



RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

A. APPLICABILITY AND INTRODUCTION

- 1. **Applicability.** This Rule describes the Interconnection, operating and Metering requirements for Generating Facilities to be connected to San Diego Gas & Electric's (SDG&E) Distribution System over which the Commission has jurisdiction. Subject to the requirements of this Rule, SDG&E will allow the Interconnection of Generating Facilities with its Distribution System. T
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- 2. **Definitions.** Capitalized terms used in this Rule, and not defined in SDG&E's other tariffs, shall have the meaning ascribed to such terms in Section H of this Rule. The definitions set forth in Section H of this Rule shall only apply to this Rule and may not apply to SDG&E's other tariffs. T
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B. GENERAL RULES, RIGHTS AND OBLIGATIONS

- 1. **Authorization Required to Operate.** A Producer must comply with this Rule, execute an Interconnection Agreement with SDG&E, and receive SDG&E's express written permission before Parallel Operation of its Generating Facility with SDG&E's Distribution System. SDG&E shall apply this Rule in a non-discriminatory manner and shall not unreasonably withhold its permission for a Parallel Operation of Producer's Generating Facility with SDG&E's Distribution System. T
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- 2. **Separate Arrangements Required for Other Services.** A Producer requiring other electric services from SDG&E including, but not limited to, Distribution Service provided by SDG&E during periods of curtailment or interruption of the Producer's Generating Facility, must sign separate agreements with SDG&E for such services in accordance with SDG&E's Commission-approved tariffs. T
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- 3. **Transmission Service Not Provided with Interconnection.** Interconnection with SDG&E's Distribution System under this Rule does not provide a Producer any rights to utilize SDG&E's Distribution System for the transmission, distribution, or wheeling of electric power, nor does it limit those rights. T
- 4. **Compliance with Laws, Rules, and Tariffs.** A Producer shall ascertain and comply with applicable Commission-approved tariffs of SDG&E; applicable Federal Energy Regulatory Commission (FERC) approved rules, tariffs, and regulations; and any local, state or federal law, statute or regulation which applies to the design, siting, construction, installation, operation, or any other aspect of the Producer's Generating Facility and Interconnection Facilities. T
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- 5. **Design Reviews and Inspections.** SDG&E shall have the right to review the design of a Producer's Generating and Interconnection Facilities and to inspect a Producer's Generating and/or Interconnection Facilities prior to the commencement of Parallel Operation with SDG&E's Distribution System. SDG&E may require a Producer to make modifications as necessary to comply with the requirements of this Rule. SDG&E's review and authorization for Parallel Operation shall not be construed as confirming or endorsing the Producer's design or as warranting the Generating and/or Interconnection Facility's safety, durability or reliability. SDG&E shall not, by reason of such review or lack of review, be responsible for the strength, adequacy, or capacity of such equipment. L
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INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

C. APPLICATION AND INTERCONNECTION PROCESS (Continued)

1. Application Process (Continued)

c. **SDG&E Performs an Initial and Supplemental Review and Develops Preliminary Cost Estimates and Interconnection Requirements:**

(1) Upon receipt of a satisfactorily completed Application and any additional information necessary to evaluate the Interconnection of a Generating Facility, SDG&E shall perform an Initial Review using the process defined in Section I. The Initial Review determines if (a) the Generating Facility qualifies for Simplified Interconnection, or (b) the Generating Facility requires a Supplemental Review.

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(2) SDG&E shall complete its Initial Review, absent any extraordinary circumstances, within 10 business days, after its determination that the Application is complete. If the Initial Review determines the proposed Generating Facility can be Interconnected by means of a Simplified Interconnection, SDG&E will provide the Applicant with a draft Interconnection Agreement pursuant to Section C.1.e.

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(3) If the Generating Facility does not qualify for Simplified Interconnection as proposed, SDG&E will notify the Applicant and perform a Supplemental Review as described in Section I. The Supplemental Review will result in SDG&E providing either (a) Interconnection Requirements beyond those for a Simplified Interconnection, and a draft Interconnection Agreement, or (b) a cost estimate and schedule for an Interconnection Study. The Supplemental Review shall be completed, absent any extraordinary circumstances, within 20 business days of receipt of a completed Application. Payment for the Supplemental Review shall be submitted to SDG&E within 10 calendar days after the results of the Supplemental Review are provided to the Applicant.

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d. **When Required, Applicant and SDG&E Commit to Additional Interconnection Study Steps.** When a Supplemental Review reveals that the proposed Generating Facility cannot be Interconnected to SDG&E's Distribution System by means of a Simplified Interconnection, or that significant SDG&E Interconnection Facilities or Distribution System improvements will be needed to accommodate an Applicant's Generating Facility, SDG&E and Applicant shall enter into an agreement that provides for SDG&E to perform additional studies, facility design and engineering, and to provide detailed cost estimates for fixed price or actual cost billing to the Applicant, at the Applicant's expense. The Interconnection Study agreement shall set forth SDG&E's estimated schedule and charges for completing such work. Initial and Supplemental Review and Interconnection Study fees for solar Generating Facilities up to 1 MW that do not sell power to the grid will be waived up to the amount of \$5,000. Generating Facilities eligible for Net Energy Metering under Public Utilities Code Section 2827 are exempt from any costs associated with interconnection studies.

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

C. APPLICATION AND INTERCONNECTION PROCESS (Continued)

1. Application Process (Continued)

e. **Applicant and SDG&E Enter Into an Interconnection Agreement and, Where Required, a Financing and Ownership Agreement for Interconnection Facilities or Distribution System Improvements.** SDG&E shall provide the Applicant with an executable version of the Interconnection Agreement, Net Energy Metering Agreement, or Power Purchase Agreement appropriate for the Applicant's Generating Facility and desired mode of operation. Where the Supplemental Review or Interconnection Study performed by SDG&E has determined that modifications or additions to its Distribution System are required, or that additional Interconnection Facilities will be necessary to accommodate an Applicant's Generating Facility, SDG&E may also provide the Applicant with other Interconnection Facilities financing and ownership agreements. These agreements shall set forth SDG&E's and the Applicant's responsibilities, completion schedules, and estimated or fixed price costs for the required work.

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f. **Where Applicable, SDG&E or Producer Installs Required Interconnection Facilities or Modifies SDG&E's Distribution System.** After executing the applicable agreements, SDG&E or Producer will commence construction/installation of the Distribution System improvements or Interconnection Facilities which have been identified in the agreements. The parties will use good faith efforts to meet schedules and fixed cost or estimated costs as appropriate.

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g. **Producer Arranges for and Completes Commissioning Testing of Generating Facility and Producer's Interconnection Facilities.** The Producer is responsible for testing new Generating Facilities and associated Interconnection Facilities, according to Section J.5 to ensure compliance with the safety and reliability provisions of this Rule prior to being operated in parallel with SDG&E's Distribution System. For non-Certified Equipment, the Producer shall develop a written testing plan to be submitted to SDG&E for its review and acceptance. Alternatively, the Producer and SDG&E may agree to have SDG&E conduct the required testing at the Producer's expense. Where applicable, the test plan shall include the installation test procedures published by the manufacturer of the generation or interconnection equipment. Facility testing shall be conducted at a mutually agreeable time, and depending on who conducts the test, SDG&E or Producer shall be given the opportunity to witness the tests.

