



### Solar PV Simplified Standard Permit Application Requirements For: Central/String Inverter(s) & Micro-Inverter(s) Systems for One and Two Family Dwellings

**SCOPE:** Use this application only for utility-interactive central/string inverter systems or micro-inverter systems not exceeding a system ac inverter output rating of 10kW on the roof of a one or two family dwelling or accessory structure. The photovoltaic system must interconnect to the **load side** of a single-phase ac service panel of nominal 120/240Vac with a busbar rating of 225 Amps or less. This application is not intended for bipolar systems, hybrid systems or systems that utilize storage batteries, charge controllers, trackers, more than two inverters or more than one dc combiner per inverter. Systems must be in compliance with current 2016 California Building Standards Codes and local amendments of the authority having jurisdiction (AHJ). Other Articles of the 2016 California Electrical Code (CEC) shall apply as specified in 690.3.

#### **Reference Information:**

- 2016 California Electrical Code (CEC)
- 2016 California Building Code and Residential Code (CBC & CRC)
- 2016 County of Santa Cruz adopted Fire Code  
*Exception to Fire code: Detached Group U non-habitable structures such as garages, parking shade structures, carports, solar trellises, and similar type structures are not subject to the rooftop setback requirements of the Fire Code.*

#### **Required Application Submittal Information:**

- Photovoltaic permit applications and installations shall be completed by "Qualified Personnel". The installation of equipment and all associated wiring and interconnections shall be performed only by qualified persons, as defined by the 2016 CEC article 100, definitions of a "qualified person", CEC 690.4(C)  
This includes the following personnel as stated by the California State Licensing Board, a General contractor, Electrical contractor and Solar Photovoltaic contractor.
- Application submittals shall show the location of the structure with the rooftop solar system on a parcel map, or the location of the ground mounted solar system and the back-fed structure on a parcel map.
- Provide a plan view for both rooftop mounted and ground mounted arrays to show the location and where required fire setbacks, all equipment configurations and locations, the point of utility connection and the rapid shut down equipment where applicable.
- Provide two copies for application submittal on a minimum 11"x17" format, equipment specification sheets may be included on 8.5" x 11" format.

- Provide an electrical single line diagram, which shall state all equipment such as modules, micro-inverters, DC to DC combiners, output combiners, central inverters, dc and ac electrical panels, conductor types, sizes and where present **raceway installation height above the rooftop**, disconnecting means, overcurrent devices, utility connection points and rapid shutdown equipment. Include equipment electrical values for sizing conductors, overcurrent devices, inverters, electrical panels and other equipment present.
- Provide manufacturer specification sheets for modules, combiner boxes, dc to dc combiners, micro-inverters, inverters, rapid shutdown equipment, solar module racking systems and any other electrical equipment present. Equipment shall be identified and listed for the application.
- Grounded dc photovoltaic arrays shall be provided with dc ground-fault protection (GFP) as required by CEC 690.5(A - C). Inverter specifications shall indicate integral GFP protection.
- Arc-Fault circuit protection shall be provided for Photovoltaic systems with dc source circuits, dc output circuits, or both, operating at a PV system maximum of 80 volts or greater, shall be protected by a listed dc arc-fault circuit interrupter, PV type, or other system components listed to provide equivalent protection meeting the requirement of CEC 690.11(1-3).
- Rapid Shutdown of PV systems on buildings shall include a rapid shutdown function that controls specific conductors in accordance with 690.12(1 – 5). Equipment that performs the rapid shutdown shall be listed and identified.
  - 1) Requirements for controlled conductors shall apply only to PV system conductors of more than 5 feet in length inside a building, or more than 10 feet from a PV array on the exterior (lengths may not be added together).
  - 2) Controlled conductors shall be limited to not more than 30 volts and 240 volt-amperes within 10 seconds of rapid shutdown initiation.  
*(Amended by NFPA TIA 14-10 to extend the shut down time required to 30 seconds)*
  - 3) Voltage and power shall be measured between any two conductors and between any conductor and ground.
  - 4) The rapid shutdown initiation methods shall be labeled in accordance with 690.56(B). (Plaque or directory)
  - 5) Equipment that performs the rapid shutdown shall be listed and identified.
- Specify module weight (including array racking) per square foot for roof loading evaluation.
- Include a detail for the roof framing layout to specify framing material, size, spacing and slope.
- State calculations for VOC per CEC Table 690.7 with a correction factor of 1.14 minimum. When open-circuit voltage temperature coefficients are supplied in the instructions for listed PV modules, the calculation shall be based on the module stated factor for the maximum PV system voltage instead of using Table 690.7.
- Maximum allowable system design (BOS) and application shall not exceed 600V dc based on maximum system VOC for one and two-family dwellings. For systems over 600V see Art. 690 Part IX.

