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## Residential Solar Photovoltaic Submittal Requirements

- **2022 California Electrical Code (CEC)**
- **2022 California Building and Residential Code (CBC & CRC)**
- **2022 California Fire Code (CFC)**

*Exceptions for CRC & CFC: Detached Group U and S non-habitable structures such as detached garages, parking shade structures, detached carports, solar trellises, detached storage buildings and similar type structures are not subject to the rooftop setback requirements.*

### **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 2022 CEC article 100 and definitions of a “qualified person”, CEC 690.4(C).
- Application submittals shall include a site map to show the location of the rooftop solar system or the ground mount solar system on the associated parcel map.
- Provide two copies for application submittal on a minimum 11”x17” format.
- Provide a plan view for both roof-top mounted or ground mounted arrays to show the location and where required, fire setbacks, 2<sup>nd</sup> story bedroom emergency egress windows, all equipment configurations and locations, the point of utility connection and the rapid shut down equipment where applicable.
- 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 module fire class “type” per Cal Fire requirements.
- 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 heights less than 7/8” above the rooftop, disconnecting means, overcurrent devices, utility connection points and rapid shutdown equipment.
- For ground mount systems with combined areas greater than 500 square feet, include the following note on the site plan: “The property owner is responsible to maintain vegetation and natural drainage patterns in the vicinity of the solar panels.”
- Ground-mounted photovoltaic arrays. R324.7.2 Ground mounted photovoltaic arrays shall comply with this section and the California Electrical Code. Setback requirements shall not apply



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to ground-mounted, free-standing photovoltaic arrays. A clear, brush-free area of 10 feet (3048 mm) shall be required for ground-mounted photovoltaic arrays. (Setbacks may apply, consult Zoning relative to height of array above grade)

- Provide manufacturer specification sheets for all electrical equipment to include, 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.
- Specify module (array) 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.
- Specify minimum system installation design of 110 mile per hour wind loading.
- State calculations for VOC per CEC Table 690.7(A) with a correction factor of 1.14 minimum, (22 – 14°F). When open-circuit voltage temperature coefficients are supplied in the instructions for listed PV modules, the adjustment calculation shall be based on the module stated temperature correction factor for the maximum PV system voltage instead of using Table 690.7(A) using 22°F (-5.55°C) as lowest average mean temperature for this region.
- State the maximum dc VOC system design. The system design shall have a maximum 600 Volts dc or less for one and two-family dwellings. CEC 690.7
- State calculations for the dc source circuit(s) and output circuit(s) ampacity and sizing based on module dc Isc values and inverter ac values to carry not less than the larger of 690.8(B) (1) or (2).
- Provide DC & AC required labeling as applicable to system design.
- Where PV source and output circuits operating at voltages greater than 30 volts are installed in readily accessible locations, circuit conductors shall be guarded or installed in Type MC cable or raceway. CEC 690.31(A)
- PV system circuits installed on or in buildings shall include a rapid shutdown function to reduce shock hazard for emergency responders in accordance with 690.12 (A) through (D).

**Exception:** *Ground mounted PV system circuits that enter buildings, of which the sole purpose is to house PV system equipment, shall not be required to comply with 690.12.*

## **Required CEC Photovoltaic Labeling as Applicable to System Design:**

- **Directory. CEC 705.10** A permanent plaque or directory denoting the location of all electric power source disconnecting means on or in the premises shall be installed at each service equipment location and at location(s) of the system disconnect(s) for all electric power production sources capable of being interconnected. (The marking shall comply with 110.21(B))



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- **Point of Connection/Two Sources. 705.12(B)(2)(3)(b)** A permanent warning label shall be applied to the distribution equipment adjacent to the back-fed breaker from the power source that displays the following or equivalent wording: (The marking shall comply with 110.21(B))