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h. **SDG&E Authorizes Parallel Operation or Momentary Parallel Operation.** The Producer's Generating Facility shall be authorized for Parallel Operation or Momentary Parallel Operation, as applicable, with SDG&E's Distribution System upon satisfactory compliance with the terms of all applicable agreements and SDG&E's express written permission. Compliance may include, but not be limited to, provision of any required documentation and satisfactorily completing any required inspections or tests as described herein or in the agreements formed between the Producer and SDG&E. A Producer shall not commence Parallel Operation of its Generating Facility with SDG&E's system unless it has received SDG&E's express written permission to do so.

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INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

C. APPLICATION AND INTERCONNECTION PROCESS (Continued)

1. Application Process (Continued)

i. **SDG&E Reconciles Costs and Payments.** If the Producer selected a fixed price billing for the Interconnection Facilities or Distribution System improvements, no reconciliation will be necessary. If the Producer selected actual cost billing, a true-up will be required. Within a reasonable time after the Interconnection of a Producer's Generating Facility, SDG&E will reconcile its actual costs related to the Generating Facility against any advance payments made by the Producer. The Producer will receive either a bill for any balance due or a reimbursement for overpayment as determined by SDG&E's reconciliation. The Producer shall be entitled to a reasonably detailed and understandable accounting for the payments.

D. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS

1. General Interconnection and Protection Requirements

a. **Protective Functions Required.** Generating Facilities operating in parallel with SDG&E's Distribution System shall be equipped with the following Protective Functions to sense abnormal conditions and cause the Generating Facility to be automatically disconnected from SDG&E's Distribution System or to prevent the Generating Facility from being connected to SDG&E's Distribution System inappropriately:

- (1) Over and under voltage trip functions and over and under frequency trip functions;
- (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 by SDG&E and is stable for at least 60 seconds;
- (3) A function to prevent the Generating Facility from contributing to the formation of an Unintended Island.

b. **Momentary Paralleling Generating Facilities.** With SDG&E's approval, the transfer switch or system used to transfer the Producer's loads from SDG&E's Distribution System to Producer's Generating Facility may be used in lieu of the Protective Functions required for Parallel Operation.

c. **Purpose of Protective Functions.** The Protective Functions and requirements of this Rule are designed to protect SDG&E's Distribution System and not the Generating Facility. A Producer shall be solely responsible for providing adequate protection for its Generating Facility and Interconnection Facilities. The Producer's protective devices shall not impact the operation of other protective devices utilized on the Distribution System in a manner that would affect SDG&E's capability of providing reliable service to its Customers.

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INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

D. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Continued)

1. General Interconnection and Protection Requirements (Continued)

- d. **Suitable Equipment Required.** Circuit breakers or other interrupting devices located at the Point of Common Coupling must be Certified or "Listed" (as defined in Article 100, the Definitions Section of the National Electrical Code) as suitable for their intended application. This includes being capable of interrupting the maximum available fault current expected at their location. Producer's Generating Facility and Interconnection Facilities shall be designed so that the failure of any one device shall not potentially compromise the safety and reliability of SDG&E's Distribution System.
- e. **Visible Disconnect Required.** The Producer shall furnish and install a manual disconnect device that has a Visible Disconnect to isolate the Generating Facility from SDG&E's Distribution System. The device must be accessible to SDG&E personnel and be capable of being locked in the open position. Generating Facilities with Non-Islanding inverters totaling one (1) kVA or less are exempt from this requirement.
- f. **Single-Phase Generators.** For single-phase Generators connected to a shared single-phase secondary system, the maximum Net Nameplate Rating of the Generating Facilities shall be 20 kVA. Generators connected to a center-tapped neutral 240-volt service must be installed such that no more than 6 kVA of imbalanced power is applied to the two "legs" of the 240-volt service. For Dedicated Distribution Transformer services, the maximum Net Nameplate Rating of a single-phase Generating Facility shall be the transformer nameplate rating.
- g. **Drawings Required.** Prior to Parallel Operation or Momentary Parallel Operation of the Generating Facility, SDG&E shall approve the Producer's Protective Function and control diagrams. Generating Facilities equipped with a Protective Function and control scheme previously approved by SDG&E for system-wide application or only Certified Equipment may satisfy this requirement by reference to previously approved drawings and diagrams.
- h. **Generating Facility Conditions Not Identified.** In the event this Rule does not address the interconnection requirements for a particular Generating Facility, SDG&E and Producer may agree upon other requirements.

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INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

D. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Continued)

2. Prevention of Interference (Continued)

Table D-1: Voltage Trip Settings

| Voltage at Point of Common Coupling (Assuming 120V base) | Maximum Trip Time* Allowed (Assuming 60 cycles per second) |
|--|--|
| Less than 60 volts | 10 cycles |
| Greater than or equal to 60 volts but less than 106 volts | 120 cycles |
| Greater than or equal to 106 volts but less than or equal to 132 volts | Normal Operation |
| Greater than 132 volts but less than or equal to 165 volts | 120 cycles (30 cycles for facilities greater than 11 kVA) |
| Greater than 165 volts | 6 cycles |

*"Maximum Trip Time" refers to the time between the onset of the abnormal condition and the Generating Facility ceasing to energize SDG&E's Distribution System. Protective Function sensing devices and circuits may remain connected to SDG&E's Distribution System to allow sensing of electrical conditions for use by the "reconnect" feature. The purpose of the allowed time delay is to allow a Generating Facility to "ride through" short-term disturbances to avoid nuisance tripping. For Generating Facilities with a Gross Nameplate Rating of 11 kVA or less, the set points are to be non-user adjustable. For Generating Facilities with a Gross Nameplate Rating greater than 11 kVA, different voltage set points and trip times from those in Table D-1 may be negotiated with SDG&E.

b. **Flicker.** Any voltage flicker at the Point of Common Coupling caused by the Generating Facility should not exceed the limits defined by the "Maximum Borderline of Irritation Curve" identified in IEEE 519 (IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, IEEE STD 519, Institute of Electrical and Electronic Engineers, Piscataway, NJ.). This requirement is necessary to minimize the adverse voltage effects experienced by other Customers on SDG&E's Distribution System. Induction Generators may be connected and brought up to synchronous speed (as an induction motor) provided these flicker limits are not exceeded.

c. **Frequency.** SDG&E controls system frequency, and the Generating Facility shall operate in synchronism with the Distribution System. Generating Facilities with a Gross Nameplate Rating of 11 kVA or less shall have a fixed operating frequency range of 59.3-60.5 Hertz. The Generating Facility must cease to energize SDG&E's Distribution System within a maximum of 10 cycles should SDG&E's Distribution System remain outside of the frequency limits. The purpose of the time delay is to allow the Generating Facility to ride through short-term disturbances to avoid nuisance tripping. SDG&E may require adjustable operating frequency settings for Generating Facilities with a Gross Nameplate Rating greater than 11 kVA.

