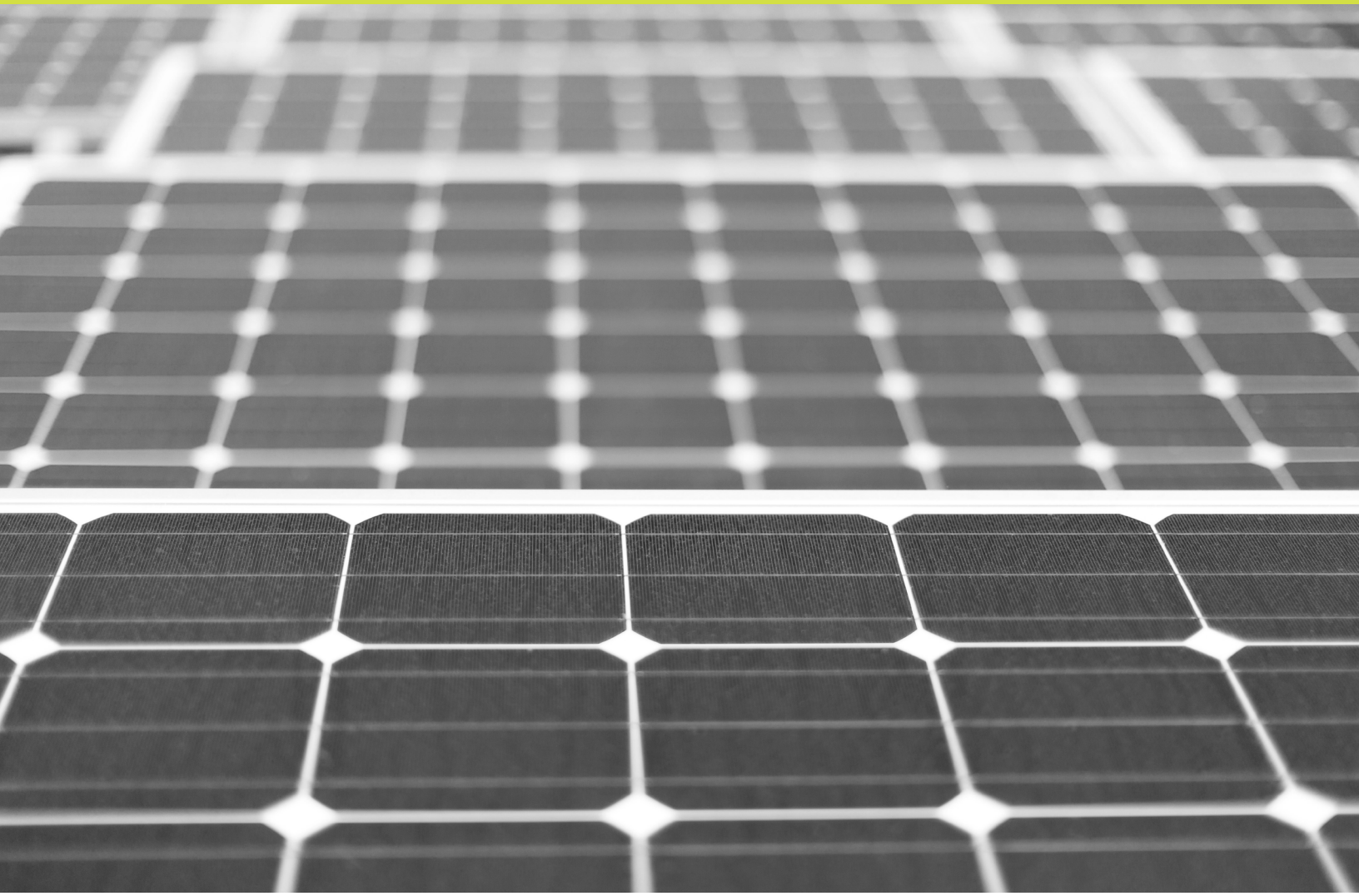
SOUTHERN CALIFORNIA EDISON®

Energy for What's Ahead℠

NET ENERGY METERING

Interconnection Handbook



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GET STARTED

Version 7.0

WHAT'S NEW

Effective Date: March 2018

This handbook has been updated from the previous version to reflect the following:

- Section 1- Added language on reference NEM 2.0 and reference Special Condition for Eligible Customer –Generators
- Section 2 - Added Schedule NEM-ST interconnection requirements and fees
- Section 3 - Added Harmonics Criteria Language
- Section 5. - Added smart inverters requirements updates
- Section 5.4.3 - Added GMA grounding requirements
- Section 5.6 - Update Signage Requirements
- Section 5.10 - Update Secondary Network Interconnection requirements
- Section 5.11 - Energy Management System Performance Requirements to not allow Energy Storage Charge from the grid

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1 OVERVIEW

A generating facility may not be operated in parallel with SCE's Distribution System UNTIL WRITTEN PERMISSION TO OPERATE IS GRANTED BY SCE, as required in Electric Rule 21 (PDF). Unauthorized operation may be dangerous and may result in injury to persons and/or may cause damage to equipment and/or property 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 the safe and reliable operation of SCE's electric system.

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

- **Schedule NEM-ST** (PDF): Net Energy Metering (including NEM Aggregation and Multiple Tariff)
- **Schedule FC-NEM** (PDF) Fuel Cell Net Energy Metering
- **Schedule NEM-V-ST** (PDF) Multi-Tenant, Multi-Meter Virtual Net Metering
- **Schedule MASH-VNM-ST** (PDF): Multi-Family Affordable Solar Housing Virtual Net Metering
- **Schedule BG-NEM** (PDF): Biogas Net Energy Metering
  (Note: Biogas digester generators must have commenced operation by December 31, 2009 to be eligible for the BG-NEM tariff)

This handbook does not address other types of generator interconnections under **Rule 21** (PDF) or the **Wholesale Distribution Access Tariff (WDAT)**. Note: **Schedule RES-BCT** (PDF) (Renewable Energy Self-Generation - Bill Credit Transfer) is addressed under Rule 21. For technical requirements for interconnection under **Rule 21** (PDF) or **WDAT**, please refer to **SCE's Interconnection Handbook** (PDF).

Under the NEM program (**CPUC § 2827**), customers installing generating facilities are eligible to interconnect if the generating facility is located on the customer's premises, generates electricity from a renewable source pursuant to paragraph (1) of subdivision (a) of Section 25741 of the Public Resources Code (i.e., biomass, solar thermal, photovoltaic, wind, geothermal, fuel cells using renewable fuels, small hydroelectric generation, digester gas, municipal solid waste conversion, landfill gas, ocean wave, ocean thermal, or tidal current), fuel cells or biogas, or a hybrid of these technologies, and is sized to offset all or part of the customer's electrical requirements. NEM 2.0 generating facilities with a gross name plate rating larger than 1 MW, NEM Aggregation requesting a new service, or NEM Aggregation retrofitting an existing service panel on a distribution circuits may require additional studies or be part of the Distribution Group Study. Reference Rule 21 section F.3.C.

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.

1.1 Eligible Customer-Generators with NEM special conditions are required to comply with NEM-ST.

(reference Schedule NEM-ST, Net Energy Metering Successor Tariff)

- California Department of Corrections (CDCR) generating facilities from 1 MW and not exceeding 8 MW.
- U.S. Armed Forces limited to the lesser of 12 MW or 1 MW over minimum load over the preceding 36 months.
  Note: An adjustment will be made by SCE, using existing telemetry data where available or information provided by the customer, to account for load served by existing on-site generation (so that the determination of minimum load is not reduced by load served by on-site generation). SCE may make additional adjustments, if necessary, to account for anomalies, such as outages, and may rely on mode minimum load registrations, daytime minimum load registrations, or other methods to reasonably determine the customer's minimum load for the sole purpose outlined above. A customer's minimum load determination shall only be updated at the request of the customer or any time a new NEM Interconnection Request for the United States Armed Forces base or facility is submitted.

NOTE: The NEM tariff is applicable for renewable electrical generating facilities that are intended primarily to offset part or all of the customer's own electrical usage and must be located on the customer's Premise. For generating facilities utilizing fuel cell technology, the total Renewable Electrical Generating Facility's capacity most not exceed 5 MW CEC-AC Nameplate rating and the lesser of 5 MW aggregate inverter capacity or 5 MW aggregate Fuel Cell gross nameplate capacity and most be located on the customer's Premise.

2 REFERENCE INFORMATION

2.1 Application Requirements

At **www.sce.com/nem**, SCE provides information about the NEM Program, NEM-ST Rate Schedules and required forms. Additionally, there is an application checklists, a sample Single Line Diagram and Plot Plan available for download.

NEM applicants are now required to use SCE's NEM online interconnection **application** system to submit an Interconnection Request (IR). Please access the online application system to view the status of an IR or submit additional documentation.

2.2 Equipment Information

Table 2.2-1: CEC Certified Equipment Listings

Equipment	Certified Listings
Inverters	http://www.gosolarcalifornia.org/equipment/inverters.php
Solar PV Modules	http://www.gosolarcalifornia.org/equipment/pv_modules.php
Wind Turbines	http://eneoia.com/erprebate/eligibile_smallwind.html
Fuel Cells	http://eneoia.com/erprebate/eligibile_fuelcells.html

NOTE: The certification listings above identify some of the electrical components of a generating facility. These components must be incorporated in the generating electrical design and shown on the Single Line Diagram (SLD) to ensure that the generating facility as a whole is compliant with the NEM tariff requirements.

If the proposed equipment is not listed on the certified equipment list, UL Certification of the equipment will need to be submitted. See Section 5.1 for details.

Calculations

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

Table 2.2-2: CEC-AC Nameplate Calculation for Inverter based Generation Facilities

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 2.2-4: Estimated Annual kWh Calculation

Technology	Estimated Annual kWh
Solar PV	Use the CSI EPBB calculator at www.csi-epbb.com or: (CEC-AC Nameplate) x 720 x 0.20 x 12 = ____ kWh
Wind	(CEC-AC Nameplate) x 720 x 0.15 x 12 = ____ kWh
Fuel Cell	(CEC-AC Nameplate) x 720 x 0.85 x 12 = ____ kWh

3 INTERCONNECTION REVIEW PROCESS

After an initial review to confirm the Application and SLD are complete and consistent, the NEM Interconnection team may refer the project 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. Projects greater than 1 MW under NEM 2.0 will be required to comply with Rule 21 tariff provisions.

The design must be in accordance with:

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

The purpose of the technical review is to facilitate the safe interconnection of eligible NEM generators to the SCE electrical Distribution System. To ensure the generator interconnection is in compliance with SCE interconnection requirements, the customer's generating facility will, at a minimum, be reviewed to ensure that the generating facility will:

- not unintentionally operate in an islanded mode with SCE's electrical system as required **by IEEE 1547**, UL 1741, and UL1741-SA listed,
- have a visible open, lockable disconnect switch and/or rackable breaker for isolation purposes, comply with SCE's **Electric Service Requirements (ESR)**.

If the generating facility exceeds the operating capabilities of the Distribution System relative to voltage control, system overload, system operating flexibility or other system condition, it will be required to mitigate such condition prior to Distribution Engineering providing technical approval. An NEM customer must bear the cost of the Interconnection Facilities. **Please refer to Decision 02-03-057, Rule 21, Section E.4., and Public Utilities Code Section 2827(g) for the delineation of cost responsibilities for Distribution Upgrades versus Interconnection Facilities**. Fail to comply with all the requirements in this section may result in potential delays. If the review determines corrections are needed, they must be completed prior to the Permission to Operate (PTO) being issued and the customer is responsible for all costs.

Document Review

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

- Completed on-line application Form: see NEM Interconnection Checklists at **sce.com/nem**;
- 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 requirements;
- Plot Plan: see **Section 5.3.6** for circumstances when a Plot Plan is required and **Appendix C** for a sample.
- Smart Inverter Specifications: see **Section 5.1** for more information;
- Photos of installed SCE decals, when applicable: see **Section 5.6** for more information.
- Intent to use a Generation Meter Adapter (GMA); see **Section 5.4** and **Appendix B**
- Line side / supply side taps: Please see **Appendix F**.
- Meter socket cut-sheets of the NGOM socket (if applicable).
- If transformers are used to interconnect the Generating Facility with SCE's Distribution System, please provide the transformer nameplate information (e.g., voltages, capacity, winding arrangements, connections, impedance).
- If a transfer switch or scheme is used to interconnect the Generating Facility with SCE's Distribution System, please provide component descriptions, capacity ratings, and a technical description of how the transfer scheme is intended to operate.
- If protective relays are used to control the interconnection, please provide protection diagrams or elementary drawings showing relay wiring and connections, proposed relay settings, and a description of how the protection scheme is intended to function: see **Section 6** for more information.

