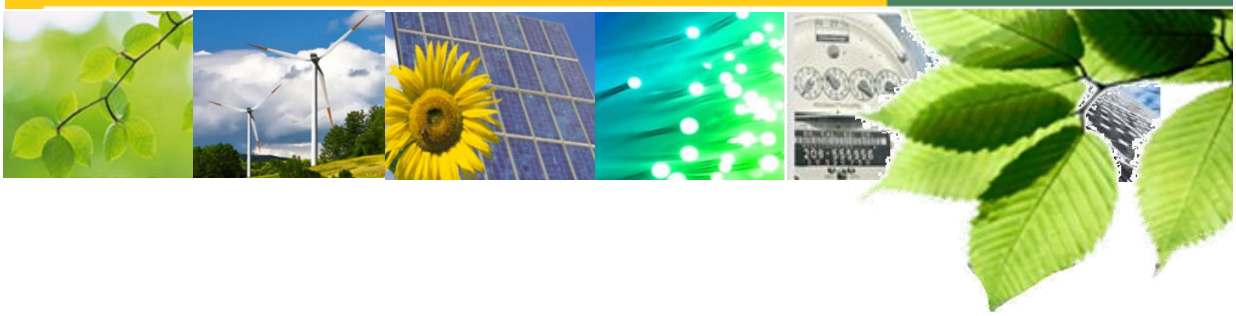
Leading the Way in Electricity



Net Energy Metering

INTERCONNECTION HANDBOOK

SOUTHERN CALIFORNIA EDISON®

An *EDISON INTERNATIONAL*® Company

Contents

1. Overview

A generating facility may not be operated in parallel with SCE's Distribution facilities UNTIL PERMISSION TO OPERATE IS GRANTED BY SCE, as required in Electric Rule 21 (PDF). Unauthorized operation may result in personal injury, equipment damage and/or property damage for which the customer may be liable.

This NEM Interconnection Handbook specifies the typical minimum technical requirements to interconnect generating facilities with SCE's electric system under the Net Energy Metering (NEM) program. These requirements are necessary to ensure safe and reliable operation of SCE's electric system.

These requirements apply to interconnection of a generating facility to SCE's electrical distribution system through the NEM program under the following SCE rate schedules:

- **Schedule NEM** (PDF): Solar & Wind Net Energy Metering
- **Schedule FC-NEM** (PDF): Fuel Cell Net Energy Metering
- **Schedule MASH-VNM** (PDF): Multi-family Affordable Solar Housing
- **Schedule BG-NEM** (PDF): Biogas Net Energy Metering
  (Note: per CPUC §2827.9, biogas digester generators must commence operation by December 31, 2009 to be eligible for the program)
- **Schedule RES-BCT** (PDF): Renewable Energy Self-Generation - Bill Credit Transfer

It does not address other types of generator interconnections under **Rule 21** (PDF) or the Wholesale Distribution Access Tariff (WDAT). For technical requirements for interconnection under **Rule 21** (PDF) or WDAT, please refer to **SCE's Interconnection Handbook** (PDF).

Under the Net Energy Metering program (CPUC §2827), customers installing generating facilities are eligible to interconnect if the generating facility is located on the customer's premises, uses solar, wind, fuel cell, biogas, or a hybrid of these technologies, and is sized to offset all or part of the customer's electrical requirements up to 1 MW for solar and wind, and 1 MW for fuel cells.

To deliver incidental power to the grid, a customer's generating system must be located on the customer's premises and be *interconnected* to SCE's electrical system, i.e. permanently connected to allow "parallel operation" with the utility grid. (Note: for standby and back-up generators **not** permanently connected to SCE's electrical system, please refer to notice requirements defined in **Section 5.8**).

2. Reference Information

Please visit **http://www.sce.com/nem**:

- For more information about the NEM Program, NEM Rate Schedules, and review process;
- To download checklists, applications, sample Single Line Diagrams and Plot Plan, and NEM Interconnection Agreements;
- To read Frequently Asked Questions and Tips to Speed through Interconnection.

2.1 Document Requirements

At **http://www.sce.com/nem**, SCE provides a Checklist for Solar & Wind project listing all the required documents for NEM Interconnection, as well as application forms, a sample Single Line Diagram and Plot Plan, and NEM Interconnection Agreements for download.

The NEM Interconnection review process is entirely paperless. All NEM Interconnection application documents should be submitted to the NEM Interconnection team via email to **customer.generation@sce.com** or via fax to (626) 571-4272. A document may be submitted via mail only if it is too large for digital transmission (Note: SCE can accept email attachments up to 7 MB; documents may be submitted in multiple emails – e.g. part 1 of 2, part 2 of 2). The NEM Interconnection mailing address is:

Southern California Edison
Attention: NEM Program
P.O. Box 800
Rosemead, CA 91770

2.2 Reference Information

Certified Equipment Listings

For CEC-certified equipment, list the manufacturer, model number, rating, voltage and other required information on the Application and Single Line Diagram *exactly* as shown at the following on-line resources:

Table 2.2-1: CEC Certified Equipment Listings

Equipment	Certified Listings
Inverters	Solar: **http://www.csi-epbb.com/default.aspx** Wind, Fuel Cell: **http://www.consumerenergycenter.org/erprebate/inverter.php**
Solar PV Modules	**http://www.csi-epbb.com/default.aspx**
Wind Turbines	**http://www.consumerenergycenter.org/cgi-bin/eligible_smallwind.cgi**
Fuel Cells	**http://www.consumerenergycenter.org/erprebate/eligibile_fuelcells.html**

For non CEC-certified equipment, refer to the information provided by the manufacturer.