**“WARNING:**

**POWER SOURCE OUTPUT CONNECTION-  
DO NOT RELOCATE THIS OVERCURRENT DEVICE”**

- **Point of Connection/Sum of Overcurrent Ampere Ratings. 705.12(B)(2)(3)(c)** The sum of the ampere rating 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. The rating of the overcurrent device protecting the busbar shall not exceed the rating of the busbar. Permanent warning labels shall be applied to distribution equipment displaying the following or equivalent wording: (The marking shall comply with 110.21(B))

**“WARNING:**

**THIS EQUIPMENT FED BY MULTIPLE SOURCES.  
TOTAL RATING OF ALL OVERCURRENT DEVICES  
EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE  
SHALL NOT EXCEED AMPACITY OF BUSBAR”**

- **Marking and Labeling Required. CEC 690.31(G)(3)** The following wiring methods and enclosures that contain PV system dc circuit conductors shall be marked with the wording **“WARNING: PHOTOVOLTAIC POWER SOURCE”** by means of permanently affixed labels or other approved permanent markings:

- (1) Exposed raceways, cable trays, and other wiring methods
- (2) Covers or enclosures of pull boxes and junction boxes
- (3) Conduit bodies in which any of the available conduit openings are unused

*\*Marking and labeling Methods and Locations per 690.31(G)(3)(4)*

- **Direct-Current PV Power Source. CEC 690.53** A permanent label for the dc PV power source indicating the information specified in (1) through (3) shall be provided by the installer at dc PV disconnecting means and at each dc equipment disconnecting means required by 690.15. Where a disconnecting means has more than one dc PV power source, the values in 690.53(1) through (3) shall be specified for each source. “

- (1) Maximum Voltage, Informational Note to (1): See 690.7 for voltage.



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(2) Maximum circuit current Informational Note to (2): See 690.8(A) for calculation of maximum circuit current.

(3) Maximum rated output current of the charge controller or dc-to-dc converter (if installed).



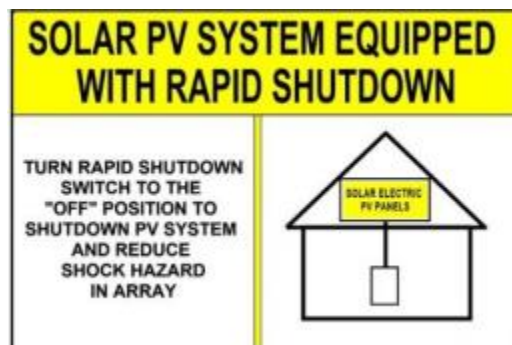
- **Buildings with Rapid Shutdown. 690.56(C)** Buildings with PV systems shall have permanent labels as described in 690.56(C) (1) through (C)(3).


**(1) Rapid Shutdown Type.** The type of PV system rapid shutdown shall be labeled as described in 690.56(C)(1)(a) or (1)(b).

(a) For PV systems that shut down the array and conductors leaving the array:

**“SOLAR PV SYSTEM IS EQUIPPED WITH RAPID SHUTDOWN.  
TURN RAPID SHUTDOWN SWITCH TO THE “OFF” POSITION  
TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK  
HAZARD IN ARRAY”**

The title **“SOLAR PV SYSTEM IS EQUIPPED WITH RAPID SHUTDOWN”** shall utilize capitalized characters with a minimum height of 3/8 in. in black on yellow background, and the remaining characters shall be capitalized with a minimum height of 3/16 in. in black on white background. (See Figure 690.56(C)(1)(a))

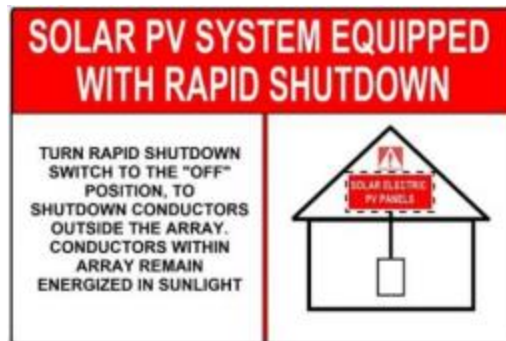


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**Figure 690.56(C)(1)(a)** Label for PV Systems that Shut Down the Array and the Conductors Leaving the Array. (b) For PV systems that only shut down conductors leaving the array:

**“SOLAR PV SYSTEM IS EQUIPPED WITH RAPID SHUTDOWN  
TURN RAPID SHUTDOWN SWITCH TO THE “OFF” POSITION TO SHUT DOWN  
CONDUCTORS OUTSIDE THE ARRAY.  
CONDUCTORS IN ARRAY REMAIN ENERGIZED IN SUNLIGHT”**

The title **“SOLAR PV SYSTEM IS EQUIPPED WITH RAPID SHUTDOWN”** shall utilize capitalized characters with a minimum height of 3/8 in. in white on red background, and the remaining characters shall be capitalized with a minimum height of 3/16 in. in black on white background. (See **Figure 690.56(C)(1)(b)**)




**Figure 690.56(C)(1)(b)** Label for PV Systems that Shut Down the Conductors leaving the Array Only.

**Labeling Continued:** 690.56(C)(1)(a) &(b)

The labels in 690.56(C)(1)(a) and (b) shall include a simple diagram of a building with a roof. The diagram shall have sections in red to signify sections of the PV system that are not shut down when the rapid shutdown switch is operated.

The rapid shutdown label in 690.56(C)(1) shall be located on or no more than 3 ft. from the service disconnecting means to which the PV systems are connected and shall indicate the location of all identified rapid shutdown switches if not at the same location.

**(2) Buildings with More Than One Rapid Shutdown Type.** For buildings that have PV systems with both rapid shutdown types or a PV system with a rapid shutdown type and a PV system with no rapid shutdown, a detailed plan view diagram of the roof shall be provided showing each different PV system and a dotted line around areas that remain energized after the rapid shutdown switch is operated.

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**(3) Rapid Shutdown Switch.** A rapid shutdown switch shall have a label located on or no more than 3 ft. from the switch the includes the following wording:

**“RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM”**

The label shall be reflective, with all letters capitalized and having a minimum height of 3/8 in. in white on red background.

**Partial CEC Articles 690 & 705 & CRC R324 for Installation:**

- Installation & Use. CEC 110.3(B) 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 located in direct sunlight, manufacture specifications will be required for adjustments above 40°C for overcurrent devices. Supply side connections shall be made using an approved and listed method and shall not void the manufacturer listing of equipment.

*In lieu of a panel listing when modifying the supply side for inspection, a field re-certification for panel modifications from a recognized NRTL such as UL, shall be stated on the application submittal and provided at the time of inspection.*

**Partial CEC Articles 690 & 705 & CRC R324 for Installation:**

- Supplemental Electrode Required. CEC 250.53(A)(2) A single rod, pipe and plate electrodes shall be supplemented by an additional electrode. The supplemental electrode shall be permitted to be bonded to one of the following.
  - 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, the supplemental electrode shall not be required. CEC 250.53(A)(2)*  
*Exception*

- **Locations of DC conductors. R324.7.3** Conduit, wiring systems, and raceways for photovoltaic circuits shall be located as close as possible to the ridge or hip or valley and from the hip or valley as directly as possible to an outside wall to reduce trip hazards and maximize ventilation opportunities. Conduit runs between sub arrays and to DC combiner boxes shall be installed in a



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manner that minimizes the total amount of conduit on the roof by taking the shortest path from the array to the DC combiner box. The DC combiner boxes shall be located such that conduit runs are minimized in the pathways between arrays. DC wiring shall be installed in metallic conduit or raceways when located within enclosed spaces in a building. Conduit shall run along the bottom of load bearing members.