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INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

D. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Continued)

2. Prevention of Interference (Continued)

- 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.
- e. **Direct Current Injection.** Generating Facilities should not inject direct current greater than 0.5% of rated output current into SDG&E's Distribution System.
- 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 SDG&E. The Producer shall notify SDG&E if it is using the Generating Facility for power factor correction.

3. Control, Protective Function and Safety Equipment Requirements

a. Technology Specific Requirements

- (1) **Three-Phase Synchronous Generators.** For three-phase Generators, the Generating Facility circuit breakers shall be three-phase devices with electronic or electromechanical control. The Producer shall be responsible for properly synchronizing its Generating Facility with SDG&E's Distribution System by means of either a manual or automatic synchronizing device. Automatic synchronizing is required for all synchronous Generators that have a Short Circuit Contribution Ratio (SCCR) exceeding 0.05. A Generator whose SCCR exceeds 0.05 shall be equipped with Protective Functions suitable for detecting loss of synchronism and rapidly disconnecting the Generator from SDG&E's Distribution System. Unless otherwise agreed upon by the Producer and SDG&E, synchronous Generators shall automatically regulate power factor, not voltage, while operating in parallel with SDG&E's Distribution System. Power system stabilization is specifically not required for Generating Facilities under 10 MW Net Nameplate Rating. Synchronization means that at the time of connection, the frequency difference shall be less than 0.2 Hertz, the voltage difference shall be less than 10%, and the phase angle difference shall be less than 10 degrees.

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INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

D. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Continued)

3. Control, Protective Function and Safety Equipment Requirements (Continued)

a. Technology Specific Requirements (Continued)

(2) **Induction Generators.** Induction Generators do not require a synchronizing function. Starting or rapid load fluctuations on induction Generators can adversely impact SDG&E's Distribution System voltage. Corrective step-switched capacitors or other techniques may be necessary and may cause undesirable ferro-resonance. When these counter measures (e.g. additional capacitors) are installed on the Producer's side of the Point of Common Coupling, SDG&E must review these measures. Additional equipment may be required as determined in a Supplemental Review or an Interconnection Study.

(3) **Inverter Systems.** Utility-interactive inverters do not require separate synchronizing equipment. Non-utility-interactive or "stand-alone" inverters shall not be used for Parallel Operation with SDG&E's Distribution System.

b. Supplemental Generating Facility Requirements

(1) **Unintended Islanding for Generating Facilities that Fail the Export Screen (Section I.3.b).** Generating Facilities must mitigate their potential contribution to an Unintended Island. This can be accomplished by one of the following options: (1) incorporating Certified Non-Islanding control functions into the Protective Functions; (2) verifying that Host Loads sufficiently exceed the Net Nameplate Rating of the Generating Facility; or (3) incorporating a Transfer Trip or an equivalent Protective Function.

(2) **Fault Detection.** A Generating Facility with an SCCR exceeding 0.1 or one with Protective Functions that do not meet any one of the options for detecting Unintended Islands in D.3.b.1 shall be equipped with Protective Functions designed to detect Distribution System faults, both line-to-line and line-to-ground, and promptly cease to energize SDG&E's Distribution System in the event of a fault. For a Generating Facility that cannot detect these faults within two seconds, SDG&E may require a Transfer Trip system or equivalent Protective Function. Reclose-blocking of SDG&E's affected recloser(s) may also be required for Generating Facilities that exceed 15% of the peak load on the Line Section.

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

E. INTERCONNECTION FACILITY AND DISTRIBUTION SYSTEM IMPROVEMENT OWNERSHIP AND FINANCING

1. Scope and Ownership of Interconnection Facilities and Distribution System Improvements

a. **Scope.** Parallel Operation of Generating Facilities may require Interconnection Facilities or improvements to be made to SDG&E's Distribution System (Distribution System improvements). The type, extent and costs of Interconnection Facilities and Distribution System improvements shall be consistent with this Rule and determined through the Supplemental Review and/or Interconnection Study described in Section C.

b. **Ownership.** Interconnection Facilities installed on Producer's side of the Point of Common Coupling may be owned, operated, and maintained by the Producer or SDG&E. Interconnection Facilities installed on SDG&E's side of the Point of Common Coupling and Distribution System improvements shall be owned, operated, and maintained only by SDG&E.

2. Responsibility for Costs of Interconnecting a Generating Facility

a. **Study and Review Costs.** A Producer shall be responsible for the reasonably incurred costs of the reviews and studies conducted pursuant to Section C.1.d of this Rule. Interconnection Study fees for solar Generating Facilities up to 1 MW that do not sell power to the grid will be waived up to the amount of \$5,000. Generating Facilities eligible for Net Energy Metering under California Public Utilities Code 2827 are exempt from any costs associated with interconnection studies.

b. **Facility Costs.** A Producer shall be responsible for all costs associated with Interconnection Facilities owned by the Producer. The Producer shall also be responsible for any costs reasonably incurred by SDG&E in providing, operating, or maintaining the Interconnection Facilities and Distribution System improvements required solely for the Interconnection of the Producer's Generating Facility with SDG&E's Distribution System. Generating Facilities eligible for Net Energy Metering under California Public Utilities Code 2827 are exempt from any costs associated with Distribution System improvements or modifications.

c. **Separation of Costs.** Should SDG&E combine the installation of Interconnection Facilities or Distribution System improvements required for the Interconnection of a Generating Facility with improvements to SDG&E's Distribution System to serve other Customers or Producers, SDG&E shall not include the costs of such separate or incremental facilities in the amounts billed to the Producer.

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INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

F. METERING, MONITORING AND TELEMETERING

1. **General Requirements.** All Generating Facilities shall be metered in accordance with this Section F and shall meet all applicable standards of SDG&E contained in SDG&E's applicable tariffs and published SDG&E manuals dealing with Metering specifications. The requirements in this Section F do not apply to Metering of Generating Facilities operating under SDG&E's Net Energy Metering tariff pursuant to California Public Utilities Code Section 2827. T
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2. **Metering by Non-SDG&E Parties.** The ownership, installation, operation, reading, and testing of Metering Equipment for Generating Facilities shall be by SDG&E except to the extent that the Commission has determined that all these functions, or any of them, may be performed by others as authorized by the Commission. T
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3. **Net Generation Metering.** For purposes of monitoring Generating Facility operation for determination of standby charges and applicable non-bypassable charges as defined in SDG&E's tariffs, and for Distribution System planning and operations, consistent with Section B.4 of this Rule, SDG&E shall have the right to specify the type, and require the installation of, Net Generation Metering equipment. SDG&E shall only require Net Generation Metering to the extent that less intrusive and/or more cost effective options for providing the necessary Generating Facility output data are not available. In exercising its discretion to require Net Generation Metering, SDG&E shall consider all relevant factors, including but not limited to: T
 - (a) Data requirements in proportion to need for information;
 - (b) Producer's election to install equipment that adequately addresses SDG&E's operational requirements; T
 - (c) Accuracy and type of required Metering consistent with purposes of collecting data;
 - (d) Cost of Metering relative to the need for and accuracy of the data;
 - (e) The Generating Facility's size relative to the cost of the Metering/monitoring; T
 - (f) Other means of obtaining the data (e.g. Generating Facility logs, proxy data, etc.); T
 - (g) Requirements under any Interconnection Agreement with the Producer. T