Calculations

> **NOTE: The technical requirements defined in this Handbook apply to systems based on the AGGREGATE INVERTER CAPACITY. By contrast, eligibility for interconnection under Net Energy Metering, however, is based on the CEC-AC nameplate (kW) of the proposed system.**

For the purposes of the NEM Interconnection Application, following are formulas used to calculate CEC-AC and CEC-DC nameplate system size (kW) and estimated monthly kWh output:

Table 2.2-2: CEC-AC Nameplate Calculation

Technology	CEC-AC Nameplate Calculation
Solar PV	(Qty of Modules) x (PTC Rating) x (Inverter Efficiency %) / 1000 = ____ kW
Wind	(Qty of Turbines) x (Power Output) x (Inverter Efficiency %) / 1000 = ____ kW
Fuel Cell	(Qty of Cells) x (Rated Output) x (Inverter Efficiency %) / 1000 = ____ kW

Table 2.2-3: CEC-DC Nameplate Calculation

Technology	DC Calculation
Solar PV	(Qty of modules) X STC Rating /1000 = ___ kW
Wind	(Qty of turbines) X (Power Output)/1000 = ___ kW
Fuel Cell	(Qty of cells) X (Rated Output)/1000 = ___ kW

Table 2.2-4: Estimated Monthly kWh Calculation

Technology	Estimated Monthly kWh
Solar PV	Use the CSI EPBB calculator at www.csi-epbb.com or: (CEC-AC Nameplate) x 720 x 0.20 = ____ kWh
Wind	(CEC-AC Nameplate) x 720 x 0.10 = ____ kWh
Fuel Cell	(CEC-AC Nameplate) x 720 x 0.85 = ____ kWh

3. Interconnection Review Process

After an initial review to confirm the Application and Single Line Diagram are complete and consistent, the NEM Interconnection team refers the project to SCE Distribution Engineering for technical review and approval. Upon referral, the installer is provided notice and contact information for the Distribution Engineer assigned to the project. At SCE Distribution Engineering's discretion, an onsite inspection and commissioning test may be required as part of the technical review – see **Section 3.2** for more information.

The design must be in accordance with:

- **Rule 21** (PDF)
- SCE's **Electric Service Requirements** (PDF)
- **SCE's Interconnection Handbook** (PDF)
- the **National Electric Code**, and
- All applicable local codes and ordinances.

SCE strongly encourages the submission of the Application and Single Line Diagram as early as possible so that any changes required as a result of SCE's technical review can be incorporated prior to installation.

If the components change from design to installation, submit revised documents with subject line 'EQUIP CHANGE' prior to scheduling the final inspection.

Failure to comply with these requirements will result in potential delay, and any corrections required to bring the project into compliance with these requirements will be at the customer's expense and must be completed before SCE will issue written authorization to interconnect in the form of a Permission to Operate (PTO) letter.

The purpose of the technical review is to facilitate the safe interconnection of eligible NEM generators (solar, wind, biogas and fuel cell) to the SCE electrical distribution system. To ensure the generator interconnection is safe and does not create a potential hazard to the customer, SCE employees, and the general public, the customer's interconnection plan will, at a minimum, be reviewed to ensure that the generator interconnection will:

- not operate in an islanded mode,
- have a visible, open, lockable disconnect switch and/or rackable breaker for isolation purposes, and
- have the necessary protection and control devices, such as fuses, breakers, and/or relays.

If the generating facility exceeds the operating capabilities of the distribution system, SCE Distribution Engineering may use the requirements in **Rule 21** (PDF) and other applicable SCE tariffs to evaluate an application before providing technical approval to operate a generating system.

3.1 Document Review

The following documents are required before SCE will begin the technical review of a proposed generating facility:

- Completed Application Form: see NEM Interconnection Checklist at **www.sce.com/nem** for information about which application form is required based on the project size and configuration;

- Single Line Diagram: see **Section 5.2** for detailed requirements and **Appendix A** for a sample.

The following additional information may also be required based on the size/configuration of the proposed system:

- Photos of the manual, visibly open, and lockable open AC Disconnect Switch, showing visible contact separation: see **Section 5.3** for manual, visibly open, and lockable open AC Disconnect Switch requirements;
- Plot Plan: see **Section 5.3.2** for circumstances when a Plot Plan is required and **Appendix B** for a sample.
- Inverter Specifications: see **Section 5.1** for more information;
- Photos of signage: see **Section 5.4** for more information.

3.2 Commissioning Test

SCE intends to conduct a commissioning test for as many sites as possible. Currently all projects greater than 10 kW are subject to a commissioning test, while projects less than 10 kW are evaluated on a case by case basis. When a commissioning test is required, a representative of the installer qualified to operate the equipment must be present.