- State calculations for the dc source circuit(s) and output circuit(s) ampacity and sizing based on module Isc values to carry not less than the larger of 690.8(B)(1) or (2).
- State calculations for the ac conductor(s) ampacities and sizing based on central inverter or micro-inverter rated output ampacity times the continuous load factor 1.25% per 690.8(A)(3).
- If conductors are installed in raceways or cables and located on rooftops, specify raceway or cable height above the rooftop and apply an additional ambient temperature adjustment using CEC Table 310.15(B)(3)(c) to the 2013 Ashrae highest monthly 2% DB design temp at 74.8°F.
- Equipment listings shall provide terminal termination temperatures for modules, dc to dc combiners, combiner boxes, overcurrent devices, micro-inverters, central inverters, disconnects and any other equipment present. If rooftop combiner boxes are in direct sunlight, manufacture specifications will be required for adjustments above 40°C for overcurrent devices per CEC 110.3(B).
- Provide a plan view for the array rack mounting attachment points. The roof mounted racking system shall include attachment and flashing details, along with the required rooftop fire rating in combination with the proposed modules fire class “type” per Cal Fire requirements.
- Back-fed PV ac Calculations per CEC 705.12(D):
  - Calculate back-fed feeders CEC 705.12(D)(2)(1)(a) & (b).
  - Calculate back-fed taps CEC 705.12(D)(2)(2).
  - Calculate the electrical service load-side ac back-feed where two sources, one a utility and the other an inverter, are located at opposite ends of a busbar that contains loads, the sum of 125 percent of the inverter(s) output current rating and the rating of the overcurrent device protecting the busbar shall not exceed 120% of the ampacity of the busbar CEC 705.12(D)(2)(3)(b).
  - The sum of the ampere ratings of all overcurrent devices on panelboards, both load and supply devices, excluding the rating of the overcurrent device protecting the busbar, shall not exceed the ampacity of the busbar CEC 705.12(D)(2)(3)(d).
  - Center-fed panelboards shall be permitted where designed under engineering supervision that includes fault studies and busbar load calculations 705.12(D)(2)(3)(d). *(Amended by NFPA TIA 14-12 to allow the 120% rule to apply at either end but not both ends, of the center-fed bus).*
- Equipment grounding conductors for photovoltaic source and output circuits shall be sized per CEC 250.122 and shall not be smaller than 14 AWG per CEC 690.45. For arrays, equipment grounding conductors smaller than 6 AWG shall comply with 250.120(C) for protection CEC 690.46.

- Grounding electrode requirements for dc systems shall be provided as required per CEC 690.47(B) in accordance with 250.166 for grounded systems or 250.169 for ungrounded systems. Systems with both ac and dc grounding requirements shall apply CEC 690.47(C)(1), (2) or (3).

\*Additionally, rod, pipe and plate electrodes shall be supplemented by an additional electrode specified in CEC 250.52(A)(2) through (A)(8). The supplemental electrode shall be permitted to be bonded to one of the following: CEC 250.52(A)(2)

- 1) Rod, pipe or plate electrode
- 2) Grounding electrode conductor
- 3) Grounded service entrance conductor
- 4) Non-flexible grounded service raceway
- 5) Any grounded service enclosure

*Exception: If a rod, pipe or plate grounding electrode has a resistance to earth of 25 ohms or less than, the supplemental electrode shall not be required. CEC 250.53(A)(2) Exception*

- Where PV source and output circuits operating at maximum system voltages greater than 30 volts that are installed in readily accessible locations, shall have circuit conductors guarded or installed in a raceway. CEC 690.31  
Ground mount PV systems shall state conductor guarding where readily accessible.

**Include CEC Photovoltaic Required Labeling in submittal as applicable to system:**

- On the photovoltaic disconnect (Inverter) the following shall be labeled, “Rated Maximum power-point current (I<sub>pm</sub>) \_\_\_\_\_, Rated maximum power-point voltage (V<sub>pm</sub>) \_\_\_\_\_, Maximum system voltage (V<sub>oc</sub>) \_\_\_\_\_, Short circuit current (I<sub>sc</sub>) \_\_\_\_\_, Maximum rated output current of the charge controller \_\_\_\_\_” CEC 690.53
- A permanent plaque or directory, denoting all electric power sources on or in the premises, shall be installed at each service equipment location and at locations of all electric power production sources capable of being interconnected. CEC 690.5 & 705.10
- At interactive points of interconnection, usually the main service, provide labeling stating “Power Source ac operating current \_\_\_\_\_, ac operating voltage \_\_\_\_\_”. CEC 690.54
- At all disconnects where terminals may be energized in the open position provide labeling stating “*Warning: Electric Shock Hazard. Do not touch terminals. Terminals on both the line and load sides may be energized in the open position*”. CEC 690.17(E)