SDG&E will report to the Commission or designated authority, on a quarterly basis, the rationale for requiring Net Generation Metering equipment in each instance along with the size and location of the facility. T
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INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

F. METERING, MONITORING AND TELEMETERING (Continued)

- 4. **Point of Common Coupling Metering.** For purposes of assessing SDG&E's charges for retail service, the Producer's Point of Common Coupling Metering shall be a bi-directional meter so that power deliveries to and from the Producer's site can be separately recorded. Alternately, the Producer may, at its sole option and cost, require SDG&E to install multi-metering equipment to separately record power deliveries to SDG&E's Distribution System and retail purchases from SDG&E. Such Point of Common Coupling Metering shall be designed to prevent reverse registration.
- 5. **Telemetry.** If the nameplate rating of the Generating Facility is 1 MW or greater, Telemetry equipment at the Net Generation Metering location may be required at the Producer's expense. If the Generating Facility is interconnected to a portion of SDG&E's Distribution System operating at a voltage below 10 kV, then Telemetry equipment may be required on Generating Facilities 250 kW or greater. SDG&E shall only require Telemetry to the extent that less intrusive and/or more cost effective options for providing the necessary data in real time are not available. SDG&E will report to the Commission or designated authority, on a quarterly basis, the rationale for requiring Telemetry equipment in each instance along with the size and location of the facility.
- 6. **Sunset Provision.** Sections F.3 and F.5 are interim provisions only. SDG&E shall file permanent Metering requirements with the Commission on or by December 31, 2004. At that time, SDG&E shall serve its application for approval of permanent Metering requirements on the service list in OIR 99-10-025.
- 7. **Location.** Where SDG&E-owned Metering Equipment is located on the Producer's premises, Producer shall provide, at no expense to SDG&E, a suitable location for all such Metering Equipment.
- 8. **Costs of Metering.** The Producer will bear all costs of the Metering required by this Rule, including the incremental costs of operating and maintaining the Metering Equipment.

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

G. DISPUTE RESOLUTION PROCESS

The following procedures will apply for disputes arising from this Rule.

1. The Commission shall have initial jurisdiction to interpret, add, delete or modify any provision of this Rule or of any agreements entered into between SDG&E and the Producer to implement this tariff ("Implementing Agreements") and to resolve disputes regarding SDG&E's performance of its obligations under its tariffs, the applicable agreements, and requirements related to the interconnection of the Producer's Generating or Interconnection Facilities pursuant to this Rule.
2. Any dispute arising between SDG&E and the Producer (individually "Party" and collectively "the Parties") regarding SDG&E's performance of its obligations under its tariffs, the Implementing Agreements, and requirements related to the interconnection of Producer's Facilities pursuant to this Rule shall be resolved according to the following procedures:
 - a. The dispute shall be reduced to writing by the aggrieved Party in a letter ("the dispute letter") to the other Party containing the relevant known facts pertaining to the dispute, the specific dispute and the relief sought, and express notice by the aggrieved Party that it is invoking the procedures under Section G.2. Within 45 calendar days of the date of the dispute letter, the Parties' authorized representatives will be required to meet and confer to try to resolve the dispute.
 - b. If the Parties do not resolve their dispute within 45 calendar days after the date of the dispute letter, the dispute shall, upon demand of either Party, be submitted to resolution before the Commission in accordance with the Commission's Rules of Practice and Procedure applicable to Customer complaints.
3. Pending resolution of any dispute under this Section, the Parties shall proceed diligently with the performance of their respective obligations under this Rule and the Implementing Agreements, unless the Implementing Agreements have been terminated. Disputes as to the application and implementation of this Section shall be subject to resolution pursuant to the procedures set forth in this Section.

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INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

H. DEFINITIONS

The definitions in this Section H are applicable only to this Rule, the Application, and Interconnection Agreements.

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.

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

Application: A Commission-approved form submitted to SDG&E for Interconnection of a Generating Facility.

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.

Certification; Certified; Certificate: The documented results of a successful Certification Testing.

Certified Equipment: Equipment that has passed all required Certification Tests.

Commission: The Public Utilities Commission of the State of California.

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.

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

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.

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

Distribution System: All electrical wires, equipment, and other facilities owned or provided by SDG&E, other than Interconnection Facilities, by which SDG&E provides Distribution Service to its Customers.

Emergency: An actual or imminent condition or situation, which jeopardizes SDG&E's Distribution System integrity.

Field Testing: Testing performed in the field to determine whether equipment meets SDG&E's requirements for safe and reliable Interconnection.

(Continued)

17C9

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

H. DEFINITIONS (Continued)

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

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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.

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

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

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Initial Review: The review by SDG&E, 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.

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

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Interconnection Agreement: An agreement between SDG&E and the Producer that gives certain rights and obligations to effect or end Interconnection.

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

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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.

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Interconnection Study: A study to establish the requirements for Interconnection of a Generating Facility with SDG&E's Distribution System.

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

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Line Section: That portion of SDG&E's Distribution System connected to a Customer bounded by automatic sectionalizing devices or the end of the distribution line.

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

H. DEFINITIONS (Continued)

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 SDG&E, as required by this Rule.

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

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

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

Net Energy Metering: Metering for the receipt and delivery of electricity between the Producer and SDG&E pursuant to Section 2827 of the Public Utilities Code and Schedule NEM, Net Energy Metering.

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.

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).

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

Non-Export; Non-Exporting: Designed to prevent the transfer of electrical energy from the Generating Facility to SDG&E.

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.

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

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

H. DEFINITIONS (Continued)

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

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

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.

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Special Facilities: As defined in SDG&E's Rule 2 governing Special Facilities.

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

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).

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Supplemental Review: A process wherein SDG&E 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.

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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 SDG&E.

Telemetry: The electrical or electronic transmittal of Metering data in real-time basis to SDG&E.

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Transfer Trip: A Protective Function that trips a Generating Facility remotely by means of an automated communications link controlled by SDG&E.

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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.

Unintended Island: The creation of an Island, usually following a loss of a portion of SDG&E's Distribution System, without the approval of SDG&E.

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.

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Visible Disconnect: An electrical switching device that can separate the Generating Facility from SDG&E'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.

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(Continued)



RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

I. REVIEW PROCESS FOR APPLICATIONS TO INTERCONNECT GENERATING FACILITIES

1. **Introduction.** This review process allows for rapid approval for the Interconnection of those Generating Facilities that do not require an Interconnection Study. The review process includes a screening to determine if a Supplemental Review is required.