3.1 Commissioning Test

SCE intends to conduct a commissioning test and onsite inspection for as many sites as possible. 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 the 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 generating facility. **Rule 21**, Section H, voltage and frequency requirements will be tested and verified during the commissioning test

Regardless of the results of the commissioning test, the customer is not authorized to energize the system until SCE issues a Permission to Operate (PTO) letter. Once the assigned Engineer returns the project to the NEM IC group, PTO will typically be issued within five business days.

3.2 Interconnection Study

If, during the course of the initial and supplemental reviews, it is determined that an interconnection study is required, SCE will perform the study in accordance with Rule 21 timelines. The interconnection study will detail any additional Interconnection Facilities or Distribution Upgrades that will be needed to accommodate the applicant's generating facility. If the generating facility exceeds the operating capabilities of the Distribution System relative to voltage control, system overload, system operating flexibility or other system condition, it will be required to mitigate such conditions prior to SCE providing technical approval. In addition, SCE may require a harmonic study during the execution and construction phase to insure that the generation facility complies with the harmonic current limits outlined in IEEE 519-2014. For project over 1 MW and NEM Aggregation projects, the customer is responsible paying all triggered upgrades.

3.3 Review Fees

- Application fees for NEM Successor Tariff vary depending on the generating capacity of the system. The application fee is as follow: 1 megawatt (MW) or smaller-$75*
- Above 1MW-$800

** Note: Both the CEC-AC rating, as applicable, and the aggregate inverter capacity must be ≤ than 1 MW for a generating facility to be considered 1 MW and smaller.*

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 generating facility may be operated during such interruptions only with an open tie to SCE.

Islanding[1] with SCE systems will not be permitted under any circumstance.

Technical Approval is based on the following criteria:

- **15% Rule**: the applicant's generating facility combined with existing generation does not exceed 15% of the maximum loading of the line section. For more information, please refer to **Rule 21**, Section G.1.m.
- **Overloading**: all distribution equipment must not be overloaded by the applicant's generating facility.
- **Voltage Operating Levels**: the applicant's generating facility must not create a voltage drop or rise that is outside the allowable operating-voltage bandwidth specified in **Rule 21** and **Rule 2** (PDF).
- **System Upgrades:** upon review by SCE, system upgrades may be required to allow the system to accommodate the interconnection of the generating facility.
- **Harmonics:** All equipment connected to the SCE distribution system, will be subjected to CPUC Rule 2.E. allowing SCE to require the IC to mitigate interference with service other SCE customers, including harmonics impacts, if the harmonics interference is caused by the Interconnection Customer.

Please refer to Section 3 (above) for the delineation of cost responsibilities for Distribution Upgrades versus Interconnection Facilities.

NOTE: For technical analysis defined in this Handbook, SCE will use the Aggregate Inverter Capacity.

Following a generation facility disconnect as a result of a voltage or frequency excursion (parameters are described in **Rule 21** Section H 1 & H 2. a. 2), the generation facility must 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.

1 Rule 21, Section C, Definitions.

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).

4.2 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.

4.3 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 may be more than these limits. It is 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 SCE's "**Rule 21** - Generating Facility Interconnections," **IEEE 1547**, UL 1741, UL 1741 SA, and **SCE's Interconnection Handbook** (PDF). If the inverter does not meet Underwriters Laboratories Standard UL 1741 and UL 1741 SA certification CSA, or Section "L" of **Rule 21** (PDF), additional protection requirements and testing may be required.

- Customers interconnecting inverter-based Generating Facilities are required to comply with the requirements of Section Hh of SCE's Electric Rule 21, including configuration protective settings in accordance with the specification therein. Verification of compliance with such requirements shall be provided by the customer upon request by SCE in accordance with SCE's Electric Rule 21
- Installers /developers are responsible to comply with contractual agreement by programming smart inverter following manufacture guidelines.
- Failure to comply with Section Hh of SCE's Electric Rule 21, and Section 4.8 of the Interconnection Agreement may results in possible delays and it will affect the permission to operate the generating facility.

Inverters listed in at the **Go Solar California site** have met UL 1741 and UL1741 SA-Listed and **IEEE 1547** standards:

- Underwriters Laboratories Standard UL 1741 and UL1741 SA certification, or
- Section "L" 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 **Consumer Energy Center**.

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

Separate single-unit or multiple-unit inverters that do not meet UL 1741 and UL1741 SA 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 generating facility to normal status. Any and all additional information necessary to demonstrate compliance with **Rule 21** 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) Appendix E;
- Reference the use of a Generation Meter Adapter (GMA), if applicable; see **Section 5.4** for installation procedures see **Appendix B**;
- Service Panels;
- Protective devices: Circuit Breakers, Fuses, CT and PT ratings, if applicable;
- Utility meter;
- Net Generation Output Meter(s), of applicant, including the meter socket built-in component, CT and PT ratings, if applicable;
- Make and model of all generators on site including existing equipment; Detailed component information (characteristics) 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;
- Other types of generation and system size, such as paired storage devices, emergency battery backup, diesel generators, permanently connected generators, etc. including their related interconnection equipment such as open transition transfer switches, relays and control systems;
- Manual, visibly open, and lockable open AC disconnect switch, including make and model (all info outlined in proposed SLD) – see **Section 5.5** for Manual, Visibly Open and Lockable AC Disconnect requirements;
- Code and version to be used for construction, repair, inspection and testing.

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

Additional Requirements for Line-Side Taps

When the point of interconnection 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

Refer to **Appendix F** for additional requirements.

CAUTION ABOUT BROKEN METER SEALS:

Per **ESR**-5, Section 1.0, (pg. 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**-6, Section 1.0 (pg. 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**-6, Section 5.0, Figure 6-8 (pg. 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 Plug-In Generation Facilities to Electrical Wall Outlet

Plug-In generation facility projects are projects that have the ability to interconnect onto the customer's facility electrical system through an electrical outlet. SCE does not approve the use of these types of plug and play generation facilities proposing to interconnect and operate in parallel with SCE's Distribution Grid. These type of interconnections pose a safety and reliability concern to the public and SCE employees due to the ability of the end user to move the plug and play generator to any electrical outlet, thereby, violating NEC code 705.12(D)(1).

5.4 Generation Meter Adapter (GMA)

A Generation Meter Adapter is an approved method to interconnect your residential NEM project to SCE's electrical grid. The GMA will be installed between the residential customer's electrical service panel socket and the SCE revenue meter, and will be used to facilitate an alternative interconnection option to the traditional supply side connection without the need to modify the service panel.

SCE will own and install the GMA at the customer's expense pursuant to the terms and conditions of an Interconnection Facilities Financing and Ownership Agreement (IFFOA).

The GMA is only to be used for NEM projects that do not include storage or additional residential load between the generator and the GMA with a maximum inverter nameplate capacity of 65 amps (15 kW).

5.4.1 General Requirements for GMA

You can request to utilize a GMA when applying for a NEM interconnection. Simply select "Line Side- Generation Meter Adapter" as a method of interconnection on the online application. Please refer to the GMA fact sheet on **www.sce.com/nem** for additional information and FAQs.

Reference: **Generation Meter Adapter for Net Energy Metering – Interconnection**

5.4.1.1 Types of Service Panels that are eligible for the GMA

- Must be residential, single phase 120 or 120/240 V service
- Must be rated at 200 amps and below
- Must be installed on a service panel manufactured with an existing main breaker
- Must have the ability for the neutral conductor to be terminated in the customer's breaker section

5.4.1.2 Types of Service Panels that are NOT eligible for the GMA

- Service panels with existing meter adapters
- Service panels with existing ESR violations
- A- Base adapter meter sockets or remoter meter panels
- Main breaker in a different location to where the SCE revenue meter is located
- Current transformer rated panels
- Residential or commercial three phase service
- Multi-metered service panels
- Old sequence service panels
- Panels that cannot have a neutral conductor terminated on customer's section

5.4.2 Technical Requirements for the GMA

SCE considers the use of the GMA as an alternative to a conventional line side connection to the customer's service panel. Please see **Section 5.2** and **Appendix B** for requirements regarding SLD and **Section 5.5.6** for plot /site plan requirements. The over-current protective device must be located between a minimum of 2 feet and a maximum of 3 feet. See **Section 5.5.5** for requirements regarding AC Disconnects.

SCE will install and own the following GMA meter socket:

- Socket Meter Extender Cat. #: EZ 1000-0-R-Solar
- Manufacturer: Marwell Corporation customer's service panel.
- Please Refer to Marwell Corporation (Part # EZ 1000-0-R-Solar) for UL Listed Meter Socket Adapter Specification Sheet

5.4.3 Grounding Customer Systems Downstream of GMA

Proper grounding on the customer panel and A/C disconnect is the customer's responsibility. The customer is responsible for properly grounding their equipment according to the AHJ requirements without relying on SCE owned equipment.

- The GMA is SCE equipment and becomes part of the meter when installed
- No customer owned conductors, including grounding conductors, are allowed in the GMA or its attached conduit
- If customer wishes to tie their generation system ground to their service panel ground they may install a second conduit to the breaker section of their service panel

5.5 Visible Open AC Disconnect Switch requirements for generation interconnection to distribution voltages 34.5KV or below[2]

Per SCE guidelines, a single visible open, lockable AC 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); see Section 5.2
- All Generation Meter Adapter applications; see **Section 5.4**

Refer to **Rule 21** Section H.1.d and **SCE's Interconnection Handbook** (PDF) for visible open disconnect requirements.

2 SCE's Interconnection Handbook provides the requirements for voltage greater than 34.5 kV.

5.5.1 Disconnect type and location must be reviewed and approved by Field Engineering

In order for SCE to operate and maintain the Distribution System safely and reliably, it is mandatory that all electrical sources to SCE's Distribution System have the ability to be disconnected from the system with a single, visible open and lockable switching device. The location requirements for such devices are as follows:

1. Line Side connections

    a. For all line side connections, the location of the single, visible open AC Disconnect shall be directly adjacent to the PCC.

    b. If the location of the AC Disconnect cannot be placed directly adjacent to the PCC then the assigned engineer will need to review and approve the location prior to installation; however, the placement of the overcurrent device shall be no further than 10 feet from the PCC.

2. Load Side connections

    a. For a load side connection, where the point of interconnection is downstream of the customer's main breaker, the single, visible open AC Disconnect shall be located near the PCC.

    b. If the location cannot be placed adjacent to the PCC, proper signage and accessibility will need to be reviewed and approved by the assigned engineer prior to installation of such device.

3. Generation Meter Adapter (GMA)

    a. When a GMA is requested to be installed, the single, fusible, visible open, lockable AC Disconnect must be installed adjacent to the PCC.

    b. If the over-current protective device is in the AC Disconnect, then the AC Disconnect must be installed at a minimum of 2 feet to a maximum of 3 feet using liquid tight flex conduit.

Having the ability to disconnect and to secure the disconnection of the various electrical sources will allow SCE's workers to safely perform the required maintenance to the Distribution System by removing, tagging and taking the required clearances to the system where maintenance is to be performed. SCE's Distribution System is designed with switches and other devices that can be used to disconnect the SCE source to any section of the Distribution System. However, in order to achieve the required, complete isolation from all the sources, the generation facility sources that are connected to the Distribution System must also have the capability of being securely disconnected with a single, visible open and lockable switching device. While SCE acknowledges that in some cases, installing the required disconnecting device may significantly increase the cost of the interconnection, SCE must ensure that the system is safe to operate and maintain and thus must

require the appropriate disconnecting device. SCE will accept the following alternatives to installation of a visible open and lockable disconnect in order to maintain the ability to disconnect the generating facilities from the Distribution System:

5.5.2 Self-Contained Meter[3] with One Main Switch (Circuit Breaker, CB)

For these facilities, SCE can utilize the SCE revenue meter to disconnect the generation and load from the SCE Distribution System. See **Figure 1** for typical system configuration. In order to use this option, the following requirements must be met:

1. Facility must have a main breaker that can be operated by the customer on the same metering switchboard (meter panel) as the revenue meter.

2. Customer must agree that when it is necessary to disconnect the generating facility by opening the main CB and then removing the revenue meter, the customer will also experience an outage to the customer's facility until the meter is re-installed.

Restrictions:

For the facilities or the conditions below, the option of removing the revenue meter for disconnection purposes is not available. The customer must install a visible open disconnect adjacent to the PCC or at an approved location that should be in line of sight with approved signage and on a single disconnecting switching device as required by Rule 21 and SCE's Interconnection Handbook.

a) Facilities that install a GMA

b) Facilities that do not have a main CB in the metering enclosure.

c) Facilities that are proposing to connect to the source side of the CB (when allowed).

d) When customers do not agree on facility outage when required to disconnect the generator from the Distribution System.

