 Certification and Testing Criteria

The multi-stakeholder working group that crafted the current version of Rule 21 believed it was important to allow low-impact Generators to pass through Initial Review easily and quickly. A key feature that allows simplified interconnection is that equipment performance and compliance to the Rule's requirements are verified through Rule 21 Certification testing. Rule 21 Certification is set up as a series of tests that may be run by an independent testing laboratory (called a Nationally Recognized Testing Laboratory, or NRTL). If the applicant makes use of a Generator/interconnection equipment package that has passed these tests, the application will pass Initial Review screen 3 (see Figure 1.4-1 above). Rule 21 Certification is designed to allow the purchaser of a Rule 21 Certified Generator/interconnection equipment to avoid the delay of utility field-testing of the unit's protective functions. All utilities that have adopted Rule 21 accept the results of Rule 21 Certification for a particular manufacturer's make and model, in lieu of testing every Generator and every piece of interconnection equipment individually[8]. Rule 21 Certification may apply to either a pre-packaged system or an assembly of components that perform the necessary functions.

This Section describes the Rule 21 Certification and test procedures and requirements for equipment used for interconnecting electricity Generators to the Distribution System. There are four kinds of tests:

- Type Testing
- Production Testing
- Commissioning Testing
- Periodic Testing.

Type Testing provides a basis for determining that equipment meets the specifications for being designated as Certified equipment under this Rule. Type tests within Rule 21 are based on the test procedures in Underwriters' Laboratories UL1741 Inverters, Converters, and Controllers used in Independent Power Systems, and specific tests within that document are referenced. Other tests not specified in UL 1741 are described in Rule 21.

Type Testing may be done in the manufacturer's factory or test laboratory, or in the field.

Production Testing, at a minimum, includes voltage and frequency variation tests.[9].

Type Tests and Production Tests are the only tests necessary for a Generator (or associated interconnection equipment) to receive Rule 21 Certification. These tests are intended to provide assurance that the Generating Facility will not adversely affect the Distribution System or maintenance personnel. The tests were developed assuming a low percentage of Generating Facility capacity and/or number of connections on a Distribution System feeder. At high

[8] FERC may also accept Rule 21 certified equipment under its small generation interconnection process.
[9] The procedures for these tests are described in Underwriter's Laboratories UL1741 document, under Manufacturing and Production Tests, Section 68.

percentage of capacity or multiple Generators on a single distribution feeder, additional requirements and corresponding test procedures may need to be defined.

Commissioning Testing is performed on-site to verify settings of Generating Facility protection functions. A Commissioning Test must be performed when the Generator first operates in parallel with the Distribution System; it may also be performed any time interconnection equipment or software affecting functionality is changed. The utility has the right to witness Commissioning Tests. Extensive commissioning testing can add significant labor costs and may require use of specialized test equipment. Certification can help reduce the cost and time involved in Commissioning Tests.

Commissioning testing may consist of:

- Over and under-voltage testing;
- Over and under-frequency testing;
- Non-Islanding function testing; (if applicable)
- Non-Exporting function testing (if applicable);
- Testing inability to energize dead line;
- Testing time delay on restart after utility source is stable;
- Utility system fault detection testing (if used);
- Testing synchronizing controls (if applicable);
- Testing other Protective Functions that may be required as part of the interconnection agreement.

Periodic Testing is specified by the manufacturer, and is performed no less than every four years. All Periodic Tests prescribed by the manufacturer must be performed.

1.4.11 Supplemental Review Guidance

The pass/fail criteria in the Initial Review Process Screens represent levels or conditions below which the proposed Generating Facility is unlikely to damage or cause misoperation of the Distribution System. When a proposed Generating Facility fails a Screen, Supplemental Review determine if the issue can be ignored or addressed with minor alterations to the interconnection or if an Interconnection Study is necessary.

Each screen has associated with it a set of issues that should be investigated. For example, Generating Facilities that export in excess of that allowed under Screen 2 may present additional risk for unintentional islanding, utility equipment overload, or voltage regulation conflicts. The utility engineer will evaluate each of the issues raised by each of the failed screens. A Supplemental Review Guideline (http://www.energy.ca.gov/distgen/interconnection/guideline.html) has been drafted to encourage uniformity in the way these issues are considered by each adopting utility. It also

provides background material on each issue that may be of use to the Generating Facility engineer in determining how best to address a screen failure.

2 An Overview of the Interconnection Application and Approval Process

If you plan to install a Generator that will be interconnected to the Distribution System, you must apply to your local utility for approval to interconnect. Each utility's web site has a link to the application form (see Section 9.2).

2.1 Introduction to the process

This Section describes the overall process flow; Section 2.2 elaborates on the major steps in the process.

The approval process for connecting electric Generators to the electric Distribution System involves the following four basic steps:

1. **Application**

   The Producer that wishes to install the electricity Generator fills out a standard application form, available from the utility or from the California Energy Commission web site, and sends it in to the utility.

2. **Electric Utility Review**

   The utility receives the application and reviews it for completeness. Remember that the utility must evaluate the application for potential impact on its system and must therefore receive all information relevant to this evaluation. Once the utility accepts the application as complete, it goes through the screening process and decides whether the Generating Facility qualifies for Simplified Interconnection, or whether Supplemental Review is required. The utility has to retrieve and evaluate information relative to its own system in the vicinity of the point of interconnection. This includes circuit diagrams for the local distribution feeders, equipment ratings, other customer information and loads and possible other Generators in the vicinity, potential load growth in the area, and so on. The utility decides whether the Generator may be interconnected subject to additional requirements, or whether the application requires an Interconnection Study. The utility then sends these results back to the applicant. If an Interconnection Study is needed, the utility provides the applicant with the cost and time necessary to complete the study.

3. **Interconnection Agreement and Other Agreements**

   If you accept the results of the utility's review/study, you may sign an interconnection agreement. Each utility has three to five different interconnection agreement forms, depending on whether you (the applicant) are a customer or third party, and based on operating mode and otherwise applicable tariffs.. These agreements are CPUC-

approved pro-forma agreements. One or more other agreements may have to be executed. These address issues such as establishing responsibility and ownership for items the utility may desire to own within your premises, or items that the utility may wish you to install (or pay for) on the utility's Distribution System. Unlike the interconnection agreement, there may be some negotiating room when establishing these additional agreements.

If you qualify for simplified interconnection, your impact upon the utility's system is minor, and you may require only the interconnection agreement.

Any other necessary agreements between the parties are also signed at this time.

4. Installation and Commissioning

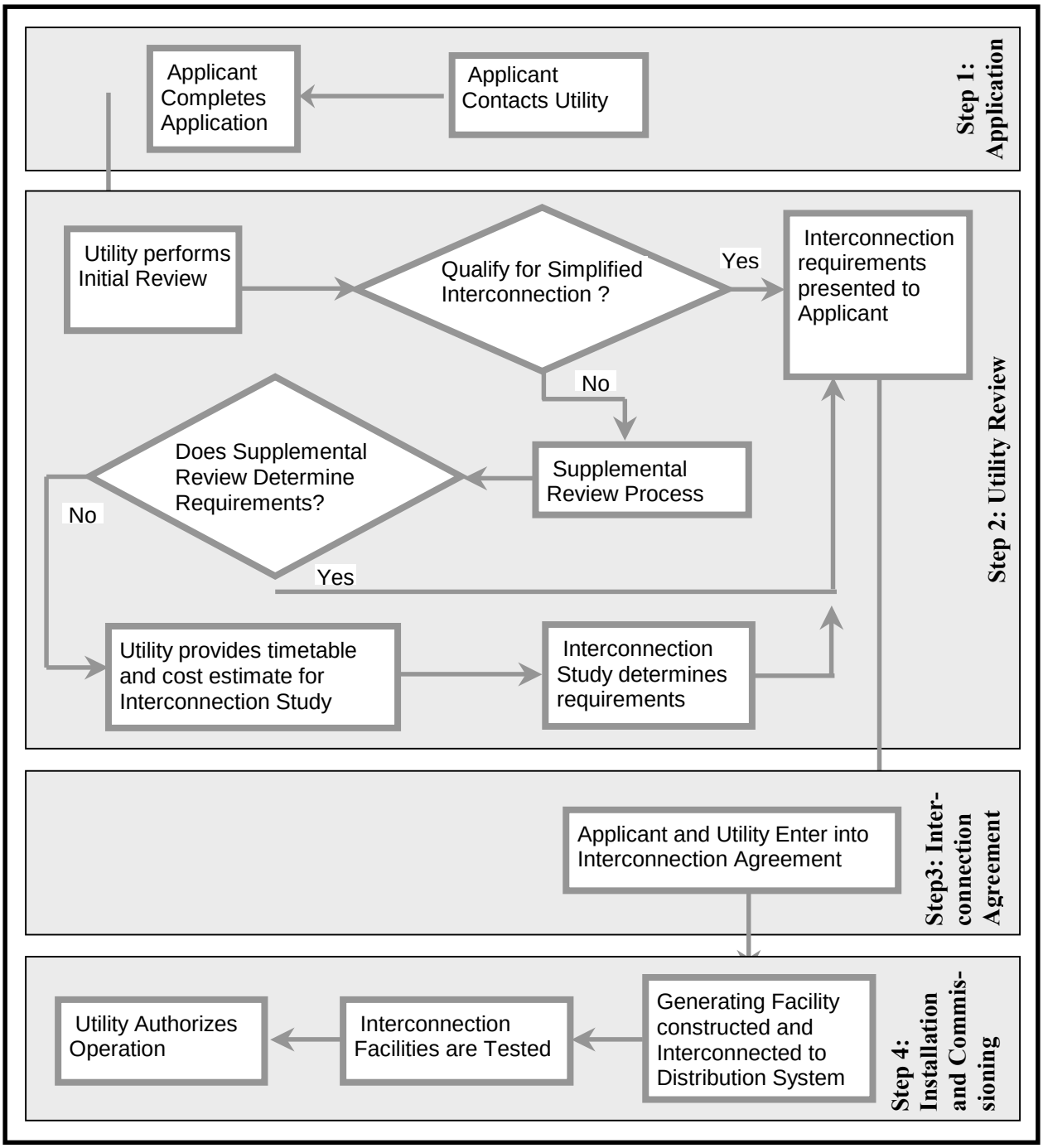
In this step, an applicant installs the Generator and the associated facilities to interconnect to the grid. The applicant interconnects the device in accordance with the provisions of the agreements (step 3). Then the system is tested under the supervision of the utility to ensure to the utility's satisfaction that it operates correctly. Following a final site inspection and written approval, the Generator may commence normal operation.

Any changes to your Generating Facility that may affect the utility Distribution System must be reported to the utility, and its written approval obtained.

2.2 Interconnection Flowchart

The flowchart in Figure 2.1-1 shows an overview of the major processes (rectangles) and decisions (diamonds) involved in interconnecting. These processes and decisions will be described in more detail in the following sections.

Figure 2-1: Interconnection Flow Chart



3 Technical Requirements & Rule 21 Certified Equipment

3.1 Generating Facility Design and Operating Requirements

The technical requirements for interconnection are described in Section D of Rule 21. Section D-1 addresses the general interconnection and protection requirements and describes those requirements that all generating facilities must include. These requirements are independent of the type of Generator and include such things as the need for properly listed equipment, for drawings, and for visible disconnects.

Section D-2 addresses the need for prevention of interference with the utilities system. The utility has the obligation to serve all its customers, and it is must therefore make sure that Generators connected to their Distribution System do not interfere with the power quality or operation of the Distribution System. Section D-2 addresses the operating characteristics of the Generator including voltage, power factor, frequency, distortion, and related issues.

Section D-3 addresses control, protective function and safety requirements. It addresses interconnection protection requirements for synchronous Generators, induction Generators, inverter-based generating systems. It also covers issues related to systems that export power and requirements for detecting faults on the system.

It is important to stress that while equipment Certification and commissioning testing (see Section 7 of this guidebook) under Rule 21 address some of the technical requirements listed in Section D of Rule 21, it remains the responsibility of the system installer to ensure that all of the requirements of Section D, as well as any additional requirements specified in the interconnection agreement, are met.

The following sections summarize and discuss the technical requirements in Section D to give the system designer a better understanding of what the requirements are intended to do and how to better meet them.

3.2 Rule 21 Certified Equipment

3.2.1 Purpose and Value of Rule 21 Certification

Screen 3 in the Initial Review Process asks "Is the Interconnection Equipment Certified for the Application?" Equipment Certification under Rule 21 verifies that many of the basic Rule 21 requirements have been met and relieves the electric utility of the burden of (and the applicant of any further costs related to) independently evaluating each piece of equipment. The Rule 21 Certification process is also important to the use under Rule 21 of functional requirements rather than specifying equipment to accomplish a particular function. For example, many distributed Generators have integrated voltage and frequency trip functions. This approach relieves the need for separate voltage and frequency detection relays. However, practical implementation requires that the integrated equipment be certified to work according to the specified standards. With a

process to certify these integrated protective functions, the manufacturer can design a product that is ultimately less expensive than installing and testing discrete devices.

Section J of Rule 21 provides the testing requirements for certified and non-certified equipment. Tests are defined by the following categories:

Type Tests	Tests, performed on a sample of a particular model, intended to evaluate that model to a defined set of requirements.
Production Tests:	Tests performed on some fraction of units coming off the production line. These tests are intended to provide some assurance that the unit has been manufactured and configured properly
Commissioning Tests:	Tests performed on a system after installation to evaluate the capabilities of the installed system.
Periodic Tests:	Tests performed at regular intervals on specific components of an installed system.

Equipment tested and approved (e.g. listed) by a NRTL as having met both the Type Testing and Production Testing requirements is considered to be Certified Equipment for purposes of interconnection with the utility's Distribution System. Section J.3.a of Rule 21 specifies the Type Tests and requirements for Interconnection Equipment Certification. The specified Type Tests and Commissioning Tests are intended to complement one another; equipment that is Certified through Type Testing has reduced Commissioning Test requirements. Conversely, any or all of the Type Tests may be required by the electric utility to be performed on non-Rule 21 Certified equipment as part of Commissioning Testing in the field.

Performing the Type Tests once in a laboratory can be significantly less expensive than performing those same tests—even a subset of those tests—in the field on every equipment. For smaller Generating Facilities, where the cost of on-site testing can significantly impact the economics and where product standardization is important, Rule 21 Certification is advantageous. As Generating Facilities increase in capacity, the cost of Commissioning testing becomes less significant and may be outweighed by the flexibility of a customized system design. Even if the entire Generating Facility/Interconnection Facility is not certified, use of Certified Equipment such as protection relays or multifunction controllers can save time and money in the application and approval process for all sizes of Generating Facilities. Rule 21 Certification of equipment provides assurance of component capabilities and reduces the need for utility evaluation and additional testing. However, use of Certified Equipment to make up a complete system does not equate to the system being Certified. The utility may still require certain Commissioning Tests.

3.2.2 Database of Rule 21 Certified Equipment

The California Energy Commission maintains on its web site a list of equipment that has been verified to meet the Rule 21 Certification requirements:

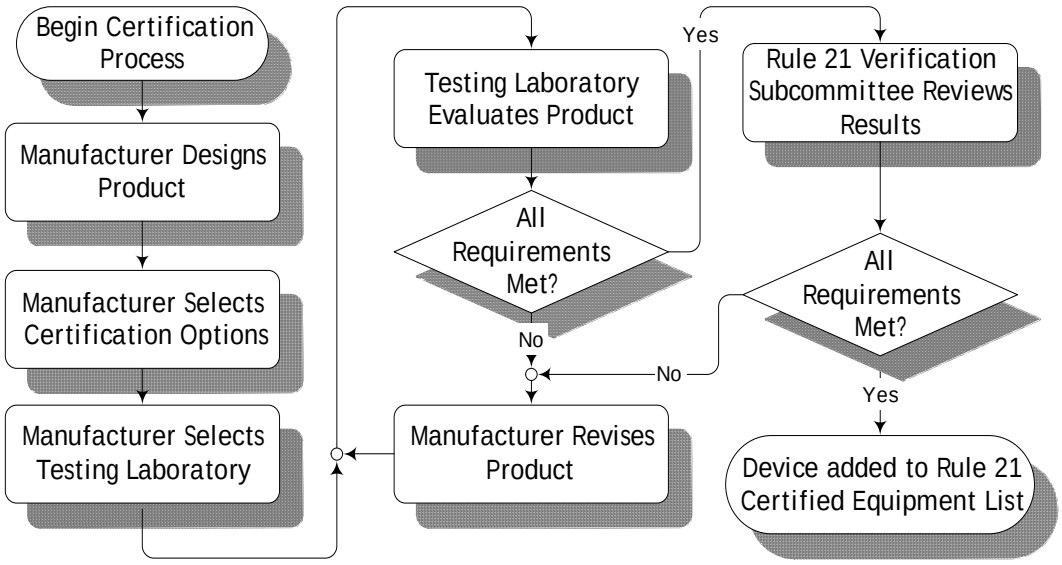
www.energy.ca.gov/distgen/interconnection/certification.html

That web page lists model numbers and other information pertinent to the application process. The reader is advised to check the web page for changes. New equipment is added regularly, as manufacturers complete testing.

3.2.3 How Equipment is Certified for Rule 21

Details of the Rule 21 Certification of equipment are beyond the scope of this document, and may be the subject of a future guide for equipment manufacturers. The basic Rule 21 Certification process is shown in Figure 3-1. This process is still being refined.

Figure 3-1: Rule 21 Certification Process Flow Chart



Test procedures and requirements for Rule 21 Certification are specified in Rule 21 Section J. A NRTL must perform the tests. A NRTL is a lab that has been evaluated by an accrediting body to an appropriate testing standard.[10]

The equipment manufacturer may select one or more laboratories to perform the required tests. A product Listing, as defined in the National Electrical Code[11], which includes the test procedures defined in Section J, has the additional advantages of expediting the permitting and electrical inspection process as well as assuring ongoing product verification by the Listing Agency.

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[10] Appropriate NRTLs include Underwriters Laboratories, Intertek Testing Services, Canadian Standards Association, and others.

[11] "Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose. " From NFPA 70 National Electrical Code 2002 Edition.

Test results must be reviewed and approved by a Rule 21 verification committee before the equipment is considered Rule 21 certified and placed on the Certified Equipment List. In most cases, discrepancies found by the review committee only require additional information or clarification from the manufacturer or testing laboratory, though it is possible that product revision and retesting might be necessary. Note that the NRTL or listing agency actually certifies the equipment; the verification committee only verifies that Rule 21 requirements have been met. Further discussion of Rule 21 Certification test requirements are provided in Appendix A.

4 How to Apply for Interconnection

4.1 The Application Form

4.1.1 Where to get it

The form is available online at the California Energy Commission's web site: http://www.energy.ca.gov/distgen/interconnection/application.html. You can get individual utility interconnection applications at their web sites; for the Uniform Resource Locator (URL) links, please see Section 9.2.1 for PG&E, Section 9.2.2 for SCE, and section 9.2.3 for SDG&E.

4.1.2 How it is laid out

The application is in four Parts, each with subsections, as follows:

Part 1 – Introduction and Overview

Applicability
Guidelines and Steps for Interconnection
Required Documents
Mailing Instructions and Assistance

Part 2 – Identifying the Generating Facilities Location and Responsible Parties

A. Generating Facility Location Information
B. Contact Information
C. Operating Date

Part 3 – Describing the Generating Facility and Host Customer's Electrical Facilities

This is covered in Section 4.4.3 below.

Part 4 – Generator Information

This is covered in Section 4.4.4 below.

4.2 Which parts of the application apply to you

Which parts of the application apply to you depends upon how your Generating Facility will interface with the utility's Distribution System. (See Application Part 3, question A.) If you intend to operate in parallel with the Distribution System, you'll need to supply all of the information requested in Parts 3 and 4 of the application.

If you intend to interconnect only for Momentary Parallel Operation (interconnection for one second or less) with the utility's Distribution System through switches or circuit breakers specifically designed and engineered for such operation, you need only answer questions A, E and F of Part 3 and questions A, B, E, F, I, L, M, N, and S of Part 4. In this case be sure to supply adequate information including diagrams and written descriptions regarding the switching device or scheme that will be used to limit the parallel operation period to one second or less. Also, you'll need to describe the back up or protective device and controls that will trip the Generating Facility should the transfer switch or scheme not complete the transfer in one second or less.

If your Generating Facility will be "isolated" and prevented from becoming interconnected with the utility's Distribution System through a transfer switch or operating scheme specifically designed and engineered for such operation, you need only answer questions A, E, and F of Part 3 and questions A, B, F, and S of Part 4. Be sure to supply adequate information including diagrams and written descriptions regarding the isolating switching device or scheme that will be used to prevent the Generating Facility from operating in parallel with the utility's Distribution System.