Before a commissioning test will be scheduled, SCE requires a copy of an Electrical Inspection Release from the appropriate Authority Having Jurisdiction (e.g. final inspection job card from the local building and safety department) to ensure that the work on the customer's side of the meter has been permitted, meets the requirements of the **National Electric Code**, applicable local codes and ordinances, and is therefore safe to energize.

The onsite inspection will ensure that the installation reflects what is shown on the single line diagram and documents provided by the applicant on the Alternating Current of the generating facility. **Rule 21** (PDF) voltage and frequency requirements will be tested and verified during the commissioning test. Regardless of the results of the onsite inspection and commissioning test, the customer may not energize the system until SCE issues a Permission to Operate (PTO) letter.

3.3 Interconnection Study

If, during the course of the initial and supplemental reviews, it is determined that an interconnection study is required, SCE will determine the study timetable on a case-by-case basis. The interconnection study will detail any additional interconnection facilities or distribution system modifications that will be needed to accommodate the applicant's generating facility.

3.4 Review Fees

There is no application fee for NEM interconnection and, unlike **Rule 21** (PDF) and WDAT, there are typically no review fees. Please refer to CPUC §2827 for the delineation of cost responsibilities for distribution modifications versus interconnection facilities.

4 Operating Evaluations

The generator shall not energize or export power to the SCE system during any interruption to the supply that serves the Point of Common Coupling. The applicant's generation may be operated during such interruptions only with an open tie to SCE.

Islanding will not be permitted under any circumstance.

Technical Approval is based on the following criteria:

- **15% Rule**: the applicant's generating system combined with existing generation does not exceed 15% of the maximum loading of line section. For more information, please refer to **Rule 21** (I)(3)(d).
- **Overloading**: all distribution equipment must not be overloaded by the applicant's generating system.
- **Voltage Operating Levels**: the applicant's generating system must not create a voltage drop or rise that is outside the allowable operating-voltage bandwidth specified in **Rule 21** (PDF) and **Rule 2** (PDF).
- **System Upgrades:** upon review by SCE Distribution Engineering, system upgrades may be required to allow the system to accommodate the interconnection of the generating facility. Please refer to CPUC §2827 for the delineation of cost responsibilities for distribution modifications versus interconnection facilities.

Following a generation facility disconnect as a result of a voltage or frequency excursion (parameters are described in **Rule 21** Section D 1. a. 2), the generation facility shall remain disconnected until the service voltage and frequency has recovered to SCE's acceptable voltage and frequency limits for a minimum of sixty (60) seconds.

SCE may require **Direct Transfer Trip (DTT)** whenever it is determined that the customer's protective relaying may not operate for certain conditions or faults and/or the installation could increase the length of interruptions on a distribution circuit or jeopardize the reliability of the circuit. The Distributed Generator shall be responsible for all costs required to deploy a DTT protective scheme.

4.1 Normal Voltage Operating Range

To minimize the adverse voltage effects experienced by other customers on SCE's electric system, any voltage flicker at the point of common coupling (PCC) caused by the generating facility must not exceed the limits defined by the "**Maximum Borderline of Irritation Curve**" shown in the Institute of Electrical Engineers (IEEE) 519, **Rule 2** (PDF), and **Rule 21** (PDF).

4.1.1 Limits Specific to Single-Phase Generating Facilities

When connected to a single phase transformer, the generator must be installed such that the aggregated gross output is balanced between the two phases of the single phase voltage and the maximum aggregated Gross Ratings for all the Generating Facilities shall not exceed the transformer rating.

4.1.2 Limits Specific to Three-Phase Generating Facilities

The applicant must balance the demand load and generation as nearly as practical between the two sides of a three-wire single-phase service and between all phases of a three-phase service.

The difference in amperes between any two phases at the customer's peak load should not be greater than 10 percent or 50 amperes (at the service delivery voltage), whichever is greater; except that the difference between the load on the lighting phase of a four-wire delta service and the load on the power phase my be more that these limits. It will be the responsibility of the customer to keep the demand load balanced within these limits.

5 Miscellaneous Requirements

5.1 Inverter

An inverter-based generating facility must meet all required criteria specified in the CPUC's "**Rule 21**-Generating Facility Interconnections", **IEEE 1547**, **UL 1741,** and **SCE's Interconnection Handbook** (PDF). If the inverter does not meet Underwriters Laboratories Standard **UL 1741** certification CSA, OR specifically meet Section "J" of **Rule 21** (PDF), as tested by a nationally recognized testing laboratory (NRTL) acceptable to SCE with the test reports acceptable to **IEEE 1547**, **Rule 21** (PDF) and SCE, additional protection requirements and testing may be required.

Inverters listed in the following lists have met **UL 1741** and **IEEE 1547** standards:

- Underwriters Laboratories Standard **UL 1741** certification , or
- Section "J" of **Rule 21** (PDF), as tested by a nationally recognized testing laboratory (NRTL) acceptable to SCE and the test reports must have been approved by SCE.

The California Energy Commission maintains a certified list of approved inverters at **http://www.consumerenergycenter.org/erprebate/inverter.php**. If one of these inverters is used, the application process is greatly simplified and expedited. If not, the customer may be required to provide additional details and the utility may need to perform additional studies to determine how the proposed system will perform under fault conditions and prevent islanding.