3 Reference SCE's Electrical Service Requirements for information on Self-Contained Meters.

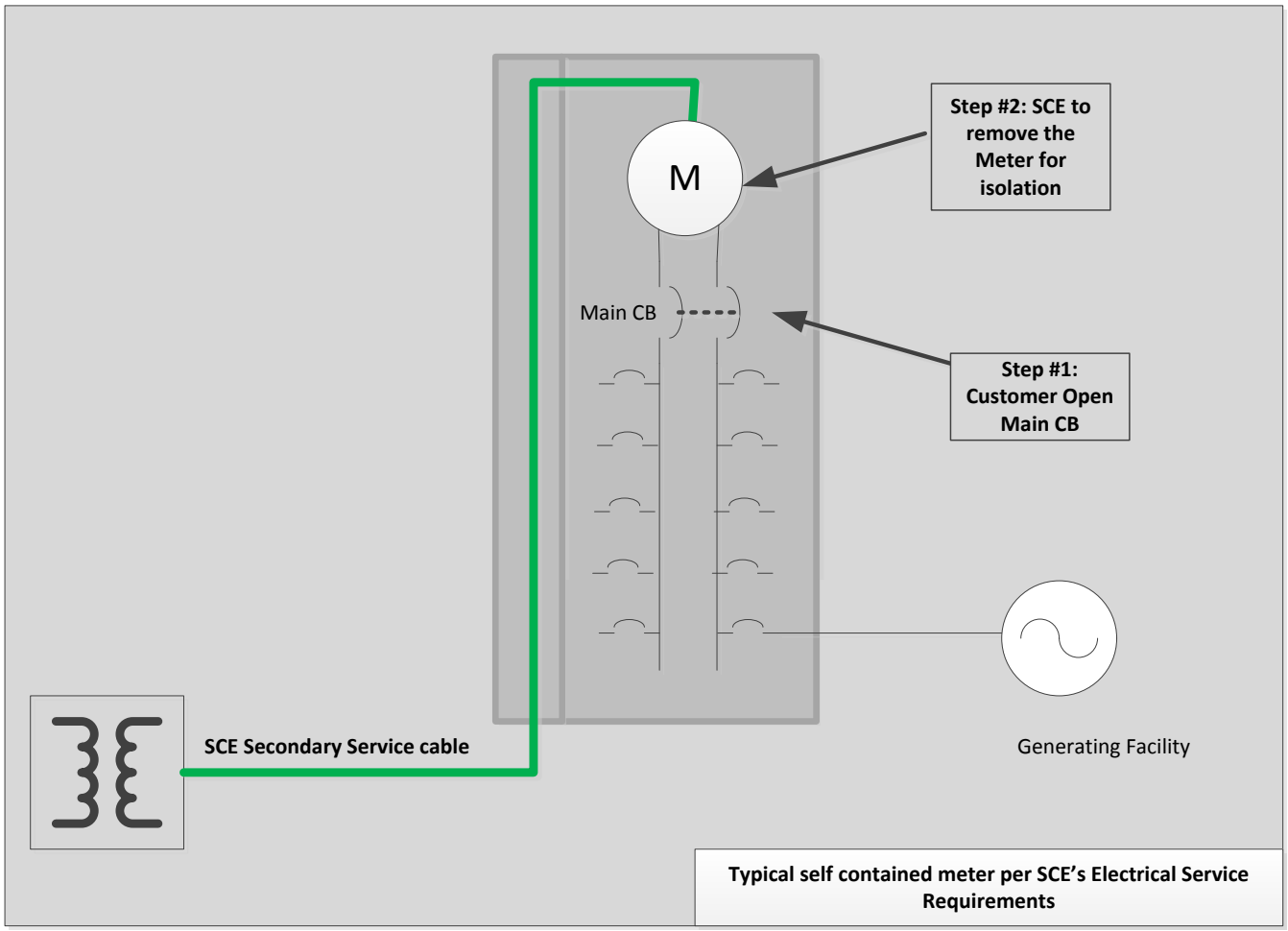


Figure 1- Typical Self-Contained Meter System

5.5.3 Non Self-Contained Meter – Secondary Voltage Connection

These generating facilities cannot be disconnected by simply removing the revenue meter as the metering is achieved by current transformers (CTs). Refer to **Figure 2** for typical installation. These types of installations are typically utilized for medium-sized commercial or industrial customers. For these types of systems, the following are the disconnect device requirements:

1. Must comply with **Rule 21** Section H.1.d – Visible Open Disconnect Requirement and **SCE's Interconnection Handbook** Section 5.11.1- Manual disconnect.

2. One single disconnect is to be used to disconnect all generation at a facility.

    a. When adding additional generation to a facility that currently has generation at the facility, the added generation must be connected to the existing disconnecting device.

3. The visible open disconnect must be adjacent to the Point of Common Coupling (PCC) ***at an approved location that should be in the line of sight with approved signage and on a single disconnecting switching device as required by*** **Rule 21** ***and*** **SCE's Interconnection Handbook,** and must comply with access requirements per **Rule 21** Section H.1.d.

    a. Inside the same electrical metering room.

    b. Immediately outside the electrical metering room.

4. Location of visible open disconnect must be approved by SCE prior to installation.

    a. Plot plan outlining the locations of the visible open disconnect must be provided in the interconnection request.

5. For all line-side connections, the Visible Open Disconnect must comply with **Section 5.5.1.**

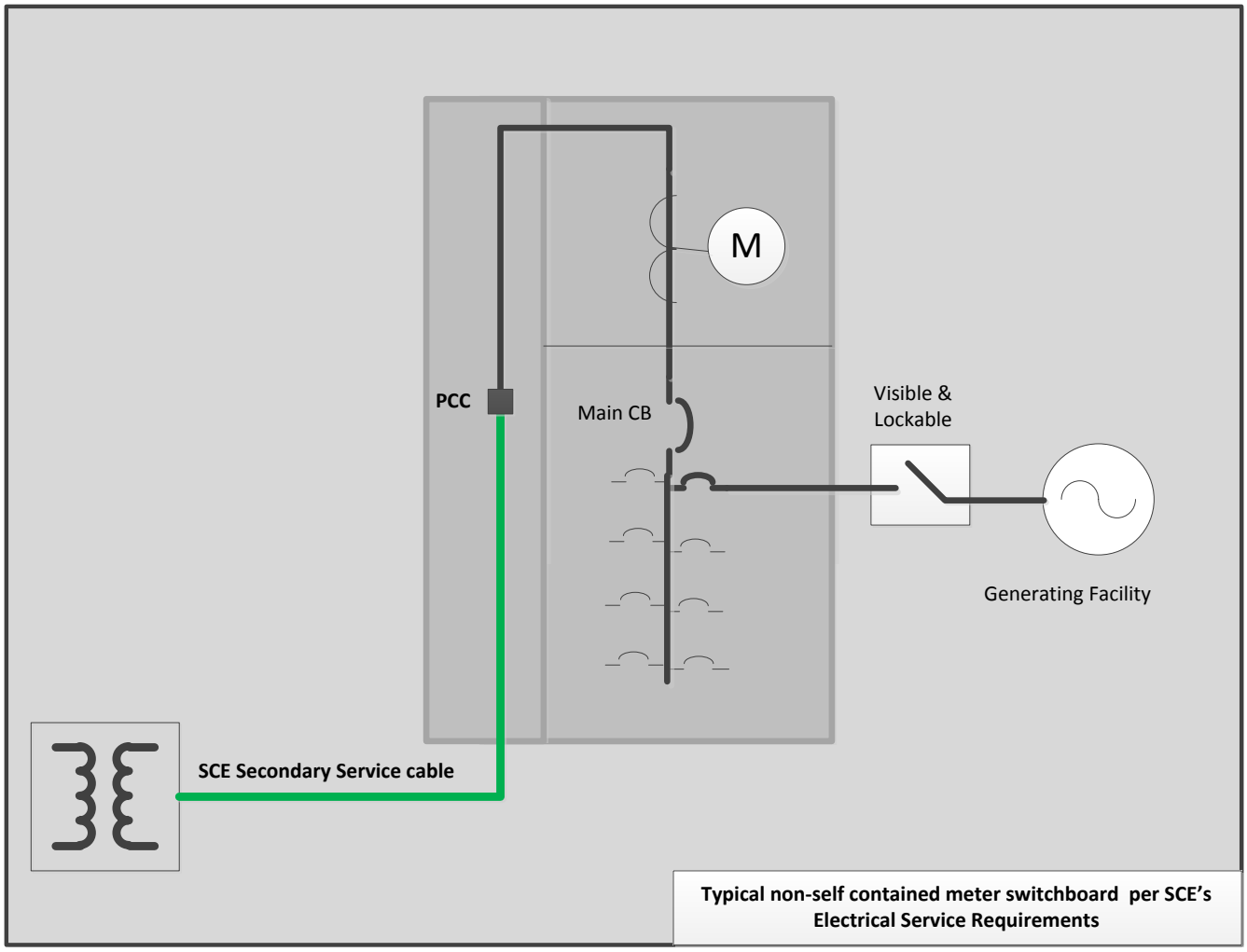


Figure 2 - Typical Non-Self-Contained Meter Switchgear

5.5.4 Primary Service Voltage Connections

These types of installations are typically utilized by large customers or by customers that have a campus-style electrical system. For these types of installations, the generation is typically installed on a panel fed by the customer's transformers (see **Figure 3**). For these types of installations, it becomes extremely difficult to comply with the "one single disconnect at the PCC" requirement. SCE's main intent is to have the ability to remove the generation from SCE's Distribution System so that SCE personnel may work on the Distribution System safely. To this extent, SCE and the customer can agree to use the customer's main rackable breaker to provide the disconnecting means when it is necessary to remove the generation from SCE's Distribution System. The following are the requirements:

1. Facility must have a main breaker that can be opened and racked-out by the customer.
    a. SCE's clearance policies can take a clearance to a customer CB when SCE can take control over the CB. This would be accomplished by witnessing that the CB was racked out and by applying SCE's lock and tagging procedures.
2. Customer must agree, when necessary, to disconnect the generating facility by opening and racking-out the CB, the customer will also experience an outage to the customer's facility.
    a. Customer must provide a letter on their company letterhead confirming agreement with this requirement.

Restrictions:

For the facilities or the conditions below, the option of using the main breaker for purposes of disconnecting the generating facility is not available; therefore, the customer must install a single visible open and lockable disconnect as required by Rule 21 and SCE's Interconnection Handbook near the PCC and on a single disconnecting device.

a) Facilities that do not have a main CB that is capable of being racked-out.
- Customer may replace the CB section with a rackable CB in order to meet the requirement.

b) When customer does not agree on facility outage when isolating the generator from the Distribution System.

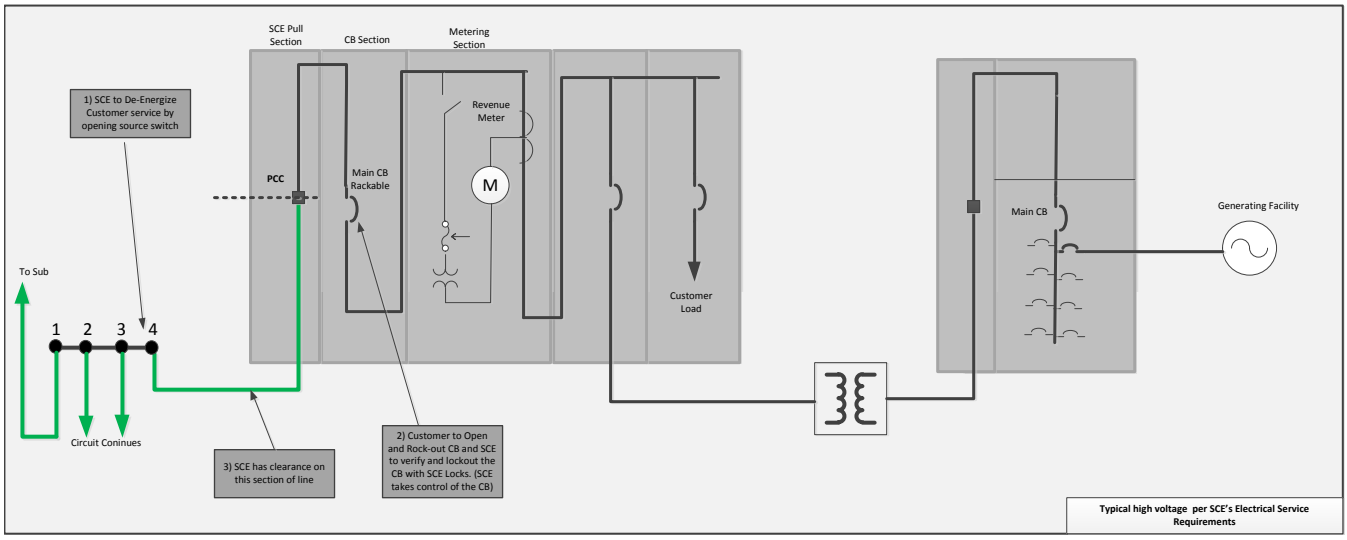


Figure 3 - Typical High-Voltage Service Interconnection

5.5.5 AC Disconnect requirements for Generation Meter Adapters (GMA)

When a customer proposes to use a GMA, a single, visible open, lockable AC Disconnect shall be installed adjacent to the PCC. The minimum distance should be least 2 feet from the SCE revenue meter to allow SCE crews to work on the residential service panel. If a fused AC Disconnect will be used, then then maximum distance can be 3 feet and customers must use liquid tight flex conduit.