Detailed instructions for filling out the technical sections (Part 3 and Part 4) of the application follow in Section 4.4.

4.3 Design considerations

Since Rule 21 relates to utility review of the interconnection design, that is, in how the design satisfies the requirements stated in Rule 21, a brief discussion of interconnection design is warranted. Rule 21 is not a design guide; neither is this guidebook. This section is intended to give insight to those new to interconnection; it is not intended for use in designing an interconnection. Applicants should seek assistance from a qualified designer for their particular Generating Facility.

4.3.1 Design approval by the local code authority

Not only does the interconnection have to satisfy Rule 21, the generating facility must also comply with all applicable codes. Local and state codes are generally based on national codes such as the National Electric Code (NEC) and the Uniform Building Code (UBC). In addition, local code authorities may require the mechanical, fuel, and electrical equipment to be listed for the application. For example, the inspector may look for listings to equipment-specific standards such as Underwriters Laboratories (UL) 2200, UL1741, and others.

The National Electrical Code is updated every three years (the latest is 2003), so the designer should make sure to use the version adopted by the local code authority as the basis for the electrical design. The designer must also consider those codes related to mechanical, structural, fire/life/safety, fuel storage/delivery, emissions (air quality and fluids), noise, zoning, etc. Since this guidebook is limited to the issues surrounding electrical interconnection, other applicable codes are not discussed here.

Once a design has been determined, a California-registered Professional Electrical Engineer should review and approve the design drawings. Aspects of the design related to other code issues should receive similar qualified review. The drawings and any required supporting calculations and data can then be submitted to the local code authority for plan check. After the drawings have been approved and fees paid, permits will be issued to allow for construction to begin. While this design approval process is typical for any construction project, plan checkers more typically review building construction projects, not Generating Facilities, so some additional material and interaction may be needed to satisfy the plan checker's concerns.

In general, the electrical plan checker will review the drawings to see if the design complies with the current electrical code. The plan checker will check to see if equipment ratings (panel bracing and load carrying ratings, device interrupting rating, etc.) are appropriate and not exceeded; the equipment is grounded properly; proper clearances are observed; and cable and conduit have been sized properly. This is not an exhaustive list but a representative sample of basic design issues considered by plan checkers.

In some cases, the code authority will request a letter from the utility indicating that the utility has approved the design. As the utility does not approve interconnection designs, only that the design satisfies Rule 21, this may require a phone call, from the utility indicating that such interconnect is legal and that the utility is reviewing the design according to Rule 21 will satisfy the code authority.

4.3.1 Utility acceptance

As stated earlier, the utility will not "approve" of the interconnection design. The utility will determine if the design satisfies the requirements of Rule 21 by reviewing the information on the application form and documents submitted with the application. (These documents are described in Section 4.4.1.)

During the review period, the utility will notify the applicant of any deficiencies and will request corrections and re-submittal of drawings after the deficiencies have been corrected.

The utility will be particularly interested in the design of the protective functions and the Net Generation Output Meter (and isolating devices.)

4.3.2 Protective Functions

A primary role of Rule 21 is to maintain the safety and reliability of the utility system. The utility system is designed to detect and take appropriate action for line disturbances (e.g. voltage

transients, frequency excursions, etc.) and faults (e.g. short circuits caused by weather, animals, equipment failures, etc.). In most of these situations, the utility will temporarily and automatically de-energize a section of the line (from a fraction of a second to a few seconds) to allow the abnormal condition to clear itself. In severe cases—when the condition does not clear itself—that section of the line will remain de-energized awaiting response from a utility lineman. The Generating Facility will have to detect and react to both transitory and longer-term events. For this reason, Rule 21 and utility application reviewers take particular interest in the design of the Generating/Interconnection Facility's Protective Functions.

Rule 21 only covers those Protective Functions that serve to protect the utility, not those that protect the Generator or owner's facilities. The basic Protective Functions of interest are under voltage (ANSI device number 27), over voltage (59), and over and under frequency (81O/U)). Non-exporting Generating Facilities employing directional power functions can use either reverse power (32R) or under (forward) power (32U) functions. The settings for these functions are clearly defined in the Rule and should be suitable for most Generating/Interconnection Facilities. The anti-islanding function available on some Generating/Interconnection Facilities does not have an ANSI designation, but is usually required when reverse or under power functions are not employed.

Note that a 60 second reconnect delay should also be included in the function settings (that is, the utility voltage and frequency must remain within the allowable limits for at least 60 seconds before the generator can be operated in parallel with the utility's Distribution System).

Additions or enhancements to these standard requirements may be required when the Generating Facility is identified to have the potential for major impact on the Distribution System. In these cases, the utility and Producer should discuss methods to mitigate system impact, generally through revised settings or the addition of other protective functions. In many cases, if a solid-state multifunction relay has been specified, these additional features can be added with little additional cost or design complexity.

Even though Rule 21 does not cover Generator protection, the manufacturer should incorporate general protection and safety practices in the Generating Facility design in order to protect the Generating Facility, personnel, and other equipment.

4.3.3 Net Generation Output Meter (NGOM) and associated isolating devices.

Section F of Rule 21 briefly discusses the requirement for net generation metering. The term "Net Generation Output Meter" (NGOM) has evolved to distinguish this Rule 21 requirement from Net Energy Metering.

In order to satisfy the technical requirements for a NGOM, the Producer must be aware of the metering standards of the particular utility in question. The technical standards for the NGOM are no different than the technical standards for other utility meters. These standards can be found in the utility's electric service guide. Service guides are available from:

SCE: http://www.sce.com; Regulatory Info Center; SCE Distribution Manuals; Electrical Services Requirements (ESR) Manual

PG&E: www.pge.com; Business Services; New Construction; Electric & Gas Service Requirements ("Greenbook")

SDG&E:
Contact SDG&E to purchase the SDG&E Service Standards and Guide

The utility will also require devices that will allow utility service personnel to isolate the NGOM from all power sources. In general, this will require at least two isolating devices: one on the utility side of the NGOM and one on the generator side. As of this writing, at least one of these devices has to have a lockable "visible open" air gap. Devices that satisfy this requirement are disconnect switches or rack-out breakers. Currently, molded case circuit breakers do not satisfy the requirement for "visible open." At the time of this writing, the Rule 21 working group is reviewing this issue, so a change may be forthcoming. A definition of "accessible, visible, lockable disconnect" is currently being developed for the Supplemental Review Guideline. Readers are directed to the latest version of that document for the revised definition. (See http://www.energy.ca.gov/distgen/interconnection/guideline.html.)

4.3.4 Underground service alert

California state law requires that prior to excavation work an underground service alert center must be contacted in order to determine if any underground utilities equipment are in the area to be excavated. Refer to Section 1, Chapter 3.1 "Protection of Underground Infrastructure", Article 2, of California Code 4216 through 4216.9. The national call number is 1-888-258-0808. In California, you should call 1-800-227-2600 at least two days before digging begins. Web sites with detailed information are:

Southern California areas: www.digalert.org
Northern California areas: www.usanorth.org

4.4 How to fill out the application form

4.4.1 Required Documents

The required documents are described in Part 1, "Introduction and Overview", Section C of the application form. As stated on the form, four copies of the documents must be submitted with the application, must conform to accepted engineering standards, and must be legible (11" by 17" drawings are preferred.) The required documents are as follows:

4.4.1.1 Single-line drawing

According to Rule 21, the Single Line Drawing should show the "electrical relationship and descriptions of the significant electrical components of the Generating Facility…"[12] Included on

[12] The quote is from Rule 21, Section H, containing the definition for "Single-Line Drawing".

the diagram should be "the primary switchgear, secondary switchboard, protective relays, transformers, generators, circuit breakers, with operating voltages, capacities, and protective functions of the Generating facility, the Customer's loads, and the interconnection with the *utility's* Distribution System."

The Single Line Drawing is a simplified representation, reducing a three-phase line diagram to a single line depiction, of the electrical connection between the generator and the Distribution System. It shows the overall relationship between Distribution System, customer's electrical system and the Generating Facility. The single-line enables utility engineers to get a broad understanding of what is proposed. In many instances, in order to determine the safety of the interconnection and the proposed impact on the Distribution System, utility engineers may require several other drawings with greater levels of detail, showing the design, switchgear, controls, layout, protective functions and operational modes. Drawings required could include Single Line Drawings, three-phase line drawings, equipment layout and cable/conduit routing drawings, a grounding plan, grounding details, a cable and conduit schedule, a symbols or legend drawing, and more. These drawings will also be necessary for proper installation, testing and operation of the generator and Interconnection Facilities. The total package of drawings required could be ten or more drawings.

Several sample Single Line Drawings are included in Appendix C: two cogeneration Generating Facilities and one photovoltaic Generating Facility. These are provided for guidance only—not for use.

4.4.1.2 Site plans and diagrams

Site plans and diagrams should show "…the physical relationship of the significant electrical components of the Generating and Interconnection Facilities, such as generators, transformers, primary switchgear/secondary switchboard, and control panels, the connection or connections to the Customer's loads, and the interconnection with "the utility's Distribution System".

This information can be provided on one or more layout drawings. A layout drawing will show the physical arrangement and location of the customer's equipment and facility (service entrance equipment, electrical room, etc.) in relationship to the location of the utility's service transformer and any generation equipment (generators, switchboards, actual point of interconnection, etc.).

If transformers are used to interconnect, provide the transformer nameplate data: primary and secondary voltages, capacity (MVA, kVA), winding arrangement (delta, wye, grounded wye), connections, impedance and any other relevant data.

4.4.1.3 Transfer switch information, if used

If a transfer switch or scheme is to be used, provide component descriptions, capacity ratings and a technical description of the transfer switch operation.

4.4.1.4 Protective relay information

If protective relays are used to control the interconnection, provide protection diagrams or elementary drawings showing the relay wiring and connections, proposed relay settings and a description of the Protective Function.

As the protective relaying is critical to the interconnection, these drawings should show all details concerning the instrument transformers used (current transformers and potential transformers), location in the circuit, wiring, connections to the relay(s), all relay inputs and outputs, trip and reconnect circuits, relay power source. All terminations should be uniquely identified. The relay settings should be based on the default values shown in Rule 21, or as otherwise agreed upon with the utility.

4.4.2 Initial Information

In Part 2 of the application the applicant is required to provide information describing where the proposed Generating Facility is to be installed and who should be contacted regarding the results of the application or for any additional questions.

A. Host Customer Facility Information – This information is necessary to identify the proposed location of the Generating Facility. Account and meter numbers should be available on the customer's electric bill and are required on the application.

B. Contact Information – To ensure timely handling of your application, be sure to name a contact person and a backup who are knowledgeable and readily available to answer any questions that may arise.

C. Operating Date – Note here, based on construction schedule, the date on which you expect to begin operation of the Generating Facility.

4.4.3 Describing the Generating Facility and Host Customer's Electrical Facilities

This Section provides a discussion of *Generating Facility Interconnection Application Part 3 – Describing the Generating Facility and Host Customer's Electrical Facilities*. Each of the application questions in Part 3 is discussed here in order.

> Question A: Indicate how this Generating Facility will interface with the Distribution System.

Three options are offered for interfacing with the electric utility (these were also discussed in Section 1.3.3):

1. **Parallel Operation –** Generating facility is able to synchronize with the prevailing utility voltage and frequency and provide some or all of the power required by local loads. Excess energy, if allowed, is exported to the utility Distribution System. Rule 21 provides the requirements for parallel operation

2. **Momentary Parallel Operation –** A form of isolated operation in which the Generator operates in parallel with and synchronized to the utility Distribution System only long enough to allow a smooth transition from utility power supply. If the transition requires parallel operation for more than 1 second (60 cycles), all of the requirements of Parallel Operation must be met. If the transition occurs in less than 1 second, reduced requirements may be allowed by the utility.

   There are currently no formal guidelines for momentary parallel operation in Rule 21. Each utility establishes its own best practices, so it is important to determine specific requirements with your utility representative as early as possible.

   In general, the utility may require some verification that the equipment will work as specified and that the Generator will either transfer within one second or will shut down. The utility may require the use of a backup timer circuit in the event of a system failure that allows parallel operation beyond 60 cycles. They will also likely review the transfer switch logic and schematics, and have internally established a list of equipment that has been reviewed and approved for this application. Finally, the utility may reserve the right to verify transfer switch operation in the field.

   Information provided in the application form will help with utility system planning and evaluation of the adequacy of protection equipment.

3. **Isolated Operation –** The Generator does not operate at any time in parallel with the utility's Distribution System. Most emergency backup Generators are operated in isolation. As with Momentary Parallel Operation, specific requirements for Isolated Operation may be provided by the utility (i.e., they are not currently specified in Rule 21). Information on the size of the Generator will help the utility maintain sufficient capacity to provide service in the event of a Generator failure of the customer that pays for standby service. Utility system planning is based on both measured load data and known data such as the presence of customer generation. <rejected Werner's deletion from here>Making decisions based only on measured load data could lead to underestimation of load requirements under emergency situations, if, for example, the customer generation is unavailable and the energy normally provided by that generation suddenly had to come from the utility. </to here>

Only the requirements for Parallel Operation are explicitly shown in Rule 21. As noted in *Part 1 A. Applicability*, the application form provides the utility information for evaluating these other options. Requirements, if any, for Momentary Parallel and Isolated Operation would be obtained from your utility based on this information. (See Sections 9.2.1, 9.2.2, and 9.2.3 for investor-owned utility contact information.)

> Question B: If the Answer to Question A was option 1, please indicate the type of agreement that is being requested with this Application. If options 2 or 3 were selected, please skip to questions E and F.

There are several types of agreements that the applicant may select from, including: Customer Generation Agreements and several variations of Generating Facility Interconnection

Agreement. For more details, the reader is referred to Section 6.1, which describes the various Contract Types currently offered by each of the Investor Owned Utilities.

> Question C: If the answer to question B was agreement 1, please indicate the option that will be used to prevent energy from being exported to the utility's Distribution System.

Within the Rule 21 Initial Review Process Export Screen 2 (see Section 5.1.1 for a discussion of this screen), four options are provided for the proposed Generating Facility to verify that it will be no- or low-export. Question C is used to determine which option the applicant is proposing to use.

1. **Reverse-Power Protective Function –** The Generating Facility meets the requirements of Rule 21 Initial Review Process Export Screen Option 1 (Rule 21 Section I.3.b.). The Generating Facility utilizes a reverse-power protective function designed to trip or isolate the Generator if the reverse power threshold is exceeded.

   The default setting for this Protective Function, when used, shall be 0.1% (export) of the service transformer's rating, with a maximum 2.0-second time delay.

   Note the reverse-power requirement shall be met at the PCC, although the devices used to meet these requirements may be located elsewhere.

2. **Under-Power Protective Function –** The Generating Facility meets the requirements of Rule 21 Initial Review Process Export Screen Option 2 (Rule 21 Section I.3.b.). The Generating Facility utilizes an under-power protective function designed to trip the Generator or reduce its output if the minimum import power threshold is not maintained.

   The default setting for this Protective Function, when used, shall be 5% (import) of the Generating Facility's total Gross Nameplate Rating, with a maximum 2.0-second time delay.

   Note the reverse-under-power requirement shall be met at the PCC, although the devices used to meet these requirements may be located elsewhere.

3. **Low Export Option –** The Generating Facility meets the requirements of Rule 21 Initial Review Process Export Screen Option 3 (Rule 21 Section I.3.b.). The requirements provided by this option are intended to assure that any power exported by the Generating Facility will be small relative to the utility Distribution System capacity and thus will not adversely impact the operation of the Distribution System. There are three requirements described by Option 3:
   a) The total Gross Nameplate Ampere Capacity of the Generating Facility must be no more than 25% of the nominal ampere rating of the customer's service equipment. If this low-level export option is selected, the applicant will need to provide the continuous ampere rating of the service equipment (service panel size) in the box marked "Amps". Note that the value used here should

be the panel rating for which utility service was originally sized or any subsequent utility-approved upgrade to the service panel rating. It is not intended that the applicant increase the panel size, without prior utility approval, to meet this requirement.

b) The total Gross Nameplate Capacity of the Generating Facility must be no more than 50% of the customer's service transformer capacity rating (this capacity requirement does not apply to customers taking primary service without an intervening transformer). This requirement does not appear on the application, but will be reviewed during the approval process.

c) The Generating Facility must be certified as Non-Islanding (as per Rule 21 Section J.3.b).

4. **Minimum Load Option –** The Generating Facility meets the requirements of Rule 21 Initial Review Process Export Screen Option 4 (Rule 21 Section I.3.b.). Under this option, the applicant will verify that the Generating Facility rating does not exceed 50 percent of the customer facility's minimum electrical load. Minimum load may be verified through measurement of 15-minute average load for the prior 12 months. With utility approval, other information regarding load size and operation, as well as Generator operation may be used to show this option is met. For example, it would be appropriate to consider the fact the Generator is a solar energy system that only exports during the day. In that case, nighttime minimums would not have to be considered.

   The applicant should provide minimum load information in the box marked "KW".

> Question D: What is the maximum 3-phase fault current that will be contributed by the Generating Facility to a 3-phase fault at the Point of Common Coupling (PCC)? (If the Generating Facility is single phase in design, please provide the contribution for a line-to-line fault.)
>
> Please indicate the short circuit interrupting rating of the host Customer Facility's service entrance ("main") panel.

The Generator maximum fault (short circuit) current is used to determine the Generating Facility Short Circuit Contribution Ratio, which is the ratio of the Generator fault current contribution to the utility's Distribution System fault current contribution at the PCC. When a Generator has the ability to produce significant fault current (exceeding 5% of the available utility fault current, or SCCR>0.05), additional synchronization and loss of synchronization equipment will be necessary (Rule 21 Section D.3.a.1).

The Initial Review Process, Screen 7 (Rule 21 Section I.3.g) evaluates the short circuit current contribution of the Generating Facility in two ways. First, the screen looks at the combined short circuit current impact of all Generators on the same circuit (aggregate SCCR must be less than 0.1). Secondly, it compares the Generating Facility short circuit current to the interrupt rating of the customer's service panel (the second value asked for in Question D) to ensure that the customer's equipment won't be overloaded.

At higher levels (SCCR of the Generating Facility >0.10), additional line to line and line to ground fault detection equipment will be required. (Rule 21 Section D.3.b.2).

The Generator fault current should be obtained from the Generator manufacturer. This is the same value that will be entered into Part 4 Question Q, below. Any impedance between the Generator output terminals and the point of the fault will reduce the fault current contribution of the Generator. Thus, transformers or significant lengths of conductors between the Generator and the PCC may reduce the fault current available at the latter. The Generating Facility designer or installer should include on the single-line diagram submitted with the application all pertinent details (conductor size and length, transformer impedances, etc) used in determining this value.

If the Generating Facility consists of more than one Generator, the Generating Facility fault current will be the sum of the fault currents of the individual Generators. However, design features that limit the number of Generators that may be operated or interconnected at any given time may be considered. Note all assumptions used in calculating the maximum fault current contribution value.

A qualified person (licensed electrician, contractor or engineer) should determine the ratings of the appropriate equipment. The rating of the interrupting device should be compared to the rating of the panel to determine if they are properly coordinated. (Please refer to Section 4.3, "Design Considerations", for additional information.)

Question E: Please indicate how this Generating Facility will be operated.

The application form offers 5 choices, of which more than one may apply to the proposed Generating Facility. Because of the utility's "Obligation to Serve", it must be able to provide your power needs if your Generator is unavailable and you contracted for standby service. The following information from your revenue meter (which records the amount of energy, and maybe the peak demand, they have provided to you) helps the utility estimate your power requirements without the Generator (avoiding what the utilities call "load masking"). This estimate is used by the utility in its "system planning" activities to determine how the Distribution System should be configured and when upgrades may be needed.

1. **Combined Heat and Power or Cogeneration –** The heat produced by some Generators can be used to heat and cool buildings, for domestic hot water, and for manufacturing processes. Cogeneration may allow the Generating Facility to qualify for incentives, favorable tariffs or rules for Qualifying Facilities (see Question F).

2. **Peak Shaving/Demand Management –** The Generating Facility is used to reduce the electrical power and energy requirements during peak utility pricing periods. The Generator may be operated to reduce utility energy consumption (kWh), peak power demand (kW), or both. Generator operation may also take into account "time of use" rates where the energy charge (¢/kWh) varies depending on the season (e.g., summer has higher demands and is therefore more expensive than winter), day of the week

(work days are more expensive than holidays or weekends) and time of day (mid morning until late afternoon is more expensive than the remainder of the day).

