What’s New

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

❖ Section 2.2 – Provide further clarification on the applicability of the NEM tariff in reference to the 1 MW maximum system size for Eligible Fuel Cell Customer-Generators.

❖ Section 5.3 /Appendix F – Update signage requirement process so that the customer can order / request the required decals earlier in the interconnection process.

❖ Section 5.5 – Clarify wiring instructions for interconnection requests requiring Net Generation Output Meter (NGOM) and NEM-Paired Storage Projects.

❖ Appendix E – Add language to the supply side connection letter to include 3rd party NRTL agencies for UL Certification.
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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** (PDF): Net Energy Metering (including NEM Aggregation and Multiple Tariff)
- **Schedule FC-NEM** (PDF): Fuel Cell Net Energy Metering
- **Schedule NEM-V** (PDF): Multi-Tenant, Multi-Meter Virtual Net Metering
- **Schedule MASH-VNM** (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) (PDF). 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 up to 1 MW per premises.

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.
2. Reference Information

Please visit [http://www.sce.com/nem](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 review technical requirements for interconnection under [Rule 21](http://www.sce.com/nem) (PDF);
- To read Frequently Asked Questions and Tips to Speed through Interconnection.

2.1 Document Requirements

At [sce.com/nem](http://www.sce.com/nem), SCE provides checklists, which list all the required documents for NEM Interconnection, as well as all of the required forms along with mark-ups and a sample Single Line Diagram and Plot Plan for download.

NEM applicants are now able to use SCE’s NEM online interconnection application system to submit NEM interconnection applications and additional documentation, document corrections online, and view the status of your submitted applications. Please access the online application system at [www.sce.com/nem](http://www.sce.com/nem).

*Note: Prior to the end of 2015, it will become mandatory for NEM applicants in all three Investor-Owned Utility service areas (SCE, Pacific Gas & Electric, and San Diego Gas & Electric) to submit NEM applications online, so we encourage you to start using the online tool now.*

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>
<thead>
<tr>
<th>Equipment</th>
<th>Certified Listings</th>
</tr>
</thead>
</table>
For non CEC-certified equipment, 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

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

### Table 2.2-4: Estimated Monthly kWh Calculation

<table>
<thead>
<tr>
<th>Technology</th>
<th>Estimated Monthly kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td>Use the CSI EPBB calculator at <a href="http://www.csi-epbb.com">www.csi-epbb.com</a> or: (CEC-AC Nameplate) x 720 x 0.20 = ____ kWh</td>
</tr>
<tr>
<td>Wind</td>
<td>(CEC-AC Nameplate) x 720 x 0.15 = ____ kWh</td>
</tr>
<tr>
<td>Fuel Cell</td>
<td>(CEC-AC Nameplate) x 720 x 0.85 = ____ kWh</td>
</tr>
</tbody>
</table>
3. Interconnection Review Process

After an initial review to confirm the Application and SLD are complete and consistent, the NEM Interconnection team refers 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.

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.

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 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 and UL 1741,
- 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.

SCE strongly encourages the submission of the Application and SLD 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.

R-850-V6-0615
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 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 B for a sample.
- Inverter Specifications: see Section 5.1 for more information;
- Photos of installed SCE decals, when applicable: see Section 5.3 for more information.
- Line side / supply side taps: Please see Appendix E.
- If the project requires an NGOM, please provide meter socket cut-sheets of the NGOM socket: see Section 5.5 for more information.
- 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.

3.2 Commissioning Test
SCE intends to conduct a commissioning test and onsite inspection 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 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 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 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.

3.4 Review Fees
There are no application and review fees for NEM interconnection requests. Please refer to Rule 21, Section E.2.c.

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 with SCE systems will not be permitted under any circumstance.

Technical Approval is based on the following criteria:

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

- **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.

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1 Rule 21, Section C, Definitions.
Please refer to Section 3 (above) for the delineation of cost responsibilities for Distribution Upgrades versus Interconnection Facilities.

Following a generation facility disconnect as a result of a voltage or frequency excursion (parameters are described in Rule 21 Section H 1. 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.

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 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 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 Section “L” of Rule 21 (PDF), 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 “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 [http://www.consumerenergycenter.org/erprebate/inverter.php](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.

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 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;
- 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;
- Generator(s) make and model;
- 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 5.3 for Manual, Visibly Open and Lockable AC Disconnect requirements;

Code and version to be used for construction, 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.

Also refer to Appendix E.

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.

5.2.1 Visible Open AC Disconnect Switch
requirements for generation interconnection to distribution voltages 34.5KV or below²

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)

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

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² SCE’s Interconnection Handbook provides the requirements for voltage greater than 34.5 kV.
5.2.2 Disconnects must be reviewed and approved by Field Engineering. Location of AC Disconnect

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. 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:

5.2.3 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 and the customer must install a visible open and lockable 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 do not have a main CB in the metering enclosure.

b) Generating facilities that are proposing to connect to the source side of the CB (when allowed).

c) 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

5.2.4 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:

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 near to the Point of Common Coupling (PCC) or an approved location that should be adjacent with approved signage 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.
5.2.5 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.**

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**Figure 3 - Typical High-Voltage Service Interconnection**

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### 5.2.6 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, showing the location 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.