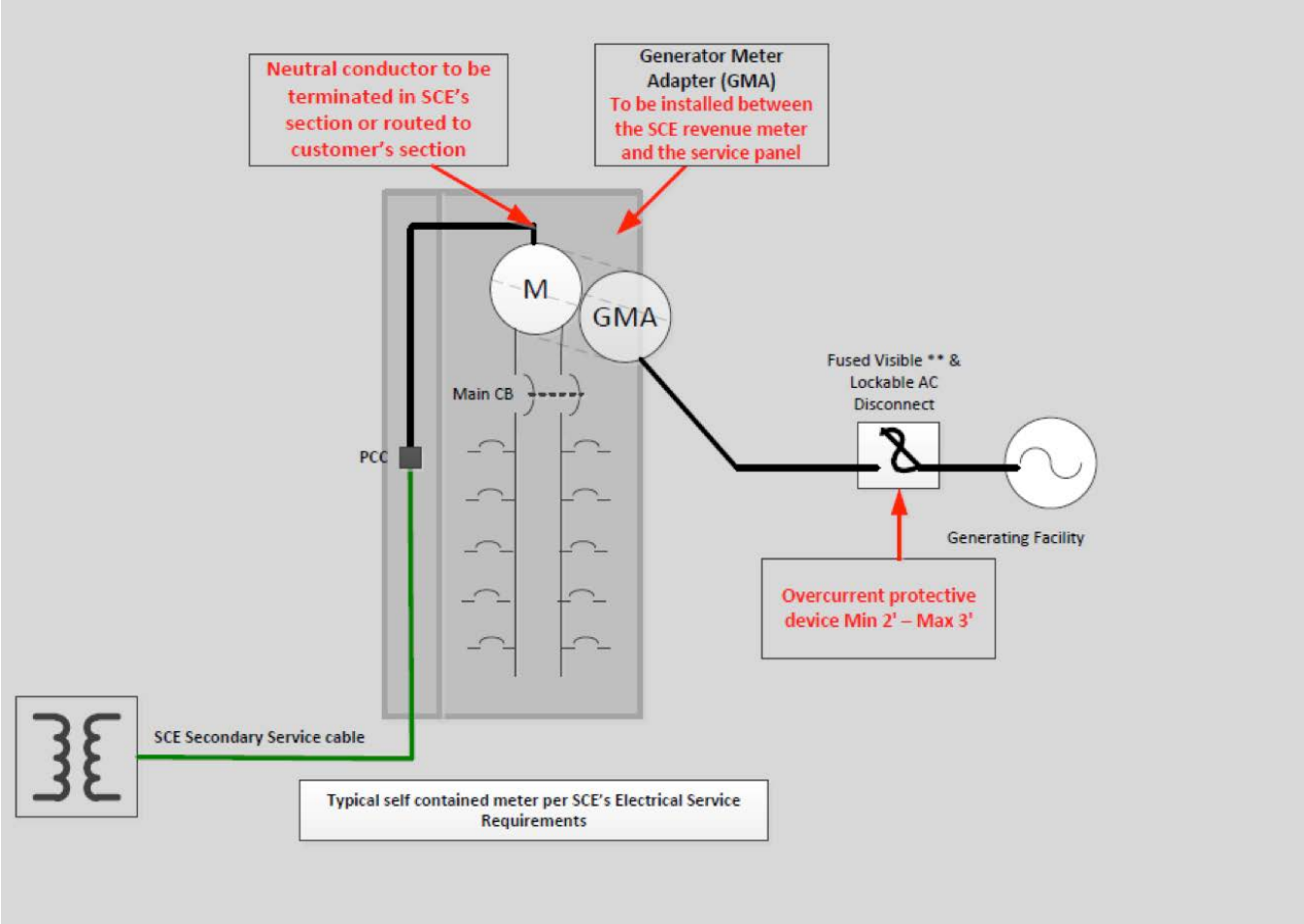


Figure 4 – Typical Self-contained service panel

5.5.6 Plot Plan Requirement

See Appendix C 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, showing the location, including the distance of the manual visibly open

and lockable open AC disconnect switch with reference to the utility meter. Note that this is a different plot plan from the plan that is required for NEM Aggregation projects.

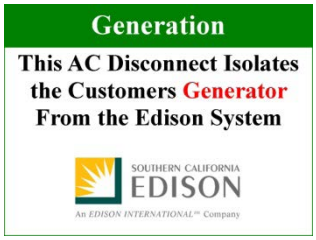
5.5.7 Circumstances when AC Disconnect May be Opened by SCE

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

- 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.

5.6 Signage Requirements

SCE may require decals to be installed on the generating facilities. The distribution engineer may require decals to be installed as a requirement. SCE may verify the decal installation during the final technical approval commissioning if required.

Decals that will be installed on the customer's main service panel	Decals that will be installed on the AC Disconnect to be used for utility isolation of the generator
	

Customer will have the option to receive the decals by the following methods:
You may order decals (25 minimum order) from the following location [**Decal Link**]

1. For decals that need to be placed on the main service panel, please order Decal number:
    a. SCE Item 15-41-A REV 1/11 Size 4"X3" for small panels
    b. SCE Item 15-43-B REV 1/11 Size 7"X5" for larger panels
2. For decals that need to be placed on the AC Disconnect[4], please order Decal Number:
    a. SCE Item 15-40-A REV 1/11 Size 4"X3" for small AC Disconnects
    b. SCE Item 15-40-B REV 1/11 Size 7"X5" for large AC Disconnects

For instructions on decal placement, please see Appendix G.

> SCE decal placement does not authorize the generation facility to operate in parallel. You may only turn on your system once you have received written notification of Permission to Operate from SCE.

5.7 Telemetering

Please refer to Section 7 of **SCE's Interconnection Handbook** for information about telemetry requirements. For NEM-paired storage projects, the nameplate of the battery storage inverter also counts towards the threshold for telemetry.

5.8 Net Generation Output Meter (NGOM)

A Net Generation Output Meter (NGOM) may be required as indicated in the applicable NEM **Rate Schedule** – see section 1 for a list of Rate Schedules. Please see **Figure 5** for additional requirements.

For Virtual Net Energy Metering projects, either **Schedule NEM-V-ST** or Schedule MASH-VNM-ST, a NGOM will be required and paid for by the customer, and the customer must also provide and install the NGO meter socket per the **ESR**. The point of interconnection must be made in parallel to other SCE revenue meters and not in SCE sealed sections. Refer to the **Electrical Service Requirements** Section 1.12., and **Figure 6** for wiring instructions of the NGO socket.

4 Please reference Section 5.2.1 of the Handbook as to when AC Disconnect is required.

5.8.1 AC Disconnect requirement for NGO meter sockets

When a NGO customer meter socket is installed, a line side and a load side ganged operated, visible open, lockable AC Disconnect shall be installed. See **Figure 5**. ** Note, Interconnection facilities must also comply with SCE Electrical Service Requirement (ESR-1, Section 12 Customer Generators).*

- For NGO meter sockets rated at greater than 600 V, the AC Disconnects shall be installed directly adjacent to the NGO meter socket.
- For NGO meter sockets rated at 600 V or below, the AC Disconnects shall be installed in line of sight of the NGO meter socket.
- These AC Disconnects may be in addition to the single AC Disconnect that is required to isolate the entire generating facility.

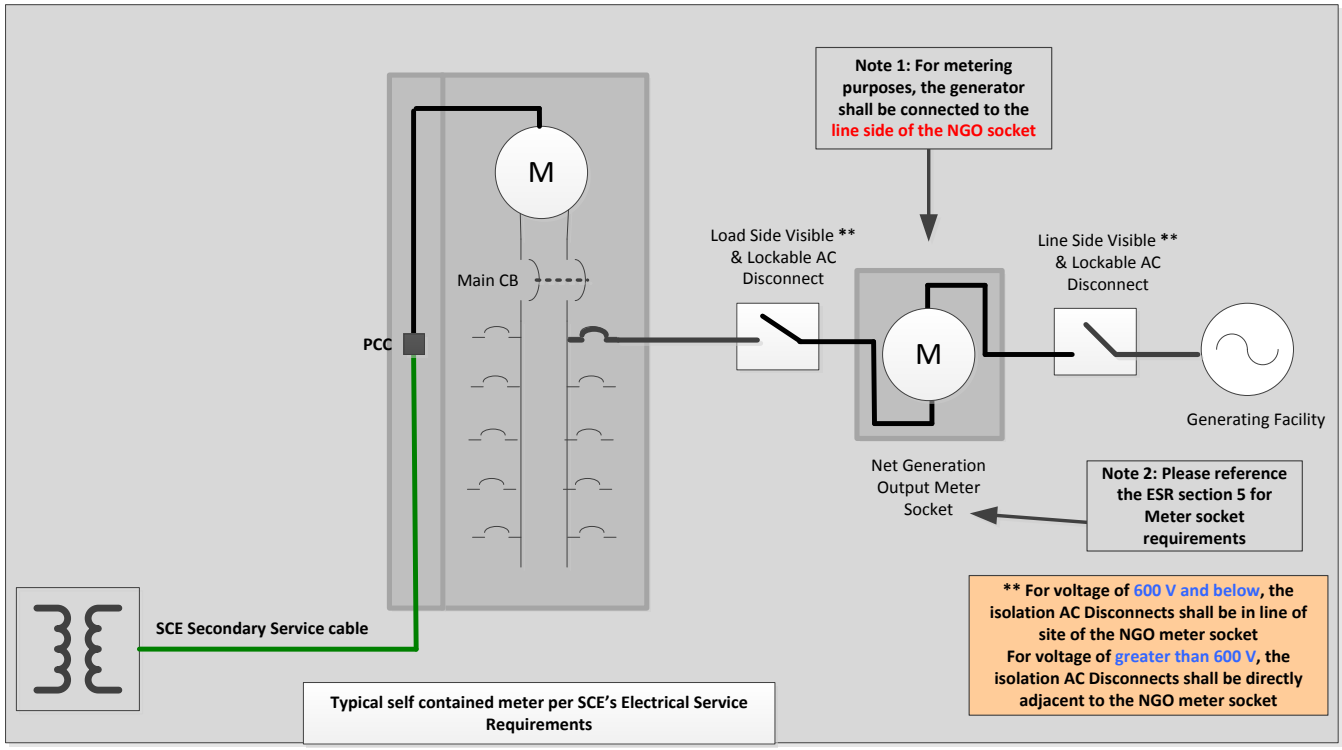


Figure 5 - Typical Self-Contained Meter System with NGO Metering and AC Disconnects