3. **Primary Power Source –** In this case, the Generating Facility is the primary source of power (because of reliability, power quality or economical fuel considerations) and the utility provides supplemental, standby, or backup power.

4. **Standby/Emergency/Backup –** The Generating Facility will normally be operated only when the utility's electrical supply is not available.

5. **Net Energy Metering –** Net Energy Metering is discussed above under Question B.

> Question F: Please indicate if Qualifying Facility Status will be obtained from the Federal Energy Regulatory Commission (FERC) for this Generating Facility.

The Public Utility Regulatory Policy Act of 1978[13] put into law the concept of a Qualifying Facility, which was defined as a small Generating Facility that uses renewable energy or alternative fuels as a primary energy source or one that uses the thermal energy given off by the generating process for some other useful purpose (cogeneration). Qualifying Facility status is not required to interconnect and operate in parallel with the utility, however, Qualifying Facilities enjoy certain rights and privileges not available to non-"QF" generating facilities.

Information on obtaining Qualifying Facility status may be found at www.ferc.gov/Electric/qfinfo/QFhow.htm .

4.4.4 Describing your Generating Units[14]

This section provides a discussion of Generating Facility Interconnection Application Part 4 – Describe each of the Generators. Each of the application questions in Part 4 is discussed here in order.

> Question #: Please indicate the number of each "type" of Generator being installed

The information on the application is entered for each type of Generator. The Generators of a given type for a specific installation are identical in all respects. A total number of a given type is requested at the beginning of this section of the application. If only one type of Generator is to be used, only one column needs to be completed. Be sure the information in the "Totals" column is correct and reflects the total number of Generator units to be installed.

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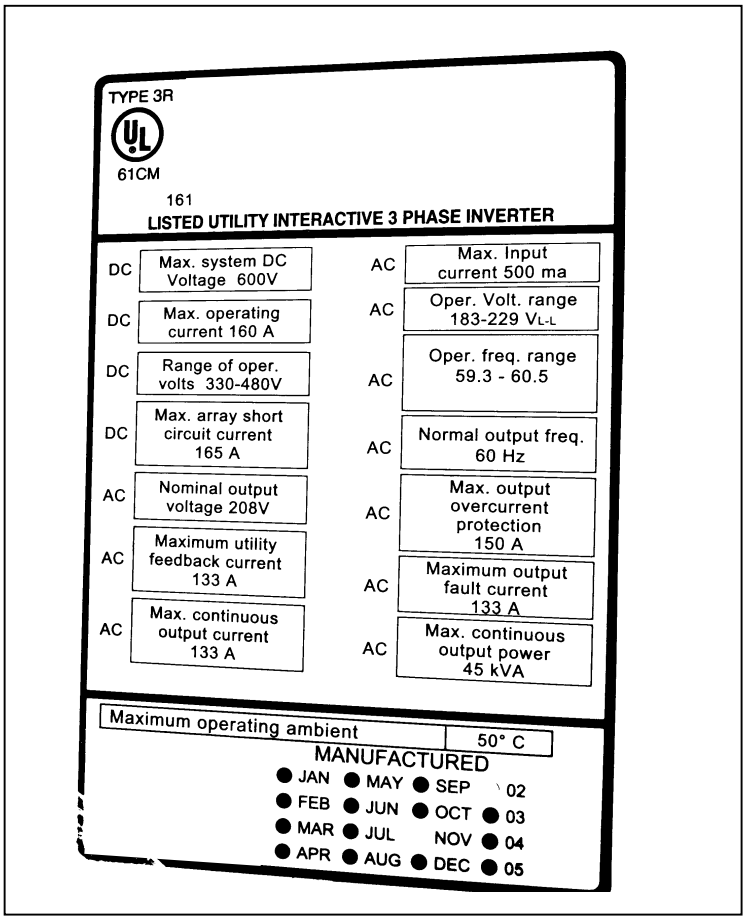
[13] Text available at: www.ferc.gov/electric/qfinfo/PURPA.htm see also, www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=119, www.epsa.org/competition/faqs.cfm?what=245

[14] This phrase "Generating Units" has been replaced in Rule 21 by the word "Generators"; the application form is being updated to reflect this change.

Question A: Generator/Inverter Manufacturer (Name)

Enter the brand name of the Generator (e.g. Capstone, Tecogen, Xantrex).

Figure 4-4-1 Typical Inverter Nameplate



Question B: Generator/Inverter Model (Name/Number)

Enter the model name or number assigned by the manufacturer of the Generator (e.g. Model 60, CM60H, PV100208).

Question C: Generator/Inverter Software Version

If this Generator's control and or protective functions are pendent on a "software" program supplied by the manufacturer of the equipment, provide the version or release number for the software that will be used (e.g. version 3.99).

Question D: Is the Generator Certified by a Nationally Recognized Testing Laboratory (NRTL) according to Rule 21?

Answer "Yes" only if the Generator manufacturer can or has provided Rule 21 Certification data. A list of currently certified equipment is available on the California Energy Commission's web site at the following URL http://www.energy.ca.gov/distgen/interconnection/certification.html. See Rule 21, Section J for additional information regarding Generator Certification.

Question E: Generator Design: Synchronous, Induction, Inverter

Indicate the design of each Generator. Designate "Inverter" anytime an inverter is used as the interface between the Generator and the utility's Distribution System regardless of the primary power production/storage device used. Generally, internal combustion machines, older wind turbines, and larger combustion turbines are either synchronous or induction Generators, while microturbines, fuel cells, photovoltaics, and newer wind turbines are inverter–based Generators.

Question F: Gross Nameplate Rating (kVA)
Question G: Gross Nameplate Rating (kW)

These are the capacity values normally supplied by the manufacturer and stamped on the Generator's "nameplate". This value is not required where the manufacturer provides only a "kW" rating. However, where both kVA and kW values are available, indicate both. For some Generating Facilities, such as a PV system where the system designer for that particular application selects the PV array and inverter, there can be some question as to what name plate rating to use. Typically, the PV array is sized to meet the load and the inverter is sized—often oversized—to accommodate the array. In most cases, the inverter kVA/kW rating will be used as the Gross Nameplate Rating. However, in some special cases, where the inverter is oversized for the array, and where it is impractical for the system owner to increase the array capacity at a later date, a lower value may be used, subject to approval by the utility.

Question H: Net Nameplate Rating (kW)

This capacity value is determined by subtracting the "Auxiliary" or "Station Service" loads used to operate the Generator or Generating Facility from the Gross Nameplate rating. Applicants are not required to supply this value but, if it is not supplied, applicable Standby Charges may be based on the higher "gross" values. Combustion turbines are an example of Generators whose net rating is considerably less than the gross rating.

Question I: Operating Voltage (Volts/kV)

This value should be the voltage rating designated by the manufacturer and used in this Generating Facility. Indicate phase-to-phase voltages for 3-phase installations (e.g. 208V, 480V). This information is often found on the Generator nameplate. See Rule 21, Section D.2.a for information on operating voltage limits.

Question J: Power Factor Rating (%)

This value should be the nominal power factor rating designated by the manufacturer for the Generator. Each Generator in a Generating Facility should be capable of operating at some point within a power factor range of 0.9 leading to 0.9 lagging. Operation outside this range is acceptable provided the reactive power of the Generating Facility is used to meet the reactive power needs of the Host Loads or that reactive power is otherwise provided under tariff by the utility. The Producer must notify the utility if it is using the Generating Facility for power factor correction.

Question K: PF Adjustment Range (Min %, Max %)

Where the power factor of the Generator is adjustable, indicate the maximum and minimum operating values. See Rule 21, Section D.2.f. for additional information.

Question L: Wiring Configuration: (Single-Phase/Three-Phase)

Indicate whether the Generator is a single-phase or three-phase device. This information can be found on most Generator nameplates. See Rule 21, Section D. 3. a. (1) for additional information.

Questions M: 3-Phase Winding Configuration (3 Wire Delta/ 3 Wire Wye/ 4 Wire Wye)

For three-phase generating units, indicate the configuration of the output wiring of the Generator, inverter, or output transformer. This refers to the connection configuration of the Generator or its output transformer to the facility wiring, not the internal wiring of the unit.

Question N: Neutral Grounding System Used (Ungrounded/ Solidly Grounded/ Ground Resistor -- (Ohms))

Wye connected generating units are often grounded - either through a resistor or directly, depending upon the nature of the electrical system to which the Generator is connected. If the grounding method used at this facility is not listed, attach additional descriptive information.

Question O: For Synchronous Generators Only: (Synchronous Reactance, Xd % / Transient Reactance, X'd % / Subtransient Reactance X"d %)

If the Generator is of a "synchronous" design, provide the synchronous reactance, transient reactance, and subtransient reactance values supplied by the manufacturer. This information is necessary to determine the short circuit contribution of the Generator and as data to be input in load flow and short circuit computer models of the utility's Distribution System. If the Generator's Gross Nameplate Capacity is 10 MW or greater, the utility may request additional data to better model the nature and behavior of the Generator with relation to its Distribution System.

Question P: For Induction Generators Only: Locked Rotor Current (Amps) or Stator Resistance (%), Stator Leakage Reactance (%), Rotor Resistance (%), Rotor Leakage Reactance (%)

If the Generator is of an "induction" design, provide the "locked rotor current" value supplied by the manufacturer. If this value is not available, the stator resistance, stator leakage reactance, rotor resistance, rotor leakage reactance values supplied by the manufacturer may be used to determine the locked rotor current. If the Generator's Gross Nameplate Capacity is 10 MW or greater, the utility may request additional data to better model the nature and behavior of the Generator with relation to its Distribution System.

Question Q: Short Circuit Current Produced by Generator (Amps)

Indicate the current each Generator can supply to a three-phase fault across its output terminals. For single phase Generators, supply the phase-to-phase fault current if the Generator is connected phase-to-phase (i.e. single phase Generator connected to a split-phase 240V or 3-phase 208V system).

Question R: For Generators that are Started as a "Motor" Only: 1. In-Rush Current (Amps); 2. Host Customer's Service Entrance Panel (Main Panel) Continuous Current Rating (Amps)

This information is needed only for Generators that are started by "motoring". This is often done when an induction Generator is initially operated as a motor to get it up to speed. Refer to Rule 21, Section I.7 for significance and additional information. If this question was answered in Part 3, Question C of this application, it does not need to be answered here.

Question S: Prime Mover Type

Indicate the type and fuel used for the "prime mover" or source of energy for the Generator.

1 = Internal Combustion Engine – Natural Gas/Propane Fueled
2 = Internal Combustion Engine – Diesel Fueled
3 = Internal Combustion Engine - Other Fuel
4 = Microturbine (< 250 kW) – Natural Gas/Propane Fueled
5 = Microturbine – Other Fuel
6 = Combustion Turbine (> 250 kW) Natural Gas/Propane Fueled
7 = Combustion Turbine - Other Fuel
8 = Steam Turbine
9 = Photovoltaic Panels
10 = Solar-thermal engine
11 = Fuel Cell– Natural Gas/Propane Fueled
12 = Fuel Cell– Other Fuel
13 = Hydroelectric Turbine
14 = Wind Turbine

5 Electric Utility Review

5.1 The Initial Review Process

This Initial Review Process was developed to create a path for selection and rapid approval for the interconnection of those generating facilities that do not require an interconnection study. This process identifies the site-specific issues related to the interconnection of a Generating Facility. Each review is based on the attributes of the Generator with respect to the attributes of the Distribution System at the point where the Generator is interconnected. In some locations, a 500 kilowatt Generator can be easily interconnected; in others, a 50 kilowatt Generator may be difficult to interconnect. The Initial Review Process is intended to identify those locations of the Distribution System that are able to more easily accommodate Generators with a minimum of review effort on the part of the serving utility.

The Initial Review Process concept was developed to provide a systematic and consistent process for the utility to follow when reviewing an interconnection. By providing a series of screening thresholds, the utility can quickly determine whether an interconnection review will be simple or more difficult. If one or more screens are not met, a more extensive review may be necessary. Failure to pass any screen of the Initial Review means only that further reviews, and/or studies, are required before the Generating Facility can be approved for interconnection with the Distribution System. It does not mean that the Generating Facility cannot be interconnected.

The screens can also provide valuable insight for the Generating Facility developer or owner to help identify problem areas before entering the review process. For instance, if a developer is

looking to apply for interconnections at several different locations, the screening process can help prioritize those sites that may qualify for simplified interconnections while identifying other sites that may require further review.

Supplemental Review

The Initial Review Process is a screening process to determine if a supplemental review is required. Supplemental review simply means that additional consideration must be given to interconnection requirements. This often entails a few hours of additional review on one or more topics. If a particular location presents challenges that cannot be addressed in the limited time allotted in the supplemental review, an estimate is made by the utility as to the cost of the interconnection study for that location. The applicant can then decide whether to pursue the interconnection, or look for another site that may be less difficult to interconnect a Generator.

5.1.1 The Initial Review Process Screens (Section I of Rule 21)

This section will discuss how the utility addresses the site-specific concerns of an interconnection through the screens in the Initial Review Process. Each screen represents one or more concerns about an interconnection that must be addressed. This section will also present helpful guidance to reduce the likelihood of the need for supplemental review or an interconnection study.

Screen 1: Is the PCC on a Networked Secondary System?

Because of the design and operational aspects of network protectors, the utility must give special consideration to Generators on networked secondary Distribution Systems. This screen addresses the issue. Since radial systems do not contain network protectors, radial Distribution Systems do not have the concerns that network protectors present. As noted in Section 1.3.2, networked secondary systems are typically located in densely populated load areas. (See Figure 1-2 and Figure 1-3.) Protecting each of the connection points to this secondary Distribution System are network protectors—relays that allow current to flow into the network, but not out of it. If current tries to flow back through the protector, the relay opens, isolating that input to the network system.[15] Network protectors are not designed for frequent operation and the cause of any operation (e.g. a fault on one of the feeders) must be determined and corrected before the network protector can be reset.

The boundary of a network system—where the network ends and radial distribution begins—is a function of the density of the load and a number of other factors. Your utility account representative[16] should be able to determine readily whether or not your building or facility is on a network secondary.

There is limited experience with the operation of Generators within secondary networks throughout the United States. Siting a Generator within a secondary network may require some special considerations. Rather than go into great detail in Rule 21 on how to address these issues,

[15] Typically reverse power flow is the result of a fault on one of the supplying feeders, which the utility does not want to feed from one of the other feeders supplying the network system.
[16] See Section 9.2 for utility contacts in case you do not know who your account representative is.

it was decided that siting a Generator within a secondary network would necessitate supplemental review. The compatibility of Generators with secondary networks is a topic that will be studied in detail over the next several years.

Screen 2: Will power be exported across the PCC?

Systems that have little or no power exported across the Point of Common Coupling (PCC) will have less impact on the local Distribution System. This streamlines the review process so that several evaluation steps do not need to be analyzed thereby reducing time and expense.

Generating facilities that intentionally export significant amounts of power (such as large Net Energy Metered systems), as well as those that may export power inadvertently (i.e. due to operational transients) need to address additional operational concerns of the Distribution System that those sites that consume all Generating Facility output do not have to address. Export is defined as when the total power generated at a producer's facility exceeds the total load, and net power flows to the Distribution System.

A primary concern regarding the interconnection of Generating Facilities on the Distribution System is the injection of power at locations not designed for that purpose. For the issues addressed in this screen, non- or low-level exporting systems—those that meet one of the four options under Screen 2—are, equivalent to the customer reducing load at their facility. Systems that intend to export power have increased potential for Islanding, and may impact the utility's voltage regulation or exceed the ratings of its equipment.

There are four options for complying with this screen.

Option 1:

To insure power is never exported, a reverse power Protective Function must be implemented at the PCC. Default setting shall be 0.1% (export) of transformer rating, with a maximum 2.0-second time delay.

Explanation: One option to insure power is never exported across the PCC is by including a reverse-power Protective Function, commonly used when the facility load is always greater than the generator capacity. This function is often accomplished through a reverse-power relay designed to open any time the on-site generator exports above some predetermined threshold. While this option does not specify a relay or any specific device, the function must perform the same functions as a reverse-power relay. Also, the reverse power equipment may be located and sense reverse power anywhere within the customer's facility such that reverse power protection at the PCC is similarly assured.

The unique aspect of this requirement is the speed and accuracy necessary to perform this function. Currently there are very few devices that are capable of meeting these requirements. The reason for the tight tolerances is that this option is relying on the device to detect when the primary conductor is disconnected from the transformer feeding the facility. In this case, the reverse power function would be able to detect the power required to energize the distribution transformer from the generating facility.

Option 2:

To insure at least a minimum import of power, an under-power Protective Function must implemented at the PCC. Default setting shall be 5% (import) of the Generating Facility Gross Nameplate Rating, with maximum 2.0-second time delay.

Explanation: Similar to a reverse-power function, under-power Protective Function is also commonly used when the facility load is always greater than the generator capacity. This function is often accomplished with an under-power relay designed to open any time the on-site load (import) drops below a certain threshold. While this option does not specify a relay or any specific device, the function must perform the same functions as an under-power relay. Also, the under power equipment may be located and sense under power anywhere within the customer's facility such that reverse power protection at the PCC is similarly assured. Rather than the very tight allowable export level in Option 1, Option 2 provides a safety margin of 5% import power. This Option is particularly useful for applications where the generator capacity is always significantly smaller than the site load.

Option 3:

To limit the incidental export of power, all of the following conditions must be met:

(a) The aggregate capacity of the Generating Facility must be no more than 25% of the nominal ampere rating of the customer's Service Equipment;

(b) The total aggregate Generating Facility capacity must be no more than 50% of the service transformer rating. (This capacity requirement does not apply to customers taking primary service without an intervening transformer);

(c) The Generating Facility must be certified as Non-Islanding.

Explanation: This option has three separate conditions that all must be met. The first of these, (a), requires that the nominal ampere rating of the Generating Facility must be no more than 25% of the service entrance equipment. Thus, to meet this condition a facility with a 400-amp service can accommodate a Generating Facility with a maximum ampere rating of 100-amps. This condition is meant to provide a sufficient site load to assure that little or no export is possible and that if export occurs, its magnitude will be small relative to the capacity of the Distribution System to which it is connected (that is, the export is incidental). Such incidental export should not pose a utility equipment-overload hazard nor should it adversely impact utility voltage regulation design.

The second condition (b) requires that the Generating Facility have a capacity no greater than 50% of the serving transformer rating. This is another means to provide sufficient on-site load to assure little or no export. As an example, a 100 kVA Generating Facility would need a transformer rating of at least 200 kVA.

The third condition (c) is certification as Non-Islanding. This requirement addresses the concern of Unintentional Islanding.

> Option 4:
>
> To insure that the relative size (capacity) of the Generating Facility compared to facility load results in no export of power without the use of additional devices, the Generating Facility capacity must be no greater than 50% of the customer's verifiable minimum load over the last 12 months.

Explanation: This option for assuring that a Generator will not export states that the Generating Facility capacity is only 50% or less of the customer's minimum Load over a year's time. Minimum load is fairly difficult to verify since it is rarely measured. An energy management system that tracks minimum load may be one way of complying with this option. This provision is primarily designed for applications where the facility load is clearly and substantially larger than the capacity of the Generating Facility.

> Screen 3: Is the Interconnection Equipment Certified under Rule 21 for the Application or does the Interconnection Equipment have Interim Electrical Corporation (Utility) Approval?

The purpose and value of Rule 21 Certification is discussed in Section 3 of this guidebook. Since Rule 21 contains primarily functional requirements of generating facilities and their associated Generators, the need for testing and Certification of those facilities under Rule 21 is extremely important. Historically, utilities have required the use of discrete protection relays that they have tested in their own laboratories. Newer, small-scale Generating Facilities are unnecessarily burdened when required to use these discrete relays since the Generating Facility may incorporate all the needed functions in their controls.

Whether implemented through discrete relays, multi-function relays or as part of an integrated control system, the protective functions must be rigorously tested. Underwriters Laboratories (UL) and other NRTLs have begun testing equipment to verify that it meets the appropriate standards. Once a NRTL has tested and verified the capabilities of a piece of equipment, it is unnecessary for each utility to independently test them saving time and money for the manufacturer and the utility.

Interim utility approval allows non-certified Generating Facility equipment to be accepted, in a particular application, with little or no additional testing. It is meant to facilitate the installation of non-certified equipment with which the utility is already familiar and has previously allowed to be interconnected. It may also be applied to newly developed Generating Facility or equipment models. The local utility may, at its discretion, use previous test results or experience with similar equipment to accept it without further review or testing. The utility will define which tests are needed for the proposed application. However, the interim approval is not meant to be a substitute for the Rule 21 Certification process Interim approval is granted at the utility's discretion and such approval for one application does not ensure approval for other applications.