2. **Purpose.** The 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 additional requirements; or
- c. If an Interconnection Study is required, the cost estimate and schedule for performing the Interconnection Study.

NOTE: Failure to pass any screen of the review process means only that further review and/or studies are required before the Generating Facility can be approved for Interconnection with SDG&E's Distribution System. It does not mean that the Generating Facility cannot be Interconnected.

(Continued)

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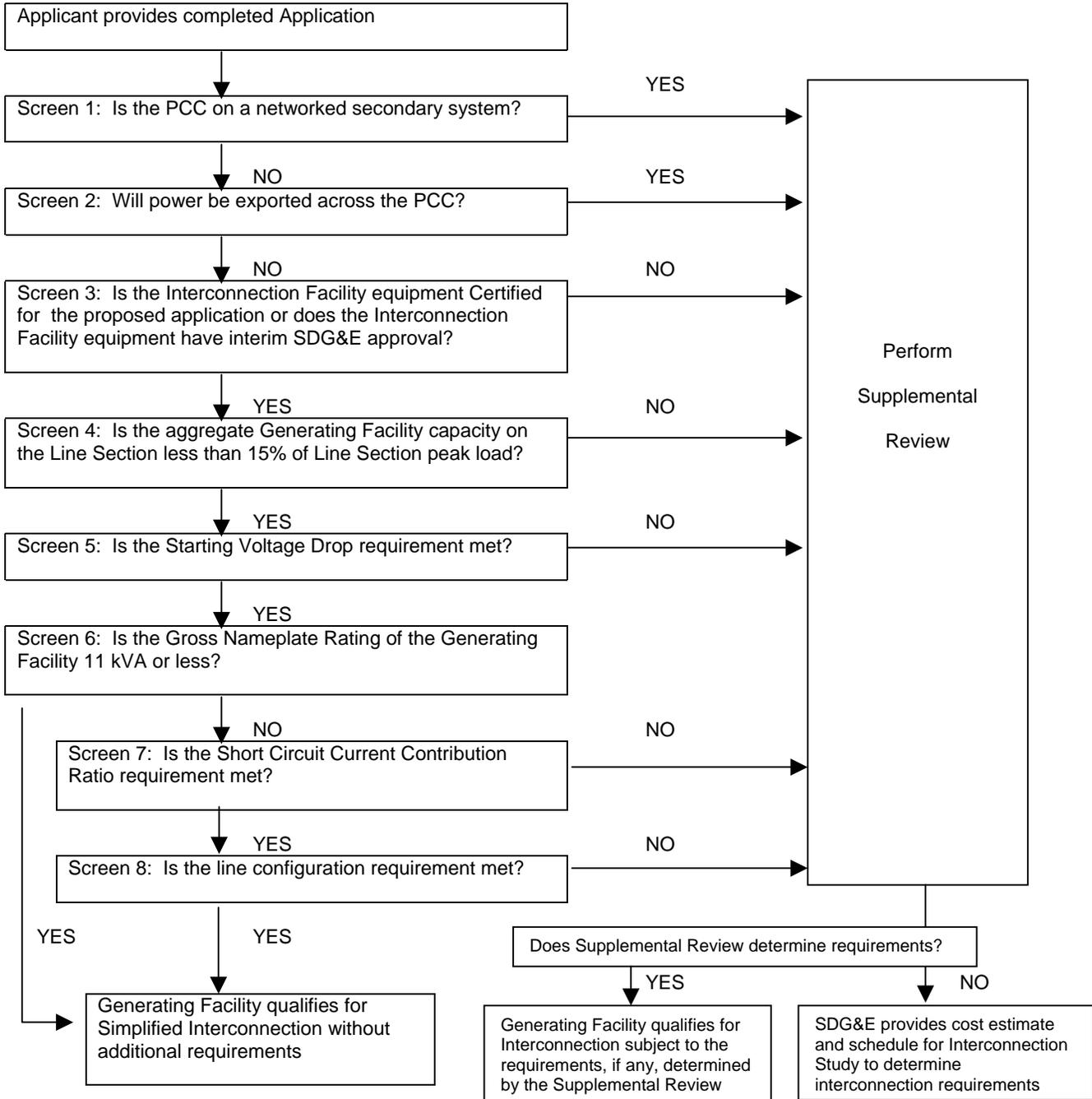


RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

I. REVIEW PROCESS FOR APPLICATIONS TO INTERCONNECT GENERATING FACILITIES
(Continued)

Initial and Supplemental Review Process Flow Chart



(Continued)



RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

I. REVIEW PROCESS FOR APPLICATIONS TO INTERCONNECT GENERATING FACILITIES
(Continued)

3. Review Process Details

a. **Screen 1: Is the PCC on a networked secondary system?**

- If Yes, Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.
- If No, continue to next screen.

Significance:

Special considerations must be given to Generating Facilities proposed to be installed on networked secondary Distribution Systems because of the design and operational aspects of network protectors. There are no such considerations for radial Distribution Systems.

b. **Screen 2: Will power be exported across the PCC?**

- If Yes, Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.
- If No, Generating Facility must incorporate one of the following four options:

Option 1 (Reverse Power Protection):

To insure power is never exported, a reverse power Protective Function must be implemented at the PCC. 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.

Option 2 (Minimum Power Protection):

To insure at least a minimum amount of power is imported at all times (and, therefore, that power is not exported), an under-power Protective Function may be implemented at the PCC. The default setting for this Protective Function, when used, shall be 5% (import) of Generating Facility's total Gross Nameplate Rating, with a maximum 2.0 second time delay.

Option 3 (Certified Non-Islanding Protection):

To insure the incidental export of power is limited to acceptable levels, this option, when used, requires that all of the following conditions be met: a) The total Gross Nameplate Rating of the Generating Facility must be no more than 25% of the nominal ampere rating of the Producer's service equipment; b) The total Gross Nameplate Rating of the Generating Facility must be no more than 50% of the Producer's service transformer capacity rating (this capacity requirement does not apply to Customers taking primary service without an intervening transformer); and c) The Generating Facility must be Certified as Non-Islanding.

(Continued)

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

I. REVIEW PROCESS FOR APPLICATIONS TO INTERCONNECT GENERATING FACILITIES
(Continued)

3. Review Process Details (Continued)

b. **Screen 2: Will power be exported across the PCC?** (Continued)

Option 4 (Relative Unit Size):

This option, when used, requires the Net Nameplate Rating of the Generating Facility to be so small in comparison to its host facility's minimum load, that the use of additional Protective Functions is not required to insure that power will not be exported to SDG&E's Distribution System. This option requires the Generating Facility's Net Nameplate Rating to be no greater than 50% of the Producer's verifiable minimum Host Load over the past 12 months.

Significance:

(1) If it can be assured that the Generating Facility will not export power, SDG&E's Distribution System does not need to be studied for load-carrying capability or Generating Facility power flow effects on SDG&E voltage regulators as the Generating Facility will be reducing load on SDG&E's Distribution System.