Note: SCE may require additional testing for a single installation of multiple CEC-approved inverter units.

To be eligible for CSI credits, the inverter must be listed at **http://www.csi-epbb.com/**.

Separate single-unit or multiple-unit inverters that do not meet **UL 1741** certification or have not been adequately tested will not be granted commercial operation status and the customer will not be permitted to interconnect to SCE's electrical distribution system.

SCE reserves the right to disconnect previously certified interconnected units when Underwriters Laboratories decertifies the units. SCE may implement an acceptable mitigation procedure for recertification at the customer's expense.

5.2 Single Line Diagram

See Appendix A for a sample Single Line Diagram.

The Single Line Diagram shows the path and graphic symbols of the entire electrical system for the site to provide a good understanding of the connections and component use. "Best" single lines provide, on one side of the page, a sequence of events such as what happens during an SCE interruption and which devices close and/or open to return the generation system to normal status. Any and all additional information necessary to demonstrate compliance with **Rule 21** (PDF) and SCE's **Electrical Service Requirements** (ESR) should be provided.

Depending on the system, the following should be included on the Single Line Diagram:

- Site location/service address (must match address on SCE account and NEM Interconnection Application);
- Detail view of the point of connection to the power grid, specifically showing whether it is on the utility or customer side of the main breaker - see below for additional requirements that apply when the point of interconnection is on the utility side of the main breaker (line-side tap);
- Service Panels;
- Protective devices: Circuit Breakers, Fuses, CT and PT ratings, if applicable;
- Utility meter;
- Generation Output Meter(s), of applicant, including built in within component;
- Generator(s) make and model;
- Detailed component information (characteristics) is included for each component (Voltage and phase of inverters, transformers, etc.);
- Inverter setting for: Under-Voltage, Extreme Under-Voltage, Overvoltage Extreme Voltage, Over-frequency, Under-frequency;
- Battery Backup and system size (CEC-AC), including transfer device;
- Other Generation type and system size (CEC-AC), including transfer device;
- Manual, visibly open, and lockable open AC disconnect switch, including make and model (all info outlined in proposed SLD) – see **Section 5.3** for Manual, Visibly Open and Lockable AC Disconnect requirements;
- Code and version to be used for construction and repair, inspection and testing.

Additional Requirements for Line-Side Taps
When the point of connection to the power grid is on the utility side of the main breaker, the Single Line Diagram must also include:

- Protective device information;
- Signed PE Stamp.

CAUTION ABOUT BROKEN METER SEALS:
Per **ESR** Section 5, Section 1.0, (pp 5-7), all enclosures and raceways on the line side (unmetered) or housing metering equipment shall be sealable. **Meter seals shall not be broken by anyone except an authorized SCE employee**.

Per **ESR** Section 6, Section 1.0 (pp 6-5), **conductors shall not be rerouted through any metering compartment.** Fused and unfused conductors shall not occupy the same raceway unless they are completely barriered from each other in a manner acceptable to SCE.

Per **ESR** Section 6, Section 5.0, Figure 6-8 (pp 6-20), Except for conductors supplying the instrument-transformer compartment, and the ground bus, no other conductors or devices shall be installed in, or routed through, the compartment or the sealed area above the compartment. The ground bus shall not infringe on utility-compartment space, or reduce any clearances. Customer connections to the ground bus shall be allowed in the instrument transformer compartment.

5.3 Visible AC Disconnect Switch

Per SCE guidelines, a visible disconnect is required for all of the following aggregate generating facilities:

- All Commercial
- All Residential Non Self-Contained Meters
- All Line-Side Taps (additional overcurrent protection required)
- All Battery Back-up Systems

Refer to **Rule 21** (PDF) Section D.1.d and **SCE's Interconnection Handbook** (PDF) for Visible Disconnect requirements.

If you come across a broken meter seal, report it immediately to (800) 655-4555.

5.3.1 Disconnects must be reviewed and approved by Field Engineering. Location of AC Disconnect

SCE requires that the manual, visibly open and lockable open AC disconnect switch is in line of sight of the customer's main panel.

Load Side Tap

When connecting to the customer side of the main circuit breaker, SCE and the applicant may come to an agreement prior to construction for the manual, visibly open and lockable AC disconnect to be installed in a location that is not adjacent to the point of common coupling (PCC), in which case permanent signage, indicating location of manual, visibly open and lockable open AC disconnect switch, must be installed at the point of connections.

If you are unsure of the type of AC disconnect you may use, please provide photos to the assigned Distribution Engineer to review.

Line Side Tap

When connecting to the utility side of the main circuit breaker, the manual, visibly open, and lockable AC Disconnect Switch must be adjacent to the PCC.

All line side interconnections must have overcurrent protection on all installations regardless of size per **ESR** section 1 requirements.

5.3.2 Plot Plan Requirement

See Appendix B for a sample Plot Plan.

If the manual, visibly open, and lockable AC disconnect is required , a Plot Plan must be provided to SCE Distribution Engineering for review (see Appendix C for a sample), showing the location of the manual visibly open and lockable open AC disconnect switch with reference to the utility meter.

