INDUSTRY PUBLIC UTILITIES
ELECTRIC SERVICE RULES, REGULATIONS AND RATE SCHEDULES

RULE 21 – Generating Facility Interconnections

A. APPLICABILITY

This Rule describes the interconnection, operating and metering requirements for Generating Facilities to be connected to the Industry Public Utility's ("IPUs") Distribution System. Subject to the requirements of this Rule, the Utility will allow the Interconnection of Generating Facilities with its Distribution System.

This rule sets forth requirements and conditions for non-Utility-owned energy resource facilities where such energy resource may be connected in parallel operation with the Utility's system. For purposes of this rule, the interconnecting entity shall be designated as the Producer.

This rule does not constitute an agreement or commitment to purchase or deliver the Producer's power. The purchase or delivery of power and other services that the Producer may require are covered under separate agreements, if any. This Rule does not apply to Eligible Customer-Generators, except those subject to Net Energy Metering 1.0 ("NEM1.0") and only to the extent set forth herein.

B. CONDITIONS

1. Prior to parallel operation of its energy resource facility with the Utility's system, the Producer shall (a) execute an interconnection agreement with the Utility in the form most recently approved by the Industry Public Utility Commission ("Net Energy Metering Interconnection Agreement"), and (b) obtain the requisite City and Los Angeles County permits and authorizations for parallel operation.
2. At all times, the Producer shall design, site, construct, install, operate, and maintain its energy resource and interconnection facilities in compliance with the following:
   a. Applicable Rates, Rules and Regulations;
   b. The City's local permitting requirements, as administered through the City's Planning & Los Angeles County Building and Safety Department;
   c. The Utility's current Generation Interconnection Standards and Guidelines ("GISG");
   d. Applicable Federal Energy Regulatory Commission approved rules, tariffs, and regulations;
   e. Any applicable federal, state, or local laws; and
   f. Such other requirements contained in the Interconnection Agreement.
3. The Utility has the right, but not the obligation, to review the design of the Producer's energy resource and interconnection facilities and to inspect the Producer's energy resource and interconnection facilities prior to the commencement of parallel operation with the Utility's system. The Utility may require the Producer to make modifications, as necessary, to comply with the requirements of Section B.2 of this rule prior to commencement of operation.
4. The Producer shall operate and maintain its energy resource and interconnection facilities in accordance with prudent electrical practices and shall maintain compliance with all applicable federal, state, or local laws.
5. Where interconnection protective equipment is owned, operated and/or maintained by the Producer, the Producer shall be responsible for damages to the IPU and/or to others arising from Producer-owned equipment.
6. The Producer is solely responsible for providing protective equipment for all Producer facilities interconnected with the Utility's system as provided in the GISG.

7. The Producer shall grant the IPU the right of ingress and egress to the energy resource and interconnection site to examine the site and applicable facilities for any purpose reasonably connected with this Rule No. 21. To the extent applicable to the IPU's right to examine the Producer's energy resource facility, the Producer shall clearly identify to the IPU any safety-related equipment and signage utilized by the Producer at this energy resource facility.

8. The Utility has the right to require the Producer to interrupt, disconnect, or reduce output from its energy resource facility as follows:

   a. When necessary, in order to construct, install, maintain, repair, replace, remove, investigate, or inspect any of the Utility's equipment or part of the Utility's system;

   b. If the Utility determines in its sole discretion that curtailment, interruption, or reduction is necessary because of emergencies, forced or scheduled outages, force majeure, or compliance with prudent electrical practices;

   c. When the Producer's energy resource facilities or their operation endanger IPU and City personnel, the Utility's system, or pose an immediate threat to any person, the environment, or any property; or

   d. When the Producer fails to operate its energy resource facility in conformance with applicable federal, state, and local laws including the Rates, Rules, and Regulations and the GISG.

   The Utility may require the disconnection of the Producer's energy resource facility for as long as the conditions of (a) through (d) above exist. The Utility may, in its sole discretion, provide the Producer with reasonable notice of the possibility or actual interruption or reduction of energy resource output that may be required. The Utility shall not be required to provide written notice to the Producer when the Utility determines an emergency or unsafe operating condition exists related to the Producer's energy resource or interconnection facilities.

C. DESIGN AND OPERATING REQUIREMENTS

1. The Producer shall design, site, construct, install, operate, and maintain its energy resource facility in such manner as to prevent or protect against adverse conditions to the Utility's system including, but not limited to:

   a. Conditions, as determined by the Utility, that can cause harm to persons, equipment damage, or electric service degradation and reverse power at the interconnection point with SCE unless approved by IPU and SCE.

   b. Inadvertent and unwanted reenergizing of a utility dead line or bus.

   c. Interconnection while out of synchronization.

   d. Overcurrent.

   e. Utility system load imbalance.

   f. Ground faults.

   g. Generated alternating current frequency outside permitted safe limits of 59.9 to 60.10.

   h. Voltage generated outside permitted limits of 5% plus or minus of normal operating voltage.

   i. Poor power factor and power factor maintained close to 0.98 lagging at all times.

   j. Harmful wave forms.

   k. Voltage flicker.

   l. Unintended islanding, with the exception of designated protected loads that are disconnected from the Utility's system for the purpose of emergency operation.

2. The necessary protective equipment (relays, switchgear, transformers, etc.) shall be provided by the Producer or by the IPU at the Producer's expense.

D. INTERCONNECTION FACILITIES AND COST RESPONSIBILITIES

1. Interconnection facilities include all required means and apparatus installed to interconnect the Producer's energy resource facility with the Utility's system. Interconnection facilities may include, but are not limited to:

   a. Connections, transformations, switching, communications, control, protective and safety equipment, accessible visual disconnects; and

   b. Any necessary reinforcements and additions to the Utility's system installed by the Utility at the Producer's expense.

2. Interconnection facilities installed on the Producer's side of the point of interconnection shall be owned, operated, and maintained by the Producer, except for those facilities owned and/or operated by the Utility.

3. Costs for initial design, engineering, testing or materials

   Except as provided under applicable law, the Producer shall be responsible for all costs associated with interconnection facilities owned by the Producer. The Producer shall also be responsible for any costs reasonably incurred by the Utility in providing, operating, or maintaining interconnection facilities and any system upgrades and/or additions required solely for the interconnection of the Producer's energy resource facility with the Utility's system.

   The Producer shall pay the Utility's reasonable costs to provide design, engineering, testing, equipment, or materials at the request of the Producer. Such payment shall include, but not be limited to, the Utility's reasonable costs for labor, contracted labor, materials, and equipment incurred by the Utility in connection with this rule. The Producer shall make payment to the Utility prior to the Utility's approval of the Producer's energy resource and interconnection facilities. At its option, the Utility may consider the service as a request for Added Facilities by the Producer. The Utility may replace the Producer's interconnection facilities at the Producer's cost and expense whenever the Utility determines that such facilities have reached the end of their useful life, unless the Producer has terminated parallel operation of those facilities.

   The Utility shall review the Producer's plans as required to evaluate the effect of any proposed new construction or modification of any existing structure or facility upon the Utility's system. The Utility shall charge its reasonable costs for the Producer's plan reviews that require staff time or labor in excess of four (4) hours to complete.

4. An interconnection study shall take no more than three months to complete by the Utility. The estimated cost of the interconnection study shall be provided to the Producer prior to commencement of the interconnection study.