(2) This Screen permits the use of reverse-power or minimum-power relaying at the PCC as a positive Anti-Islanding Protective Function.

c. **Screen 3: Is the Interconnection Facility equipment Certified for the application or does the Interconnection Facility equipment have interim SDG&E approval?**

- If Yes, continue to next screen.
- If No, Generating and/or Interconnection Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.

Significance:

If the Generating and/or Interconnection Facility has been Certified or previously approved by SDG&E, SDG&E does not need to repeat its full review and/or test of the Generating and/or Interconnection Facility's Protective Functions. Site Commissioning Testing may still be required to insure that the Protective Functions are working properly.

Certification indicates the following criteria have been tested and verified:

- Basic Protective Function requirements met.
- Harmonic distortion limits met.
- Synchronizing requirements met.
- Power factor regulation requirements met.
- Non-Islanding requirements met.
- If used, reverse power function requirement met.
- If used, under-power function requirement met.

(Continued)



RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

I. REVIEW PROCESS FOR APPLICATIONS TO INTERCONNECT GENERATING FACILITIES
(Continued)

3. Review Process Details (Continued)

d. **Screen 4: Is the aggregate Generating Facility capacity on the Line Section less than 15% of Line Section peak load?**

- If Yes, continue to next screen.
- If No, Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review to determine cumulative impact on Line Section.

Significance:

- 1) Low penetration of Generating Facility installations will have a minimal impact on the operation and load restoration efforts of SDG&E's Distribution System.
- 2) The operating requirements for a high penetration of Generating Facilities may be different since the impact on SDG&E's Distribution System will no longer be minimal, therefore requiring additional study or controls.

e. **Screen 5: Is the Starting Voltage Drop within acceptable limits?**

- If Yes, continue to next screen.
- If No, Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review

Note: This Screen only applies to Generating Facilities that start by motoring the Generator(s).

SDG&E has two options in determining whether Starting Voltage Drop could be a problem. The option to be used is at SDG&E's discretion.

Option 1:

SDG&E may determine that the Generating Facility's starting In-Rush Current is equal to or less than the continuous ampere rating of the Customer's service equipment.

Option 2:

SDG&E may determine the impedances of the service distribution transformer (if present) and the secondary conductors to Customer's service equipment and perform a voltage drop calculation. Alternatively, SDG&E 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 Interconnections and 5% for secondary Interconnections.

Significance:

- (1) This Screen addresses potential voltage fluctuation problems for Generators that start by motoring.
- (2) When starting, Generating Facilities should have minimal impact on the service voltage to other SDG&E Customers.
- (3) Passing this Screen does not relieve the Producer from ensuring that its Generating Facility complies with the flicker requirements of this Rule, Section D.2.b.

(Continued)



RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

I. REVIEW PROCESS FOR APPLICATIONS TO INTERCONNECT GENERATING FACILITIES
(Continued)

3. Review Process Details (Continued)

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

- If Yes, Generating Facility qualifies for Simplified Interconnection. Skip remaining screens.
- If No, continue to next screen.

Significance:

The Generating Facility will have a minimal impact on fault current levels and any potential line overvoltages from loss of Distribution System neutral grounding.

g. **Screen 7: Is the Short Circuit Current Contribution Ratio within acceptable limits?**

- If Yes, continue to next screen.
- If No, Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.

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

- (1) When measured at primary side (high side) of the Dedicated Distribution Transformer serving a Generating Facility, the sum of the Short Circuit Contribution Ratios of all Generating Facilities connected to the Distribution System circuit that serves the Generating Facility must be less than or equal to 0.1, and
- (2) When measured at the secondary side (low side) of a shared distribution transformer, the short circuit contribution of the Generating Facility must be less than or equal to 2.5% of the interrupting rating of the Producer's Service Equipment.

Significance:

If the Generating Facility passes this Screen, it can be expected that it will have no significant impact on SDG&E's Distribution System's short circuit duty, fault detection sensitivity, relay coordination or fuse-saving schemes.

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

J. CERTIFICATION AND TESTING CRITERIA (Continued)

3. Type Testing (Continued)

a. **Type Tests and Requirements for Interconnection Equipment Certification**
(Continued)

The following table defines the test requirements by Generator or inverter technology. While UL 1741(1) was written specifically for inverters, the requirements are readily adaptable to synchronous Generators, induction Generators, as well as single/multi-function controllers and protection relays. Until a universal test standard is developed, SDG&E or NRTL shall adapt the procedures referenced in the following table as appropriate and necessary for a Generating and/or Interconnection Facility or associated equipment performance and its control and protection system functions.

| Type Test | Reference (1) | Inverter | Synchronous Machine | Induction Machine |
|---|------------------|----------|---------------------|-------------------|
| Utility Interaction | UL 1741 - 39 | X | X | X |
| DC Isolation | UL 1741 - 40.1 | X | — | — |
| Simulated PV Array (Input) Requirements | UL 1741 - 41.2 | X | — | — |
| Dielectric Voltage Withstand | UL 1741 - 44 | X | X | X |
| Power Factor | UL 1741 - 45.2.2 | X | X | X |
| Harmonic Distortion | UL 1741 - 45.4 | X | X | X |
| DC Injection | UL 1741 - 45.5 | X | — | — |
| Utility Voltage and Frequency Variation | UL 1741 - 46.2 | X | X | X |
| Reset Delay | UL 1741 - 46.2.3 | X | X | X |
| Loss of Control Circuit | UL 1741 - 46.4 | X | X | X |
| Short Circuit | UL 1741 - 47.3 | X | X | X |
| Load Transfer | UL 1741 - 47.7 | X | X | X |
| Surge Withstand Capability | J.3.e | X | X | X |
| Anti-Islanding | J.3.b | (2) | (2) | (2) |
| Non-Export | J.3.c | (3) | (3) | (3) |
| In-Rush Current | J.3.d | — | — | (4) |
| Synchronization | J.3.f | (5) | X | — |

Table Notes:

X = Required – = Not required

- (1) References are to section numbers in either UL 1741 (Inverters, Converters and Charge Controllers for use in Independent Power Systems) or this Rule. References in UL 1741 to “photovoltaics” or “inverter” may have to be adapted to the other technologies by the testing laboratory to appropriately apply the tests to other technologies.
- (2) Required only if Non-Islanding designation is desired.
- (3) Required only if Non-Export designation is desired.
- (4) Required for Generators that use SDG&E power to motor to speed.
- (5) Required for all synchronous Generators as well as inverters that operate as voltage sources when connected to SDG&E’s Distribution System.