Screen 4: Is the aggregate Generating Facility capacity on the Line Section less than 15% of Line Section Peak Load?

This requirement is designed to make sure that the aggregate Generating Facility capacity on a line section is well below the maximum peak load on that section. The purpose is to provide a check for the protection engineer to determine whether a significant amount of Generating Facility has already been installed on a line section. If this is the case, it may require a more detailed analysis to see if adjustments need to be made to the line section to accommodate more Generating Facilities.

The 15% level is a surrogate for knowing the actual minimum load on a line section. Since peak loads are normally measured and minimum loads may not be, the threshold is based on a percentage of peak load—information that is readily available. A typical line section minimum load is at least 30% of the peak load, therefore at 15% aggregate, the generating capacity would be no more than 50% of the minimum load of the Line Section. In this case, the generation would be sufficiently low compared to the load to minimize the chance of an unintended island.

This screen was not meant to imply that Generating Facility capacity above the 15 percent mark, or, for that matter, that 16 or 22 percent would be unacceptable. It flags interconnection applications that may begin to impact Distribution System operation, safety, or reliability.

Screen 5: Is the Starting Voltage Drop Within Acceptable Limits?

This screen only applies to generating facilities that start by motoring the Generator to operating speed, often done with induction Generators. If the Generator is large enough, the starting current required for motoring, as with any large motor, can cause local voltage on the Distribution System to sag momentarily. Such sags can cause annoying flickering of lights and misoperation of or damage to equipment.

The utility follows very specific standards to limit the voltage sags caused by the starting of large motors and the same standards apply to motoring of Generators. Generator starting should have minimal impact on the service voltage of other utility customers. Passing this screen does not relieve the producer from ensuring that its Generating Facility complies with the flicker requirements of Section D in Rule 21. There are two options for complying with this screen.

Option 1:

Electrical Corporation may determine that the Generating Facility's starting Inrush Current is equal to or less than the continuous ampere rating of the customer's service equipment.

Explanation: This option requires that the inrush current of the Generator is tested and verified through the test outlined in Section J.7.b. of Rule 21. If the tested inrush current is less than the continuous rating of the customer's service entrance equipment, including the conductors from the utility, this option is met. For instance, if a facility has an 800-amp, 480-Volt service from the utility, the maximum allowable inrush current would be 800 amps.

Option 2:

The utility may determine the impedances of service distribution transformer (if present) and secondary conductors to customer's service equipment and perform a voltage drop calculation. Alternatively, Electrical Corporation may use tables or nomographs to determine the voltage drop. Voltage drops caused by starting a Generator as a motor must be less than 2.5% for primary interconnection and 5% for secondary interconnection.

Explanation: This option is typical of the methods used by many utilities to determine the impact of starting large motors on local system voltage. It classifies the limitation of voltage drop on primary interconnections (e.g. 12 kV) to 2.5% and on interconnections through a distribution transformer to 5%.

Screen 6: Is the Gross Nameplate Rating of the Generating Facility 11 kVA or less?

The purpose of this screen is to put a lower limit on the need to review the short circuit current contribution and the line-configuration screens. At this power level, the last two screens have no relevance. Although this threshold may be used by utilities for other purposes, the intent of this screen is to bypass the last two screens for very small Generators.

Screen 7: Is the Short Circuit Current Contribution Within Acceptable Limits?

Short Circuit Current Ratio (SCCR) is the ratio of the short circuit current contribution of the Generating Facility divided by the short circuit current contribution of the Distribution System at the PCC. This ratio is designed to define a Generating Facility capacity in comparison to the local Distribution System below which no further review is necessary.. It is a very important metric in determining the impact of the Generating Facility on the local Distribution System protection requirements.

The Short Circuit Current Contribution Screen consists of two criteria; both of which must be met when applicable:

1) At primary side (high side) of the Dedicated Distribution Transformer, the sum of the Short Circuit Contribution Ratios (SCCR) of all Generating Facilities on the Distribution System circuit may not exceed 0.1.
2) At secondary (low side) of a shared distribution transformer, the short circuit contribution of the proposed Generating Facility must be less than or equal to 2.5% of the interrupting rating of the Producer's service equipment.

Both of the short circuit current contribution requirements are meant to show that the Generating Facility has a small enough impact and that it is unnecessary to perform a short circuit contribution analysis. These analyses can be quite involved and add a significant amount of unpredictability to the cost of an engineering analysis. The first criterion sets the SCCR limit at 0.1 on the high voltage side of the service transformer. A typical SCCR for a 10 kW Generating Facility in a residential neighborhood would be 0.01.

Screen 8: Is the Line Configuration acceptable for Simplified Interconnection?

If the primary distribution circuit serving the Generating Facility is of a three-wire type, or if the Generating Facility's interconnection (distribution) transformer is single-phase and connected in a line-to-neutral configuration, then there is no concern about overvoltages to the Distribution System or other customer's equipment caused by loss of system neutral grounding during the operating time of anti-islanding protection.

If the Generating Facility is served by a three-phase four wire service or if the Distribution System connected to the Generating Facility is a mixture of three and four wire systems, then aggregate Generating Facility capacity that exceeds 10% of the Line Section peak load must be reviewed. The reason for this screen is to limit overvoltages to the Distribution System or customer's equipment caused by loss of system neutral grounding during an Unintentional Island before the operating time of anti-islanding protection. The 10% limit ensures that the local load is much greater than the output of the Generating Facility so that the load causes a significant voltage drop and prevents the possibility of overvoltage caused by loss of system neutral grounding.

5.2 Responding to requests for further information

The application process is intended to be thorough in gathering the needed information to assist the utility to accomplish the Initial Review Process as quickly and efficiently as possible. Particularly with new types or models of Generating Facilities or unique site situations, there may be a need to provide additional information to help in the review process. It is extremely important to be as responsive as possible in a request for additional information. The utility has 10 days after receipt of the application to state whether it is complete. If it deems the application is not complete, the time clock "stops" until the application is completed, delaying the overall interconnection. If it is deemed complete, the utility must complete its Initial Review, outlined above, within 10 days.

Keeping an open line of communication with your utility contact is very important during the review process. It may be that the information in the application is not exactly what was requested by the utility for a variety of reasons. The utility contact may need a very brief clarification that could be handled verbally or with a simple fax or email. Providing ready access to the knowledgeable project personnel is critical to keep the process on track through the review process.

5.3 Possible outcomes of review

There are three possible outcomes outlined in Rule 21 to the Initial Review Process. The Purpose of the Initial Review Process is stated in Section I.2.

I. 2. Purpose. The Initial Review determines:

a. If a Generating Facility qualifies for Simplified Interconnection;

b. If a Generating Facility can be made to qualify for interconnection with a Supplemental Review determining any potential additional requirements, or

c. If an Interconnection Study is required, the cost estimate and schedule for performing the Interconnection Study.

5.3.1 Simplified Interconnection

The Initial Review Process was designed as a simple utility Distribution System impact study and is designed to approve systems that should have no impact on the Distribution System to which they are to be connected. Simplified Interconnection means that the minimum amount of review was necessary because all the thresholds set forth in the Initial Review Process were met.. The series of screens describes the extent of issues that must be reviewed and provides substantiation for simplified Interconnection. Simplified Interconnections often apply for relatively small capacity Generators in a section of the Distribution System designed to serve relatively large customer loads. The Initial Review Process has very few references to the capacity of the Generator, because the importance Generator size is relative to the capacity and design of the distribution system to which it will be connected. Size has been used in the past to indicate when certain additional requirements would be imposed but it is typically a surrogate of the real parameters of interest, such as short-circuit duty.

5.3.2 Supplemental Review

Supplemental Review is intended to provide a slightly more detailed review of the conditions that caused the system not to meet one or more of the Initial Review Process screens. The utility, absent "extraordinary circumstances"[17], must complete the Supplemental Review within 20 business days of receipt of a completed application. The purpose of this review is to determine which of the following is true:

1. No additional requirements are necessary to allow interconnection,
2. Some additional requirements or changes (to the Generating Facility, the Distribution System, or both) are necessary to allow interconnection, or
3. A more detailed interconnection study is necessary (the cost and schedule for the study are also provided).

Simply because one or more screens are not met does not automatically necessitate that additional requirements will be imposed on the interconnection. It simply means that further review—often by more highly qualified personnel—is necessary to determine what the requirements are. A detailed description of the supplemental review process is provided in a document entitled: *California Electric Rule 21Supplemental Review Guideline*, available on the California Energy Commission web site at http://www.energy.ca.gov/distgen/interconnection/guideline.html.

For the utility engineer, this guideline provides a basis for performing the Supplemental Review in a manner consistent with other engineers and other utilities, and for focusing his efforts on generally agreed primary issues of concern. For the applicant or Generating Facility designer, this document can act as a primer on the topics addressed by the Initial Review Process, as a

[17] These are undefined in Rule 21; see Rule 21 Section C.1.c.(3).

guide to possible solutions when it is anticipated that one or more screens may not be met, and as a basis for understanding the utility's decision as a result of a Supplemental Review.

5.3.3 Interconnection Study

An Interconnection Study is simply defined as an engineering review of specific aspects of the proposed Generating Facility and the Distribution System to which it will be connected to establish the requirements for interconnection of the Generating Facility. The issues to be evaluated in the Study, as well as the cost and timeline for completion of the study, are determined in the Supplemental Review process. Initial Review and Supplemental Review delineate those installations that are relatively straightforward from those where one or more significant issues necessitate a detailed review to determine interconnection requirements. The fact that a study is found to be necessary does not mandate that additional requirements will be necessary to address the interconnection issues. The study may show that no additional requirements are necessary or that enhancements are necessary in order for the Generator to be interconnected.

If the Supplemental Review shows that an interconnection study is necessary, the applicant may either authorize the study or cancel the application. Cancellation may be preferable if the cost of the study and the potential additional costs to interconnect a Generator at the proposed location are uneconomical. It should be noted that prior to the current Rule 21 process, most Generating Facility installations were subjected to interconnection studies, because a consistent screening process for low impact systems had not been devised. The current Initial Review Process, which itself is a Simplified Interconnection study, will continue to be refined.

6 Interconnection Agreements and Other Agreements

Generating Facility interconnection agreements are not like business agreements between unregulated entities. They were developed in a multi-stakeholder working group process of utilities, manufacturers, regulators and Producers, with all parties working for consensus. They are adopted by the CPUC and are pro-forma agreements; pro-forma language cannot be modified except through a regulatory approval process. The utility will fill out most of the agreement and send it to the Producer (and the customer, if different) for signature. There is provision in the agreement for modification. (See the Section entitled "Amendment and Modification" in the agreement.) Although this appears to be a contradiction, it allows the utility to make wording modifications, at the Producer's request, and the utility's risk. In most of the agreements there is a clause that gives the utility discretion to decide whether "prior Commission [CPUC] approval is required for such amendments and modifications". If the utility decides that CPUC approval is required, the process will be slow, laborious and uncertain of approval and incorporation of the change.

After the utility has completed its Initial Review, and, if necessary, the Supplemental Review, it will send the agreement to the Producer.

6.1 Contract types

The interconnection agreements of SCE, SDG&E, and PG&E are mostly consistent, between agreement types and between utilities. The following points out some minor differences. The SDG&E agreements were chosen arbitrarily as the "reference" for consistency.

6.1.1 San Diego Gas & Electric

6.1.1.1 Generating Facility Interconnection Agreement

This agreement, called ICAForm142-050202, or Agreement A, is between the utility and a customer that wishes to self-generate. It covers the case of a customer that wishes to interconnect (without third-party operation of the Generating Facility), and agrees to preventing export of electricity from its Generating Facility.

In this agreement, the Generating Facility owner operator is called an "Electrical Producer", though the entity is called a "Producer" in all other agreements and in Rule 21. Both are defined as "The entity that executes an Interconnection Agreement with [the utility]". The term Producer, in its strict definition (above) could refer either to the customer of record, called the "Customer" in Rule 21, (in other words, the entity that receives electric service on the Distribution System) or to a third party. But its meaning in this original agreement is to the Generating Facility owner/operator that is also the Customer.

Section 1, "Scope and Purpose", states that the agreement is for a parallel interconnection. The reference to Section 218 of the California Public Utilities Code is relevant only if your Generating Facility is a Cogenerator. (See Section 4.4.3.) The exception referred to allows Cogenerators and other non-conventional power sources to export power to two adjacent neighbors. (See California Public Utilities Code, Section 218(b)2 for details.)

Section 2, "Summary and Description of EP's Generating Facility", asks for information about the Generating Facility. Although this information is part of the completed application, it must be included in the agreement form so that it is part of the Agreement.

6.1.1.2 Generating Facility Interconnection Agreement (Inadvertent Export)

This agreement, called ICA Form142-0544, or Agreement B, is between the utility and a customer that wishes to self-generate. It covers the case of a customer that wishes to interconnect (without third-party involvement), and wishes to be allowed to export electricity inadvertently from its Generating Facility from time-to-time.

Agreement B is identical to Agreement A (Section 6.1.1.1 above), with the following exceptions:

> Section 2.8 is added to state the maximum instantaneous power that may be exported by the Generating Facility (in kW).
>
> Section 2.10 is the same as Agreement A Section 2.8, except that it has no Competition Transition Charge ("CTC") exemption provision; the CTC exemption warranty for cogeneration is moved to Appendix C (see below).

Section 3, Appendix D is added allowing the Producer to declare that its Generating Facility meets the requirements of "Distributed Energy Resources Generation", as defined in PUC 353.1. Appendix E is added setting specific conditions and limitations on inadvertent power export; these are to be negotiated.

Section 4.1(b) is a sub-provision for termination of the agreement in case the Producer's electric service account is closed or terminated.

Section 5.1 is to ensure that the Producer is responsible for operating its Generating Facility in compliance with all applicable tariffs, laws and rules.

Section 5.2 (amended from Agreement A Section 5.1) deletes the provision of PUC Section 218, disallowing service by cogenerator to adjacent facilities.

Section 5.3 is a sub-provision requiring that the inadvertent deliveries correspond to the limits set in an attached document. You will need to discuss the specific limitations with the utility. If the utility discovers that the inadvertent export exceeds the limits set, or if the utility finds that the inadvertent export is causing some unforeseen problem, it may require the Producer to disconnect its Generating Facility

Sections 5.4, 5.5, and 5.6 set further limits on the inadvertent exports. The utility considers inadvertent deliveries "solely an accommodation". It will not accept inadvertent deliveries of reactive power, nor allow deviations from Protective Function requirements, unless agreed to by the parties in writing.

Appendix C, entitled "Producer's Warranty that the Generating Facility is a 'Cogeneration Facility' Pursuant to Section 218.5 of the California Public Utilities Code" requires that the Producer continue to meet the overall cogeneration efficiency requirements of 42.5% throughout the term of operation of the Generating Facility.[18] Terms and conditions of utility inspections and procedures for the Status Change are described.

Appendix D, titled "Producers Warranty that the Generating Facility is a 'Distributed Energy Resources' Generation Facility Pursuant to Section 353.1 of the California Public Utilities Code" requires a warranty that the Generating Facility meets the requirements of the PUC Code 353.1 to be classified as 'Distributed Energy Resources' Generation. The warranty includes these provisions: 1. Must commence operation between May 1, 2001 and June 1, 2003; 2. Must be located within a single facility; 3. Must be <= 5MW; 4. Must serve loads on-site, or over-the-fence, as allowed by PUC Coded 218 (see preceding paragraph); 5. Must use fuel other than diesel; 6. Must comply with emissions standards.[19] Appendix E is added entitled "Specific Conditions and Limitations for Inadvertent Deliveries". As mentioned above, you should contact the utility for details of how to specify inadvertent export conditions and limitations.

6.1.1.3 Customer Generation Agreement

This agreement, called ICAForm142-0541, or Agreement C, is between the utility and a customer that wishes to employ a third party to operate its Generating Facility. This customer

[18] The PUC Section 218.5 states in part: "Where useful thermal energy follows power production, the useful annual power output plus one-half the useful annual thermal energy output equals not less than 42.5 percent of any natural gas and oil energy input."
[19] See http://caselaw.lp.findlaw.com/cacodes/puc/353.1-353.15.html

Agreement C will always be accompanied by an agreement between the utility and the third party, called a "Producer Agreement", as described in Section 6.1.1.4 (called Agreement 1) or 6.1.1.5 (called Agreement 2).

Agreement C adds provisions to clarify the customer's obligation to the utility and to separate that from the Producer's obligation to the utility. However, it is simpler than the previous two agreements because it does not have any of the provisions regarding interconnection or operation of the Generating Facility. For this reason, the following sections are omitted:

- Documents Included
- Generating Facility Operation
- Interconnection Facilities
- Insurance

Added provisions include:

Section 2.4 on the Producer Agreement;

Section 2.5, the Producer's contact information;
Section 3.1 acknowledging authorization for installation operation of the Generating Facility by the Producer;

Section 3.2 taking responsibility for payment of tariffs and acknowledging that it is the customer;

Section 3.3 acknowledging operation of the Generating Facility according to the utility tariffs including any charges and conditions related to operation;

Section 3.4 taking responsibility for payment of tariffs if the Producer's Generating Facility fails to operate in accordance with the Producer Agreement;

Section 3.5 declaring customer intent to make the Generating Facility accessible to the utility.

6.1.1.4 Generating Facility Interconnection Agreement (3rd Party Inadvertent Export)

This agreement, called ICAForm142-0542, or Agreement 1, is between the utility and a third party. It covers the case of a third-party that wishes to export electricity inadvertently from the Generating Facility from time-to-time. The Customer Generation Agreement refers to this 3rd party agreement as the "Producer Agreement".

Agreement 1 is identical to Agreement B, with the exception of provisions to account for separate customer and Producer agreements with the utility.

Additions include:

Section 1.2 references the customer Agreement by name and date;

Section 3 references Appendix F, added to the existing five containing the Customer Generation Agreement (Agreement C).

Section 5.7 requires that the Customer Generation Agreement be signed prior to parallel operation.

6.1.1.5 Generating Facility Interconnection Agreement (3rd Party Non-Exporting)

This agreement, called ICAForm142-0543, or Agreement 2, is between the utility and a third party. It covers the case of a third-party that agrees to prevent export of electricity from the Generating Facility. The Customer Generation Agreement refers to this 3rd party agreement as the "Producer Agreement".

Agreement 2 is identical to Agreement 1, except that references to inadvertent export have been removed and replaced with provisions for non-export:

Section 2.8 from Agreement 1 is removed;

Appendix E from Agreement 1 is removed;

Section 5.3 is added to prevent export.

6.1.2 Southern California Edison

6.1.2.1 Generating Facility Interconnection Agreement

This agreement, called 14-731 (Non-Export) is between the utility and a customer that wishes to self-generate; it covers the case of a customer that wishes to interconnect (without third-party involvement), and agrees to prevent export electricity from its Generating Facility. It is not identical, but very similar to SDG&E's "Agreement A". As mentioned above, some of the provisions of "Agreement A" were changed in all later agreements as an improvement, or to remove anachronism (call them "version improvements"). All those changes have been made in the SCE agreements.

The similarities and differences (other than version improvements) are as follows:

Section 1 (Scope and Purpose). Unlike SDG&E's Agreement A, does not contain any exception to non-export for Section 218 of the California Public Utilities Code—the provision allowing Qualifying Facilities to export power to two adjacent facilities. An arrangement for delivery of electric power from the customer's Generating Facility to the Distribution System "must be made separately between SCE and Producer".

Section 2 (Summary and Description of Producer's Generating Facility). SCE's agreement assigns a Generating Facility ID in the upper-right hand corner of the form (so the customer has no confusion about who is to fill it in). It does not ask for the electric service account number. Section 2.7 (equivalent to Section 2.8 in SDG&E's Agreement A) deletes the reference to CTC and PU Code 218.5 and replaces it with a reference to the Distributed Energy Resources Generation (DERG) qualification in PU Code 353.1.

Section 3 (Documents Included). SCE's Appendix B has an optional place for the Interconnection Facility financing and ownership agreement. Appendix C is the "Producer's warranty that the Generating Facility meets the requirements for 'Distributed

Energy Resources Generation' as defined in Section 353.1 of the California Public Utilities Code".

Section 5 (Generating Facility Operation). Sections 5.3 and 5.4 are identical to language in the Agreement 2 of SDG&E (3rd party non-export) and constitute the most up-to-date non-export language.