- Raceways & Cables Exposed to Sunlight on Rooftops. CEC 310.15(B)(3)(c) If conductors are installed in raceways or cables and located on rooftops, specify raceway or cable type and height above the rooftop. Apply an additional ambient temperature of 60°F adjustment where installed less than 7/8 in. above the roof to the high mean average temperature of 77°F.
- Inverter Output Circuit Current. 690.8(A)(3) 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%.
- Arc-Fault Circuit Protection (Direct Current). CEC 690.11 Photovoltaic systems with dc operating at 80 volts dc or greater between any two conductors shall be protected by a listed PV arc-fault circuit interrupter or other system components listed to provide equivalent protection.

***Exception:** For PV systems not installed on or in buildings, PV output circuits and dc to dc converter output circuits that are direct buried, installed in metallic raceways, or installed in enclosed metallic cable trays are permitted without arc-fault circuit protection. Detached structures whose sole purpose is to house PV system equipment shall not be considered buildings according to this exception.*

- **Rapid Shutdown of PV systems on Buildings. 690.12** PV system circuits installed on or in buildings shall include a rapid shutdown function to reduce shock hazard for emergency responders in accordance with 690.12(A) through (D).

**(B)(1) Outside the Array Boundary.** Controlled conductors located outside the boundary (more than 1 ft. from array) or more than 3 ft. from the point of entry inside a building shall be limited to not more than 30 volts within 30 seconds of rapid shutdown initiation. Voltage shall be measured between any two conductors and between any conductor and ground.

**(B)(2) Inside the Array Boundary.** The PV system shall comply with one of the following:

(1) The PV array shall be listed or field labeled as a rapid shutdown PV array. Such a PV array shall be installed and used in accordance with the instructions included with the rapid shutdown PV array listing or labeling.



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(2) Controlled conductors located inside the boundary (1 ft.) or not more than 3 ft. from the point of penetration of the surface of the building shall be limited to not more than 80 volts within 30 seconds of rapid shutdown initiation. Voltage shall be measured between any two conductors and between any conductor and ground.

(3) PV arrays with no exposed wiring methods, no exposed conductive parts, and installed more than 8 ft. from exposed grounded conductive parts or ground shall not be required to comply with 690.12(B)(2).

- **Methods Permitted. CEC 690.31(A)** Where PV source and output circuits operating at voltages greater than 30 volts are installed in readily accessible locations, circuit conductors shall be guarded or installed in Type MC cable or in raceway.


## **Partial CEC Articles 690 & 705 & CRC R324 for Installation:**

- **Ground-Fault Protection. CEC 690.41(B)** DC PV arrays shall be provided with dc ground-fault protection (GFP) of 690.41(B)(1) and (2) to reduce fire hazard.

*Exception: PV arrays with not more than two PV source circuits and with all PV system dc circuits not on or in buildings shall be permitted without ground-fault protection where solidly grounded.*

- **Size of Equipment Grounding Conductors. CEC 690.45** Equipment grounding conductors for photovoltaic source and output circuits shall be sized per CEC 250.122 and shall not be smaller than 14 AWG.
- **Array Equipment Grounding Conductors. CEC 690.46** For PV modules, equipment grounding conductors smaller than 6 AWG shall comply with 250.120(C) for protection.
- **Grounding Electrode System. 690.47(A) Buildings or structures supporting a PV Array.** A building or structure supporting a PV array shall have a grounding electrode system installed in accordance with Part III of Article 250.

PV array equipment grounding conductors shall be connected to the grounding electrode system of the building or structure supporting the PV array in accordance with Part VII of Article 250. This connection shall be in addition to any other equipment grounding conductor requirements in 690.43(C). The PV array equipment grounding conductors shall be sized in accordance with 690.45.

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For PV systems that are **not solidly grounded (functional grounded)**, the equipment grounding conductor for the output of the PV system, connected to associated distribution equipment, shall be permitted to be the connection to ground for the ground-fault protection and equipment grounding of the PV array.

For **solidly grounded PV systems**, as permitted in 690.41 (A)(5), the grounded conductor shall be connected to a grounding electrode system by means of a grounding electrode conductor sized in accordance with 250.166.