E. METERING, PROTECTIVE DEVICES AND OTHER RELATED EQUIPMENT

1. For the purposes of monitoring the Producer's operation, the Utility shall have the right to install meters and associated equipment at the Producer's expense.

2. The Producer shall provide, at no expense to the Utility, a suitable location for all meters and associated equipment.

3. The producer shall pay for the installation of the meter, protective devices, and other related equipment at the interconnection point with SCE of WDAT Switchgear or substation if required based on the power system analysis to safety connect generation with IPU distribution system and prevent reverse power to the electric grid unless approved by IPU and SCE.

F. ELIGIBLE CUSTOMER-GENERATORS

1. At its discretion, the Utility may determine that an NEM Eligible Customer-Generator is a Producer under this Rule No. 21. In the event of such determination, the Eligible Customer-Generator will be treated as a Producer under this Rule and must comply with all provisions of this Rule, Schedule ERG Tariff and ERG Interconnection Agreement.

2. Each NEM Eligible Customer-Generator, who is not subject to Section F.1 above, must comply with the Rates, Rules, and Regulations and applicable provisions of the GISG and Eligible Renewable Generation ("ERG") Interconnection Agreement.

Industry Public Utilities (IPU)

Generation Interconnection Standards and Guidelines

February 1, 2023

These standards and guidelines have been prepared by the Industry Public Utilities (IPU or Utility). They are available to interested parties for information, planning design, and construction of interconnection facilities for customer generators. Copies of this document and information pertaining to other requirements for electrical system interconnection to the Utility's distribution system may be obtained by downloading directly from Website address cityofindustry.org/city-hall/departments/industry-public-utilities/electric or by phone contacting 626-333-2211.

This document, in conjunction with applicable city, county, state and federal rules and regulations combine to form the standard to which all new interconnecting facilities for customer generation, shall conform.

The effective date of these standards and guidelines and revision dates are indicated on the title page of each document. All requirements of the guidelines are subject to change without notice; therefore, those who are contemplating any venture with the Utility, which will be regulated by these standards and guidelines, should make sure that they have the most current and latest revision.

The purpose of this document is to standardize equipment and facilities relating to interconnection facilities for both customer-owned and IPU-owned distributed generation systems within the Utility's service territory. Distributed generation is generally defined as generating sources whose combined gross output is less than 1 megawatts (MW) that is connected to the Utility system at a single point of interconnection. This document is designed to provide typical standards and guidelines for interconnection facilities for most distributed generation systems including solar, battery storage, gas-fired turbines, fuel cells, and reciprocating engines, however, design requirements are subject to adjustment as necessary.

Standards, rules and regulations of other agencies with jurisdiction in areas covered by this document are not altered in any way by these standards and guidelines. Any and all questions regarding applicability of various rules and regulations shall always be resolved in favor of the more stringent requirements.

Modifications and/or deviations to/from the requirements of the standards and guidelines contained in this document must be authorized, in writing, by the IPU Public Utilities Director. No work, which includes modifications to this document, should proceed without this written approval.

Generation Interconnection Standards and Guidelines

1.0 Introduction

These standards and guidelines state the minimum requirements for safe and effective operation of customer-owned and IPU-owned generation on the IPU electric system. Customers and IPU personnel shall be guided by this document when planning installations of distributed generation that is capable of extended parallel operation with the Utility system.

1.1 Policy on Customer Generation

As specified in the Utility Electric Rates, Rules and Regulations, Rule No. 21, it is the policy of the Utility to permit any customer to operate generating equipment in parallel with the electric system whenever this can be done without adverse effects on the general public, or to Utility equipment or personnel. Certain protective devices (relays, circuit breakers, etc.), specified by the Utility must be installed at any location where a customer desires to operate generation in parallel with the Utility. The purpose of these devices is to promptly disconnect within two seconds the customer's generating equipment from the Utility system whenever faults, abnormal, or unsafe operation occur. Other modifications to electrical system configuration or protective relays may be required to accommodate parallel generation.

The Utility will not assume any responsibility for protection of the customer's generator(s), or of any other portion of the customer's electrical equipment. The customer is fully responsible for protecting their equipment in such a manner that faults or other disturbances on the Utility system do not cause damage to the customer's equipment, or adversely affect the customer in any way.

1.2 Generation Sources

The customer may elect to use any of a variety of energy sources including solar, wind, battery storage or other types of sources, in addition to conventional fossil fuels. The end conversion of the connection to the Utility system must be into 60 Hz alternating current.

The customer may elect to run the generator in parallel with the utility or as a separate system with the capability of non-parallel load transfer between the two independent sources. The requirements of these two methods of operation are outlined in Sections 1.3 and 1.4.

1.3 Separate Systems

A separate system is defined as one in which there is no possibility of connecting the customer's generating equipment in parallel with the Utility's system. For this design to be practical, the customer must be capable of transferring load between the two systems in an open transition or non-parallel mode. This can be accomplished by either an electrically or mechanically interlocked switching arrangement that precludes operation of both switches in the closed position. Separate systems are typically designed as standby or backup emergency generation that serves dedicated loads at the customer facility in the event of an outage, i.e., when there is no electric service from the Utility.

If the customer has a separate system, the Utility will require verification that the transfer scheme meets the non-parallel requirements. This will be accomplished by approval of drawings by the IPU in writing

and, if the IPU so elects, by field inspection of the transfer scheme. The IPU will not be responsible for approving the customer's generation equipment and assumes no responsibility for its design or operation.

Most Uninterruptible Power Supply (UPS) systems do not specifically meet the separate system criteria. However, if they are not capable of back feed, they will be classified as a separate system. If they can back feed, they must meet the requirements of parallel operation.

1.4 Parallel Operation

A parallel system is defined as one in which the customer's generation can be connected to a bus common with the Utility's system. A transfer of power between the two systems is a direct and often desired result. A consequence of such parallel operation is that the parallel generator becomes an electrical part of the Utility system that must be considered in the electrical protection of the Utility's facilities.

Utility lines are subject to a variety of natural and man-made hazards. The electric problems that can result from these hazards require that the damaged equipment be de-energized as soon as possible and within two seconds of unintended islanding because of the hazards they pose to the public and to the operation and stability of the Utility system.

In systems without parallel generation, the Utility controls the only source of power supply to a given line and therefore has the responsibility to install equipment, which is adequate, under expected circumstances, to detect faulted equipment and de-energize it. A parallel generator connected to a Utility line represents another source of power to energize the line and must also have adequate protective devices installed to sense trouble on the Utility system.

For installations with larger generators, the probability of isolated operation is higher since the available generation may be sufficient to carry the entire load of the Utility's circuit. For these installations, specific devices are required for the detection of short circuits and grounds on the Utility system as well as voltage and frequency relays to detect isolated operation.

The general and specific requirements for parallel generation installations of various sizes are discussed in the following sections.