6.1.2.2 Generating Facility Interconnection Agreement (Inadvertent Export)

This agreement, called 14-745 (Inadvertent Export) is between the utility and a customer that wishes to self-generate; it covers the case of a customer that wishes to interconnect (without third-party involvement), and wishes to be allowed to export electricity inadvertently from its Generating Facility from time-to-time. It is not identical, but very similar to SDG&E's "Agreement B".

The similarities and differences are as follows:

Section 2 (Summary and Description of Producer's Generating Facility). All dissimilarities in Section 2 are the same ones as between SCE's Non-Export agreement above and the corresponding SDG&E Agreement A. SCE is consistent in taking out references to PU Code 218 and 218.5 (as in Section 2.8); it includes only the reference to the Distributed Energy Resources Generation (DERG) qualification in PU Code 353.1.

Section 3 (Documents Included). SCE has only four Appendices, having eliminated the PU Code 218.5 warranty.

Appendix D (Specific Conditions and Limitations for Inadvertent Deliveries). SDG&E has left this section blank; SCE, on the other hand, has provided a form for the Producer to fill out. It requests the following information:

1. Conditions expected to cause inadvertent deliveries;
2. Total inadvertent delivery power, not-to-exceed the kW number;
3. Total seconds of inadvertent power per instance, not-to-exceed the number of seconds inserted (usually not more than 60 seconds);
4. Total inadvertent delivery instances per day/hour/minute;
5. When Producer expects inadvertent deliveries to occur (three options);
6. Load following equipment used by Producer (must be capable of ramping the Generator 1% of nameplate rating per second, or faster);
7. Reverse power relay used to prevent export;
8. Protective schemes used to coordinate operations with the Distribution System.

6.1.2.3 Customer Generation Agreement

This agreement, called 14-744 (Customer Generation), is between the utility and a customer that wishes to work with a third party to operate its Generating Facility. From the utility's

perspective, this customer agreement will always be accompanied by an agreement between the utility and the third party, what SCE calls the "Generation Interconnection and Operating Arrangements", as described in Section 6.1.2.4 or 6.1.2.5.

This agreement is nearly identical to SDG&E's "Agreement C". Besides tariff references, the only difference is the reference name to the 3rd party agreements, mentioned above.

6.1.2.4 Generating Facility Interconnection Agreement (3rd Party Inadvertent Export)

This agreement, called 14-743 (3rd Party Inadvertent Export) is between the utility and a third party. It covers the case of a third-party that wishes to be allowed to export electricity inadvertently from the Generating Facility from time-to-time. This 3rd party agreement one of those SCE refers to as "Generation Interconnection and Operating Arrangements".

This agreement has the same function as SDG&E's Agreement 1 and is identical to it with these exceptions:

> Section 2 (Summary and Description of Producer's Generating Facility). As in previous agreements, SCE does not ask for the Generating Facility ID or the customer account number in this Section. Also, as in other agreements, SCE has pulled out all references to PU Code 218.5, the exception that allows QFs to export power to two adjacent facilities.
>
> Section 3 (Documents Included). SCE leaves out Appendix C, a warranty that the Generating Facility meets the requirements for cogeneration pursuant to PU Code 218.5. As in SCE's Agreement 14-745 (Inadvertent Export), Appendix D ("Specific Conditions and Limitations for Inadvertent Deliveries") asks 8 questions to spell out the specific conditions and limitations of inadvertent export.

6.1.2.5 Generating Facility Interconnection Agreement (3rd Party Non-Exporting)

This agreement, called 14-742 (3rd Party Non-Export) is between the utility and a third party. It covers the case of a third-party that agrees to prevent export of electricity from the Generating Facility. This 3rd party agreement one of those SCE refers to as "Generation Interconnection and Operating Arrangements".

SCE, as before, leaves out all references requirements for cogeneration pursuant to PU Code 218.5.

6.1.3 Pacific Gas & Electric

The primary difference between the interconnection agreements of PG&E, when compared with the agreements of SCE and SDG&E, is that there is no accommodation for inadvertent export: there is no customer inadvertent export agreement, and there is no third party inadvertent export agreement. PG&E, then, has a total of three agreements:

1. Generating Facility Interconnection Agreement, a customer non-export agreement;
2. Customer Generation Agreement (3rd Party Generator on Premises) (Non-Exporting);

3. Generating Facility Interconnection Agreement (3rd Party Non-Exporting).

The few minor differences between these agreements and their counterparts at SCE and SDG&E are discussed in the following three sections respectively.

6.1.3.1 Generating Facility Interconnection Agreement

This agreement, Form 79-973, is between the utility and a customer that wishes to self-generate. It covers the case of a customer that wishes to interconnect (without third-party involvement), and agrees to prevent export electricity from its Generating Facility. This agreement is nearly identical to the SCE and SDG&E agreements, and is a combination of both. The few minor differences are described below.

Section 1 (Scope and Purpose). Like SCE, this agreement adopts Rule 21 language (current as of 2003), so that all terms are defined in Section H. Like the SDG&E agreement, it keeps the Section 218 language allowing export to two adjacent facilities for QFs.

Section 2 (Summary and Description of Producer's Generating Facility) and Section 3 (Documents Included; Defined Terms). These sections contain the same questions and Appendices as the SDG&E agreements. Appendix C uses the PG&E tariff name "Special Facility Agreement". You'll have to check and see whether this agreement differs in substance from the "interconnection facility financing and ownership agreement" used by the other two utilities; these documents are outside the scope of Rule 21.

All other sections contain language identical to SDG&E's Agreement A.

6.1.3.2 Customer Generation Agreement (3rd Party Generator on Premises, Non-Exporting)

This agreement, Form 79-992, is between the utility and a customer that wishes to work with a third party to install and operate its Generating Facility. From the utility's perspective, this customer agreement will always be accompanied by an agreement between the utility and the third party, called a "Producer Agreement" (as it is by SDG&E) as described in Section 6.1.3.3.

With the exception of utility specifics (names, tariff names, notice contact and addresses, etc.), it is identical to SDG&E's Customer Generation Agreement ("Agreement C").

6.1.3.3 Generating Facility Interconnection Agreement (3rd Party Non-Exporting)

This agreement, called Form 79-988 is between the utility and a third party. It covers the case of a third-party that agrees to prevent export of electricity from the Generating Facility. The Customer Generation Agreement refers to this 3rd party agreement as the "Producer Agreement".

In Section 2 (Summary and Description of Producer's Generating Facility), PG&E drops the subsections 2.2, the Generating Facility ID, and 2.3, the electric service account number, that they assign. But, like SDG&E, they keep the language for PU Code 218.5. Section 3 (Documents Included), too, references Appendix C, the PU Code 218.5 cogeneration warranty.

The rest of the agreement, with the exception of utility specifics (names, tariff names, notice contact and addresses, etc.), is identical to SDG&E's Agreement 2.

6.2 Which agreement is right for you?

The determination of which agreement is the right one for you will be made, as mentioned in the introduction to this Section 6, by the utility.

6.3 Completing the agreement

The utility will complete the agreement blanks that apply to it; and leave the others for you to complete. All the information required in the agreement will be a duplication of information that is included in the application; therefore no instruction is required for you to fill out the agreement, since this information is readily available to you.

7 Installation and Commissioning

This section provides guidance on the installation and commissioning processes as they relate to interconnection approval from the electric utility. Using certified equipment should simplify the commissioning test step, so certified and non-certified equipment are addressed in separate sections.

7.1 Installation

Installation of the Generating Facility should follow the designs and use the equipment approved in the application process and specified in the interconnection agreement. Any changes to the design or equipment should be approved by the utility. Good communication leads to a good working relationship with the utility engineer and will help resolve unforeseen circumstances as they arise.

At some point in the installation process, it may be necessary to temporarily operate the Generator in parallel with the utility for testing and verification purposes prior to formal review and approval by the utility. However, interconnection agreements require that the utility provide written approval before the Generating Facility may operate in parallel with the grid. An installer that operates a Generator in parallel with the utility before receiving utility approval to do so, even momentarily, assumes a great deal of liability for injury and damage.

7.2 Commissioning

Commissioning Testing is the final step in assuring the Generating Facility owner and the electric utility that the Generating Facility has been designed, manufactured, installed, and set properly. A competent installer will perform a well-defined set of tests at various stages of installation to ensure that the Generating Facility is installed and functioning properly and to locate and correct any mistakes as installation progresses rather than having to remobilize and correct the errors at a later time. Thorough testing and commissioning will provide reassurance that the Generating Facility works as intended. It will also provide assurance to the utility

engineers, that the impact upon the utility Distribution System is acceptable, even under upset conditions.

As detailed in Section 3.2, there are four test areas for verifying the performance and operation of interconnection equipment: Type, Production, Commissioning, and Periodic Tests. The extent of Commissioning Testing required by the interconnection agreement will depend on the extent to which the Generating Facility has previously been tested. Rule 21 Certified Generating Facilities will, in general, require the least amount of Commissioning testing .

The installer should develop a Commissioning Test plan detailing the steps to be taken to meeting the established test requirements. The plan should note which components are to be used in each test (e.g., the specific disconnects to be used in the non-islanding test J.5.a.2).

7.2.1 Rule 21 Certified Equipment

Rule 21 Certified interconnection equipment can be a completely factory-assembled system, such as an inverter or a multifunction relay/Generator package, or a collection of certified components, for example discrete and multifunction relays and associated switchgear. In the former case, the equipment has been tested as a package, meaning the functional requirements have been verified, the individual pieces work together, and, the settings have been confirmed. In the latter case, each individual piece has been evaluated for its specific function and the interaction of the selected components has been confirmed as a package, however, field connections and settings will likely need to be verified.

Table B-1 (contained in Appendix B: Rule 21 Certified Equipment Commissioning Test Requirements) covers minimum commissioning test requirements, from Rule 21, Section J.5.a. Table B-2 (also in Appendix B) covers other commissioning test requirements, from Section J.5.f.

As noted previously, additional testing requirements may be imposed as a result of Supplemental Review or Interconnection Study. The interconnection agreement and any supplemental documentation should provide adequate description of those additional test requirements.

7.2.2 Non-Certified Equipment

Commissioning testing for non-certified equipment, with or without interim utility approval, will be specified in the interconnection agreement. At a minimum, the Commissioning testing described for Rule 21Certified Equipment in the previous section will need to be performed. In addition, at the discretion of the electric utility, non-certified equipment may need to pass some or all of the appropriate Type Tests described in Rule 21 Section J.3. The equipment manufacturer/installer may negotiate with the utility to determine which tests may be performed in the factory and which shall be performed as part of the Commissioning process. Alternative tests to those described in Section J or Rule 21 may be used, based on mutual agreement between the utility and the installer or equipment manufacturer.

The Supplemental Review Guideline (http://www.energy.ca.gov/distgen/interconnection/guideline.html) provides additional guidance that may be used in this area.

8 Problem and Dispute Resolution

8.1 What to do if there is a problem

There are three steps you can take when a problem or dispute hinders the interconnection process:

- Seek resolution through project meetings;
- Seek resolution under Rule 21;
- Seek resolution by the California Public Utilities Commission.

Resolution through one or more project meetings will likely take the least time and the fewest resources; formal resolution by the CPUC will likely take the most time and resources. At each step of dispute resolution, it is prudent to weigh the cost and benefit of pursuing resolution, and look for compromise positions that can serve both parties' needs and expedite the process.

8.2 Project meeting resolution

Project meeting resolution is often the form of recourse with the least cost and quickest results. Often a problem begins as a lack of communication among project team members as parties to interconnection. When you communicate your needs in a way that the other party can understand, resolution becomes easier. The key is to focus on needs: the other party's and your own, and to avoid blame. The following procedure is helpful when you notice a problem or a potential problem in the interconnection process:

1. Identify the nature of the problem (technical, legal, procedural, etc.);

2. Identify the need you have that is not being met because of the problem (in other words, identify why the problem is a problem to you);

3. Identify the likely consequences of the unmet need;

4. Write down the nature of the problem, the unmet need, and its likely consequences;

5. Discuss the problem as you've written it with others on your interconnection team to see if they concur with your analysis;

6. Batch the problem in priority with the other problems or issues arising in the interconnection process;

7. Contact the utility, or other party, to discuss the best time and place to resolve the prioritized batch of issues and problems; make the appointment;

8. Prior to the meeting, disseminate information necessary for the discussion so that all parties have an opportunity to come to the meeting informed;

9. Discuss the high priority issues first, focusing on communicating your own needs, and listening in understanding the needs of the other party;

10. Look for compromise positions that meet both parties' needs;

11. If you cannot find resolution because the issue is more complex, facilitate information exchange, and be willing to meet again to look for consensus;

12. Continue until the issue is resolved, or until both parties agree that project meetings will not achieve resolution.

If both parties agree that project meeting resolution isn't enough, other forms of resolution can be brought to bear. Write the issue down again (to capture any changes in your view of the situation) and document your efforts at resolution. Then you can begin looking for other forms of resolution.

8.3 Resolution under Rule 21

Rule 21 Section G covers dispute resolution; Section G.2 describes the procedure to be followed:

1. Write a dispute letter to the other party containing the facts of the dispute and the relief you are seeking; reference Section G.2 of Rule 21; date and send the letter;

2. Plan to meet with the representative of the other party within forty-five days of the date of the dispute letter;

3. Try again to reach consensus;

4. If you don't reach consensus, the issue will be "submitted to resolution before the Commission in accordance with the Commission's Rules of Practice and Procedure applicable to Customer complaints".

The CPUC will then decide the matter.

8.4 Dispute Clarification and Resolution Resources within the California Public Utilities Commission

There is a formal process involving an Administrative Law Judge for resolving disputes within the CPUC, and anyone who has a dispute with a utility may file a formal dispute and use the process. Of the dispute resolution procedures available for interconnection in California, this is usually the most time-consuming approach.

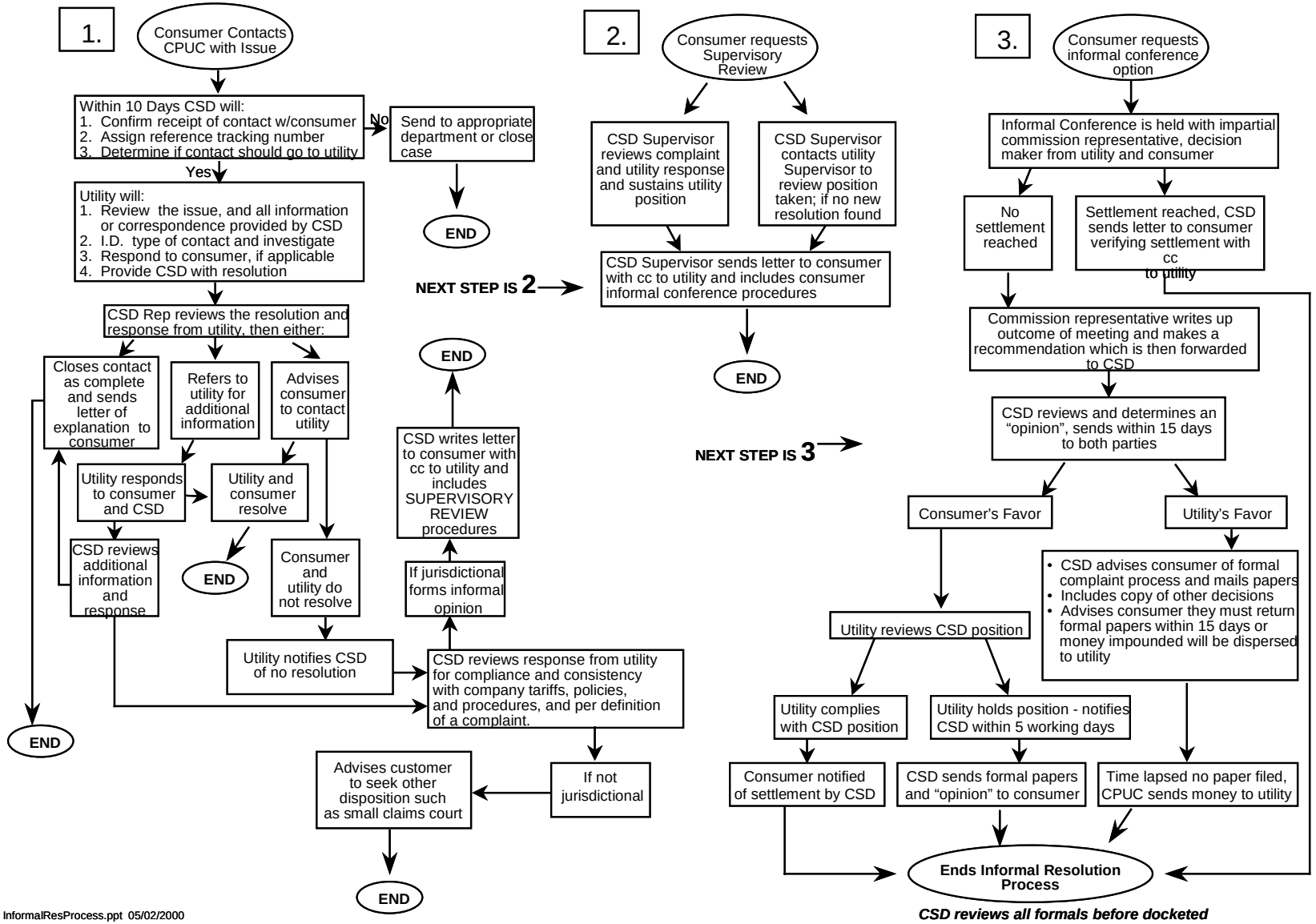
To expedite matters, the CPUC has set up an Informal Resolution Process that is administered through its Consumer Services Division. Most small disputes are resolved through this process in a few days; it could also take 25 days or more. In many cases, it may be quicker than Rule 21 resolution, which has a 45-day timeframe. Probably the best and quickest way for you may utilize this option through the CPUC web site at http://www.cpuc.ca.gov/, click on "file a complaint", then click on "File Informal Complaint" and filling out the Informal Complaint Application.

Alternately, you may contact the Consumer-Affairs Division at consumer-affairs@cpuc.ca.gov or 1-800-649-7570 or 1-415-703-1170.

A flowchart of the Informal Resolution Process is provided below. The informal process is comprised of three simple steps and each step may resolve the issue:

1. Phone resolution
2. Supervisory Review
3. A conference

Figure 8-1: CPUC Informal Resolution Process



9 Where to go for more information

[Note: This section contains web links and addresses for documents only. Besides a description of what the link is, there is no explanatory text.]