***Informational Note:** Most PV systems installed in the past decade are actually functional grounded systems rather than solidly grounded systems as defined in this Code. For functional grounded PV systems with an interactive inverter output, the ac equipment grounding conductor is connected to associated grounded ac distribution equipment. This connection is often the connection to ground for ground-fault protection and equipment grounding of the PV array.*

- **Photovoltaic Systems Connected to Energy Storage Systems. 690.55** The PV system output circuit conductors shall be marked to indicate the polarity where connected to energy storage systems.
- **Energy Storage Systems. 690.71** An energy storage system connected to a PV system shall be installed in accordance with Article 706.
- **Point of Connection. Dedicated Overcurrent & Disconnect. 705.12(B)(1)** Each source interconnection of one or more power sources installed in one system shall be made at a dedicated circuit breaker or fusible disconnecting means.
- **CEC 705.12(B)(2)** Bus or Conductor Ampere Rating. One hundred twenty-five percent of the power source output circuit current shall be used in ampacity calculations for the following:

- (1) **Feeders.** Calculate back-fed per CEC 705.12(B) (2)(1)(a) & (b),
- (2) **Taps.** Calculate back-fed per CEC 705.12(B) (2)(2),
- (3) **Busbars.** One of the methods that follows shall be used to determine the ratings of busbars in panelboards. CEC 705.12(B) (2)(3),

(a) The sum of 125 percent of the power source(s) output circuit and the rating of the overcurrent device protecting the busbar shall not exceed the ampacity of the busbar.

(b) Where two sources, one a primary source and the other another power source, are located at opposite ends of a busbar that contains loads, the sum of 125 percent of the power source output circuit current and the rating of the overcurrent device protecting the busbar shall not exceed 120% of the ampacity of the busbar. The busbar shall be sized for the loads connected in accordance with Article 220.

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(c) 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. The rating of the overcurrent device protecting the busbar shall not exceed the rating of the busbar.

(d) A connection at either end, but not both ends, of a center-fed panelboard in dwellings shall be permitted where the sum of 125 percent of the power source(s) output circuit current and the rating of the overcurrent device protecting the busbar does not exceed 120 percent of the current rating of the busbar.

(e) Connections shall be permitted on multiple-ampacity busbars where designed under engineering supervision that includes available fault current and busbar load calculations.

**Rooftop Setback Requirements Per CRC R324.6**

**R324.6 Roof access and pathways.** Roof access, pathways, and setback requirements shall be provided in accordance with Sections R324.6. 1 through R324.6.2.1. Access and minimum spacing shall be required to provide emergency access to the roof, to provide pathways to specific areas of the roof, to provide for smoke ventilation opportunity areas, and to provide emergency egress from the roof.

**Exceptions:**

1. Detached, non-habitable structures, including but not limited to detached garages, parking shade structures, carports, solar trellises, and similar structures, shall not be required to provide roof access.
2. Roof access, pathways, and setbacks need not be provided where fire code official has determined that rooftop operations will not be employed.
3. These requirements shall not apply to roofs with slopes of 2 units vertical in 12 units horizontal (2: 12) or less.

**R324.6.1 Pathways.** Not less than two minimum 36-inch-wide (914 mm) pathways on separate roof planes, from lowest roof edge to ridge, shall be provided on all buildings. At least one pathway shall be provided on the street or driveway side of the roof. For each roof plane with a photovoltaic array, a minimum 36-inch- wide (914 mm) pathway from the lowest roof edge to ridge shall be provided on the same roof plane as the photovoltaic array, on an adjacent roof plane, or straddling the same and adjacent roof planes. Pathways shall be over areas capable of