2.0 General Design Requirements

2.1 Design Requirements

2.1.1 The customer's installation must meet all applicable national, state, and local construction and safety codes.

a. Major equipment that is not included on the California Energy Commission's eligible equipment lists shall be evaluated for compliance with these interconnection guidelines.

b. It shall comply with the latest requirements of the following standards:

- ANSI/IEEE 1547 -2003 (R2008)- IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems – Approved June 12, 2003, Reaffirmed September 25, 2008
- IEEE 1547a- 2014(Amendment to IEEE Std. 1547- 2003)- IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems Amendment 1 – Approved May 16, 2014
- IEEE 1547.1 -2005 -IEEE Standard for Conformance Tests Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems- Approved June 9, 2005, and Reaffirmed June 16, 2011.
- IEEE 1547.2 – 2008- IEEE Application Guide for IEEE 1547- 2003, IEEE Standard for Interconnecting Distributed Resources with Electric Power System – Approved December 10, 2008.
- ANSI/IEEE 1547.3 – 2007- IEEE Guide for Monitoring, Information Exchange and Control of Distributed Resources Interconnected with Electric Power System – Approved May 17, 2007, by IEEE and October 30, 2007, by ANSI.
- IEEE 1547.7 – 2013 – IEEE Guide for Conducting Distribution Impact Studies for Distributed Resources Interconnection – Approved December 11, 2013.

- UL 1741- 2010 – UL Standard for Inverters, Converters, Controllers, and Interconnection System Equipment for Use with Distributed Energy Resources – published by UL LLC- Edition January 28, 2010,

- UL 1741-SA -2017 and Rule 21 – Enhanced anti – island testing to ensure PV systems disconnect when required and Safety Test Standards for certifying products which meet the rigorous requirements needed to ensure safe and reliable operation. Rule 21 is inverter related revision to the State of California Tariff Rule 21 made by CPUC

- NFPA 70 National Electrical Code (NEC) Standards for the Safe Installation of Electrical Wiring and Equipment

- National Electrical Safety Code (NESC@) Safety Standards for Underground Electric Utility and Communications Utility Installations
    - o Section 9 Grounding Methods for Electric Supply and Communications Facilities
    - o Section 11 Protective Arrangements in Electric Supply Stations

2.1.2 Protective devices (relays, fuses, circuit breakers, ground banks, etc.) for the protection of the Utility' system and synchronizing equipment must be installed as required by the City and Utility. A producer shall be solely responsible for providing adequate protection of its generating facility. Producer's protective functions shall not impact the operation of other protective functions on the Utility's system in a manner that would affect the Utility's capability of providing reliable service to its customers. For all generation systems including inverter-based resources, the responsible engineer/consultant shall make sure that work meets all the required safety and government rules and regulations and the correctness of protection. The City and Utility will review and approve the protection and SCADA interface requirements only.

2.1.3 Visible, Accessible, Lockable disconnect required. Customer shall furnish and install ganged, manually operated isolation switch near the point of interconnection to isolate the generator from the Utility's system. The following requirements shall be met:

- The disconnecting device shall allow visible verification that separation of the generator from the Utility's system has been accomplished. This requirement may be met by opening the enclosure to observe contact separation.

- The disconnecting device shall include markings or signage that clearly indicates open and closed positions.

- During electrical emergencies, it may be required to disconnect the generator from the Utility's system. Therefore, the disconnecting device shall be capable of being accessed quickly and conveniently 24 hours a day, 7 days a week by the Utility personnel without obstacles or requiring those seeking access to obtain keys, special permission, or security clearances, unless other arrangements for access are mutually agreed upon by both parties.

- The disconnecting device shall be capable of being locked using standard Utility padlocks in the open position.

- The disconnecting device shall be clearly marked on the submitted one-line diagram and its type and location approved by the Utility prior to installation.

- The disconnecting device shall be installed in such a location and in such a manner that Utility personnel will have access under all conditions and at all times.

- Monitoring, Information Exchange, and Control. As recommended by IEEE 1547.3 –

    1. 0 to 250 KVA – no real time monitoring is required.
    2. 251- 500 KVA – Real- time monitoring may be required depending upon the power system analysis.
    3. Above 500 KVA- Real- time monitoring of real power, reactive power, voltage and connection status via telemetry or installation of a SCADA RTU may be required.

- Based on the power system analysis additional work practices and procedures may be required for the maintenance and the operation of the IPU's distribution circuit with the customer generation in parallel operation.

2.1.4 Metering requirements are subject to the Utility's approval. Metering equipment must meet the Utility's specifications for service panel equipment and meters.

- For Commercial Distributed Generation sites with an output rating of equal to or less than 200Amps, the power production meter requires a commercial type service panel with test blocks.

- For Distributed Generation sites with an output rating of more than 200Amps, the power production meter requires a commercial type service panel that is at minimum 400Amps and is Current Transformer (CT) rated.

- Connection to metering equipment from Distributed Generation AC output must be to the top meter clips of the power production meter.

2.1.5 The customer shall provide three (3) sets of preliminary design drawings for initial review by the IPU, City and LAC Building and Safety, (given the number of reviewers is that enough sets?) and four (4) sets of final design drawings once all approvals are met. The IPU may request a title block on the drawings to allow for approval signatures as necessary. Drawings may be submitted in digital format; Design packages shall include:

Mandatory for all distributed generation systems:

- Interconnection Application Form
- Interconnection Agreement or Net Energy Metering Agreement
- Single-line diagram
- Site layout diagram, with generating source(s) and safety devices clearly identified
- Description of safety features (mechanical and electrical)
- All electrical elementary/wiring diagrams

Other information as required by the IPU, City and LA County Building and Safety:

Description of the distributed generation system, electrical parameters, mechanical parameters, operating principles and procedures

- All relay settings and coordination calculations, fuse sizes, breaker settings, and any associated data
- Transformer and cable data
- The design limitation of the excitation system for synchronous generators
- The design of the ground grid system
- The design and application of any solidly grounded transformer
- Certified test reports on all required relays showing relay settings and trip tests to the appropriate circuit breaker. The customer must specify that the IPU will approve only those portions of the drawings which apply to protection of the Utility system. The IPU may comment on other areas which appear to be incorrect or deficient but will not assume responsibility for the correctness of protection pertaining to the customer's system.

2.2 General Operating Requirements

2.2.1 The interconnection of the customer's generating equipment with the Utility system shall not cause any reduction in the quality of service being provided to other customers, with no abnormal voltages, frequencies, or interruptions being permitted. If high or low voltage complaints or flicker complaints result from operation of the customer's generation, such generating equipment shall be disconnected until the problem is resolved.

2.2.2 The customer may not commence parallel operation of generator(s) until the Utility has reviewed the design submittal and given final written approval. The Utility reserves the right to inspect the customer's facility and witness testing of any equipment or devices associated with the interconnection.

2.2.3 Customer shall comply with all the terms of the applicable Interconnection Agreement or the Net Metering Agreement.

2.2.4 The customer will not be permitted to energize a de-energized utility circuit and unintentional islanding. Certification to pass an applicable non- islanding test shall be required to ensure disconnecting generation within two seconds from the de-energized utility circuit in the event of unintentional islanding.

2.2.5 Operation of the customer's generator shall not adversely affect the voltage regulation of the Utility's system. Adequate voltage control shall be provided, by the customer, to minimize voltage regulation on the system caused by changing generator-loading conditions.

2.2.6 The customer shall maintain his equipment in good order. The Utility reserves the right to inspect the customer's facilities whenever it appears that the customer is operating in a manner hazardous to the Utility system's integrity.