## Labeling Continued

- Marking and labeling is required on all exposed **dc** raceways, enclosures, cable assemblies and junction boxes. The equipment shall be marked with materials permanently affixed or other approved permanent markings. The marking shall contain the words *“PHOTOVOLTAIC POWER SOURCE”*. Marking shall be placed every 10 feet, above and below all penetrations of roof/ceiling assemblies and all walls and or barriers. The labels shall be reflective, and all letters shall be capitalized and shall be a minimum height of 3/8” in white on a red background. CEC 690.31(G)(4)
- The PV power source system shall be labeled with the following warning at each junction box, combiner box, disconnect, and device where energized, ungrounded circuits may be exposed during service: CEC 690.35(F)

*“WARNING  
ELECTRIC SHACK HAZARD, THE DC CONDUCTORS OF THIS  
PHOTOVOLTAIC SYSTEM ARE UNGROUNDED AND MAY BE  
ENERGIZED”*

- A warning label shall appear on the utility-interactive inverter or be applied by the installer near the ground-fault indicator at a visible location, stating the following:

*“Warning  
Electric Shack Hazard  
If a Ground Fault Is Indicated,  
Normally Grounded Conductors May  
Be Ungrounded and Energized”*

When the PV system also has batteries, the same warning shall also be applied by the installer in a visible location at the batteries. CEC 690.5(C)

- Rapid Shut Down Labeling. Buildings or structures with both utility service and a PV system, complying with 690.12, shall have a permanent plaque or directory including the following words:

*“PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN”*

The plaque or directory shall be reflective, with all letters capitalized and having a minimum height of 3/8”, in white on red background. CEC 690.56(C)

- A permanent warning label shall be applied to the distribution equipment adjacent to the back-fed breaker from the inverter that displays the following or equivalent wording:  
CEC 705.12(D)(2)(3)(b)

*“Warning  
Inverter Output Connections  
Do Not Relocate This Overcurrent Device”*

## **Labeling Continued**

- Where panelboards are back-fed by multiple sources a permanent warning label shall be applied to the distribution equipment that displays the following or equivalent wording:  
705.12(D)(2)(3)(c)

*“Warning:  
This Equipment Fed by Multiple Sources.  
Total Rating of all Overcurrent Devices,  
Excluding Main Supply Overcurrent Device,  
Shall Not Exceed Ampacity of Busbar”*

## **Fire Department Requirements:**

- Roof access, setbacks, pathways and spacing requirements shall be provided in order to ensure access to the roof; provide pathways to specific areas of the roof; provide for smoke ventilation operations; and to provide emergency egress from the roof.

### Exceptions:

1. Requirements relating to ridge, hip, and valleys do not apply to roof slopes of two units vertical in twelve units horizontal (2:12) or less.
  2. Residential structures shall be designed so that each array is no greater than 150 feet by 150 feet in either axis.
  3. The fire chief may allow panels/modules to be located up to the ridge when an alternative ventilation method acceptable to the fire chief has been provided or where the fire chief has determined vertical ventilation techniques will not be employed.
- Residential buildings with hip roof layouts shall have panels/modules located in a manner that provides a 3-foot-wide clear access pathway from the eave to the ridge on each roof slope where panels/modules are located. The access pathway shall be located at a structurally strong location on the building capable of supporting the live load of fire fighters accessing the roof.
  - Residential building with a single ridge shall have panels/modules located in a manner that provides two 3-foot-wide access pathways from the eave to the ridge on each roof slope where panels/modules are located.
  - Residential hips and valleys shall have panels/modules located no closer than 18 inches to a hip or valley if panels/modules are to be placed on both sides of a hip or valley. If the panels are to be located on only one side of a hip or valley that is of equal length, then the panels shall be permitted to be placed directly adjacent to the hip or valley.
  - Smoke ventilation requires panels/modules be located no higher than 3 feet below the ridge in order to allow for fire department smoke ventilation operations.
  - Ground mounted photovoltaic arrays do not require setbacks. Vegetation shall be kept clear for a minimum of 10 feet from the ground mounted arrays and associated equipment.