9.1 Links to Basic Information about Distributed Energy Resources

9.1.1 California Energy Commission

http://www.energy.ca.gov — California Energy Commission home page

http://www.energy.ca.gov/distgen — Distributed Generation page

From this page, you can select a number of different resources, as noted in the column on the left hand side of the page.

http://www.energy.ca.gov/distgen/interconnection/interconnection.html — Interconnection page

http://www.concieo.net/dg/utility.cfm — Online Rule 21 application forms for SDG&E and SCE

9.1.2 California Public Utility Commission

http://www.cpuc.ca.gov/ — California Public Utilities Commission

http://ora.ca.gov — CPUC Office of Ratepayer Advocates

9.1.3 U.S. Department of Energy

http://www.energy.gov — U.S. Department of Energy

http://www.eere.energy.gov/distributedpower/ — U.S. Department of Energy

http://www.eren.doe.gov — Energy Efficiency and Renewable Energy Network

http://www.eere.energy.gov/ — Office of Energy Efficiency and Renewable Energy

http://www.eren.doe.gov/der — Distributed Energy Resources

http://www.eren.doe.gov/state_energy/states.cfm — DESIRE Database

http://fossil.energy.gov — Office of Fossil Energy

http://www.netl.doe.gov — National Energy Technology Laboratory

http://www.nfcrc.uci.edu/fcresources/index.htm — National Fuel Cell Research Center

http://www.nrel.gov — National Renewable Energy Center

9.1.4 California Power Authority

http://www.capowerauthority.ca.gov/default.htm — Consumer Power and Conservation Financing Authority

9.2 Links to Electric Utilities

9.2.1 Pacific Gas & Electric

http://www.pge.com — PG&E home page

9.2.1.1 Rule 21 and Related Interconnection information

http://www.pge.com/customer_services/business/tariffs/pdf/ER21.pdf — Rule 21

Rule 21 Contact: Generator Hotline - (415) 972-5676

http://www.pge.com/gen/retail_gen.shtml — Retail generators page

http://www.pge.com/002_biz_svc/gen/pdf/wi_handbook/toc.pdf — PG&E Interconnection Handbook

9.2.1.2 Metering and interconnection-related tariffs

http://www.pge.com/002_biz_svc/gen/retail_gen_net_metering.shtml — Net Energy Metering (called ENet and Expanded ENet)

9.2.1.3 Links to Utility Services Offered for Distribution System Modifications and System Upgrades

9.2.2 Southern California Edison

http://www.sce.com — SCE home page

9.2.2.1 Rule 21 and Related Interconnection information

http://www.sce.com/NR/sc3/tm2/pdf/Rule21.pdf — Rule 21

http://www.sce.com/NR/rdonlyres/epndwz2wmbjdehdp4eo7m5nxybmnojkhtx6okoj6y2mu4c5jbpbs5rjoqlt2jazcrdyozwmd2ot5k5arl7xg2bylycb/DG_GFI_app_web.pdf — Application

Rule 21 Contact: Tom Dossey - (626) 302-8242 customer.generation@sce.com

http://www.sce.com/sc3/002_save_energy/002k_gen_your_own_power/default.htm — Generating Your Own Power page

9.2.2.2 Metering and interconnection-related tariff

http://www.sce.com/sc3/002_save_energy/002k_gen_your_own_power/nemfaq.htm — Net Energy Metering
http://www.sce.com/NR/rdonlyres/egepskqmrefntdeow5l53fa2gopzwhnwyy46qbve2snipnurmwfu22tl5ahgsplaqglzbqbnbnndgq2no7ao73hg6wg/wholesale_distribution_access_tariff.pdf — Wholesale Distribution Access Tariff

9.2.2.3 Links to Utility Services Offered for Distribution System Modifications and System Upgrades

9.2.3 San Diego Gas & Electric

http://www.sdge.com — SDG&E home page

9.2.3.1 Rule 21 and Related Interconnection information

http://www.sdge.com/tm2/pdf/ERULE21.pdf — Rule 21

Rule 21 Contact: Mike Iammarino - (858) 650-6166 selfgensd@semprautilities.com

http://www.sdge.com/self_generation.html — Self-generation

http://www.sdge.com/interconnection.html — Interconnection

http://www.sdge.com/interconnection.html — Interconnection Agreements

9.2.3.2 Metering and interconnection-related tariff

http://www.sdge.com/net_metering.html — Net Energy Metering

http://www.sdge.com/tm2/pdf/E-DEPART.pdf — Departing Load Charges

http://www.sdge.com/solutions/interconnections.html — Transmission Level Interconnections

http://www.sdge.com/tariff/ — SDG&E tariffs

http://www.sdge.com/metering.html — Metering information

9.2.3.3 Links to Utility Services Offered for Distribution System Modifications and System Upgrades

9.2.4 California Municipal Utilities

http://www.smud.org — Sacramento Municipal Utility District (SMUD)

http://www.smud.org/pv — SMUD Solar Program

http://www.ci.riverside.ca.us/utilities/default.htm — City Of Riverside

http://www.ladwp.com — Los Angeles Department of Water and Power

http://www.greenla.com/solar/index.htm — LADWP Solar Program

http://www.cpau.com/ — City of Palo Alto

http://www.siliconvalleypower.com — Silicon Valley Power

http://cho.ci.santa-clara.ca.us/211.html — City of Santa Clara

http://cho.ci.santa-clara.ca.us/40914.html — Santa Clara Solar program -

http://www.ci.pasadena.ca.us/waterandpower — Pasadena Water & Power

http://www.ci.pasadena.ca.us/waterandpower/solarpower_info.asp — Pasadena Solar Program

http://www.burbankwaterandpower.com — Burbank Water & Power

http://www.anaheim.net/utilities — Anaheim Public Utilities

http://www.anaheim.net/utilities/adv_svc_prog/pv/pv_intro.html — Anaheim Solar Program

http://reddingelectricutility.com — Redding Electric Utility

http://www.ci.redding.ca.us/electric/energysvc/renewables.html — Redding Renewables Program

http://www.ci.glendale.ca.us/government/gwp — Glendale Water & Power

http://www.ci.glendale.ca.us/government/gwp/money saving programs/Residential Programs/solarsolutions.html — Glendale Solar Program

9.3 Links to Incentives for Distributed Energy Resources

9.3.1 California Energy Commission

http://www.consumerenergycenter.com/erprebate/ — Emerging Renewables Incentive Program

http://www.californiasolarcenter.org/incentives.html — State wide Solar energy Incentive programs

9.3.2 California Public Utilities Commission

http://www.pge.com/selfgen — PG&E Self Generation Program

http://www.scespc.com/sgip.nsf/MainPageView/ProgramDescription — SCE Self Generation Program

http://sdenergy.org/selfgen/ — SDG&E Self Generation Program

9.3.3 Other Resources

http://www.californiasolarcenter.org/legislation.html — Solar Incentive legislation (Scroll down to the Financial Incentives section)

9.4 Links to National Interconnection and Device Standards and Works in Progress

9.4.1 IEEE P1547 (and 929)

http://grouper.ieee.org/groups/scc21/index.html — IEEE Standards Coordinating Committee 21

http://grouper.ieee.org/groups/scc21/1547/1547_index.html — IEEE 1547 workgroup Page

http://shop.ieee.org/store/product.asp?prodno=SH94811 — IEEE 929 order page

http://shop.ieee.org/store/ — IEEE 519 order page

9.4.2 Underwriters Laboratories

http:// www.ul.com/dge/ — Distributed Generation page

9.4.3 National Electrical Code

http://www.nfpa.org/Codes/nfpa_codes_and_standards/list_of_nfpa_documents/nfpa_70.asp — National Electric Code

9.4.4 FERC Generator Interconnection Activities

http://www.ferc.gov/Electric/gen_inter.htm — Federal Energy Regulatory Commission Interconnection

9.5 Links to Regulation and Legislation Affecting Distributed Energy Resources

http://www.leginfo.ca.gov/calaw.html — Search California legislation

> To find existing California Legislation, select "Public Utilities Code", type in the number of the legislation, and click on "search".

http://www.californiasolarcenter.org/legislation.html — Solar energy related legislation

9.6 Links to Nationally Recognized Testing Laboratories

> This list is meant to provide examples and is not comprehensive. The presence of a company on this list does not imply endorsement.

http://www.etlsemko.com/elecprodsaf.html — Intertek Testing Services, ETL SEMKO

http://www.ul.com/dge/ — Underwriter's Laboratories

http://www.csa-international.org — Canadian Standards Association

9.7 If You Have Questions that are Not Answered by this Guidebook

If they are questions related to Rule 21, the following procedure should help you:

1. Look in Rule 21 for the answer;

If you do not find it there,

2. Go to the utility's handbooks and other Rule-21-related tariff information;

If you do not find it there,

3. Call the utility contact assigned to your interconnection application and ask.

All other questions are outside the scope of this guidebook.

Appendix A: Detailed Explanation of Generating Facility Design and Operating Requirements (Section D of Rule 21)

This section provides further background and description of the Rule 21 technical requirements. It is intended to be explanatory and give examples of some methods for meetings the requirements. The explanations and examples are not prescriptive and may not be acceptable under all circumstances.

In the following discussion, direct quotes of Rule 21 language are in a different font and inset to distinguish them from explanatory text:

> Sample Rule 21 text...

Section D.1: General Interconnection and Protection Requirements

Section D.1.a. Protective Functions Required Protective Functions include the ability of the Generator to sense abnormal conditions on the utility Distribution System and to disconnect the Generator from the utility system when necessary. The following three protective functions are required for all interconnected Generators regardless of type.

> Over and under voltage trip functions and over and under frequency trip functions;

Over and under voltage, and over and under frequency trip functions are described in detail in section 3.1.2.

> A voltage and frequency sensing and time delay function to prevent the Generating Facility from energizing a de-energized Distribution System circuit and to prevent the Generating Facility from reconnecting with the Distribution System unless the Distribution System service voltage and frequency is within a range specified the utility and is stable for at least 60 seconds;

The reason that an automatic function is required for disconnect and reconnect is to prevent human error from either not disconnecting a Generator during a problem with the Distribution System or reenergizing a Generator when the Distribution System problem is yet to be resolved. The reenergizing of deenergized lines without the consent of the utility circuits is a primary concern of utility protection engineers. This requirement sets guidelines for deenergizing and a timeframe for when a Generator can automatically resume parallel operation after a utility disturbance. It is set at 60 seconds to allow time for automatic reclosers to return to their normal operating state.

A function to prevent the Generating Facility from contributing to the formation of an Unintended Island.

This requirement addresses the concern that generating facilities outside of the direct control of the Distribution System operator must be designed such that they do not contribute to an Unintended Island. Compliance with this requirement may be accomplished through a variety of means including under or reverse power functions, anti-islanding control functions and designing the facility such that the load is always greater than the Generating Facility capacity.

Section D.1.b. Momentary Paralleling Generating Facilities Subject to the utility's approval, a customer's loads may be transferred from the utility's system to an onsite Generating Facility, or vice versa, through an operation called Momentary Paralleling. This mode of operation does not necessarily require the same level of Protective Functions specified for Parallel Operation. Momentary Paralleling is defined as the interconnection of a Generating Facility to the Distribution System for one second (60 cycles) or less. This is typically done to provide seamless transfer from utility power to Generator power and back.

Section D.1.c. Purpose of Protective Functions The purpose of the required protective functions is to protect the Distribution System, not the Generating Facility. The Producer is solely responsible for the protection of their facilities. Any protection that the Producer installs on their facility cannot compromise the utility's service to other customers.

Section D.1.d. Suitable Equipment Required Interrupting devices (i.e. circuit breakers) located at the PCC with the utility must be Certified or "Listed" as suitable for the application. The Generating Facility shall be designed so that the failure of any one device will not compromise the safety and reliability of the Distribution System. This means that a single failure cannot disable the protective functions and allow the Generating Facility to operate in parallel to the Distribution System.

Section D.1.e. Visible Disconnect Required Generating Facilities greater than 1 kVA aggregate must include a manual, lockable, accessible, Visible Disconnect to isolate the Generator from the Distribution System. The primary need for this means of disconnect is to allow utility lineworkers to comply with their rules to have access to a visible open, lockable disconnect for all power sources. By providing this disconnect, lineworkers can work on utility-owned conductors adjacent to the Generating Facility without needing to know what type of generating equipment is beyond the switch. The switch also provides a means of lockout should the terms of the interconnection contract be violated.

Section D.1.f. Single-Phase Generators

- Shared secondary - 20 kVA maximum: To allow customers on a shared single-phase secondary to have equal access to the capacity of the shared utility distribution transformer, a limit is placed on individual customer's Generating Facility capacity. This limit allows for some diversity of loads and generation at each of the customer's electrical service in a shared secondary without overloading the serving distribution transformer.

- Imbalance – maximum of 6 kVA of imbalance between the two sides of a center-tapped 240-volt service. The 6 kVA limit for imbalances on single-phase 240-Volt services is to protect from excessive power imbalances causing overloading of the neutral conductor supplied by the utility. This neutral conductor, which mainly carries an amount of current similar to the difference in current between the two 240-Volt supply conductors is often undersized compared to either of the 240-Volt supply conductors. For instance, if one supply conductor is carrying 35 amps and the other supply conductor is carrying 25 amps, the neutral conductor would carry the difference, or approximately 10 amps. An imbalanced Generating Facility can increase the difference in current between the two supply conductors and thus increase the current carried by the neutral conductor.
- Dedicated transformer: - transformer nameplate rating: Particularly in rural areas where no three-phase service exists, a large single-phase distribution transformer of up to 100 kVA in size may serve some customers. This provision allows for these customers to install larger single-phase Generators because the Distribution System serving the customer has the capacity and because the transformer serves no other customers. In other words, there is no shared secondary.

Section D.1.g. Drawings Required Generator protection and control wiring diagrams. such as single-line diagrams, depicting the layout and design of the Generating Facility and the associated interconnection facilities, must be reviewed and approved by the utility. Rule 21 Certified or previously approved equipment may help satisfy this requirement by providing a basis for understanding some or all of the design of the interconnection facilities and confidence that certain requirements have been met..

Section D.1.h. Generating Facility Conditions Not Identified In the event that Rule 21 does not address the interconnection requirements for a particular Generating Facility, the utility and the Producer may agree upon other requirements. This provision is intended to provide a basis for flexibility on the part of both the utility and the Producer to develop requirements for Generating Facilities that are not addressed in the general requirements or the interconnection review process.

Section D.2: Prevention of interference

The Generating Facility must not superimpose a voltage or current on the Distribution System that interferes with service to the utility's customers or communication facilities. If such interference occurs, the Producer must take corrective action at its own expense to remedy the problem. The utility will provide notice and a reasonable time to implement corrective action. This is particularly important since it carries significant consequences for non-compliance. If the Producer does not take corrective action in a timely manner, or continues to operate the facilities causing interference without restriction or limit, the utility has the right, without liability, to disconnect the Producer's facilities from the Distribution System.

To eliminate undesirable interference caused by operation of the Generating Facility, it shall include means of meeting the requirements in the following table:

Table A-1 Summary Table of Trip Settings and Operating Requirements

	Range		Max Trip Time (1)	
Voltage @ PCC (2)	**Volts-120V base**	**%**	**Cycles**	**Seconds**
Fast Under	$V_{POC} < 60$	<50%	10	0.167
Under	$60 \leq V_{POC} < 106$	50% - 88%	120	2.0
Normal	$106 \leq V_{POC} \leq 132$	88% - 110%	Normal Operation	
Over	$132 < V_{POC} < 165$	110% - 137%	120/30 (3)	2.0/0.5 (3)
Fast Over	$V_{POC} > 165$	>137%	6	0.1
	Range		**Max Trip Time (1)**	
Frequency (2)	**Hz – 60 Hz base**	**%**	**Cycles**	**Seconds**
Under	<59.3	99.2%	10	0.167
Normal	59.3 - 60.5	98.8 - 100.8	Normal Operation	
Over	>60.5	100.8	10	0.167
Flicker	Generating facility should not cause the voltage at the PCC to exceed the limits defined by the "Maximum Borderline of Irritation Curve" in IEEE STD 519-1992[20].			
Harmonics (2)	Generating facility harmonic distortion shall be in compliance with IEEE STD 519-1992. Exception: shall be evaluated using the same criteria as for the loads at that site.			
Power Factor	Between 0.9 leading and lagging. Operation outside this range may be acceptable for power factor correction purposes or if otherwise allowed by utility.			
Direct Current Injection	≤ 0.5% of Generating Facility rated output current			

(1) - "Maximum Trip time" – maximum allowable time between the onset of the abnormal condition and the Generating Facility ceasing to energize the Distribution System.
(2) - "PCC" means Point of Common Coupling; it is a defined term in Rule 21. For generating facilities ≤11kVA; set points may be fixed. For a generating facilities > 11 kVA, set points and trip times shall be field adjustable and different voltage set points and trip times may be negotiated with the utility.
(3) - Trip times are for a generating facilities ≤11kVA/>11kVA

Explanation of Operational Limits

Fast over-voltage trip
The Fast over-voltage trip setting of the Protective Functions is 137% of the nominal voltage. Above this voltage, the Protective Functions must cease to energize the system in six cycles. This trip setting is for detecting series voltage problems on the Distribution System and to shut down very rapidly in the event the utility voltage goes well above the normal operating range. Some of the reasons for these high over-voltage excursions can include higher voltage distribution lines falling on lower voltage distribution lines, which can cause permanent damage

[20] IEEE STD 519-1992 is a standard entitled *Recommended Practices and Requirements for Harmonic Control in Electric Power Systems*, published by the Institute of Electrical and Electronic Engineers

to customer's equipment. The fast trip time ensures that the Generating Facility is off-line very quickly to minimize damage to equipment. It is also in the best interest of the owners of most generating equipment that the Generators disconnect even more quickly than this requirement to protect their own circuitry.

Over-voltage trip
The over-voltage trip setting of the Protective Functions is 110% of the nominal voltage. Above this voltage, the Protective Functions must cease to energize the system if this condition persists for 30 cycles if the unit is more than 11 kVA. For units of 11 kVA or less, the Protective Functions shall cease to energize the system if this condition persists for 120 cycles.
The reason for two separate over-voltage requirements is related to the realities of operating equipment on the Distribution System. Brief overvoltages are a relatively common occurrence on the Distribution System. This is especially true for rural portions of the Distribution System where many of the smaller (11kVA or less) systems are likely to be located. In either case (for systems greater or less than 11 kVA) additional delays are needed to allow for short-term, less severe over-voltages. Larger systems (above 11 kVA may be able to provide some local voltage support to the system and therefore must react more quickly (30 cycles as opposed to 120 cycles) to an over-voltage than very small systems.

Under-voltage trip
The under-voltage trip setting of the Protective Functions is 88% of the nominal voltage. Below this voltage, the Protective Functions must cease to energize the system if this condition persists for 120 cycles. The reason for two separate under-voltage requirements is related to the realities of operating equipment on the Distribution System. Brief under-voltages are a relatively common occurrence on the Distribution System due to starting of motors and other large loads. This is especially true for the less stiff portions of the Distribution System where additional delays are needed to allow for short-term under-voltages that commonly occur under normal conditions. This allows the Generating Facility to operate through these normal excursions without nuisance trips.

Fast under-voltage trip
The fast under-voltage trip setting of the Protective Functions is 50% of the nominal voltage. Below this voltage, the Protective Functions must prevent the system from being energized if this condition persists for six cycles. This trip setting is for detecting serious voltage problems on the Distribution System and to shut down very rapidly in the event of a low voltage excursion. Some of the reasons for these very low over-voltage excursions can include power lines falling to the ground in a storm. The fast trip time ensures that the Generating Facility is off-line very quickly to allow the utility's equipment to detect and address the problem with their Distribution System equipment designed for dealing with these situations.

Over-frequency trip
The over-frequency trip setting of the Protective Functions is 60.5 Hertz. A Generating Facility operating at a frequency above 60.5 Hertz must cease to energize the system in six cycles. The over-frequency trip setting is meant to address two concerns. The first concern is that of Unintentional Islanding. A tight upper frequency setting will cause the Generating Facility to cease to energize the Distribution System should the local load be smaller than the Generating

Facility and the load-to-generation imbalance cause even a brief over-frequency condition. The second concern is for the case where the portion of the Distribution System connected to the Generating Facility undergoes a large enough load-to-generation imbalance to cause the frequency in region to rise. In this case, all generation outside the direct control of the utility or the system operator must cease to energize the system until stability is restored.

The quick response time is meant to protect equipment susceptible to higher frequencies, but the response time is slow enough that short-term disturbances will not cause nuisance tripping. Short-term disturbances are those that only last for a few cycles and will not damage customer's equipment. To unnecessarily trip the Generator for such disturbances will reduce the availability of the Generator without improving system protection.

Under-frequency trip
The under-frequency trip setting of the Protective Functions is 59.3 Hertz for fast frequency excursions. A Generating Facility operating at a frequency below 59.3 Hertz must cease to energize the system in six cycles. As well as detecting serious system conditions, the under-frequency trip setting helps address Unintentional Islanding. A tight under frequency setting will tighten the capacitive to inductive load ratio necessary to maintain an acceptable resonant frequency. The settings should allow the unit to ride through transient disturbances and not cause nuisance tripping.

Flicker limits
Voltage flicker caused by the Generator at the PCC should not exceed the limits defined by the "Maximum Borderline of Irritation Curve" identified in IEEE 519-2000. This requirement is intended to minimize adverse effects on neighboring customers on the Distribution System. Induction Generators may be connected and brought up to synchronous speed (as an induction motor) provided these flicker limits are not exceeded.

Section D.2.d. Harmonics.

> Harmonic distortion shall be in compliance with IEEE 519. Exception: The harmonic distortion of a Generating Facility located at a Customer's site shall be evaluated using the same criteria as for the loads at that site.

IEEE 519, IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, is the document that sets the limits for harmonic distortion on electric power systems. Rather than developing a new set of requirements independent of this standard, it was decided by the Rule 21 working group to use this standard. The IEEE 519 is currently being revised so that referencing the standard in general without reference to a specific revision or section will allow the California standard to stay current with the latest version as it becomes available. The exception is meant to address an important concern with the existing version of IEEE 519-1992. This version forces a customer's site that installs a Generating Facility to come into compliance with the most stringent harmonic requirements regardless of the characteristics of the local Distribution System. This is overly conservative and does not have sufficient technical basis to cause the Rule 21 working group to adopt IEEE 519 without comment.

Section D.2.e. Direct Current Injection.

> Generating Facilities should not inject direct current (DC) greater than 0.5% of rated output current into the utility's Distribution System.