5.3.3 Circumstances when AC Disconnect May be Opened by SCE

The manual, visibly open, and lockable open AC Disconnect Switch or rackable circuit breaker may be operated by SCE:

- Pre-emergency or emergency conditions on the SCE system.
- A hazardous condition is revealed by an SCE inspection.
- To eliminate a condition that constitutes a potential hazard to SCE personnel or the general public.
- When protective device tampering is discovered.
- A generator-owner has failed to make available records of Verification tests and maintenance of its protective devices.
- A generator-owner's system interferes with SCE equipment or equipment belonging to other SCE customers.
- A generator owner's system is found to affect quality of service of adjoining customers.

5.4 Signage Requirements

The main service entrance panel and manual, visibly open, and lockable open AC disconnect switch shall be permanently labeled with machine-engraved, laminated-phenolic (or equivalent) labels. The labels shall utilize quarter-inch high white letters and numbers on red-colored material, and shall be readily visible and mechanically attached.

When labeling indoor non-raintight (NEMA-1) or outdoor raintight (NEMA-3R) service equipment, labels shall be placed on the exterior access door to the appropriate compartment.

Note: In the near future SCE will manufacture, install, and maintain the required signage.

5.4.1 At the Main Service

When the interconnection is on the utility side of the main circuit breaker, the protective device (typically a fused disconnect) MUST be adjacent to the main panel. Below is an example of adequate verbiage:

> *"Warning: Generation system is connected on the UTILITY SIDE OF THE MAIN CB. Disconnect all sources prior to servicing this equipment. Generation system AC Disconnect switch is located [Identify location of each Manual visibly open and lockable open AC disconnect switch]."*

When the interconnection is on the customer side of the main circuit breaker, below is an example of adequate verbiage:

> *"Warning: This service is fed by multiple power sources. Disconnect all sources prior to servicing this equipment. Generation system AC Disconnect switch is located [Identify location of each Manual visibly open and lockable open AC disconnect switch]."*

When applicable, extra signage may be required to illustrate the location of the manual visibly open and lockable open AC disconnect switch with respect to the rest of the facility. In such cases, provide a map that includes the following:

- True North
- Main Panel
- Sub-Panel(s)
- AC Disconnect Switches
- Generators/Inverters

5.4.2 At the Manual, Visibly Open, and Lockable AC Disconnect Switch

Signage at the manual, visibly open, and lockable open AC disconnect switch should note: NEM AC disconnect switch. Below are examples of adequate verbiage:

> *"Solar Photovoltaic AC disconnect switch, VAC, Phase, Amps per Pole"*

> *"Fuel Cell AC disconnect switch, VAC, Phase, Amps per Pole"*

When connecting to a breaker downstream of the main breaker, label that breaker as the connection point for the generation.

5.5 Telemetering

Please refer to section 7 of **SCE's Interconnection Handbook** (PDF) for information about telemetry requirements.

5.6 Net Generation Output Meter (NGOM)

A Net Generation Output Meter (NGOM) may be required as indicated in the applicable Rate Schedule – see section 1 for a list of Rate Schedules.

5.7 Generating Systems with Battery Back-Up

Battery back-up systems are typically NEM projects that include battery storage and may be used to carry critical loads during a grid interruption. Battery back-up requires an "open transition" transfer switch which is used to prevent back feed to the grid in the event of a grid interruption. This switch may be internal to the inverter or may need to be supplied separately.

The system must be installed such that the battery back-up downstream connections (i.e. sub panel) with relation to the rest of the facility will not be in parallel with loads not normally fed by the battery system.

For systems with a standby generator or back-up battery **not** connected to SCE's electrical system, please see **section 5.8** for requirements.

5.7.1 Additional Single Line Diagram Requirements for Battery Back-Up Systems

In addition to the requirements shown on the sample Single Line Diagrams in **Appendix A**, the Single Line Diagram for a system with back-up must also include:

- Detailed connection representation of the battery back-up point of connection;
- Detailed connection representation of isolated loads fed by battery back-up system via a sub panel;
- A functionality description;
- Additional manual, visibly open, and lockable open AC disconnect (if required)
- Battery back-up system requiring separate inverters

The Single Line Diagram must also be accompanied by a written statement describing the isolation of customer generation from grid.

5.8 Secondary Network Interconnection

Interconnection of NEM facilities onto SCE's secondary network distribution system is permitted. However, due to the complexity of secondary networks, additional requirements must be met to ensure continued reliable operation of the network.

In addition to standard NEM requirements, NEM interconnections must use one of the following to ensure non-export to the SCE secondary network:

- (Preferred) An under-power relay (minimum-import relay) should be installed to monitor power flow at the PCC. The relay should be set to disconnect the NEM generator from the SCE system when input power at the PCC falls below **Rule 21** (PDF) requirements (5% of the Generating Facility's total Gross Nameplate Rating, with a maximum 2.0 second delay).
- A reverse power relay should be installed to monitor power flow at the PCC. The relay should be set to disconnect the NEM generator from the SCE system when reverse power flow at the PCC falls exceeds **Rule 21** (PDF) requirements (0.1% of the service transformer's rating, with a maximum 2.0 second delay).
- Install dynamically controlled inverters (DCI) that monitor power flow at the PCC and will initiate a reduction of power output from the NEM to maintain a minimum import level.