2.2.7 The customer shall discontinue parallel operation when requested by the Utility:

a. To facilitate maintenance, test, or repair of utility facilities.

b. During system emergencies.

c. When the customer's generating equipment is interfering with other customers on the system.

d. When an inspection of the customer's generating equipment reveals a condition hazardous to the Utility system or a lack of scheduled maintenance or maintenance records for equipment necessary to protect the Utility system.

2.2.8 When required, and typically for larger generators (>1,000 kW), the customer shall maintain an operating log at each generating facility indicating changes in operating status (available or unavailable), maintenance outages, trip indications or other unusual conditions found upon inspection. For generators that are "blockloaded" to a specific kWh level, changes in this setting shall also be logged.

2.2.9 The Utility typically requires separate metering for distributed generation systems. The cost of the metering shall be at the expense of the Customer. In most cases, the Customer may be required to establish a new service account for the generating system. Contact Customer Service to establish a new service account.

2.3 Design Information — The Utility System

2.3.1 The Utility's primary distribution voltage is 12 kilovolts (kV), 3-wire, delta system. The customer should contact the Utility for information on the specific circuit serving the customer's facility.

2.3.2 Customers with three-phase generators should be aware that certain conditions in the Utility system might cause negative sequence currents to flow in the generator. It is the sole responsibility of the customer to protect his equipment from excessive negative sequence currents.

2.4 Induction Generators

Reactive power supply for induction generators may pose difficult design problems, depending on the generator size. For generator aggregating less than 100 kVA capacity, the Utility will supply the var requirements from general system sources without a specific charge to the customer. Installations over 100 kVA capacity will likely require capacitors to be installed to limit the adverse effects of reactive power flow on the Utility's system voltage regulation. Such capacitors will be installed at generating customer's expense. The installation of capacitors for reactive power supply at, or near, in induction generator greatly increases the risk that the induction machine may become self-excited if accidentally isolated from the Utility's system. Where self-excitation problems appear likely, special service arrangements will be required such as two-line loop service to avoid the induction generator becoming isolated with small amounts of load. In many cases, the additional expense for such special service methods may outweigh the cost savings associated with induction generators.

In cases where starting of, or load changing on, induction generators will have an adverse impact on system voltage, step-switched capacitors or other techniques may be required to bring the voltage changes to acceptable levels.

2.5 Synchronous Generators

For synchronous generators, sufficient generator reactive power capability shall be provided to withstand normal voltage changes on the Utility system. The generator voltage-var schedule, voltage regulator, and transformer ratio settings will be jointly determined by the Utility and the customer to ensure proper coordination of voltages and regulator action. Customers are encouraged to generate their own var requirements to minimize power factor adjustment charges and enhance generator stability. When the Utility installs capacitors to meet the var requirements of the system resulting from the customer's generator, the customer shall pay all costs of labor and associated costs incurred by the Utility in completing such installation.

Synchronous generator installations require a three-phase ground bank on the Utility system for sensing ground faults. The ground bank will be furnished and installed by the Utility at the Customer's expense.

2.6 Inverter Systems

Reactive power supply requirements for inverter systems are similar to those for induction generators and the general guidelines discussed in Section 2.4 apply. Likewise, inverter systems are also capable of isolated operation.

Self-commutated inverters have this capability of design. Line commutated inverters could operate isolated if connected to rotating machines which provide the necessary commutation. Because of these possibilities of self-excited operation, inverter systems are treated as induction machines in these guidelines.

If a customer using such a device is found to be adversely affecting the power quality of other customers or the utility, the Customer shall be required to install filtering to bring the harmonic output of his inverter to acceptable levels.

FIGURE A
CUSTOMER GENERATION INSTALLATION
(CONCEPTUAL ILLUSTRATION, NOT FOR DESIGN)
LESS THAN 100 KW

3.0 Specific Requirements

The IPU has established three different classes for customer-owned parallel generation, each with distinctive protection, metering and operating requirements. These classes are:

1. Less than or equal to 100 kW

2. Greater than 100 kW and less than 1,000 kW

3. Greater than 1,000 kW, with customer-owned protection

Where multiple generators are connected to the Utility's system through a single service point, the class will be determined by the sum of the ratings of the generators.

These classes have been established for convenience and are based on circuits with normal load density. The final decision as to the requirements for each installation will be made depending on customer load, the magnitude of other load connected to that circuit/system, available short circuit contribution, etc.

3.1 Total Generation Less Than or Equal To 100 kW

3.1.1 The following requirements for small generators are based on an assumed low density of parallel generation customers on the serving circuit. Other conditions may be imposed should the density exceed a tolerable limit. Refer to Figure A and/or D.

3.1.2 Customer generator controls to be equipped with a line voltage relay or contactor that will prevent the generator from being connected to a de-energized or single-phased (if normally three-phase) source. This relay is to disconnect the generator from a de-energized utility line and prevent its reconnection until the Utility reenergizes the line.

3.1.3 Specific site or technology conditions may have additional requirements.

3.2 Total Generation Greater Than 100 kW and Less Than 1,000 kW

3.2.1 Customer generator controls to be equipped with a line voltage relay or contactor that will prevent the generator from being connected to a de-energized or single-phased (if normally three-phase) source. This relay is to disconnect the generator from a de-energized utility line and prevent its reconnection until the Utility reenergizes the line.

3.2.2 Customer is to be served through a dedicated distribution transformer that serves no other customers. The purpose of the dedicated transformer is to ensure that the generator cannot become isolated with a small amount of other customer load. It also serves to confine any voltage fluctuations or harmonics produced by the generator to the customer's own system. In instances where it is impractical to provide a dedicated transformer, the relays may be accepted in lieu of the dedicated transformer. The relays may be arranged to de-energize the contactor. Refer to Figure B and/or D.

3.2.3 In order to reduce the possibility of self-excited operation, all reactive power requirements for induction generators or power inverters shall be supplied by the Utility. Except in an unusual

situation, this var supply will be from general utility sources and no specific charge will be made to the customer for the reactive power.

3.2.4 Existing kWh meters may be equipped with a ratchet device, or equivalent, to prevent reverse operation. Where surplus power sales are anticipated, the Utility will install additional metering so that kWh (in) and kWh (out) are separately recorded. Additional metering for kW and kVAR will be determined by the requirements of the individual installation.

3.3 Total Generation Greater Than 1,000 kW, With Customer-Owned Protection

3.3.1 All installations in this class require City review of the protective functions to be provided. Refer to Figure C for a typical installation. Note that certain requirements regarding liability and indemnity may apply to installations using customer-owned protection, which shall be defined in an Interconnection Agreement.

3.3.2 The customer shall provide adequate protective devices to:

a. Detect and clear the generator(s) from short circuits or grounds on the Utility facilities serving the customer.

b. Detect the voltage and frequency changes, which can occur if the Utility facilities serving the customer are disconnected from the system and clear the customer generation from the isolated system.

c. Prevent re-paralleling the customer generation, after an incident of trouble, unless the Utility service voltage is of normal magnitude and phase sequence.

3.3.3 Typical protection devices which may be required to satisfy the above requirements are:

a. Phase overcurrent trip devices.

In some cases, these will have to be voltage-restrained or voltage-controlled overcurrent relays in order to provide coordination with the Utility's relays.

b. Residual overcurrent or overvoltage relays to trip for ground faults on the Utility's system.

c. Under/overvoltage relays.