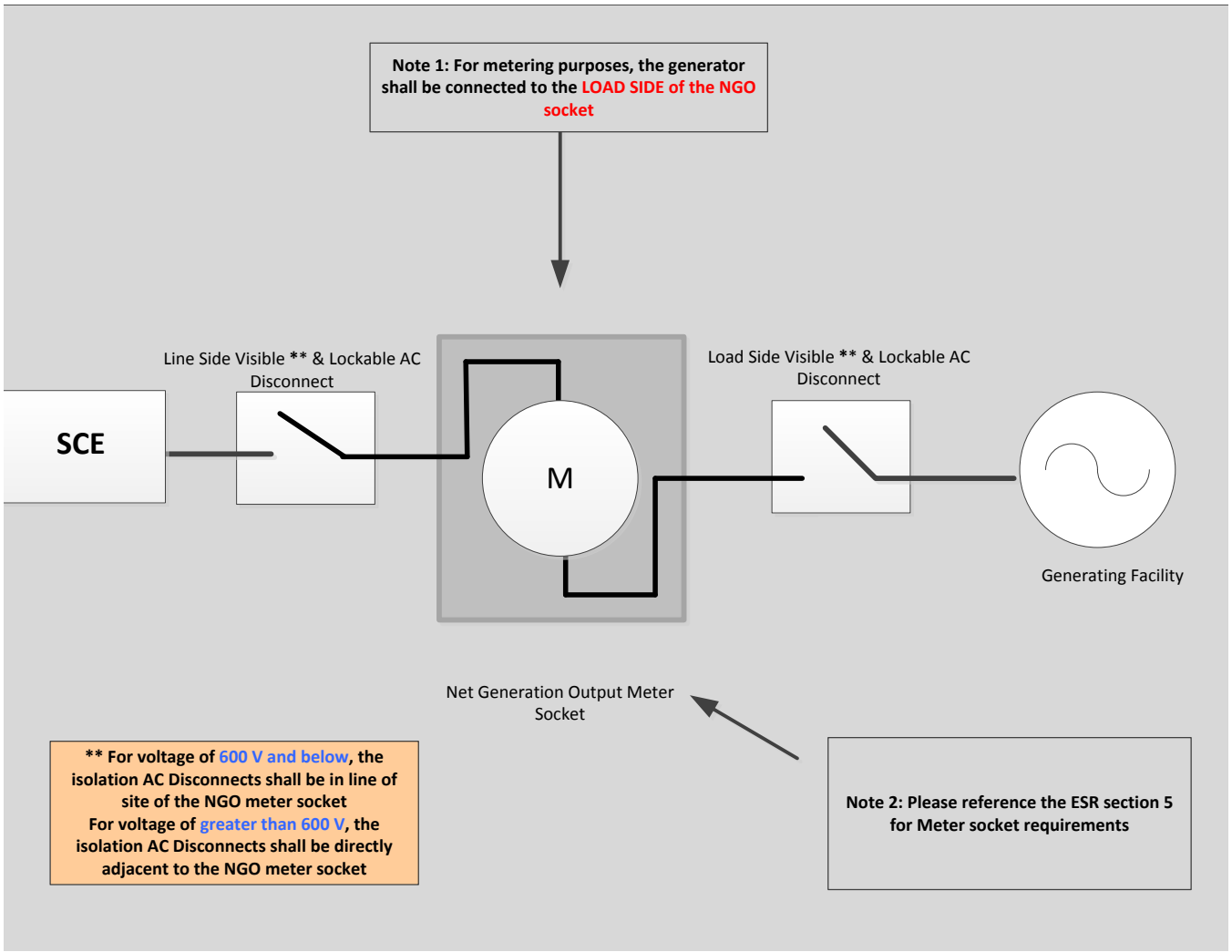


Figure 6 - Wiring of a NGO Meter Socket for Virtual Net Metering Projects

5.9 Sizing Requirements for NEM Interconnection with Paired Energy Storage devices

Per the CPUC NEM-Paired Storage Decision (D. 14-05-033), if the storage device (e.g., batteries, flywheels) is paired with an NEM eligible generator (e.g., solar, wind, etc.), and the storage device has an Inverter Rating of 10 kW (AC) and below, there are no sizing restrictions or requirements for the storage device (e.g., no requirement to be sized to the customer demand or the NEM generator).

For energy storage devices where the Inverter Rating is >10 kW (AC), the maximum output power of the storage device cannot be larger than 150% of the NEM Renewable Electrical Generating Facility's (REGF) capacity. For example, if the REGF is sized to load at 20 kW, then the inverter rating for the storage device can be a maximum of 30 kW (AC).

5.9.1 Metering for NEM-Paired Storage Device

For NEM-paired storage systems where the storage device has an Inverter Rating of 10 kW (AC) and below, no additional metering on either the NEM REGF or the storage device is required. Instead, an estimation methodology will be used in lieu of metering to validate the eligible NEM credits. However, a customer can opt-in to installing a net generation output meter (NGOM) or non-export relay, when it is technically feasible to do so, instead of having the estimation methodology applied[5]. In this case, the project must adhere to the metering requirements similar to those in the NEM-MT (multiple tariff) section of Schedule NEM.

For NEM-paired storage facilities where the storage device has an Inverter Rating >10 kW (AC), the project must adhere to the metering requirements similar to those in the NEM-MT section of Schedule NEM. These projects will be required to

- Install a non-export relay[6] on the storage device(s) or
- Install a NGOM directly to the NEM REGF(s).

Projects falling under this category must adhere to the NEM-MT metering provisions, and are not eligible for the estimation methodology in lieu of metering. See **Figure 7** for metering configurations.

5 For projects that opt-in to install an NGOM or for projects that require an NGOM, Section 5.5.1 of this Handbook apply.
6 Please Reference Rule 21 Section G.1.i – Option 1 or Option 2.

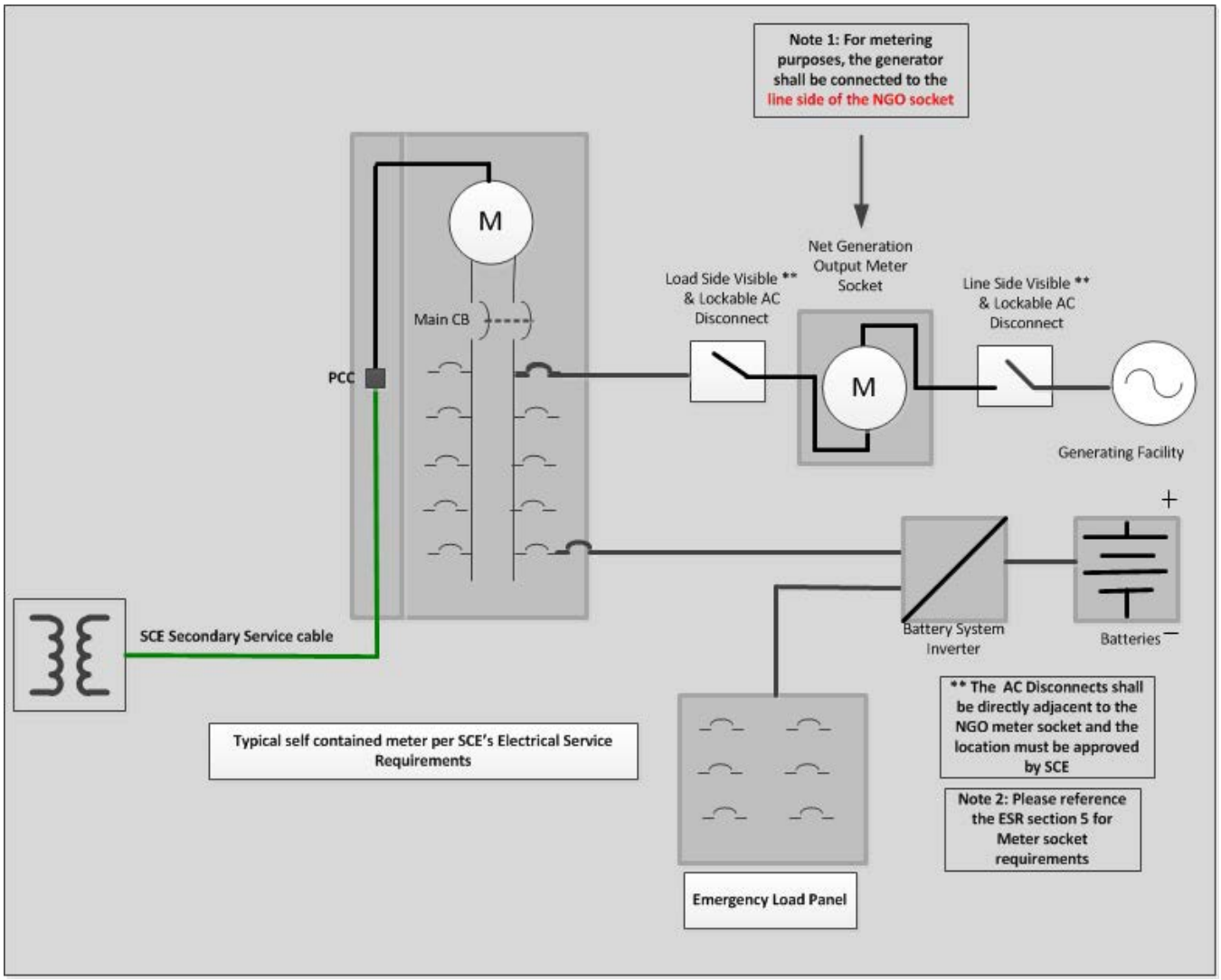


Figure 7 - Wiring of a NGO Meter Socket for NEM-Paired Storage Devices

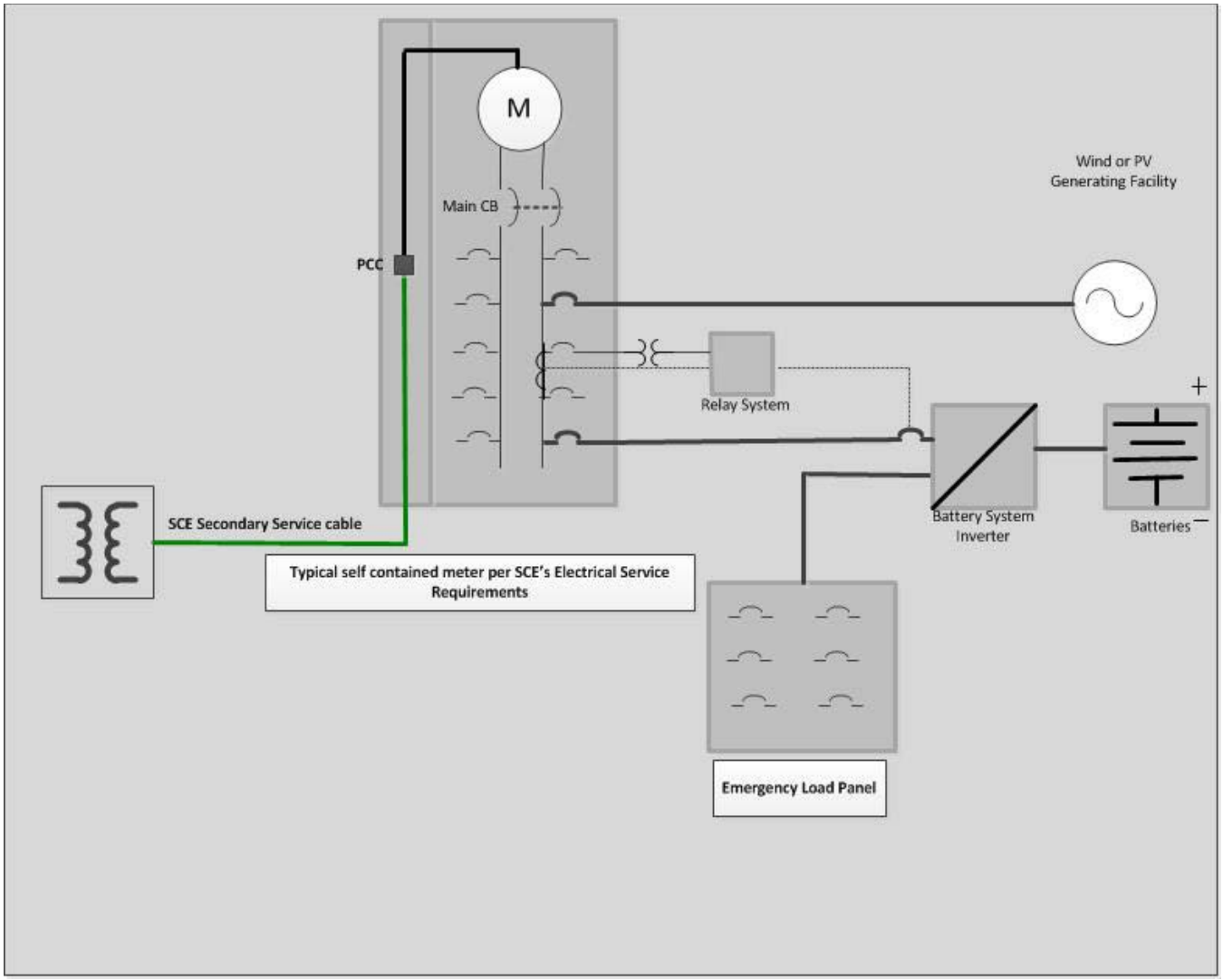


Figure 8 - For Systems that Install a Relay Device in lieu of a NGO Meter for NEM-Paired Storage Devices

5.10 Secondary Network Interconnection

Interconnection of NEM facilities onto SCE's secondary network Distribution System will require a supplemental review. 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, G.1.i.** 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 exceeds the requirements outlines in **Rule 21, G.1.i.** (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 generating facility to maintain a minimum import level.