5.9 Not Permanently Connected to SCE's Electrical System

A back-up generator or stand-by generator that is connected to the customer's distribution system through a transfer switch and is **not permanently interconnected with the utility** must be isolated from SCE's electric grid.

For such systems, the customer is not required to sign an NEM Interconnection Agreement, but the Generating Facility Interconnection Application (GFIA) must be submitted to satisfy SCE's notice requirements for operating an isolated generating facility.

For more information, please contact SCE's Grid Interconnections group at **rule21@sce.com**.

6 Protection Requirements

The interconnection of a new NEM generation facility to the SCE distribution system must not degrade any of the existing SCE protection and control schemes nor lower the existing levels of safety and reliability to other customers.

Generating Facilities operating in parallel with SCE's Distribution system shall be equipped with the following Protective Functions to sense abnormal conditions on SCE's Distribution System and cause the Generating Facility to be automatically disconnected from SCE's Distribution System or to prevent the Generating Facility from being connected to SCE's Distribution System inappropriately:

- Over and under voltage trip functions and over and under frequency trip functions.
- 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 SCE's Distribution System unless SCE's Distribution System service voltage and frequency are within normal operating limits and are stable for at least 60 seconds.
- A function to prevent the Generating Facility from contributing to the formation of an Unintended Island, and cease to energize SCE's Distribution System within two seconds of the formation of an Unintended Island (Island; Islanding: A condition on SCE's Distribution System in which one or more Generating Facilities deliver power to Customers using a portion of SCE's Distribution System that is electrically isolated from the remainder of SCE's Distribution System.)
- The Generating Facility shall cease to energize SCE's Distribution System for faults on SCE's Distribution System circuit to which it is connected (IEEE 1547-4.2.1). The Generating Facility shall cease to energize SCE's Distribution circuit prior to re-closure by SCE's Distribution System equipment (IEEE 1547-4.2.2)

Please reference SCE's Interconnection Handbook (PDF) for additional information.

The customer's system-protection facilities are at the customer's expense, and must be installed, operated, and maintained in accordance with all the applicable regulatory requirements and in accordance with the design and application requirements of this Handbook.

If an NEM Generation facility is to be connected on the line side of the customer's main breaker then it must have overcurrent protection per **ESR** section 1.11 requirements and **NEC** Article 690.9. Note: All connections made on the main service side of the main circuit breaker (line-side tap) require a signed professional engineer's stamp on the Single Line Diagram.

6.1 Inverter Protection Settings

Approved voltage and frequency setting per SCE's **Rule 21** (PDF) below:

- If inverter is 30KW or below, protection settings approved if inverter is UL listed (all CEC approved inverters meet this guideline)
- If inverter is larger than 30kW, protection settings are field adjustable

- Verify that it is UL listed
- Verify settings on each inverter during commissioning test by installer displaying settings on connected computer or on inverter panel.

If settings cannot be verified during a commissioning test, obtain a letter from the inverter manufacturer providing the inverter settings and their respective serial number. Distribution Engineering will verify the proposed settings to insure that they meet **Rule 21** (PDF) requirements -- see Appendix C.

Table 7.1-1 Voltage Relay Settings

Element	Element Name	Settings (< or =) % of Nominal	120V Base	480V Base	208V Base	Maximum Timing	
						Cycles	Seconds
27	Extreme Under-Voltage	50%	60	240	104	10	0.167
27	Under-Voltage	88%	105.6	422.4	183	120	2
59	Over-Voltage	110%	132	528	228.8	60	1
59	Extreme Over –Voltage	120%	144	576	249.6	10	0.167

Note: Producer can set relays more stringent than required by **Rule 21** (PDF). Such is the case in inverter systems.

Table 7.1-2 Frequency Relay Trip Settings

Element	Element Name	Settings	Maximum Timing	
			Cycles	Seconds
81O	Over-Frequency	> 60.5 HZ	10	0.167
81U	Under-Frequency	< 59.3 HZ	10	0.167

Unless otherwise required by SCE, a trip frequency of 59.3 Hz and a maximum trip time of 10 cycles shall be used.

6.1.1 Fuses

Fuses can be used as the protection device as long as the inverter is used as the generator protection. Fuses **cannot** be used as the generator protection for a generation facility because fuses:

- Are single-phase devices;
- May not operate under certain fault conditions;
- Do not always automatically completely separate the generation facility from SCE;
- Cannot be operated by the protective relays.

SCE allows customers to utilize fused manual, visibly open, and lockable open AC disconnects in conjunction with inverter/generator protection if they are connecting an NEM system ahead of the main breaker as permitted by the Authority Having Jurisdiction. For more information, please refer to SCE's **Electric Service Requirements** (PDF) and **Rule 21** (PDF).

If the customer utilizes primary switchgear, SCE does not allow the customer to use primary fuses nor circuit breakers which do not coordinate with SCE upstream protection.