Undervoltage relays should be adjustable from 75-90% of nominal voltage and have time delay to prevent unnecessary tripping on external faults. Overvoltage relays should be adjustable from 110-120% of nominal voltage and may be instantaneous. Setting change with temperature variation should not exceed ± 2 volts over the expected temperature range.

d. Under/over frequency relays.

The underfrequency relay should be adjustable from 55-59 Hz and the overfrequency relay from 61-65 Hz. Setting change with temperature variation over the expected range, or voltage variation over ± 10%, should not exceed ± 1 Hz.

e. Phase sequence/undervoltage relay.

To permit paralleling when the Utility's voltage and phase sequence are normal.

f. Synchronizing relay

To permit parallel operation, and to synchronize with the Utility's system.

3.3.4 In specific installations, particularly with large generators (over 1,000 kW), the Utility may require specific additional protective functions such as loss of excitation, loss of synchronism and overexcitation protection, if these conditions would have an impact on the Utility system.

3.3.5 Depending on the size of the generation and the size of the distribution system to which it is connected, the Utility may require the customer to utilize "utility quality" protective relays, which are subject to the Utility's approval. Such relays have more stringent tolerances and more flexible, widely published characteristics than "industrial quality" relays. This requirement can be invoked only if generation is of such size that close coordination with the Utility relays is required. In general, installations aggregating less than 1,000 kVA will not be subject to this requirement.

3.3.6 Where induction generators or static inverters are employed rather than synchronous machines the phase overcurrent protective devices required by the Utility will be waived since these sources will not deliver sustained overcurrents.

3.3.7 In some cases, protective devices supplied with the generating equipment will meet some or all of these requirements, provided that it is capable to trip the generator whenever the Utility source is lost. If the customer desires to automatically separate from the Utility and commence isolated operation upon loss of the Utility source, additional devices will be necessary to affect the separation.

3.3.8 All protective devices supplied to satisfy these requirements shall be equipped with operation indicators (targets) or shall be connected to an annunciator or event recorder so that it will be possible to determine, after the fact, which devices caused a particular trip.

3.3.9 All protective devices supplied to satisfy these requirements shall be tested by qualified personnel at intervals at least as frequent as those used by the Utility for the relays protecting the line(s) serving the customer. This interval is currently four years for lines of 12.4kV and below. Special tests may also be requested by the Utility to investigate apparent mis-operations or to have a record of the performance for anticipated litigation.

Each routine or special test shall include both a calibration check and the actual trip of the circuit breaker from the device being tested. For each test a report shall be prepared and sent to the Utility listing the tests made and the "as found" and "as left" calibration values.

3.3.10 Projects where the customer is served from the Utility's four-wire multi-grounded neutral distribution circuit, adequate grounding must be provided to ensure neutral stability during any isolation of the line from the main system. This is necessary to avoid dangerous overvoltages on other customers served from phase-to-neutral connected distribution transformers. Adequate grounding can be provided either by the use of a wye-delta main power transformer or by installing an appropriate grounding transformer. In order to limit the effects of such grounding on the Utility's ground relay sensitivity, the Utility may require that the grounding impedance be limited to the highest value suitable for neutral stabilization.

3.3.11 Installations where surplus power sales are anticipated and for all simultaneous buy and sell arrangements, the Utility will install appropriate metering. Generators that export power to the Utility,

with the exception of Net Metered accounts, must execute a separate power sales agreement with the Utility.

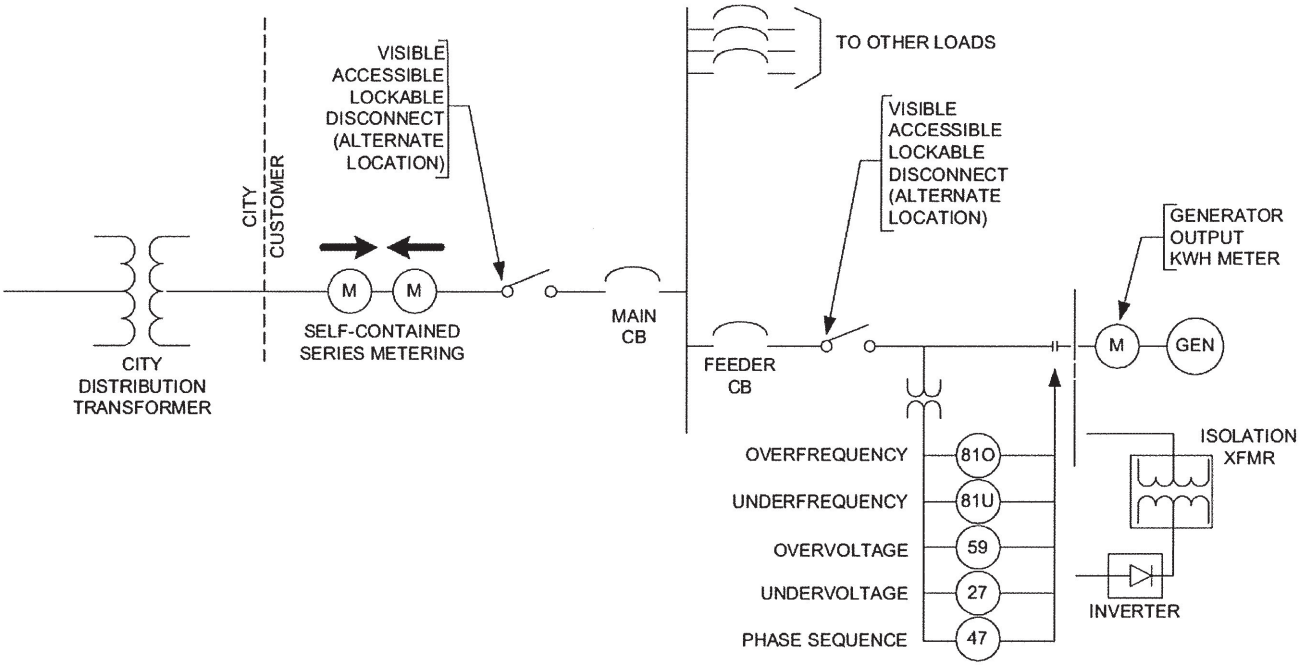
3.3.12 Telemetering equipment at the Generator Metering location may be required at the Producer's (and Customer's) expense. The Utility shall only require Telemetering to the extent that less intrusive and more cost effective options for providing the necessary data in real time are not available.

FIGURE A

CUSTOMER GENERATION INSTALLATION

(CONCEPTUAL ILLUSTRATION, NOT FOR DESIGN)

LESS THAN 100 KW



NOTES:

1. ALL MAJOR EQUIPMENT MUST BE INCLUDED ON THE CEC'S ELIGIBLE EQUIPMENT LISTS.

2. AN ISOLATION TRANSFORMER SHALL BE REQUIRED TO INTERFACE THE ENERGY SOURCE TO THE SERIES METERING EQUIPMENT FOR THREE-PHASE SYSTEMS, AND MAY BE REQUIRED FOR SINGLE-PHASE SYSTEMS AS DETERMINED BY THE UTILITY.