5.11 Energy Management System Performance Requirements to Not Allow Energy Storage to Charge from the Grid

5.11.1 Scope and Purpose of testing procedures:

The purpose of the test procedure is to demonstrate that the Energy Management System (EMS) under evaluation will not allow energy storage devices within a Generating Facility to charge from the grid while allowing auxiliary power to be used by the storage devices or control systems.

The results of the performance test shall demonstrate that the energy storage device will not charge from the grid by halting or preventing the charging of the energy storage when the electrical power flowing towards the grid measured at the Measurement Control Point (MCP) (as shown in Figure 1 or Figure 2) is at or below a value specified by the manufacturer.

A specified level of auxiliary power is allowed to flow from the grid to the energy storage or control system for purposes of providing the necessary control power and not allowed for charging the energy storage pack. The maximum level of auxiliary power is required to be specified prior to testing.

This testing procedure does not specifically dictate how the EMS will prevent the energy storage from charging from the grid. Below are example options which may be used:

1. When power towards the grid at MCP is less than the specified value, the EMS may cause the storage dc/dc converter devices, inverters, or other specified devices to stop current flow.

2. When power towards the grid at MCP is less than the specified value, the EMS can direct the inverter/converter to reduce voltage on DC port below the certified minimum operating DC voltage of the energy storage. The DC voltage level may be used to coordinate the behavior of the EMS and battery energy storage charger controls in this control scheme. Note: When this option is utilized, the documentation supplied by the NRTL shall evaluate the performance of both the EMS and the energy storage system as a system.

5.11.2 Qualification for Performing Test:

Testing should be conducted or witnessed by a National Recognized Testing Laboratory (NRTL) personnel.

5.11.3 Limitation of Application

These testing procedures are used exclusively for utilities to evaluate the operations of the Renewable Energy Generating Facilities (REGF)7, the co-located Energy Storage systems, and the EMS controls to prevent the storage from charging from the grid. This testing and related results do not represent certification of these systems nor does it represent compliance with any safety related requirements as may be determined by local, state or federal compliance requirements. RGS with storage Generating Facility owners are still required to comply with all certification requirements as determined by local jurisdiction.

Any changes to operational parameters which may affect NEM integrity shall be permitted only with authorization from the Area EPS Operator and will require a new NRTL evaluation.

5.11.4 System Arrangement - Energy Management System Under Test (EUT):

The PV-Storage system and related testing sensing devices should be setup in one of the following configuration depending on the type of system under test. The EMS system shall take the measurement information from MCP and prevent the energy storage to charge from the grid. Measurement Point A and B are used to provide verification of EMS performance but are not used as control points. Measurement Points A, B and MCP may be external sensors or may be internal to the DC-DC converters, Inverters or other power control devices.

7 A REGF means a generating facility that generates electricity by using a renewable energy source as defined by the California Energy Commission's (CEC's) Renewable Portfolio Standard (RPS) Eligibility Guidebook.

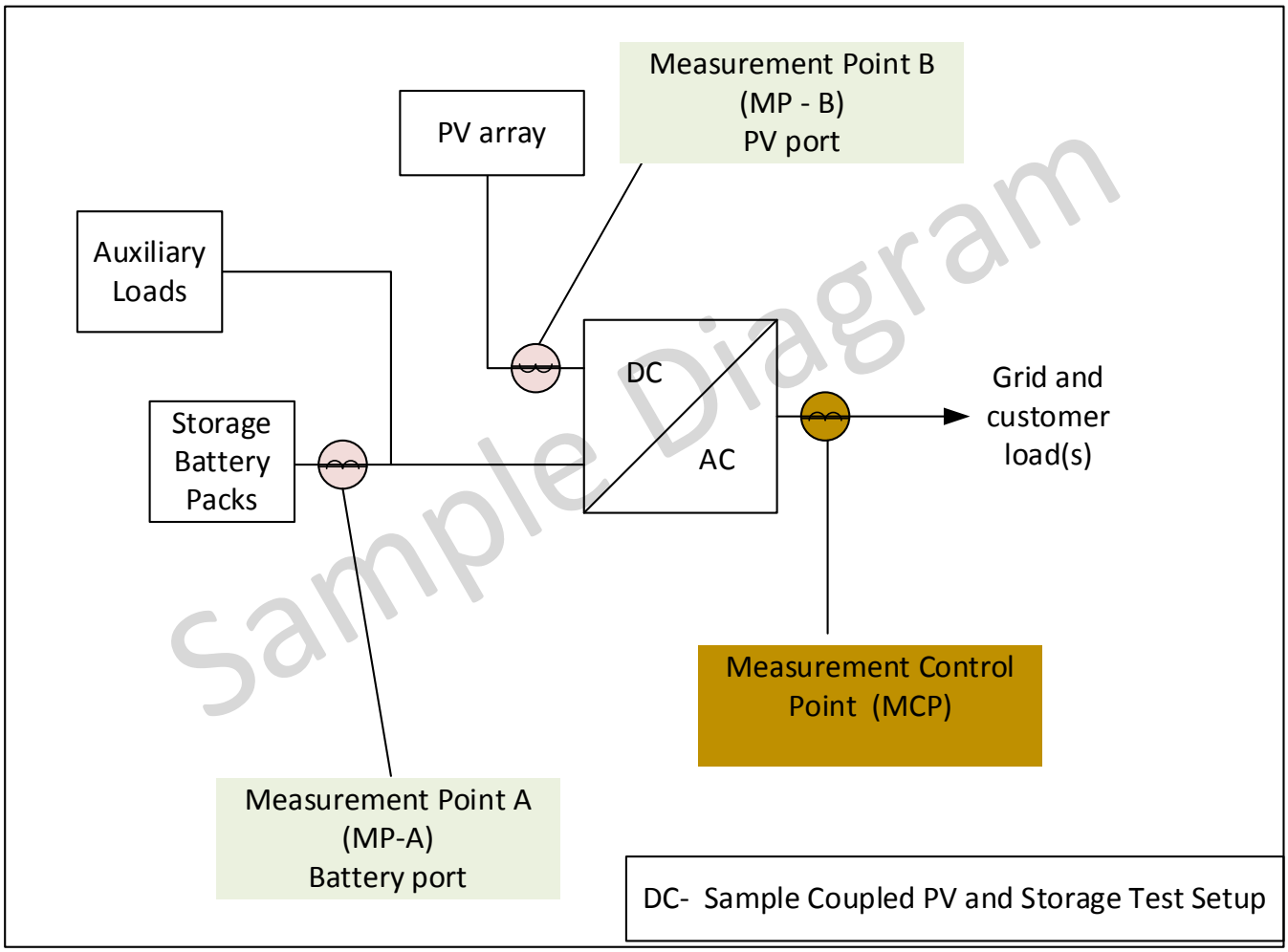


Figure 9 – Example PV and Storage coupled on the DC side of the inverter (DC-Coupled)

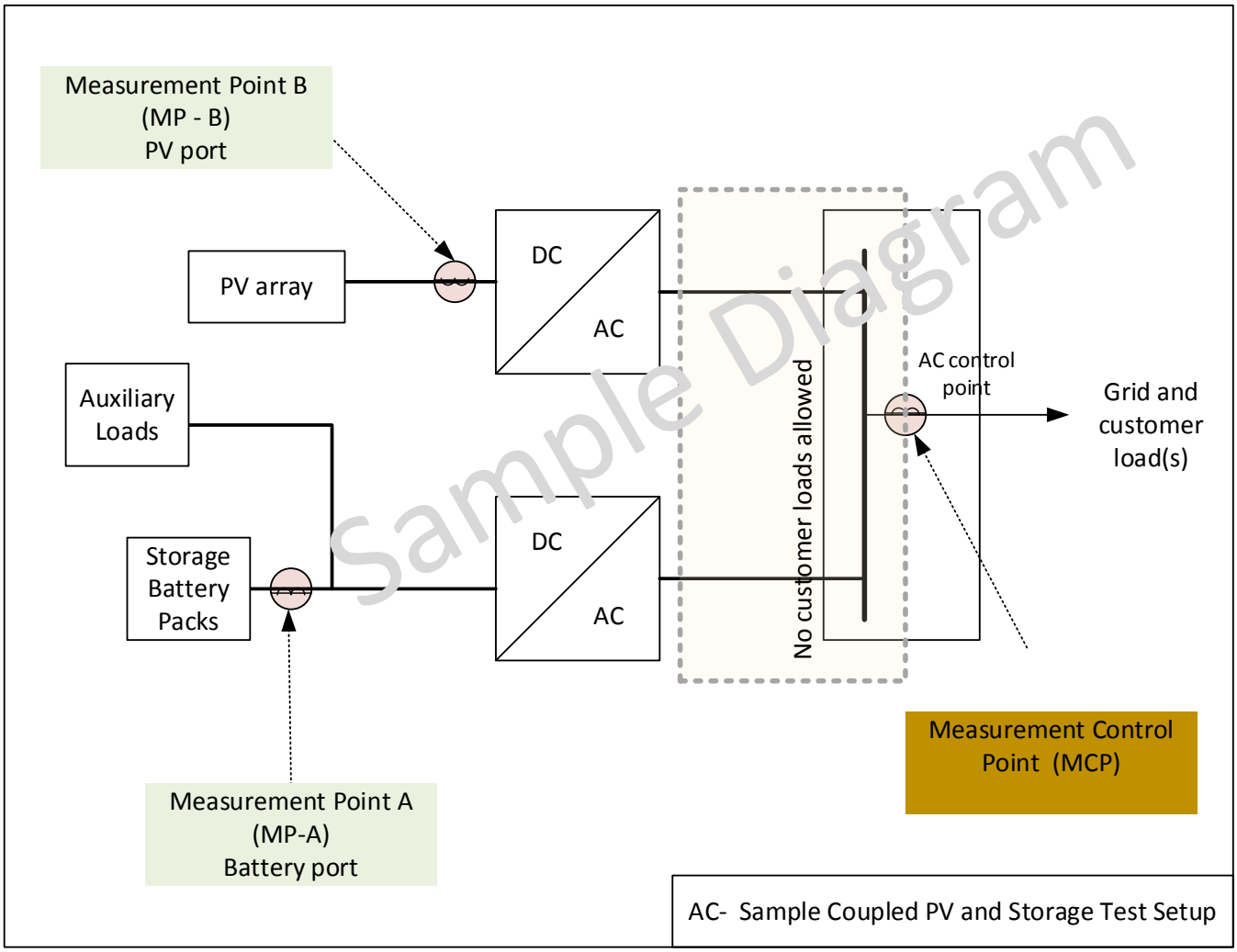


Figure 10 – Example PV and Storage coupled on the AC side of the inverter (AC-Coupled)

- MCP- Is the control point where power flow is to be measured for EMS control purposes. This MCP may be located within the inverters or between the inverter/converter AC port and any customer loads. No customer load can be located between MCP and the inverter/converter
- MP-A and MP-B are for performance verifications only and are not used for control purposes for this testing demonstration

General Testing Setup Requirements

External monitoring or sensors shall be required to verify the performance of the EMS system during validation testing.

- Sensing devices and equipment used for testing must be independent and separate from devices used for the DER EMS system

5.11.5 Default settings and ranges of adjustability

The following should be provided:

- Default minimum export active power or current level at MCP and range of adjustability. This is the level of export active power or current to the grid at which the EMS is to prevent the energy storage from charging from the grid
  - Export refers to the power or current flow at MCP toward the grid and customer load(s)
  - Import refers to the power flow or current at MCP toward the PV, energy storage and auxiliary loads
- Auxiliary Power Import at MCP. This is the level of expected auxiliary load that is used by the energy storage system and which is allowed to flow toward the auxiliary load for purposes of control power
- Default charging rate, ramp rate, and range of adjustability
- Default discharge rate, ramp rate, and range of adjustability

5.11.6 Test Description:

- Demonstrates that the EMS automatically prevents the energy storage from charging when the power measured at MCP is below the default value. Any one of the following methods may be used:
  - Demonstration can be opening of contacts on dc/dc converters or inverters for the storage devices with verification measurement at MP-A
  - Demonstration can be by halting the gating of power electronics for the storage dc/dc converter or the inverter DC port
  - Demonstration can be by reducing the storage DC bus port voltage below the storage dc/dc converter minimum turn-on level with verification measurement at MP-A When this option is used, certification of the DC/DC converter minimum turn on voltage must be provided
  - Other as required by the test setup or with prior approval of the Area EPS Operator

5.11.7 Test Procedures details

The following are test procedures are to be used to demonstrated that the DER EMS will prevent the energy storage from charging from the grid.