### 5.2.7 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.
5.3  Signage Requirements

SCE may at its discretion require decals to be installed on generating facilities. For example, generating facility applications that are referred to a Distribution Engineer for technical review will typically require a decal. A photograph with the installed decals must be submitted to the NEM Interconnection team with the final Permit Inspection (see section 2.1). SCE will verify the decal installation during the final technical approval.

<table>
<thead>
<tr>
<th>Decals that will be installed on the customer’s main service panel</th>
<th>Decals that will be installed on the AC Disconnect to be used for utility isolation of the generator</th>
</tr>
</thead>
</table>

![Decal Image]

You have the option to receive the decals by the following methods:

1. 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:
   
   - SCE Item 15-41-A REV 1/11 Size 4”X3” for small panels
   - 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, please order Decal Number:
   
   - SCE Item 15-40-A REV 1/11 Size 4”X3” for small AC Disconnects
   - SCE Item 15-40-B REV 1/11 Size 7”X5” for large AC Disconnects

For instructions on decal placement, please see Appendix F.

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.

5.4  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 count towards the threshold for telemetry.

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4 Please reference Section 5.2.1 of this Handbook as to when an AC Disconnect is required.
5.5 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 4 for additional requirements.

For Virtual Net Energy Metering projects, either Schedule NEM-V or Schedule MASH-VNM, a NGO meter 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 5 for wiring instructions of the NGO socket.

5.5.1 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 4.

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

Figure 5 - Wiring of a NGO Meter Socket for Virtual Net Metering Projects
5.6  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).

5.6.1 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\(^6\). 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\(^7\) 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 6 for metering configurations.

---

\(^6\) For projects that opt-in to install an NGOM or for projects that require an NGOM, Section 5.5.1 of this Handbook apply.

\(^7\) Please Reference Rule 21 Section G.1.i – Option 1 or Option 2.
Figure 6 - Wiring of a NGO Meter Socket for NEM-Paired Storage Devices
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, 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.

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 System 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 C.

### Table 7.1-1 Voltage Relay Settings

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

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

<table>
<thead>
<tr>
<th>Element</th>
<th>Element Name</th>
<th>Settings</th>
<th>Maximum Timing Cycles</th>
<th>Maximum Timing Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>81O</td>
<td>Over-Frequency</td>
<td>&gt; 60.5 HZ</td>
<td>10</td>
<td>0.167</td>
</tr>
<tr>
<td>81U</td>
<td>Under-Frequency</td>
<td>&lt; 59.3 HZ</td>
<td>10</td>
<td>0.167</td>
</tr>
</tbody>
</table>

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 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.

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 Plot Plan

<table>
<thead>
<tr>
<th>PROJECT NAME ADDRESS</th>
<th>DRAWING: PLOT PLAN</th>
<th>REV.</th>
<th>DESCRIPTION</th>
<th>DATE</th>
<th>BY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SCALE: X:XXX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NOTES:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTES:
- LIST ANY ACCESS LIMITATIONS
- LIST SCE/APPLICANT LIE DETECT LOCATIONS
- NOTE SIGNAGE PLACEMENT/VERBIAGE @ MAIN & DISC.

ENSIZED PLAN

SCALE: 1"=50'-0"
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

<table>
<thead>
<tr>
<th>Description</th>
<th>Actual Level</th>
<th>Actual Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Under Voltage</td>
<td>%</td>
<td>s or cycles</td>
</tr>
<tr>
<td>Under Voltage</td>
<td>%</td>
<td>s or cycles</td>
</tr>
<tr>
<td>Extreme Over Voltage</td>
<td>%</td>
<td>s or cycles</td>
</tr>
<tr>
<td>Over Voltage</td>
<td>%</td>
<td>s or cycles</td>
</tr>
<tr>
<td>Under Frequency</td>
<td>Hz</td>
<td>s or cycles</td>
</tr>
<tr>
<td>Over Frequency</td>
<td>Hz</td>
<td>s or cycles</td>
</tr>
</tbody>
</table>

Best regards,

[Signature of representative]

Manufacture Representative

Manufacture Contact Information
Appendix D: Maximum Borderline of Irritation Curve

VOLTAGE FLUCTUATION DESIGN LIMITS
SOUTHERN CALIFORNIA EDISON COMPANY CRITERIA
MAY 1994

SCE VOLTAGE FLUCTUATION LIMIT CURVE
BORDER LINE OF IRRITATION
BORDER LINE OF VISIBILITY OF FLICKER

FREQUENCY OF SAGS
Appendix E: 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 switchgear equipment or customer’s residential service panel, (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 switchgear or customer’s residential service panel and could compromise the ratings and withstand capabilities that the switchgear or residential service panel 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 switchgear or existing customer’s residential service panel.

SCE considers the project’s proposed method of interconnection to be a potential safety issue because of the modification of the switchgear / residential service panel. 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 switchgear. 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 switchgear or existing residential service panel 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 customer switchgear or residential service panel 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 panel 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 panel.

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.

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 switchgear or the customer’s residential service panel 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 customer switchgear or customer’s residential service panel continues to meet UL certification requirements or that the modified equipment has been recertified for its new configuration.

Name & Title: ___________________________ Signature: ___________________ Date: __________
Appendix F: 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 Distribution Engineer directly.