3. THE CUSTOMER SHALL PROVIDE, INSTALL, AND MAINTAIN THE INDICATED ENERGY SOURCE DISCONNECT EQUIPMENT.

4. THE CUSTOMER SHALL BE RESPONSIBLE FOR THE PROTECTION OF HIS EQUIPMENT AGAINST FAULTS OR OTHER SYSTEM DISTURBANCES.

5. THE VISIBLE, ACCESSIBLE, LOCKABLE DISCONNECTION DEVICE SHALL BE INSTALLED IN SUCH A LOCATION AND IN SUCH A MANNER THAT UTILITY PERSONNEL WILL HAVE ACCESS UNDER ALL CONDITIONS AND AT ALL TIMES. THE DEVICE SHALL BE CAPABLE OF BEING LOCKED IN THE OPEN POSITION USING STANDARD UTILITY LOCKS.

6. CUSTOMER MAY BE REQUIRED TO PROVIDE VOLTAGE AND FREQUENCY PROTECTION FOR GRID TIE CONNECTION IN INVERTER CIRCUITRY (REFER TO SECTION 2.5 - INVERTER SYSTEMS IN THIS GUIDLINE).

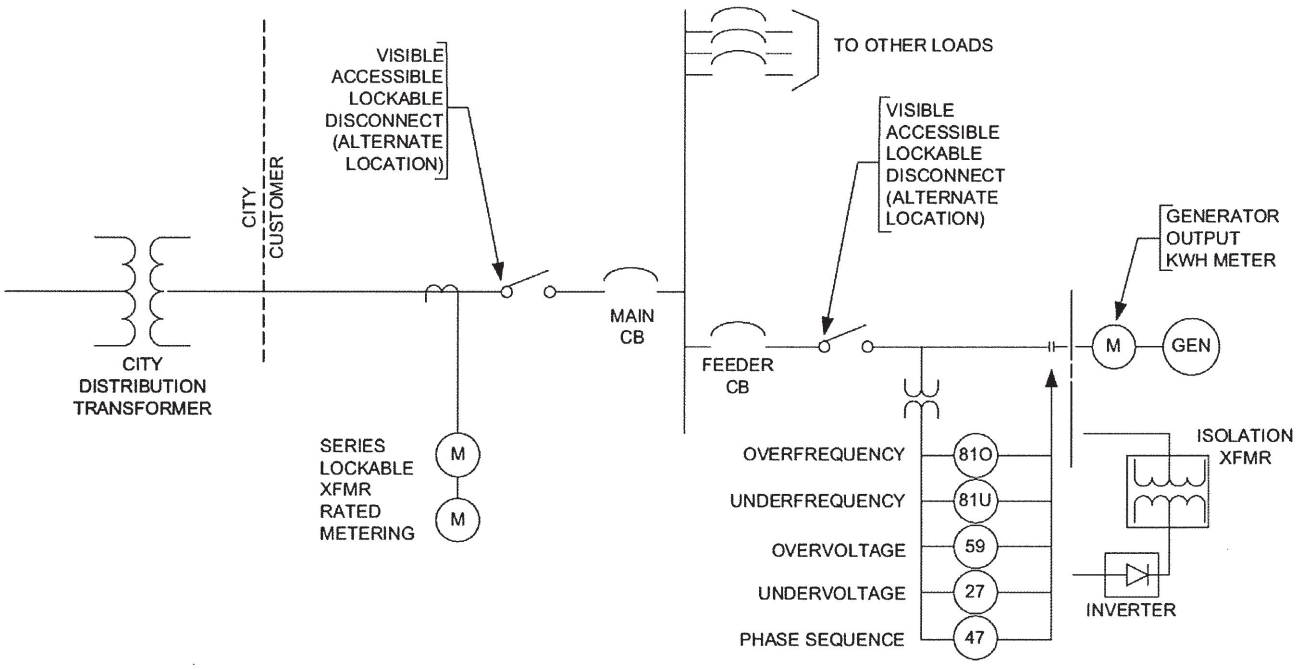
7 NET METER AND PRODUCTION METER SHOULD BE LOCATED IN SAME AREA; NET METER AND PRODUCTION METER SHALL BE LOCATED NO MORE THAN 5 FEET APART UNLESS APPROVED BY THE UTILITY.

FIGURE B

CUSTOMER GENERATION INSTALLATION

(CONCEPTUAL ILLUSTRATION, NOT FOR DESIGN)

BETWEEN 100 – 1,000 KW



NOTES:

1. ALL MAJOR EQUIPMENT MUST BE INCLUDED ON THE CEC'S ELIGIBLE EQUIPMENT LISTS.

2. AN ISOLATION TRANSFORMER SHALL BE REQUIRED TO INTERFACE THE ENERGY SOURCE TO THE SERIES METERING EQUIPMENT FOR THREE-PHASE SYSTEMS, AND MAY BE REQUIRED FOR SINGLE-PHASE SYSTEMS AS DETERMINED BY THE UTILITY.

3. THE CUSTOMER SHALL PROVIDE, INSTALL, AND MAINTAIN THE INDICATED ENERGY SOURCE DISCONNECT EQUIPMENT.

4. THE CUSTOMER SHALL BE RESPONSIBLE FOR THE PROTECTION OF THEIR EQUIPMENT AGAINST FAULTS OR OTHER SYSTEM DISTURBANCES.

5. THE VISIBLE, ACCESSIBLE, LOCKABLE DISCONNECTION DEVICE SHALL BE INSTALLED IN SUCH A LOCATION AND IN SUCH A MANNER THAT UTILITY PERSONNEL WILL HAVE ACCESS UNDER ALL CONDITIONS AND AT ALL TIMES. THE DEVICE SHALL BE CAPABLE OF BEING LOCKED IN THE OPEN POSITION USING STANDARD UTILITY LOCKS.

6. CUSTOMER MAY BE REQUIRED TO PROVIDE VOLTAGE AND FREQUENCY PROTECTION FOR GRID TIE CONNECTION IN INVERTER CIRCUITRY (REFER TO SECTION 2.5 - INVERTER SYSTEMS IN THIS GUIDELINE).

7 NET METER AND PRODUCTION METER SHOULD BE LOCATED IN SAME AREA; NET METER AND PRODUCTION METER SHALL BE LOCATED NO MORE THAN 5 FEET APART UNLESS APPROVED BY ANAHEIM PUBLIC UTILITIES.