Test Procedure: Demonstrates that the EMS automatically prevents the energy storage from charging when the power measured at MCP is below the default value.

Step #1. Setup (connect) the DER system as normal operating conditions per manufacturer's specifications

- PV simulator or equivalent
- Storage Simulator or equipment
- Exporting power to the grid over the default export level per nameplate ratings

Step #2. Reduced PV simulator output and **maintain constant storage charging level**.

This test should demonstrate that when the PV is reduced at a specified ramp rate to the point where the power or current measured at MCP is below the default value, the EMS will automatically stop the charging of storage device within 5 seconds. Overshoot or positively damped oscillation's during this period shall be permitted and recorded during the test.

Record over the entire test time period:

- PV power production and ramp rate
- Power or current flow data at MCP – export to the grid
- Power or current flow data at MP-A – Charging load
- Power or current flow data at MP-B – PV production
- Storage DC port voltage data when DC voltage regulation is used as part of charging control
- Response time. Time from when the deviation was detected at MPC to when storage stop charging should be no greater than 5 seconds. This can be verified by measurement at MP-A
- All measurements must be synchronized in the same output chart or may utilize a common time base reference.
- The sampling rate shall be sufficient to verify the performance of the system.

Step #3. Repeat Step #2 5 times

Step #4. **Maintain constant PV output** and **increase charging levels**

This test should demonstrate that when PV is maintained at a constant point but charging level of storage is increased as a defined ramp rate where the power measure at MCP towards the grid is below the default value, the EMS will automatically stop the charging of storage device.

Record:

- PV power production rate
- Power or current flow data at MCP – export to the grid
- Power or current flow data at MP-A – Charging load
- Power or current flow data at MP-B – PV production

- Storage DC port voltage data when DC voltage regulation is used as part of charging control
- Response time. Time from when the deviation was detected at MPC to when storage stop charging should be no greater than 5 seconds. This can be verified by measurement at MP-A
- All measurements must be synchronized in the same output chart or may utilize a common time base reference.

Step #4. Repeat Step #3 5 times

5.11.8 Reporting

The following should be provided to the utility:

1. Description of control system

    a. Provide a block diagram of EMS being utilized and a basic explanation of how it prevents the storage from charging from the grid

    b. Describe the DER system components as applicable.

        - Storage
        - PV
        - Converter
        - Inverter
        - EMS
        - Communication system

    c. Equipment used for testing

        - Sensing equipment
        - Measurement equipment
        - Power supplies (AC & DC)

2. Provide at minimum Power, current and voltage data resulting from the Test Procedures Step #1 - #4

3. Letter from NRTL indicating the results of the test

6 PROTECTION REQUIREMENTS

The interconnection of a new NEM generating 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 for 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 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.

6.1 Inverter Protection Settings

Approved voltage and frequency settings per SCE's **Rule 21** below:

- If the inverter is 30 kW or below, protection settings are approved if the inverter is UL listed (all CEC approved inverters meet this guideline)
- If inverter is larger than 30 kW, 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 ensure that they meet **Rule 21**, Section H requirements -- see **Appendix D**.

Table 7.1-1 Voltage Relay Settings

Region	Voltage at point Common Coupling (% Nominal Voltage)	Ride-Through Until	Operating Mode	Maximum Trip Time
High Voltage 2 (HV2)	V ≥ 120			0.16 seconds
High Voltage 1 (HV1)	110 < V < 120	12 seconds	Momentary Cessation	13 seconds
Near Nominal (NN)	88 ≤ V ≤ 110	Indefinite	Continuous Operation	Not Applicable
Low Voltage 1 (LV1)	70 ≤ V < 88	20 seconds	Mandatory Operation	21 seconds
Low Voltage (LV2)	50 ≤ V < 70	10 seconds	Mandatory Operation	11 seconds
Low Voltage (LV3)	V < 50	1 seconds	Momentary Cessation	1.5 seconds

*Note: The customer can set relays more stringent than required by **Rule 21**. Such is the case in inverter systems.*

Table 7.1-2 Frequency Relay Trip Settings

System Frequency Default settings (Hz)	Minimum Range of Adjustability (Hz)	Ride Through Until	Ride Trough Operational Mode	Maximum Trip Time
f > 62	62 - 64	No Ride Through	Not Applicable	0.16 seconds
60.5 < f ≤ 62	60.1 - 62	299 seconds	Mandatory Operation	300 seconds
58.5 ≤ f ≤ 60.5	Not Applicable	Indefinite	Continuous Operation	Not Applicable
57.0 ≤ f < 58.5	57 - 59.9	299 seconds	Mandatory Operation	300 seconds
F ≤ 57.0	53 - 57	No Ride Through	Not Applicable	0.16 seconds

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

6.2 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.

The ground-fault-sensing scheme will consist of either a ground detector or ground bank depending on the configuration of SCE's Distribution System.

7 DEFINITIONS

Accessible: A device that is accessible to SCE 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 the normal SCE 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.

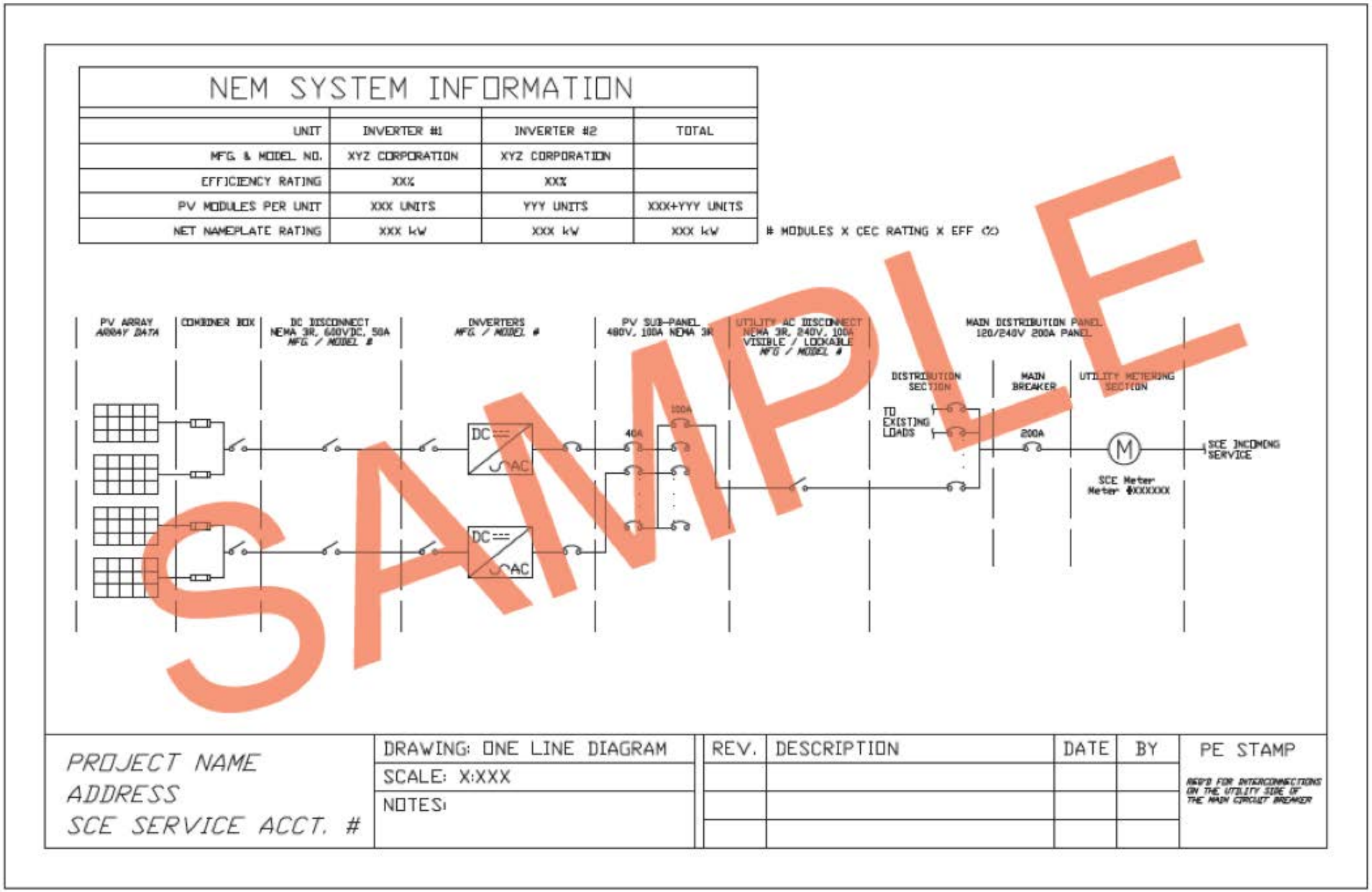
Premises: All of the real property and apparatus employed in a single enterprise on an integral parcel of land undivided, excepting in the case of industrial, agricultural, oil field, resort enterprises, and public or quasi-public institutions, by a dedicated street, highway, or other public thoroughfare, or a railway. Automobile parking lots constituting a part of and adjacent to a single enterprise may be separated by an alley from the remainder of the premises served.

Smart Inverter: A Generating Facility's Inverter that performs functions that when activated can autonomously contribute to grid support during excursions from normal operating voltage and frequency system conditions by providing dynamic reactive/real power support, voltage and frequency ride-though, ramp rate controls, communication systems with ability to accept external commands and other functions.

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 Open: 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).