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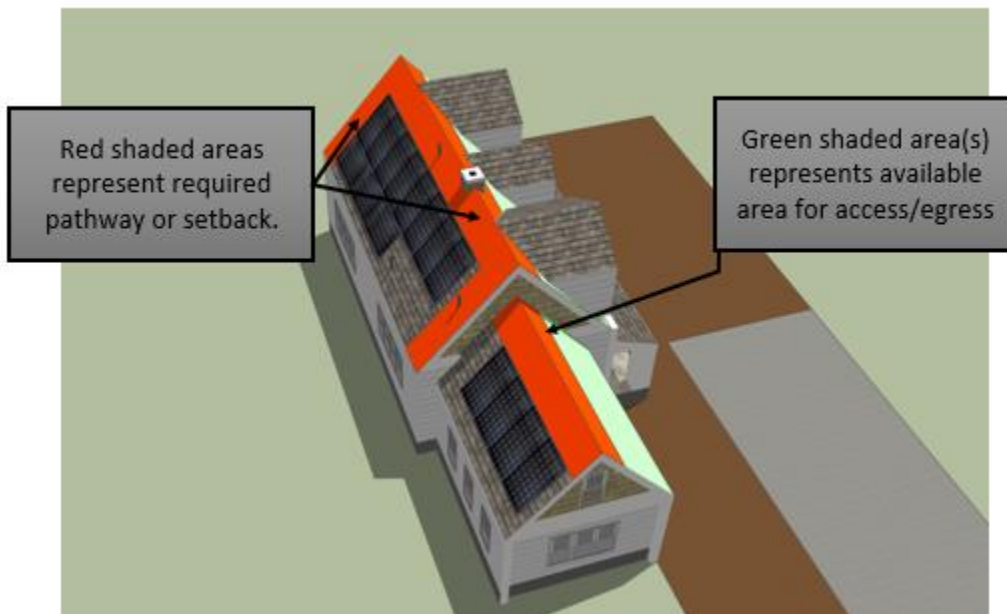
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supporting fire fighters accessing the roof. Pathways shall be located in areas with minimal obstructions such as vent pipes, conduit, or mechanical equipment.

## **Rooftop Setback Requirements Per CRC R324.6**

### **Pathway to Ridge**





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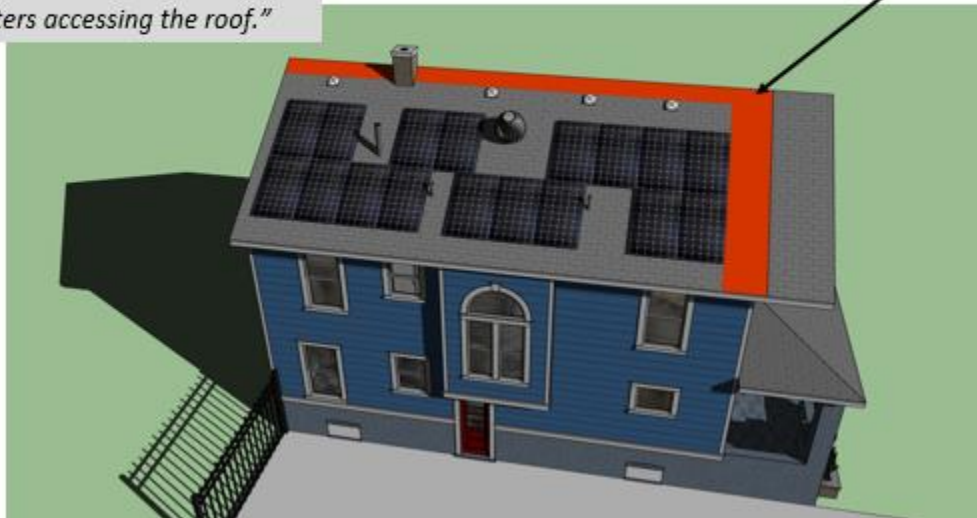
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## Structural Support of Pathways

*"Pathways shall be over areas capable of supporting fire fighters accessing the roof."*

Large roof overhang not well supported requires pathway to move over bearing wall.