8 POWER FACTOR CLOSE TO 0.98 LAGGING WILL BE REQUIRED AT ALL TIMES.

FIGURE C

CUSTOMER GENERATION INSTALLATION

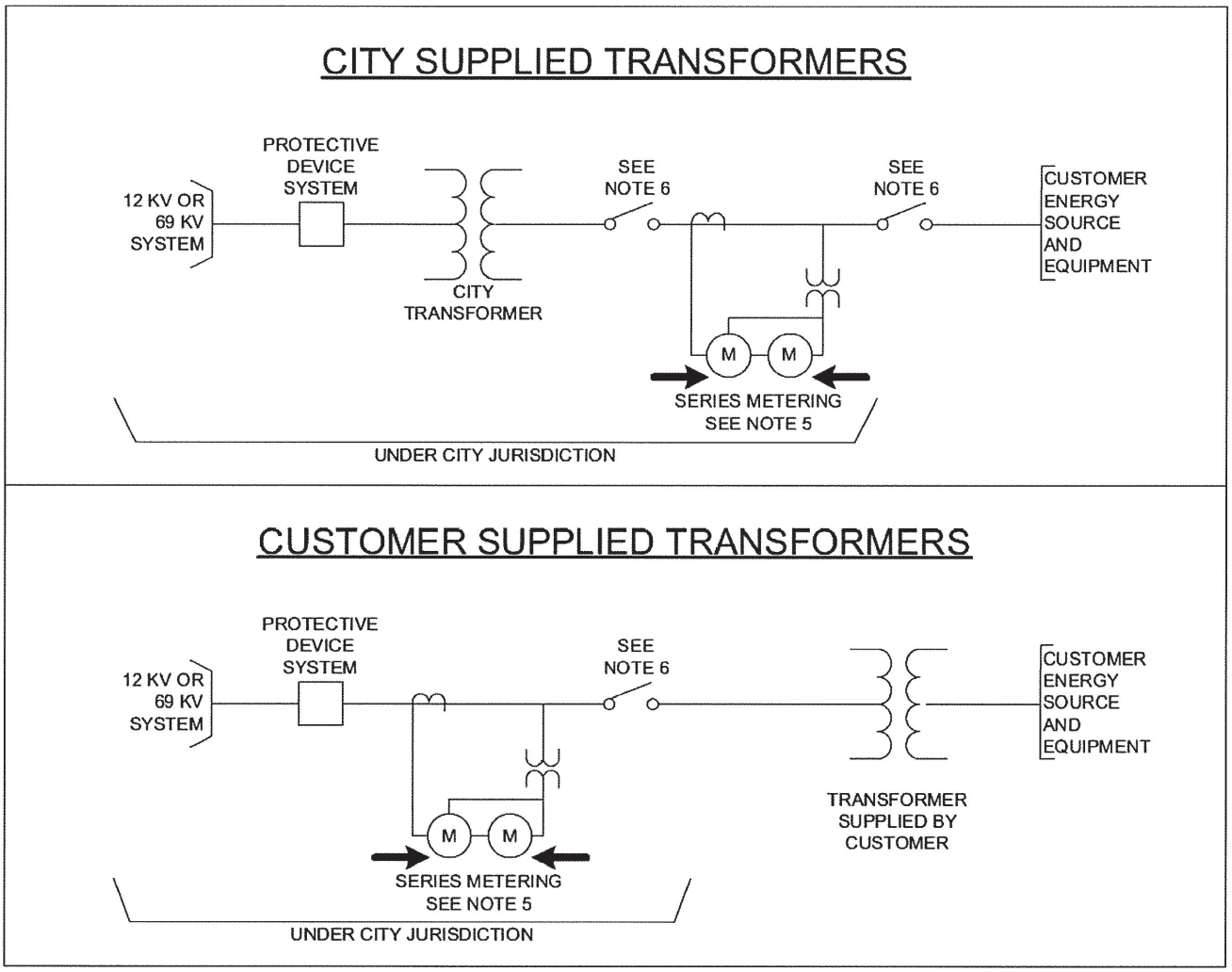
(CONCEPTUAL ILLUSTRATION, NOT FOR DESIGN)

1,000 KW AND OVER

9 MONITORING, INFORMATIONAL EXCHNAGE AND CONTROL ABOVE 500 KVA – REAL TIME MONITRING OF REAL POWER, REACTIVE POWER, VOLTAGE AND CONNECTION STATUS VIA TELEMETERY OR SCADA – RTU WILL BE REQUIRED.

10 CERTIFICATION TO PASS AN APPLICABLE NON-ISLANDING TEST WILL BE REQUIRED.

11



NOTES:

1. ALL MAJOR EQUIPMENT MUST BE INCLUDED ON THE CEC'S ELIGIBLE EQUIPMENT LISTS.

2. AN ISOLATION TRANSFORMER SHALL BE REQUIRED TO INTERFACE THE ENERGY SOURCE TO THE SERIES METERING EQUIPMENT FOR THREE-PHASE SYSTEMS, AND MAY BE REQUIRED FOR SINGLE-PHASE SYSTEMS AS DETERMINED BY THE UTILITY.

3. THE CUSTOMER SHALL BE RESPONSIBLE FOR THE PROTECTION OF HIS EQUIPMENT AGAINST FAULTS OR OTHER SYSTEM DISTURBANCES.

4. ALL ENERGY SOURCE PROTECTION SCHEMES SHALL BE DESIGNED TO BE COMPATIBLE WITH THE UTILITY EQUIPMENT PROTECTION SCHEMES.

5. METERING REQUIREMENTS ARE SUBJECT TO THE UTILITY'S APPROVAL.

6 THE CITY SHALL REQUIRE THAT THE CUSTOMER PROVIDE SUITABLE FACILITIES ON CUSTOMER PROPERTY FOR THE UTILITY TO INSTALL CABLE TERMINATIONS, DISCONNECTS, CIRCUIT BREAKERS AND TRANSFORMERS.

7 THE VISIBLE, ACCESSIBLE, LOCKABLE DISCONNECTION DEVICE SHALL BE INSTALLED IN SUCH A LOCATION AND IN SUCH A MANNER THAT UTILITY PERSONNEL WILL HAVE ACCESS UNDER ALL CONDITIONS AND AT ALL TIMES. THE DEVICE SHALL BE CAPABLE OF BEING LOCKED IN THE OPEN POSITION USING STANDARD UTILITY LOCKS.

8. NET METER AND PRODUCTION METER SHOULD BE LOCATED IN SAME AREA; NET METER AND PRODUCTION METER SHALL BE LOCATED NO MORE THAN 5 FEET APART UNLESS APPROVED BY UTILITY.

9. POWER FACTOR CLOSE TO 0.98 LAGGING WILL BE REQQUIRED AT ALL TIMES.

10. MONITORING, INFORMATIONAL EXCHNAGE AND CONTROL – REAL TIME MONITRING OF REAL POWER, REACTIVE POWER, VOLTAGE AND CONNECTION STATUS VIA TELEMETERY OR SCADA – RTU WILL BE REQUIRED.