This requirement is designed to address one of the primary reasons utilities require isolation transformers on distributed Generation, to control DC injection. If DC injection can be controlled via active circuitry that senses and removes the Generator in the event of a problem, there is no need for a transformer to decouple the power source from the Distribution System. The 0.5% of rated output current limit was established in IEEE 929-2000, Recommended Practice for Utility Interface of Photovoltaic (PV) Systems, as a limit below that which may cause standard Distribution System transformers to saturate or lead to service reliability problems.

Section D.2.f. Power Factor.

> Each Generator in a Generating Facility shall be capable of operating at some point within a power factor range of 0.9 leading to 0.9 lagging. Operation outside this range is acceptable provided the reactive power of the Generating Facility is used to meet the reactive power needs of the Host Loads or that reactive power is otherwise provided under tariff by the utility. The Producer shall notify the utility if it is using the Generating Facility for power factor correction.

The purpose of power factor limits are to guard against a Generating Facility that would attempt use the Distribution System for reactive power services in excess of those allowed for loads.

Section D.3. Control, Protective Function and Safety Equipment Requirements

Section D.3.a.Technology-specific requirements

The requirements for synchronous Generators, induction Generators, and inverter systems are broken down into individual bullets and explained to provide better clarity.

Section D.3.a.1. Three-Phase Synchronous Generators

- Circuit breakers must be three-phase devices with electronic or electromechanical control. Excessive current on any or all phases causes the breaker to open.
- Unless otherwise agreed upon by the Producer and the utility, synchronous Generators must automatically regulate power factor, not voltage, while operating in parallel with the Distribution System. The utility is responsible for voltage control of the Distribution System. Since the utility generally does not have active control of non-utility Generators, distributed Generators are not used specifically to help control voltage.
- Power system stabilization is not required for generating facilities less than10 MW.
- Short Circuit Current Ratio (SCCR) ≤ 0.05 (small relative to the size of local Distribution System): The Generating Facility synchronizing function may be either manual or automatic.
- SCCR > 0.05 (large relative to the size of local Distribution System): The Generating Facility synchronizing function shall be automatic; Generating Facility shall be equipped with loss of synchronism Protective Functions. This requirement does not allow manual synchronizing for generating facilities that are large in comparison to local Distribution System to which they are connected. The reason this is not allowed is that synchronizing

improperly can cause severe voltage problems that can be a nuisance or possibly cause damage to customer's equipment.

Section D.3.a.2. Induction Generators

- Induction Generators do not require a synchronizing function since they inherently synchronize with the grid based on their speed. This means that it is unnecessary to install separate synchronizing equipment.
- Starting or rapid load fluctuations on induction Generators can adversely impact the Distribution System's voltage. As induction machines start to generate, they can cause voltage fluctuations that can become severe enough to require the installation of corrective capacitors or other means. These corrective capacitors have been known to cause ferroresonant voltages that can cause damage to sensitive equipment. Corrective step-switched capacitors or other measures installed on the Producer's side of the PCC must be reviewed. Additional equipment may be required as determined in a Supplemental Review or an Interconnection Study.

Section D.3.a.3. Inverter Systems

- Inverter systems do not require separate synchronizing equipment. In order for an inverter to be classified as utility-interactive, it must have its own, on-board synchronizing software. This software not only allows it to synchronize but also must prevent the unit from improperly synchronizing.
- Non-utility-interactive or "stand-alone" inverters must not be used for parallel operation. If the unit does not have this specialized utility-interactive synchronizing software, the unit will be damaged by the utility system and could cause damage to customer's equipment when that damage occurs. This is why Rule 21 specifically prohibits non-utility-interactive inverters operating in parallel with the Distribution System.

Section D.3.b. Supplemental Generating Facility Requirements

Section D.3.b.1. Unintended Islanding Mitigation for Generating Facilities that Fail the Export Screen: A Generating Facility must prevent not contribute to an Unintended Island by employing one of the three following methods.

1. The Generating Facility has certified Non-Islanding control functions. Certified Non-Islanding controls are designed to prevent the islanding concerns caused by Generators that export power from the customer's facility.
2. The utility can verify that local loads sufficiently exceed the Generating Facility Net Nameplate Rating. If the local load on the Distribution System is sufficiently large, the Generating Facility may be incapable of supporting an unintended island beyond the Generator's host site.
3. The Generating Facility incorporates transfer trip or an equivalent Protective Function. If neither of the two above options can address Unintended Islanding, it may be necessary to incorporate some method of direct utility control like transfer trip. Transfer trip is generally prohibitively expensive for Generators smaller than a few megawatts.

Section D.3.b.2. Fault Detection. For Short Circuit Current Ratio (SCCR) > 0.1 or Generating Facility that do not meet any one of the Unintended Islanding options above shall be equipped

with Protective Functions designed to detect Distribution System faults, both line-to-line and line-to-ground. This requirement is designed to provide the fault protection requirements necessary for Generating Facility that are a major source of fault current on the local Distribution System. This is generally only necessary for extremely large generating facilities.

- For a Generating Facility that cannot detect these faults within two seconds, transfer trip system or equivalent may be required. Without the ability to sense faults in a timely manner often requires some method of direct utility control like transfer trip.

Reclose-blocking may also be required for a Generating Facility that exceeds 15% of the peak load on the Line Section. For very large generating facilities that represent a large percentage of the local load, utility distribution equipment, called reclosers, designed to automatically clear faults, may need to be disabled (i.e. blocked from operating).

Appendix B: Rule 21 Certified Equipment Commissioning Test Requirements

Rule 21 Section J.5.a specifies that, for Rule 21 Certified equipment qualifying for Simplified Interconnection, only the tests described in Table B-1 are required for commissioning a test. The tests listed in Table B-2 (from Rule 21 Section J.5.f) may also need to be performed in certain circumstances.

Table B-1: Rule 21 Certified Equipment Commissioning Test Minimum Requirements

Rule 21 Requirement (Section J.5.a)	**Discussion**
Protection settings that have been changed after factory testing will require field verification. Tests will be performed using injected secondary voltages and currents, applied waveforms, a test connection using a Generator to simulate abnormal utility voltage or frequency, or varying the set points to show that the device trips at the measured (actual) utility voltage or frequency.	Voltage and frequency Protective Function settings for small generating facilities (11kVA or less) are intended to be factory set and tested to the values specified in Section D.2.a and D.2.c of Rule 21. Large Generators may also be factory set and tested at those values but are also required to be field adjustable and different values may be specified in the interconnection agreement. If the Protective Function settings are changed in the field, then the Commissioning Test shall verify that the settings are correct.

Rule 21 Requirement (Section J.5.a)	**Discussion**
Non-Islanding function, if included, will be checked by opening a load break disconnect switch to verify the interconnection equipment ceases to energize the line and does not re-energize for the required time delay after the switch is closed.	This test is not intended to be a comprehensive evaluation of the non-islanding function but rather a simple verification that the unit will detect and respond to the loss of utility power. It also verifies the reconnect delay as specified in Rule 21 Section D.1.a.3. Typically, the Generator isolation device, if it is rated for opening under load (load break), is used for this test. The test does not require load, matched or otherwise, on the Generator side of the chosen disconnect switch. The Generator should be operating normally at the time the switch is opened, providing at least 25% of its rated output.
Non-Export function, if included, will be checked using secondary injection techniques. This function may also be tested by adjusting the Generating facility output and local loads to verify that the applicable non-export criteria (i.e., reverse power or under power) are met.	For systems with discrete or multifunction relay, secondary injection (test signals injected into the relay that simulate various current and voltage transformer outputs) is probably the most convenient method of performing this test. In large facilities, the load adjustment technique may only be practical outside of normal business hours when the facility load can be reduced below the Generator rating.

Table B-2: Additional Commissioning Test Requirements

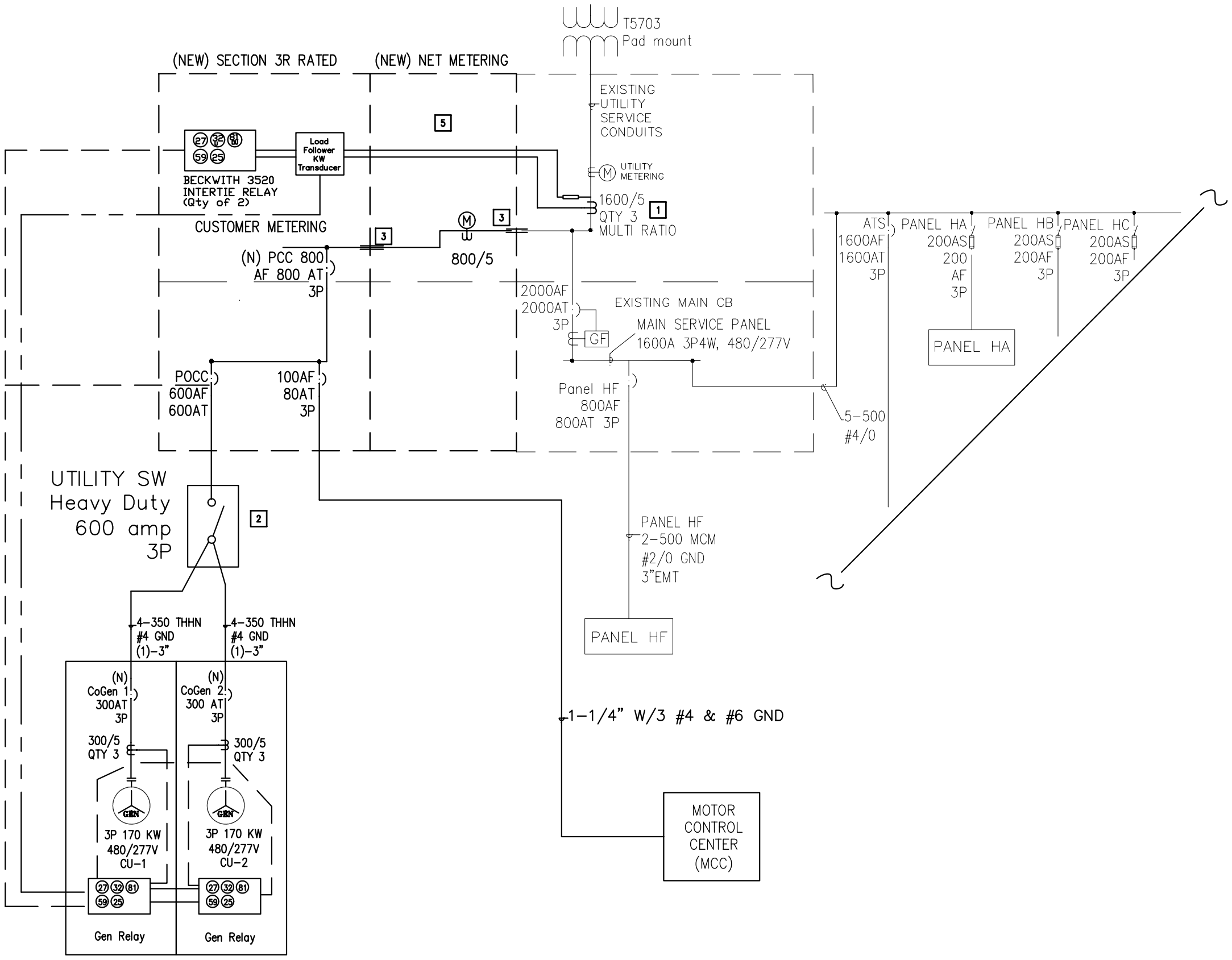
Rule 21 Requirement	**Discussion**
J.5.f Trip Tests Interconnection Protective Functions and devices (e.g., reverse power relays) that have not previously been tested as part of the Interconnection Facilities with their associated interrupting devices (e.g., contactor or circuit breaker) shall be trip tested during commissioning. The trip test shall be adequate to prove that the associated interrupting devices open when the protective devices operate. Interlocking circuits between Protective Function devices or between interrupting devices shall be similarly tested unless they are part of a system that has been tested and approved during manufacture	This test verifies that the output signal from the Protective Function device is compatible with the interrupting device and that they are wired together properly.
J.5.f In-Service Tests Interconnection Protective Functions and devices that have not previously been	This test will verify the wiring and compatibility between the Protective Function device and the transducers

Rule 21 Requirement	Discussion
tested as part of the Interconnection Facilities with their associated instrument transformers or that are wired in the field shall be given an in service test during commissioning. This test will verify proper wiring, polarity, CT/PT ratios, and proper operation of the measuring circuits. The in-service test shall be made with the power system energized and carrying a known level of current. A measurement shall be made of the magnitude and phase angle of each Alternating Current (AC) voltage and current connected to the protective device and the results compared to expected values. For protective devices with built in Metering functions that report current and voltage magnitudes and phase angles, or magnitudes of current, voltage, and real and reactive power, the metered values may be used for in service testing. Otherwise, portable ammeters, voltmeters, and phase angle meters shall be used.	Function device and the transducers providing signals to that device.

Appendix C: Sample Single-Line Drawings

Three sample Single Line Drawings are shown below. The first single-line is for two 170 kW generators, and the second is for a 140 kW generator; all three generators are associated with cogeneration facilities. The third single-line is for a 230 kW Photovoltaic generator. These samples contain the level of detail required by utilities for the size and complexity of the systems shown.

The single-lines are provided for guidance only. Each system is unique, and requires its own Single Line Drawings, custom made for the location.



KEYED NOTES:

1. INSTALL NEW CURRENT TRANSFORMERS AND VOLTAGE TAPS FOR REVERSE POWER RELAY.
2. UTILITY SWITCH: PROVIDE VISIBLE MEANS OF DISCONNECT TO SATISFY UTILITY REQUIREMENTS. SWITCH SHALL BE HEAVY DUTY AND MINIMUM OF TWO AUXILIARY CONTACTS FOR EACH POSITION. UTILITY WILL ASSIGN SWITCH NUMBER AND WILL INSTALL POWER COMPANY LOCK.
3. TAP EXISTING HORIZONTAL BUS TO NEW STRUCTURE PROVIDE MIN OF 2-1/4"X4" PLATES.
4. ALL NEW LOADS ARE PARASITIC TO THE COGEN UNIT.
5. NEW NET METER SECTION BUILT TO UTILITY STANDARDS

GENERAL NOTES:

CONFIGURATION:
TWO INDIVIDUALLY PROTECTED COGEN UNITS WITH BECKWITH M3520 INTERTIE RELAYS.

INTERCONNECTION TO UTILITY VIA UTILITY OPERATED VISIBLE DISCONNECTING SAFETY SWITCH AND CIRCUIT BREAKER ACTING AS THE POINT OF COMMON COUPLING.

BOLD LINES INDICATE NEW WORK, LIGHT LINES INDICATE EXISTING.

ONLY THE WIRE SIZES THAT HAVE BEEN FIELD VERIFIED ARE SHOWN.

THIS SINGLE LINE IS A PARTIAL REPRESENTATION PRESENTED TO ILLUSTRATE THE PORTION OF THE SYSTEM AFFECTED BY THE PROPOSED NEW WORK.

PROPOSED UTILITY INTERTIE CONNECTION SINGLE LINE DIAGRAM

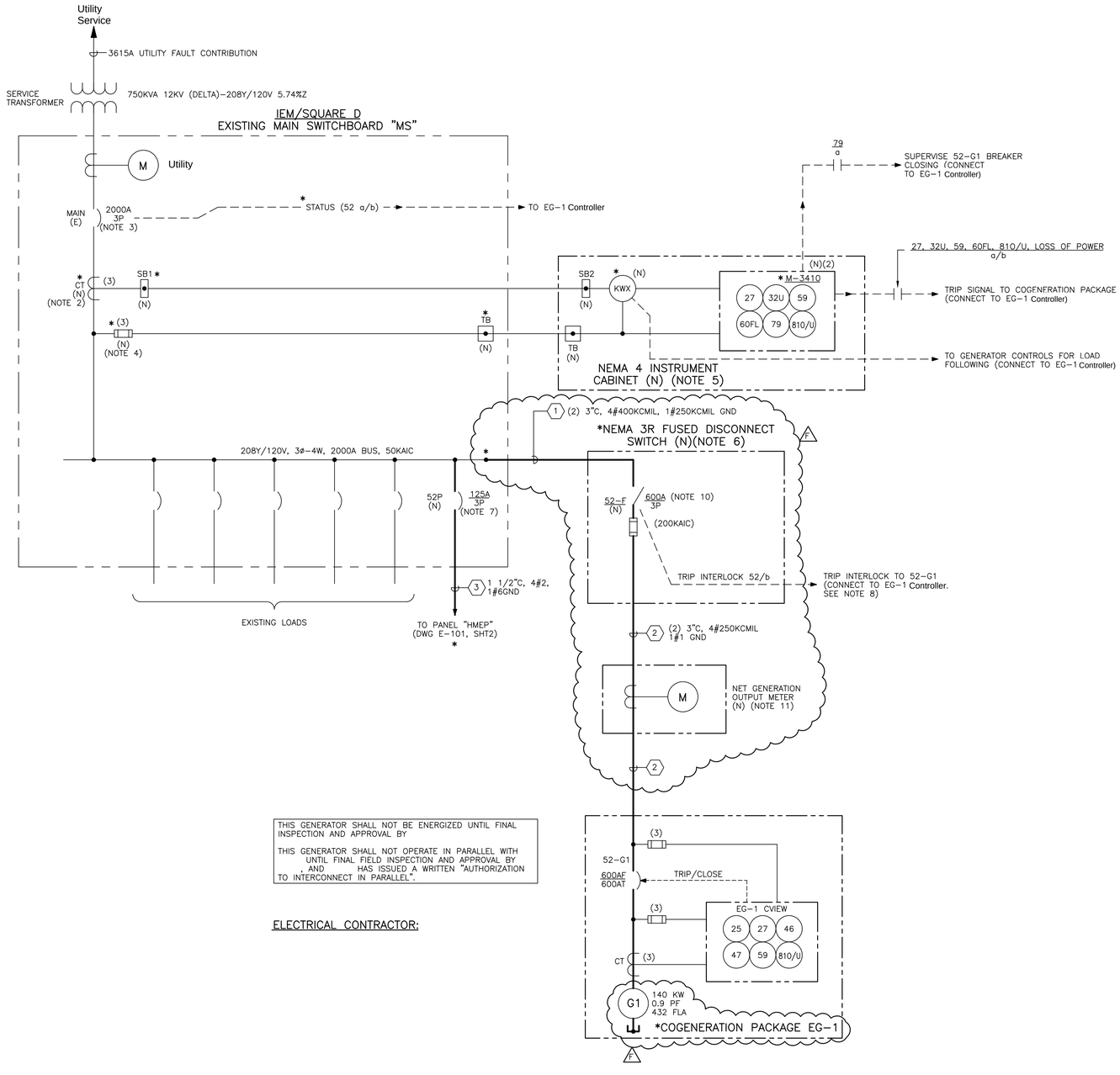
REGISTERED PROFESSIONAL ENGINEER
No. Exp. 9-30-06
ELECTRICAL
STATE OF CALIFORNIA

DATE SIGNED:

REV:	DATE:	DESCRIPTION:
1	1-23-03	PLAN CHECK REVISIONS
2		NERAL REVISIONS
3	5-7-03	ELECTRICAL CHANGES
4	5-20-03	ELECTRICAL CHANGES
5	6-6-03	ADDED NET METERING

SHEET TITLE
PROPOSED SINGLE LINE DIAGRAM

PROJECT NO:
CHECKED BY:
DRAWN BY:
DATE:
SHEET:
SHEET NO.



SEQUENCE OF OPERATION:

THIS DESIGN IS FOR PARALLEL OPERATION ONLY. THE COGENERATION PACKAGE EG-1 WILL OPERATE IN PARALLEL WITH THE UTILITY. THE FACILITY LOADS WILL CONSUME ALL OF THE NET POWER FROM THE COGENERATION PACKAGE. THE POWER TRANSDUCER (KWX) WILL MONITOR THE POWER FLOW AT THE SERVICE ENTRANCE AND WILL CONTROL THE OUTPUT OF THE ELECTRICAL GENERATOR TO MAINTAIN NET IMPORT POWER FROM THE UTILITY. IF POWER IMPORT IS NOT MAINTAINED, THE INTERTIE RELAYS WILL TRIP THE GENERATOR WITHIN 2 SECONDS IF POWER IMPORT FALLS BELOW A SET LIMIT.

ON LOSS OF UTILITY POWER OR DETECTION OF A GRID FAULT (27, 59, 81 O/U), THE INTERTIE RELAYS WILL OPEN THE GENERATOR BREAKER. UPON RESTORATION OF UTILITY POWER, THE INTERTIE RELAYS WILL DELAY (79) CLOSING OF THE GENERATOR BREAKER FOR 60 SECONDS.