(Continued)



RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

J. CERTIFICATION AND TESTING CRITERIA (Continued)

3. Type Testing (Continued)

b. **Anti-Islanding Test**

Devices that pass the Anti-Islanding test procedure described in UL 1741 Section 46.3 will be considered Non-Islanding for the purposes of these Interconnection requirements. The test is required only for devices for which a Certified Non-Islanding designation is desired.

c. **Non-Export Test**

Devices that pass the Non-Export test procedure described in Section J.7.a. will be considered Non-Exporting for the purposes of these Interconnection requirements. This test is required only for devices for which a Certified Non-Export designation is desired.

d. **In-rush Current Test**

Generation equipment that utilizes SDG&E power to motor up to speed will be tested using the procedure defined in Section J.7.b. to determine the maximum current drawn during this startup process. The resulting In-rush Current is used to estimate the Starting Voltage Drop.

e. **Surge Withstand Capability Test**

Interconnection equipment shall be tested for surge withstand capability (SWC), both oscillatory and fast transient, in accordance with the test procedure defined in IEEE/ANSI C62.45 using the peak values defined in IEEE/ANSI C62.41 Tables 1 and 2 for location category B3. An acceptable result occurs even if the device is damaged by the surge, but is unable to operate or energize SDG&E's Distribution System. If the device remains operable after being subject to the surge conditions, previous Type Tests related to SDG&E's protection and power quality will need to be repeated to ensure the unit will still pass those tests following the surge test.

f. **Synchronization Test**

This test verifies that the unit synchronizes within the specified voltage/frequency/phase angle requirements. It is applied to synchronous Generators and inverters capable of operating as voltage-source while connected to SDG&E's Distribution System. This test is not necessary for induction Generators or current-source inverters. The test will start with only one of the three parameters: 1) voltage difference between Generating Facility and SDG&E's Distribution System, 2) frequency difference, or 3) phase angle outside of the synchronization specification. Initiate the synchronization routine and verify that the Generating Facility is brought within specification prior to synchronization. Repeat the test five times for each of the three parameters. For manual synchronization with synch check or manual control with auto synchronization, the test must verify that paralleling does not occur until the parameters are brought within specifications.

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

J. CERTIFICATION AND TESTING CRITERIA (Continued)

4. Production Testing

As a minimum, the Utility Voltage and Frequency Variation Test procedure described in UL1741 under Manufacturing and Production Tests, Section 68, shall be performed as part of routine production (100 percent) on all equipment used to interconnect Generating Facilities to SDG&E's Distribution System. This testing may be performed in the factory or as part of a Commissioning Test (J.5.).

5. Commissioning Testing

a. Commissioning Testing, where required, will be performed on-site to verify protective settings and functionality. Upon initial Parallel Operation of a Generating Facility, or any time interface hardware or software is changed that may affect the functions listed below, a Commissioning Test must be performed. An individual qualified in testing protective equipment (professional engineer, factory-Certified technician, or licensed electrician with experience in testing protective equipment) must perform Commissioning Testing in accordance with the manufacturer's recommended test procedure to prove the settings and requirements of this Rule. SDG&E has the right to witness Commissioning Tests as described below, or to require written Certification by the installer describing which tests were performed and their results. Protective Functions to be tested during commissioning, particularly with respect to non-Certified equipment, may consist of the following:

- (1) Over and under-voltage
- (2) Over and under-frequency
- (3) Anti-Islanding function (if applicable)
- (4) Non-Exporting function (if applicable)
- (5) Inability to energize dead line
- (6) Time delay on restart after utility source is stable
- (7) Utility system fault detection (if used)
- (8) Synchronizing controls (if applicable)
- (9) Other Interconnection Protective Functions that may be required as part of the Interconnection Agreement

b. Other checks and tests that may need to be performed include:

- (1) Verifying final Protective Function settings
- (2) Trip test
- (3) In-service test

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

J. CERTIFICATION AND TESTING CRITERIA (Continued)

5. Commissioning Testing (Continued)

c. Certified Equipment

Generating Facilities qualifying for Simplified Interconnection incorporate Certified equipment that have, at a minimum, passed the Type Tests and Production Tests described in this Rule, are judged to have little or no potential impact on SDG&E's Distribution System. For such Generating Facilities, it is necessary to perform only the following tests:

- (1) Protective Function settings that have been changed after factory testing will require field verification. Tests shall be performed using injected secondary frequencies, voltages and currents, applied waveforms, at 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.
- (2) The Non-Islanding function shall be checked by operating a load break disconnect switch to verify the Interconnection equipment ceases to energize SDG&E's Distribution System and does not re-energize it for the required time delay after the switch is closed.
- (3) The Non-Exporting function shall 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-Exporting criteria (i.e., reverse power or underpower) are met.

The Supplemental Review or an Interconnection Study may impose additional components or additional testing.

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

J. CERTIFICATION AND TESTING CRITERIA (Continued)

5. Commissioning Testing (Continued)

d. Non-Certified Equipment

Non-Certified equipment shall be subjected to the appropriate tests described in Type Testing (Section J.3.) as well as those described in Certified Equipment Commissioning Test (Section J.5.c.). With SDG&E's approval, these tests may be performed in the factory, in the field as part of commissioning, or a combination of both. SDG&E, at its discretion, may also approve a reduced set of tests for a particular application or, for example, if it determines it has sufficient experience with the equipment.

e. Verification of Protective Function Settings

If the testing is part of the commissioning process, then, at the completion of such testing, the Producer shall confirm all devices are set to SDG&E-approved settings. This step shall be documented in the Commissioning Test Certification.

f. Trip Tests

Interconnection Protective Functions and devices (e.g. reverse power relays) that have not previously been tested as part of the Interconnection Facility 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.

g. In-service Tests

Interconnection Protective Functions and devices that have not previously been tested as part of the Interconnection Facility 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 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.

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

J. CERTIFICATION AND TESTING CRITERIA (Continued)

6. Periodic Testing

Periodic Testing of Interconnection-related Protective Functions shall be performed as specified by the manufacturer, or at least every four years. All Periodic Tests prescribed by the manufacturer shall be performed. The Producer shall maintain Periodic Test reports or a log for inspection by SDG&E. Periodic Testing conforming to SDG&E test intervals for the particular Line Section may be specified by SDG&E under special circumstances, such as high fire hazard areas. An Interconnection Facility that depends upon a battery for Protective Function shall be checked and logged once per month for proper voltage. Once every four years, the battery must be either replaced or a discharge test performed.

7. Supplemental Testing Procedures

This Section describes the additional Type Tests necessary to qualify a device as Certified, for use on SDG&E's Distribution System. These Type Tests are not contained in Underwriters Laboratories UL 1741 Standard *Inverters, Converters and Controllers for Use in Independent Power Systems*, or other referenced standards, but are considered necessary for Certification by SDG&E.

a. **Non-Exporting Test Procedures**

The Non-Exporting test is intended to verify the operation of relays, controllers and inverters designed to limit the export of power and certify the equipment as meeting the requirements of Screen 2, Options 1 and 2, of the review process. Tests are provided for discrete relay packages and for controllers and inverters that include the intended function.

(1) Discrete Reverse Power Relay Test

This version of the Non-Exporting test procedure is intended for discrete reverse power and underpower relay packages provided to meet the requirements of Options 1 and 2 of Screen 2. It should be understood that in the reverse power application, the relay will provide a trip output with power flowing in the export (toward the SDG&E Distribution System) direction.