11. CERTIFICATION TO PASS AN APPLICABLE NON-ISLANDING TEST WILL BE REQUIRED.

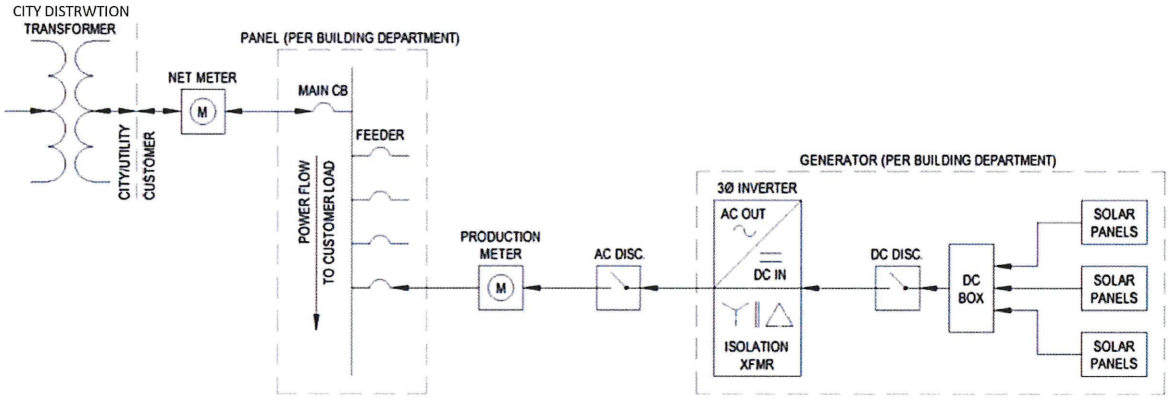
FIGURE D

CUSTOMER GENERATION INSTALLATION

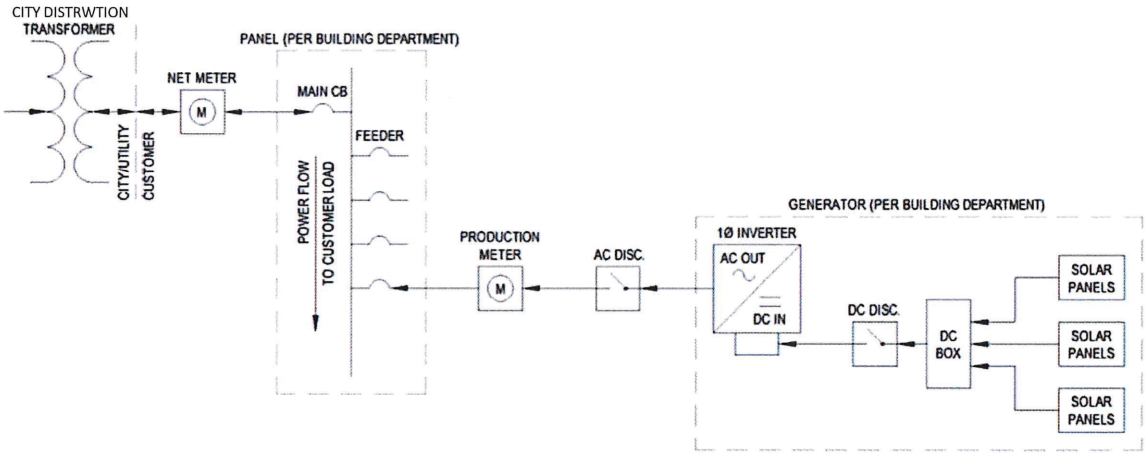
(CONCEPTUAL ILLUSTRATION, NOT FOR DESIGN

PHOTOVOLTAIC SOLAR ELECTRIC SYSTEM

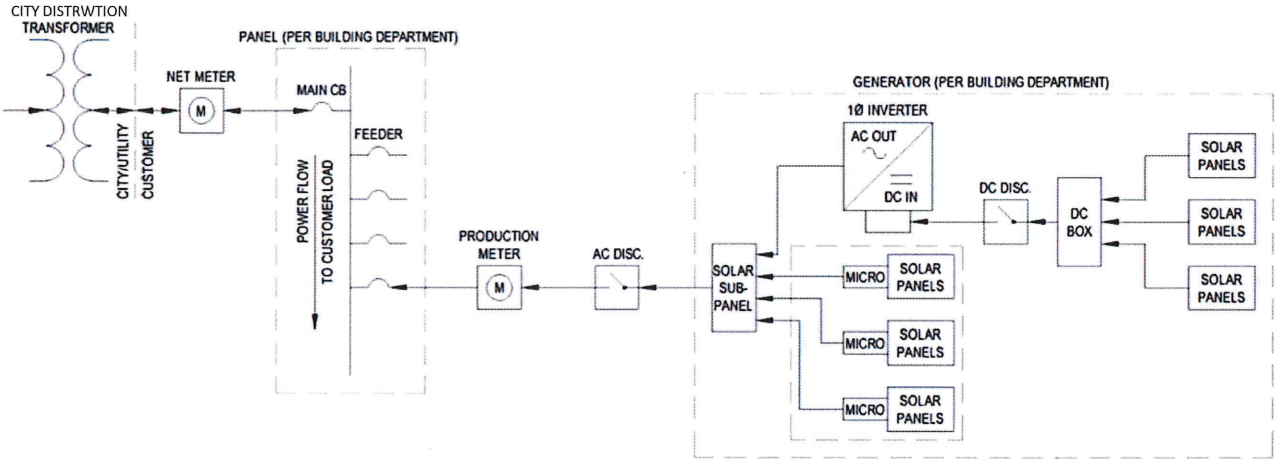
TYPICAL 3Ø COMMERCIAL PHOTOVOLTAIC SYSTEM



TYPICAL 1Ø COMMERCIAL PHOTOVOLTAIC SYSTEM



TYPICAL 1Ø /COMMERCIAL PHOTOVOLTAIC SYSTEM (OPTION TO ADD MICRO-INVERTERS)



NOTES:

1. ALL MAJOR PHOTOVOLTAIC SOLAR ELECTRIC SYSTEM COMPONENTS, INCLUDING PV MODULES AND INVERTERS MUST BE INCLUDED ON THE CEC'S ELIGIBLE EQUIPMENT LISTS.

2. THE CUSTOMER SHALL PROVIDE, INSTALL, AND MAINTAIN THE INDICATED ENERGY SOURCE DISCONNECT EQUIPMENT.

3. THE CUSTOMER SHALL BE RESPONSIBLE FOR THE PROTECTION OF HIS EQUIPMENT AGAINST FAULTS OR OTHER SYSTEM DISTURBANCES.

4. THE VISIBLE, ACCESSIBLE, LOCKABLE AC DISCONNECT DEVICE SHALL BE INSTALLED IN SUCH A LOCATION AND IN SUCH A MANNER THAT UTILITY PERSONNEL WILL HAVE ACCESS UNDER ALL CONDITIONS AND AT ALL TIMES. THE DEVICE SHALL BE CAPABLE OF BEING LOCKED IN THE OPEN POSITION USING STANDARD UTILITYY LOCKS.

5. CUSTOMER MAY BE REQUIRED TO PROVIDE VOLTAGE AND FREQUENCY PROTECTION FOR GRID TIE CONNECTION IN INVERTER CIRCUITRY (REFER TO SECTION 2.5 - INVERTER SYSTEMS IN THIS GUIDELINE).

6. POWER PRODUCTION METERING REQUIREMENTS ARE SUBJECT TO THE UTILITY'S APPROVAL. CUSTOMER SHALL FURNISH AND INSTALL METERING PANEL FOR THE POWER PRODUCTION METER. CHECK WITH THE UTILITY FOR TYPE OF METER PANEL/SOCKET.

- FOR COMMERCIAL SOLAR ENERGY SITES WITH AN OUTPUT RATING OF EQUAL TO OR LESS THAN 200A, THE POWER PRODUCTION METER REQUIRES A COMMERCIAL TYPE SERVICE PANEL WITH TEST BLOCKS

- FOR SOLAR ENERGY SITES WITH AN OUTPUT RATING OF MORE THAN 200A, THE POWER PRODUCTION METER REQUIRES A COMMERCIAL TYPE SERVICE PANEL THAT IS AT MINIMUM 400AMPS AND IS CT RATED.

- ALL SERVICE PANELS MUST MEET UTILITY SPECIFICATIONS FOR SERVICE PANEL EQUIPMENT.

- CONNECTION TO METERING EQUIPMENT FROM DISTRIBUTED GENERATION AC OUTPUT MUST BE TO THE TOP METER CLIPS OF THE POWER PRODUCTION METER.

7. NET METER AND PRODUCTION METER SHOULD BE LOCATED IN SAME AREA; NET METER AND PRODUCTION METER SHALL BE LOCATED NO MORE THAN 5 FEET APART UNLESS APPROVED BY UTILITY.