LEGEND

25	SYNCH CHECK/SYNCHR CLOSER
27	UNDER VOLTAGE RELAY FUNCTION
32u	DIRECTIONAL POWER RELAY FUNCTION (UNDERPOWER)
46	NEGATIVE PHASE SEQUENCE CURRENT RELAY FUNCTION
47	NEGATIVE PHASE SEQUENCE VOLTAGE RELAY FUNCTION
52	CIRCUIT BREAKER
59	OVER VOLTAGE RELAY FUNCTION
60FL	BLOWN FUSE DETECTION
79	RECONNECT ENABLE DELAY
81U/O	UNDER/OVER FREQUENCY RELAY FUNCTION
CT	CURRENT TRANSFORMER
KWX	POWER (KW) TRANSDUCER
M-3410	BECKWITH MULTIFUNCTION INTERTIE RELAY
(N)	NEW WORK
(E)	EXISTING WORK
⟨1⟩	CABLE/CONDUIT NUMBER
SB1, SB2	CT SHORTING BLOCK
FB	FUSE BLOCK & FUSES

NOTE:

1. NEW WORK FOR COGENERATION PROJECT IS SHOWN IN BOLD.
2. INSTALL THREE (3) CT'S IN MAIN SWITCHBOARD FOR INPUTS TO THE KW TRANSDUCER AND INTERTIE RELAYS. (SEE DRAWING E-102 FOR SPECIFICATION).
3. ADD "a" AND "b" CONTACTS TO EXISTING 2000A MAIN BREAKER, SQUARE D MODEL PEF362000LI.
4. INSTALL 3 FUSES AND ASSOCIATED FUSE BLOCK FOR VOLTAGE INPUTS TO KWX TRANSDUCER AND INTERTIE RELAYS.
5. INSTALL KWX TRANSDUCER, INTERTIE RELAYS, ALL NECESSARY TERMINAL BLOCKS AND INSTRUMENT CABINET.
6. (F) CONTRACTOR SHALL INSTALL NEW BUS TAP AND EXTERNAL FUSED DISCONNECT SWITCH FOR FEEDER TO COGENERATION PACKAGE. TAP SHALL COMPLY WITH 1999 NEC ART. 240-21 (b) (2).
7. CONTRACTOR WILL PROCURE AND INSTALL NEW SQUARE D BREAKER INTO EXISTING LOAD DISTRIBUTION BOARD TO FEED EG-1 AUXILIARY LOAD PANEL "HMEP".
8. COGENERATION PACKAGE CONTROLLER SHALL TRIP OPEN GENERATOR BREAKER WHEN UPSTREAM BREAKER OR DISCONNECT SWITCH IS OPEN.
9. EQUIPMENT DENOTED BY AN ASTERISK (*) TO BE SUPPLIED BY MFR.
10. (F) FUSED DISCONNECT SWITCH SHALL BE SQUARE D TYPE H326R WITH THE FOLLOWING KITS: NEUTRAL, GROUND (2), CLASS R FUSE AND ELECTRICAL INTERLOCK (1 NO, 1 NC.) FUSES SHALL BE BUSSMANN FRN-R-600 (250VAC, 600A, 200KAIC) OR EQUIVALENT. SWITCH SHALL BE LOCKABLE IN THE OPEN POSITION.
11. NET GENERATION OUTPUT METER CAN (600VAC, 3 PHASE, 4 WIRE, 13 JAWS) SHALL BE CIRCLE AW MODEL 122013 (OR U122013) WITH 800A UTILITY CT MOUNTING BASE 6067HEEL (OR 6067HEELS), OR EQUIVALENT.

M-3410 INTERTIE RELAY SETTINGS:

1. UNDER (27) AND OVER (59) VOLTAGE SETTINGS:

VOLTAGE		MAXIMUM TRIP TIME (CYCLES)
PERCENT OF BASE	SETTING 120V BASE	
50%	60	10
88.3%	106	120
110%	132	30
137.5%	165	6

2. FEQUENCY (81O/U) SETTINGS:

FREQUENCY (HZ)	MAXIMUM TRIP TIME (CYCLES)
60.5	10
59.3	10

3. DIRECTIONAL POWER (32) SETTING:
DEFAULT SETTING IS 5% (IMPORT) OF GROSS NAMEPLATE GENERATION WITH MAXIMUM DELAY OF 2 SECONDS.

GROSS NP RATING (KW)	MINIMUM SETTING (KW, PRIMARY)	MAXIMUM DELAY (SECONDS)
140	7	2

4. FUSE LOSS (60FL) DETECTION SETTING:
SET AT 10 CYCLES.

5. RECONNECT DELAY (79) SETTING:
SET AT 60 SECONDS (3600 CYCLES).

REVISIONS

A	ISSUED FOR REVIEW	09-27-02
B	ISSUED FOR PLAN CHECK	02-12-03
C	ADDED SECOND INTERTIE RELAY	02-12-03
D	REVISED PER NOTE 9	02-18-03
E	PLAN CHECK CORRECTIONS	04-08-03
F	REPLACED EXTERNAL BREAKER (52-F) WITH FUSED DISCONNECT SWITCH FOR VISIBLE OPEN. ADDED NET GENERATION OUTPUT METER. REMOVED GENERATOR NEUTRAL GROUND. REVISED AND ADDED NOTES. REVISED CONDUCTOR SIZES.	04-17-03

REGISTERED PROFESSIONAL ENGINEER ★ STATE OF CALIFORNIA ELECTRICAL EXP. 06/30/05

DATE SIGNED SEAL

DESIGNED	DRAWN	CHECKED	APPROVED	APPROVED
DATE 09-26-02	DATE 09-26-02	DATE 09-26-02	DATE	DATE
M. EDDS				

SINGLE LINE DIAGRAM
140 KW COGENERATION SYSTEM

SIZE D | JOB NO. 05702 | CLIENT NO.

SCALE NOTED

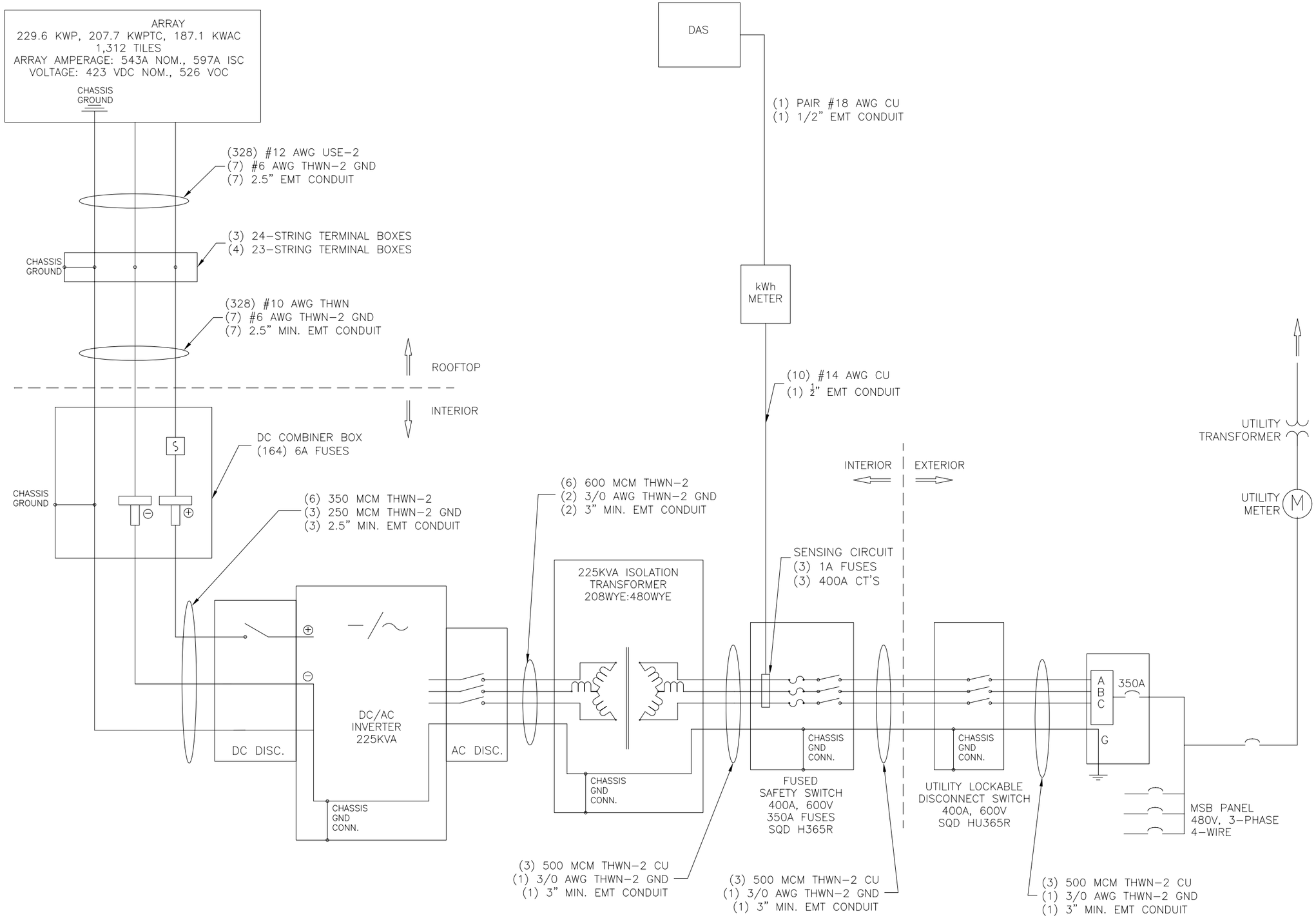
DWG NO. E-101 | REV. F

SHEET 1 OF 2

PEN SETTINGS	
COLOR	PEN WT.
1	.35
2	.50
3	.70
4	.35
5	.50
6	.70
7	.35
8-61	.35
62-123	.50
124-185	.70
186-249	.25
250-256	.20

05702E-1011 1=1 04-16-03

05702E-1011.dwg



CUSTOMER

SITE LOCATION

REV	DESCRIPTION	DATE	DB	CB

PROJECT NO

PROJECT NAME

DOCUMENT NO.

DOCUMENT TITLE

C

DRAWN BY	SHEET
DATE 07/01/03	1 of 1
SCALE NTS (1:1)	

Appendix D: Glossary

Note: All definitions from Section H of Rule 21 are marked thus: (R21).

Active Anti-Islanding Scheme: A control scheme installed as part of the Generating or Interconnection Facility that senses and prevents the formation of an Unintended Island. (R21)

Applicant: The entity submitting an Application for Interconnection pursuant to this Rule. (R21)

Application: A Commission-approved form submitted to the utility for Interconnection of a Generating Facility. (R21)

Certification Test: A test pursuant to this Rule that verifies conformance of certain equipment with Commission-approved performance standards in order to be classified as Certified Equipment. Certification Tests are performed by NRTLs. (R21)

Certification; Certified; Certificate: The documented results of a successful Certification Testing under Rule 21. (R21)

Certified Equipment: Equipment that has passed all required Certification Tests. (R21)

Commission: The Public Utilities Commission of the State of California. (R21)

Commissioning Test: A test performed during the commissioning of all or part of a Generating Facility to achieve one or more of the following:

- Verify specific aspects of its performance;
- Calibrate its instrumentation;
- Establish instrument or Protective Function set-points. (R21)

Customer: The entity that receives or is entitled to receive Distribution Service through the Distribution System. (R21)

Dedicated Transformer; Dedicated Distribution Transformer: A transformer that provides electricity service to a single Customer. The Customer may or may not have a Generating Facility. (R21)

Distribution Service: All services required by, or provided to, a Customer pursuant to the approved tariffs of the utility other than services directly related to the Interconnection of a Generating Facility under this Rule. (R21)

Distribution System: All electrical wires, equipment, and other facilities owned or provided by the utility, other than Interconnection Facilities, by which the utility provides Distribution Service to its Customers. (R21)

Emergency: An actual or imminent condition or situation, which jeopardizes the utility's Distribution System integrity. (R21)

Field Testing: Testing performed in the field to determine whether equipment meets the utility's requirements for safe and reliable Interconnection. (R21)

Generating Facility: All Generators, electrical wires, equipment, and other facilities owned or provided by Producer for the purpose of producing electric power. (R21)

Generator: A device converting mechanical, chemical, or solar energy into electrical energy, including all of its protective and control functions and structural appurtenances. One or more Generators comprise a Generating Facility. (R21)

Gross Nameplate Rating: The total gross generating capacity of a Generator or Generating Facility as designated by the manufacturer(s) of the Generator(s). (R21)

Host Load: Electrical power that is consumed by the Customer at the property on which the Generating Facility is located. (R21)

Initial Review: The review by the utility, following receipt of an Application, to determine the following: a) the Generating Facility qualifies for Simplified Interconnection; or b) if the Generating Facility can be made to qualify for Interconnection with a Supplemental Review determining any additional requirements. (R21)

In-rush Current: The current determined by the In-rush Current test. (R21)

Interconnection Agreement: An agreement between the utility and the Producer that gives certain rights and obligations to effect or end Interconnection. (R21)

Interconnection; Interconnected: The physical connection of a Generating Facility in accordance with the requirements of this Rule so that Parallel Operation with the utility's Distribution System can occur (has occurred). (R21)

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 Common Coupling, as appropriate to their purpose and design. Interconnection Facilities may be integral to a Generating Facility or provided separately. (R21)

Interconnection Study: A study to establish the requirements for Interconnection of a Generating Facility with the utility's Distribution System. (R21)

Island; Islanding: A condition on the utility's Distribution System in which one or more Generating Facilities deliver power to Customers using a portion of the utility's Distribution System that is electrically isolated from the remainder of the utility's Distribution System. (R21)

Line Section: That portion of the utility's Distribution System connected to a Customer bounded by automatic sectionalizing devices or the end of the distribution line. (R21)

Metering: The measurement of electrical power flow in kW and/or kWh, and/or energy in kWh, and, if necessary, kVAR at a point, and its display to the utility, as required by this Rule. (R21)

Metering Equipment: All equipment, hardware, software including meter cabinets, conduit, etc., that are necessary for Metering. (R21)

Momentary Parallel Operation: The Interconnection of a Generating Facility to the Distribution System for one second (60 cycles) or less. (R21)

Nationally Recognized Testing Laboratory (NRTL): A laboratory accredited to perform the Certification Testing requirements under this Rule. (R21)

Net Energy Metering: Metering for the receipt and delivery of electricity between the Producer and the utility pursuant to Section 2827 of the Public Utilities Code and Schedule NEM, Net Energy Metering. (R21)

Net Generation Metering: Metering of the net electrical power or energy output in kW or energy in kWh, respectively, from a given Generating Facility. This may also be the measurement of the difference between the total electrical energy produced by a Generator and the electrical energy consumed by the auxiliary equipment necessary to operate the Generator. For a Generator with no Host Load and/or Public Utilities Code Section 218 Load (Section 218 Load), Metering that is located at the Point of Common Coupling. For a Generator with Host Load and/or Section 218 Load, Metering that is located at the Generator but after the point of auxiliary load(s) and prior to serving Host Load and/or Section 218 Load. (R21)

Net Nameplate Rating: The Gross Nameplate Rating minus the consumption of electrical power of a Generator or Generating Facility as designated by the manufacturer(s) of the Generator(s). (R21)

Network Service: More than one electrical feeder providing Distribution Service at a Point of Common Coupling. (R21)

Non-Export; Non-Exporting: Designed to prevent the transfer of electrical energy from the Generating Facility to the utility. (R21)

Non-Islanding: Designed to detect and disconnect from a stable Unintended Island with matched load and generation. Reliance solely on under/over voltage and frequency trip is not considered sufficient to qualify as Non-Islanding. (R21)

Parallel Operation: The simultaneous operation of a Generator with power delivered or received by the utility while Interconnected. For the purpose of this Rule, Parallel Operation includes only those Generating Facilities that are Interconnected with the utility's Distribution System for more than 60 cycles (one second). (R21)

Periodic Test: A test performed on part or all of a Generating Facility at pre-determined time or operational intervals to achieve one or more or the following: 1) verify specific aspects of its performance; 2) calibrate instrumentation; and 3) verify and re-establish instrument or Protective Function set-points.

Point of Common Coupling (PCC): The transfer point for electricity between the electrical conductors of the utility and the electrical conductors of the Producer. (R21)

Point of Common Coupling Metering: Metering located at the Point of Common Coupling. This is the same Metering as Net Generation Metering for Generating Facilities with no Host Load and/or no Section 218 Load. (R21)

Point of Interconnection: The electrical transfer point between a Generating Facility and the Distribution System. This may or may not be coincident with the Point of Common Coupling. (R21)

Power Purchase Agreement (PPA): An agreement for the sale of electricity by the Producer to the utility. (R21)

Producer: The entity that executes an Interconnection Agreement with the utility. The Producer may or may not own or operate the Generating Facility, but is responsible for the rights and obligations related to the Interconnection Agreement. (R21)

Production Test: A test performed on each device coming off the production line to verify certain aspects of its performance. (R21)

Protective Function(s): The equipment, hardware and/or software in a Generating Facility (whether discrete or integrated with other functions) whose purpose is to protect against Unsafe Operating Conditions. (R21)

Prudent Electrical Practices: Those practices, methods, and equipment, as changed from time to time, that are commonly used in prudent electrical engineering and operations to design and operate electric equipment lawfully and with safety, dependability, efficiency, and economy. (R21)

Scheduled Operation Date: The date specified in the Interconnection Agreement when the Generating Facility is, by the Producer's estimate, expected to begin operation pursuant to this Rule.

Secondary Network: A network supplied by several primary feeders suitably interlaced through the area in order to achieve acceptable loading of the transformers under Emergency conditions and to provide a system of extremely high service reliability. Secondary Networks usually operate at 600 V or lower. (R21)

Section 218 Load: Electrical power that is supplied in compliance with California Public Utilities Code Section 218. Public Utilities Code Section 218 defines an "Electric Corporation" and provides conditions under which a transaction involving a Generating Facility would not classify a Producer as an Electric Corporation. These conditions relate to "over-the-fence" sale of electricity from a Generating Facility without using the utility's Distribution System. (R21)

Short Circuit Contribution Ratio (SCCR): The ratio of the Generating Facility's short circuit contribution to the short circuit contribution provided through the utility's Distribution System for a three-phase fault at the high voltage side of the distribution transformer connecting the Generating Facility to the utility's Distribution System. (R21)

Simplified Interconnection: Interconnection conforming to the minimum requirements under this Rule, as determined by Section I. (R21)

Single Line Diagram; Single Line Drawing: A schematic drawing, showing the major electrical switchgear, Protective Function devices, wires, Generators, transformers and other devices, providing sufficient detail to communicate to a qualified engineer the essential design and safety of the system being considered. (R21)

Special Facilities: As defined in the utility's Rule 2 governing Special Facilities. (R21)

Stabilization; Stability: The return to normalcy of the utility's Distribution System, following a disturbance. Stabilization is usually measured as a time period during which voltage and frequency are within acceptable ranges. (R21)

Starting Voltage Drop: The percentage voltage drop at a specified point resulting from In-rush Current. The Starting Voltage Drop can also be expressed in volts on a particular base voltage, (e.g. 6 volts on a 120-volt base, yielding a 5% drop). (R21)

Supplemental Review: A process wherein the utility further reviews an Application that fails one or more of the Initial Review Process screens. The Supplemental Review may result in one of the following: a) approval of Interconnection; b) approval of Interconnection with additional requirements; or c) cost and schedule for an Interconnection Study. (R21)

System Integrity: The condition under which a Distribution System is deemed safe and can reliably perform its intended functions in accordance with the safety and reliability rules of the utility. (R21)

Telemetering: The electrical or electronic transmittal of Metering data in real-time basis to the utility. (R21)

Transfer Trip: A Protective Function that trips a Generating Facility remotely by means of an automated communications link controlled by the utility. (R21)

Type Test: A test performed on a sample of a particular model of a device to verify specific aspects of its design, construction and performance. (R21)

Unintended Island: The creation of an Island, usually following a loss of a portion of the utility's Distribution System, without the approval of the utility. (R21)

Unsafe Operating Conditions: Conditions that, if left uncorrected, could result in harm to personnel, damage to equipment, loss of System Integrity or operation outside pre-established parameters required by the Interconnection Agreement. (R21)

Visible Disconnect: An electrical switching device that can separate the Generating Facility from the utility's Distribution System and is designed to allow visible verification that separation has been accomplished. This requirement can be met by opening the enclosure to observe the contact separation. (R21)