6.1.2 Ground-Fault-Sensing and Stabilization

When required by **SCE's Interconnection Handbook** (PDF), a ground-fault-sensing scheme detects SCE's ground faults and trips the generator breaker or the generator's main circuit breaker, preventing the generator from continuously contributing to the ground fault.

Ground-fault-sensing scheme will consist of either a ground detector or ground bank depending on the configuration of SCE's power system.

7 Definitions

Accessible: A device that is accessible to Edison maintenance personal consistent with **Rule 21** (PDF) requirements.

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

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

Line-Side Tap: A point of interconnection on the utility, or line side of the main breaker.

Load-Side Tap: A point of interconnection on the customer, or load side of the main breaker.

Lockable: The disconnect must have provisions for a common 3/8" padlock, used as part of normal Edison maintenance lockout procedure. (see **Section 5.3** Manual, Visibly Open and Lockable AC Disconnect Switch)

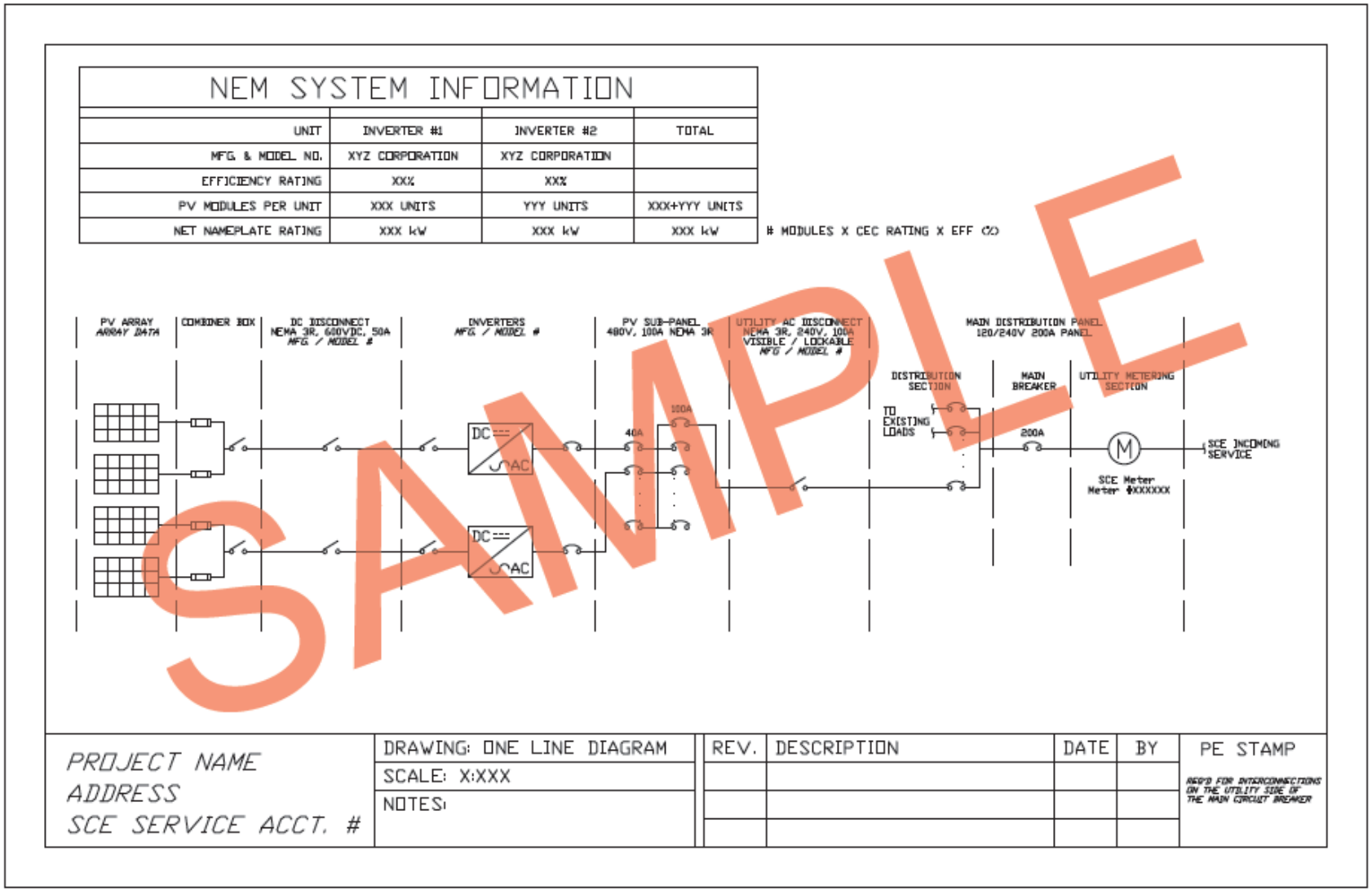
Non-Islanding: Designed to detect and disconnect from a stable **Unintended Island** with matched load and generation. Reliance solely on under/over voltage and frequency trip is not considered sufficient to qualify as Non-Islanding.

Non -Self Contained Meter: An SCE revenue grade meter at a customer panel that uses external current transformers to measure the flow of current.