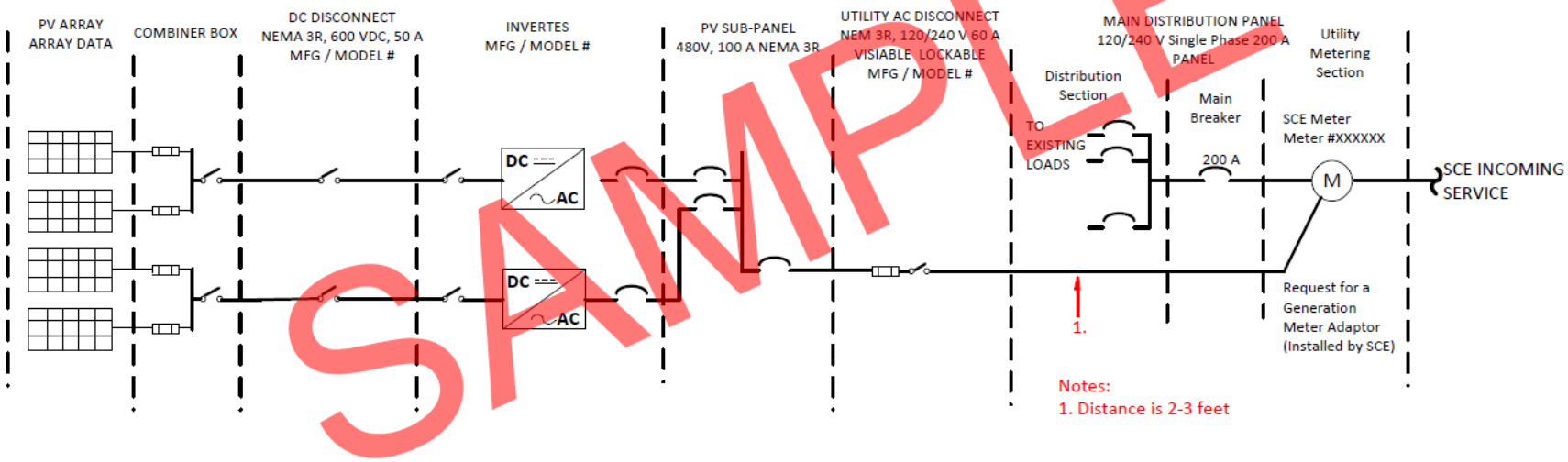
Appendix A: Sample Single Line Diagram



Appendix B: Sample Single line Diagram for GMA installations

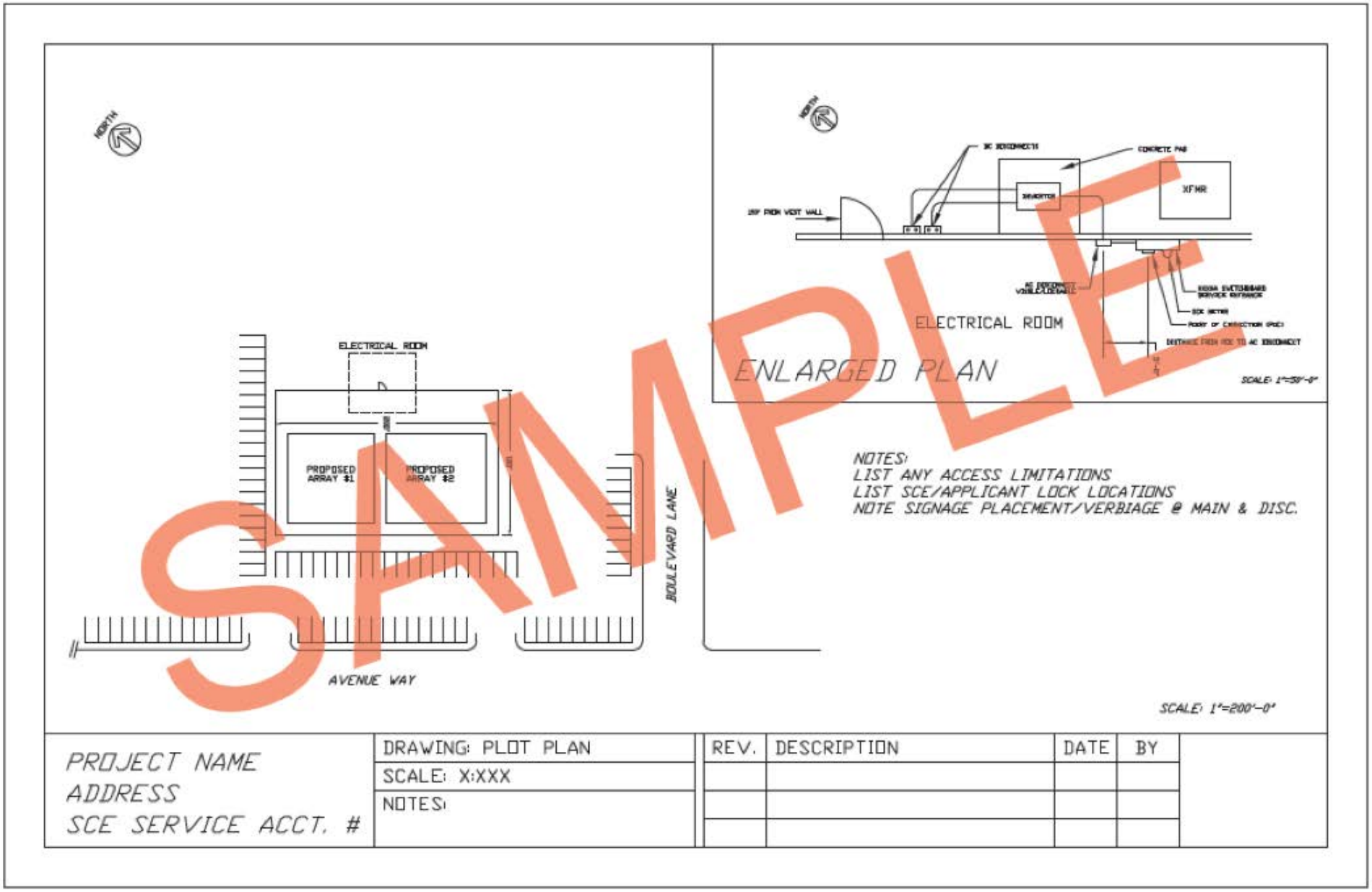
NEM SYSTEM INFORMATION			
Unit	Inverter # 1	Inverter # 2	Total
MFG & Model	XYZ Corporation	XYZ Corporation	
Efficiency Rating	XX %	XX %	
PV Modules Per Unit	XXX UNITS	XXX UNITS	XXX + YYY UNITS
Net Nameplate Rating	XXX Kw	XXX Kw	XXX kW

MODULE x CEC RATING x EFF



PROJECT NAME ADDRESS SCE SERVICE ACCT. #	DRAWING: ONE LINE DIAGRAM	REV.	DESCRIPTION	DATE	BY
	SCALE: X:XXX				
	NOTES:				

Appendix C: Sample Plot Plan



Appendix D: 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

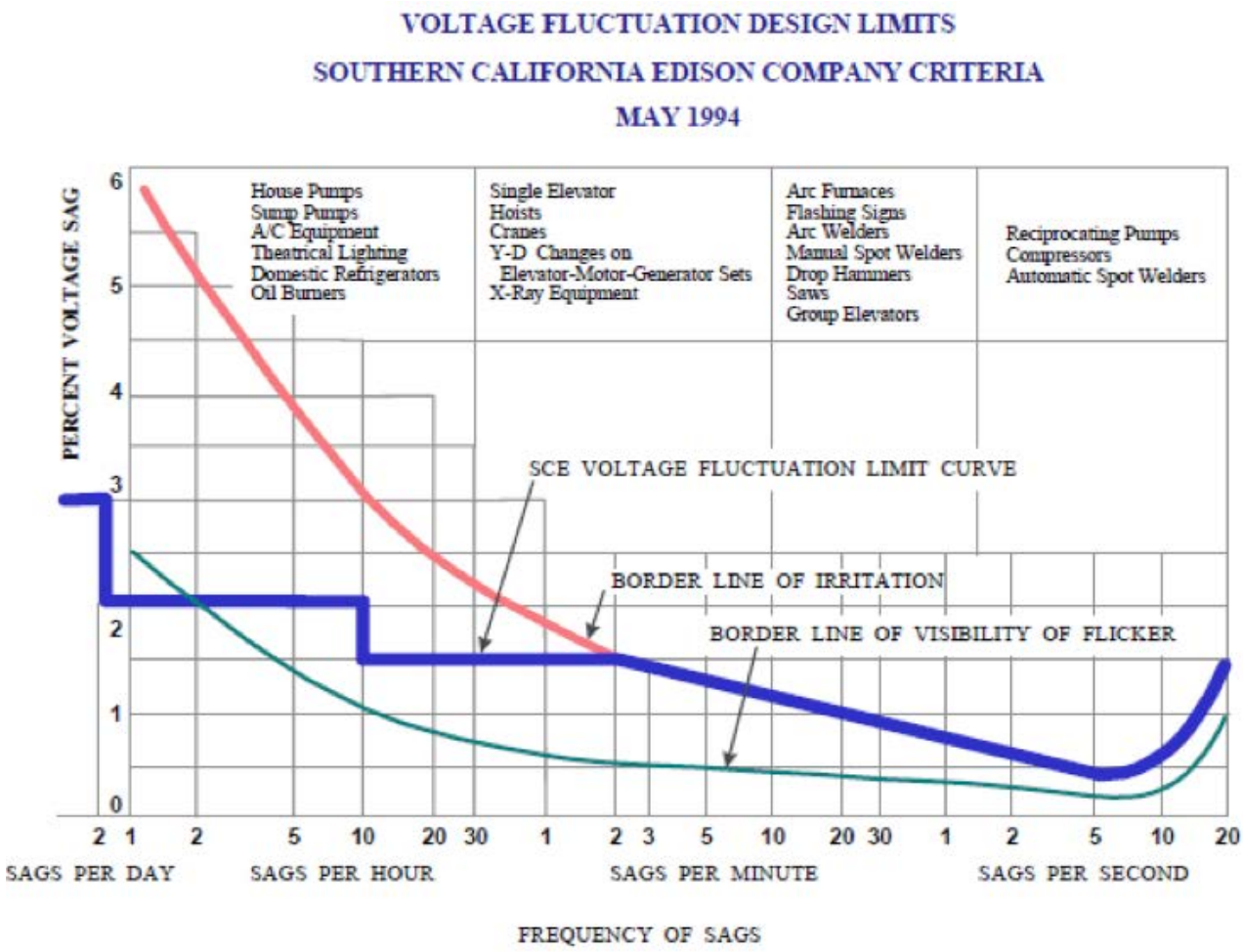
Best regards,

[Signature of representative]

Manufacture Representative

Manufacture Contact Information

Appendix E: Maximum Borderline of Irritation Curve



Appendix F: Supply Side / Line Side connections

To: _____ SCE Project #: _____

SCE has received the application for a ___kW solar generating facility located at _____.

The single line for the proposed project indicates that the proposed method of interconnection to the SCE system is to connect the generating facility to the source side of the existing customer's main breaker (Line Side Tap). This proposed method of interconnection requires the existing interconnecting customer's electrical service equipment, (busses, connectors, termination points, cables, etc.) to be modified in order to connect the generation on the source side of the customer's main circuit breaker. Such modifications could compromise the UL certification of the existing customer's electrical service equipment and could compromise the ratings and withstand capabilities that the customer's electrical service equipment was originally designed for. SCE strongly encourages the customer to modify its proposed method of interconnection, and interconnect the generating facility to the load side of the main circuit breaker in accordance with the original intent of the existing electrical service equipment.

SCE considers the project's proposed method of interconnection to be a potential safety issue because of the modification of the customer's electrical service equipment. To ensure that the project's interconnection facilities meet SCE's safety requirements, SCE must receive verification of UL compliance for the modifications to the existing electrical service equipment. This can be accomplished in the following ways:

1. A copy of the attached verification signed by the inspecting authority, acknowledging the following: (1) that the existing customer's electrical service equipment has been altered to allow the interconnection of the generating facility to the source side of the customer's main breaker; and (2) that the altered electrical service equipment continues to meet UL certification requirements or that the modified equipment has been recertified for its new configuration.

2. A document from the manufacturer of the existing electrical equipment indicating that the proposed modification or connection to the source side of that panel does not compromise the UL rating of the panel.

3. A UL certification of the proposed modification or connection to the source side of the customer's main circuit breaker of the existing electrical equipment.

4. A Nationally Recognized Testing Laboratory (NRTL) certification of the proposed modification or connection to the source side of the customer's main circuit breaker.

5. A Field Evaluation Body (FEB) equipment evaluation report of the supply side connection including but not limited to, busses, connectors, termination points and cables has been inspected and certified. The FEB shall be recognized by the International Accreditation Service listings - **Link to site**

SCE must receive one of these verifications before it will approve the generating facility for interconnection to SCE's Distribution System via the source side of the existing customer's main breaker (Line Side Tap). It should be noted that in addition to the requirements above, the customer must comply with other existing requirements including a P.E. stamped Single Line, plot plan, equipment requirement, etc.

Return to:
Southern California Edison
Assigned Field Engineer

City / Authority Having Jurisdiction:_____

SCE Project #:_____

I, _____, hereby certify that:

1. The existing customer's electrical service equipment has been altered to allow the interconnection of the generating facility to the source side of the customer's main breaker; and

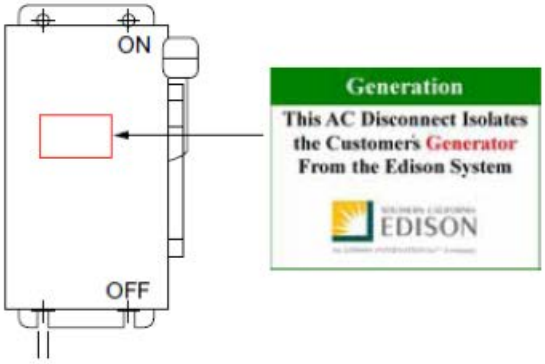
2. The altered electrical service equipment continues to meet UL certification requirements or that the modified equipment has been recertified for its new configuration.

Name & Title:_____ Signature:_____ Date: _____

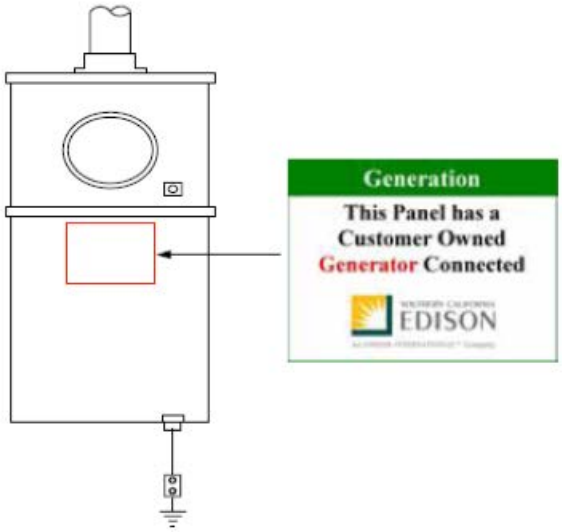
Appendix G: Vendor Decal Instructions

Once the decals are received, please place the decals in accordance with the instructions below:

: Example of Labeling Practice for an AC Isolation Disconnect with Generation



: Example of Labeling Practice for a Residential Meter Panel with Generation



NOTE: The examples above are intended to portray typical customer equipment. If you have any questions or concerns about signage placement, please contact a SCE NEM customer care representative at customer.generation@sce.com or, if applicable your assigned SCE Field Engineer directly.