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

J. CERTIFICATION AND TESTING CRITERIA (Continued)

7. Supplemental Testing Procedures (Continued)

a. **Non-Exporting Test Procedure** (Continued)

(1) Discrete Reverse Power Relay Test (Continued)

Step 1: Power Flow Test at Minimum, Midpoint and Maximum Pickup Level Settings

Determine the corresponding secondary pickup current for the desired export power flow of 0.5 secondary watts (the minimum pickup setting, assumes 5 amp and 120V CT/PT secondary). Apply nominal voltage with minimum current setting at 0 degrees phase angle in the trip direction. Increase the current to pickup level. Observe the relay's (LCD or computer display) indication of power values. Note the indicated power level at which the relay trips. The power indication should be within 2% of the expected power. For relays with adjustable settings, repeat this test at the midpoint, and maximum settings. Repeat at phase angles of 90, 180 and 270 degrees and verify that the relay does not operate (measured watts will be zero or negative).

Step 2: Leading Power Factor Test

Apply rated voltage with a minimum pickup current setting (calculated value for system application) and apply a leading power factor load current in the non-trip direction (current lagging voltage by 135 degrees). Increase the current to relay rated current and verify that the relay does not operate. For relays with adjustable settings, this test should be repeated at the minimum, midpoint, and maximum settings.

Step 3: Minimum Power Factor Test

At nominal voltage and with the minimum pickup (or ranges) determined in Step 1, adjust the current phase angle to 84 or 276 degrees. Increase the current level to pickup (about 10 times higher than at 0 degrees) and verify that the relay operates. Repeat for phase angles of 90, 180 and 270 degrees and verify that the relay does not operate.

Step 4: Negative Sequence Voltage Test

Using the pickup settings determined in Step 1, apply rated relay voltage and current at 180 degrees from tripping direction, to simulate normal load conditions (for three-phase relays, use I_a at 180, I_b at 60 and I_c at 300 degrees). Remove phase 1 voltage and observe that the relay does not operate. Repeat for phases 2 and 3.

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

J. CERTIFICATION AND TESTING CRITERIA (Continued)

7. Supplemental Testing Procedures (Continued)

a. **Non-Exporting Test Procedure** (Continued)

(1) Discrete Reverse Power Relay Test (Continued)

Step 5: Load Current Test

Using the pickup settings determined in Step 1, apply rated voltage and current at 180 degrees from the tripping direction, to simulate normal load conditions (use I_a at 180, I_b at 300 and I_c at 60 degrees). Observe that the relay does not operate.

Step 6: Unbalanced Fault Test

Using the pickup settings determined in Step 1, apply rated voltage and 2 times rated current, to simulate an unbalanced fault in the non-trip direction (use V_a at 0 degrees, V_b and V_c at 180 degrees, I_a at 180 degrees, I_b at 0 degrees, and I_c at 180 degrees). Observe that the relay, especially single phase, does operate properly.

Step 7: Time Delay Settings Test

Apply Step 1 settings and set time delay to minimum setting. Adjust the current source to the appropriate level to determine operating time, and compare against calculated values. Verify that the timer stops when the relay trips. Repeat at midpoint and maximum delay settings.

Step 8: Dielectric Test

Perform the test described in IEC 414 using 2 kV RMS for 1 minute.

Step 9: Surge Withstand Test

Perform the surge withstand test described in IEEE C37.90.1.1989 or the surge withstand capability test described in J.3.e.

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RULE 21

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

J. CERTIFICATION AND TESTING CRITERIA (Continued)

7. Supplemental Testing Procedures (Continued)

a. **Non-Exporting Test Procedure** (Continued)

(2) **Discrete Underpower Relay Test**

This version of the Non-Exporting test procedure is intended for discrete underpower relay packages and meets the requirements of Option 2 of Screen 2. A trip output will be provided when import power (toward the Producer's load) drops below the specified power level.

Note: For an underpower relay, pickup is defined as the highest power level at which the relay indicates that the power is less than the set level.

Step 1: Power Flow Test at Minimum, Midpoint and Maximum Pickup Level Settings

Determine the corresponding secondary pickup current for the desired power flow pickup level of 5% of peak load minimum pickup setting. Apply rated voltage and current at 0 degrees phase angle in the direction of normal load current.

Decrease the current to pickup level. Observe the relay's (LCD or computer display) indication of power values. Note the indicated power level at which the relay trips. The power indication should be within 2% of the expected power. For relays with adjustable settings, repeat the test at the midpoint, and maximum settings. Repeat at phase angles of 90, 180 and 270 degrees and verify that the relay operates (measured watts will be zero or negative).

Step 2: Leading Power Factor Test

Using the pickup current setting determined in Step 1, apply rated voltage and rated leading power factor load current in the normal load direction (current leading voltage by 45 degrees). Decrease the current to 145% of the pickup level determined in Step 1 and verify that the relay does not operate. For relays with adjustable settings, repeat the test at the minimum, midpoint, and maximum settings.

Step 3: Minimum Power Factor Test

At nominal voltage and with the minimum pickup (or ranges) determined in Step 1, adjust the current phase angle to 84 or 276 degrees. Decrease the current level to pickup (about 10% of the value at 0 degrees) and verify that the relay operates. Repeat for phase angles 90, 180 and 270 degrees and verify that the relay operates for any current less than rated current.

Step 4: Negative Sequence Voltage Test

Using the pickup settings determined in Step 1, apply rated relay voltage and 25% of rated current in the normal load direction, to simulate light load conditions. Remove phase 1 voltage and observe that the relay does not operate. Repeat for phases 2 and 3.

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RULE 21

Sheet 41

INTERCONNECTION STANDARDS FOR NON-UTILITY OWNED GENERATION

J. CERTIFICATION AND TESTING CRITERIA (Continued)

7. Supplemental Testing Procedures (Continued)

b. In-rush Current Test Procedures

This test will determine the maximum In-rush Current drawn by the Generator.

(1) **Locked-Rotor Method**

Use the test procedure defined in NEMA MG-1 (manufacturer's data is acceptable).

(2) **Start-up Method**

Install and setup the Generating Facility equipment as specified by the manufacturer. Using a calibrated oscilloscope or data acquisition equipment with appropriate speed and accuracy, measure the current draw at the Point of Interconnection as the Generating Facility starts up and parallels with SDG&E's Distribution System. Startup shall follow the normal, manufacturer-specified procedure. Sufficient time and current resolution and accuracy shall be used to capture the maximum current draw within 5%. In-rush Current is defined as the maximum current draw from SDG&E during the startup process, using a 10-cycle moving average. During the test, the utility source, real or simulated, must be capable of maintaining voltage within +/- 5% of rated at the connection to the unit under test. Repeat this test five times. Report the highest 10-cycle current as the In-rush Current. A graphical representation of the time-current characteristic along with the Certified In-rush Current must be included in the test report and made available to SDG&E.

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