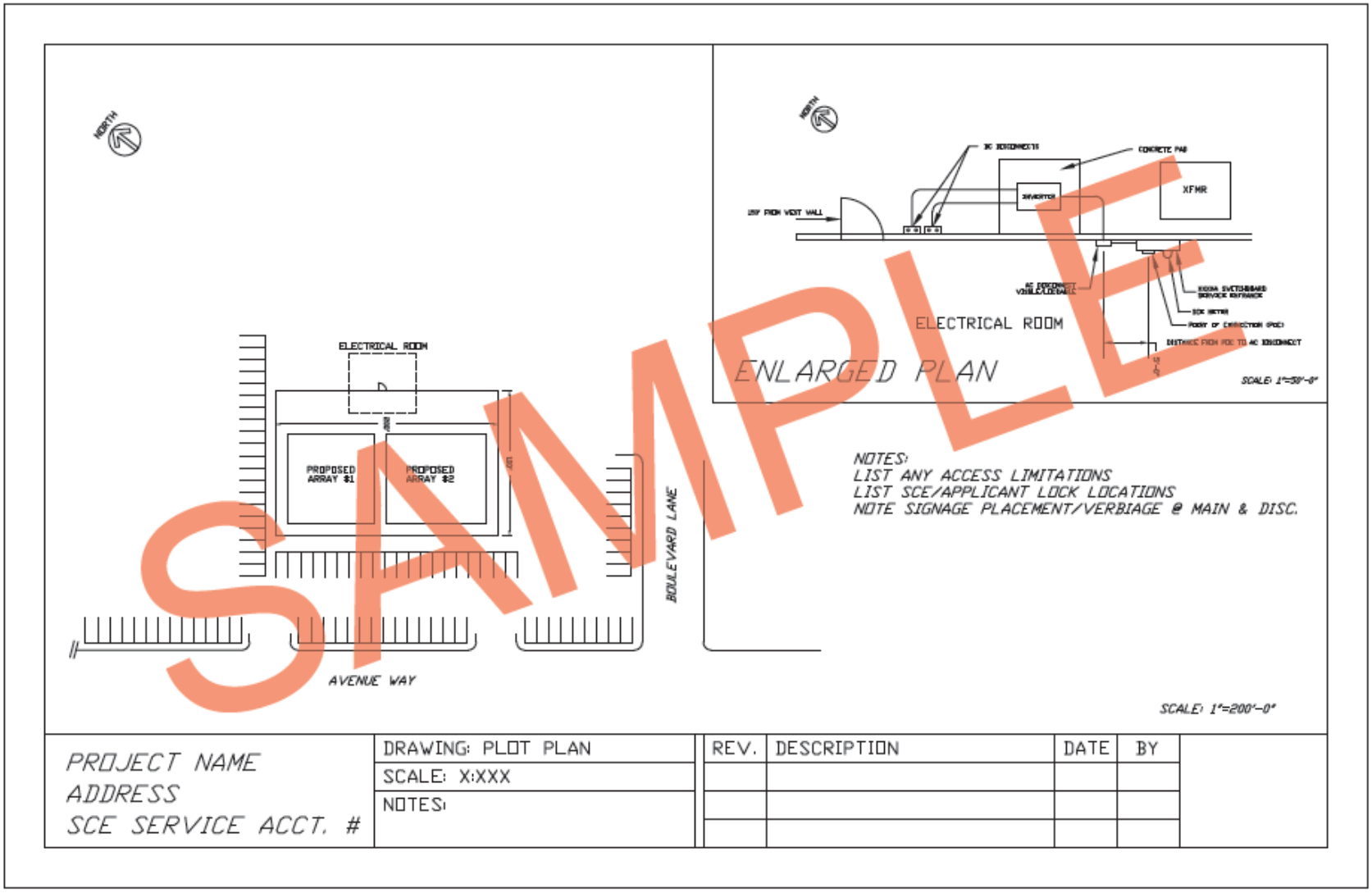
Unintended Island: The creation of an **Island**, usually following a loss of a portion of SCE's Distribution System, without the approval of SCE.

Visible: Visible means visible break; when the disconnect is in the open position, there is a visible separation between the contacts, and the separation may be observed without disassembling the device. Typically, this switch contains visible blades inside an enclosure, an external lever, and a positive indication that the switch is in the off position. (see **Section 5.3** Manual, Visibly Open and Lockable AC Disconnect Switch)

Appendix A: Sample Single Line Diagram



Appendix B: Sample Plot Plan



Appendix C: Inverter Settings Request

[Company Logo]

Friday, November 05, 2010

SCE Project NM #:

Inverter Model: _____

These settings apply to the following Serial Numbered Inverters:

1234-56789, 9876-54321, & 4561-23789

Project Location Address: *Enter Address Here*

Base Voltage (Nominal voltage):_____

Table 1: Voltage Trip Settings

Description	Actual Level		Actual Time
Extreme Under Voltage		%	s or cycles
Under Voltage		%	s or cycles
Extreme Over Voltage		%	s or cycles
Over Voltage		%	s or cycles
Under Frequency		Hz	s or cycles
Over Frequency		Hz	s or cycles

Best regards,

[Signature of representative]

Manufacture Representative

Manufacture Contact Information

Appendix D: Maximum Borderline of Irritation Curve