## Rooftop Setback Requirements Per CRC R324.6

### Pathways to Ridge – Example 1

*"Not less than two minimum 36 in. (914 mm) wide pathways on separate roof planes, from lowest roof edge to ridge, shall be provided on all buildings."*

Pathway to Ridge



*"For each roof plane with a photovoltaic array, a minimum 36 in. (914 mm) wide pathway from the lowest roof edge to ridge shall be provided on the same roof plane as the photovoltaic array, on an adjacent roof plane, or straddling the same and adjacent roof planes."*



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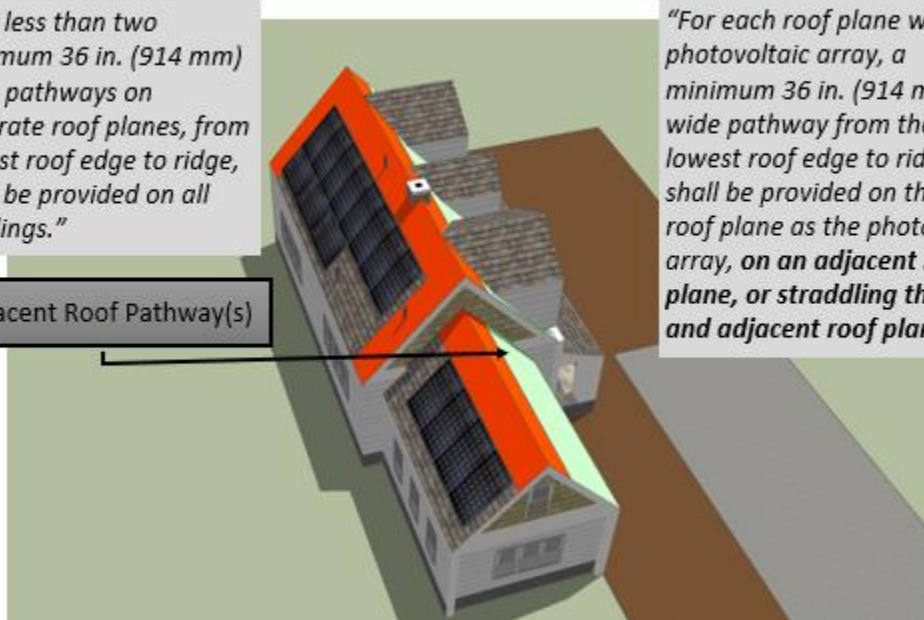
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## Pathways to Ridge – Example 2

*“Not less than two minimum 36 in. (914 mm) wide pathways on separate roof planes, from lowest roof edge to ridge, shall be provided on all buildings.”*

Adjacent Roof Pathway(s)



*“For each roof plane with a photovoltaic array, a minimum 36 in. (914 mm) wide pathway from the lowest roof edge to ridge shall be provided on the same roof plane as the photovoltaic array, on an adjacent roof plane, or straddling the same and adjacent roof planes.”*

### Rooftop Setback Requirements Continued:

**R324.6.2 Setback at ridge.** For photovoltaic arrays occupying not more than 33 percent of the plan view total roof area, not less than an 18-inch (457 mm) clear set back is required on both sides of a horizontal ridge. For photovoltaic arrays occupying more than 33 percent of the plan view total roof area, not less than a 36-inch (914 mm) clear set back is required on both sides of a horizontal ridge.



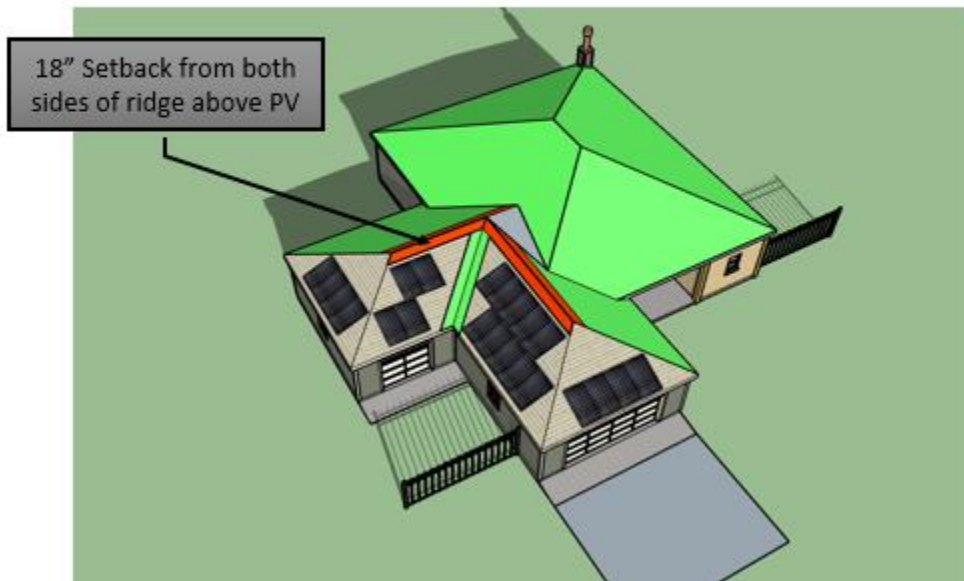
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## Ridge Setbacks – <33% Total Roof Area



**R324.6.2.1 Alternative setback at ridge.** Where an automatic sprinkler system is installed within the dwelling in accordance with NFPA 13D setbacks at ridges shall conform with one of the following:

1. For photovoltaic arrays occupying not more than 66 percent of the plan view total roof area, not less than an 18-inch (457 mm) clear setback is required on both sides of a horizontal ridge.
2. For photovoltaic arrays occupying more than 66 percent of the plan view total roof area, not less than a 36 inch (914 mm) clear setback is required on both sides of a horizontal ridge.



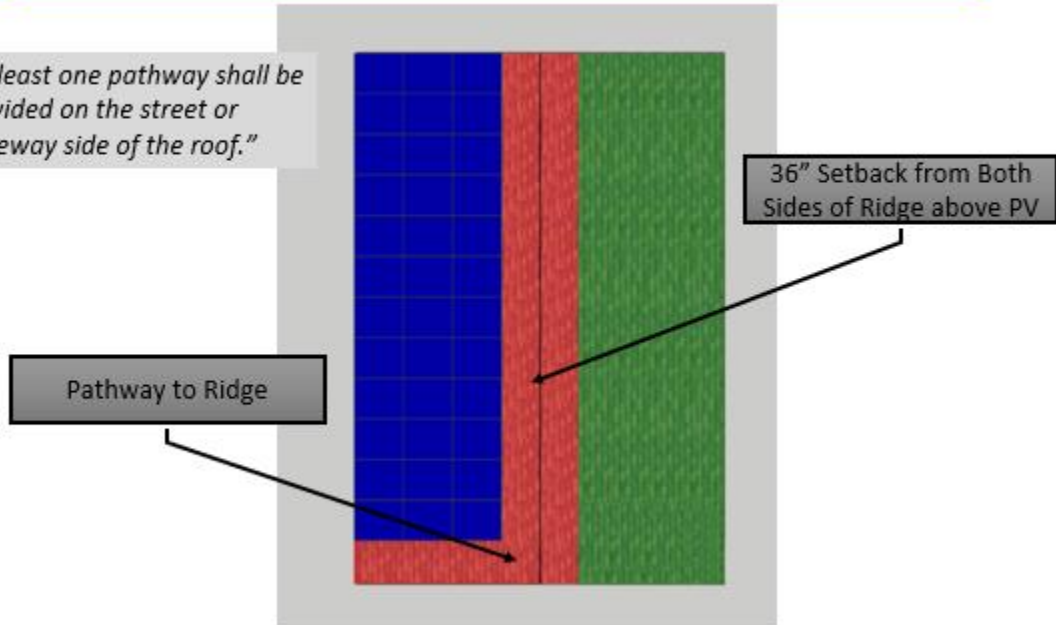
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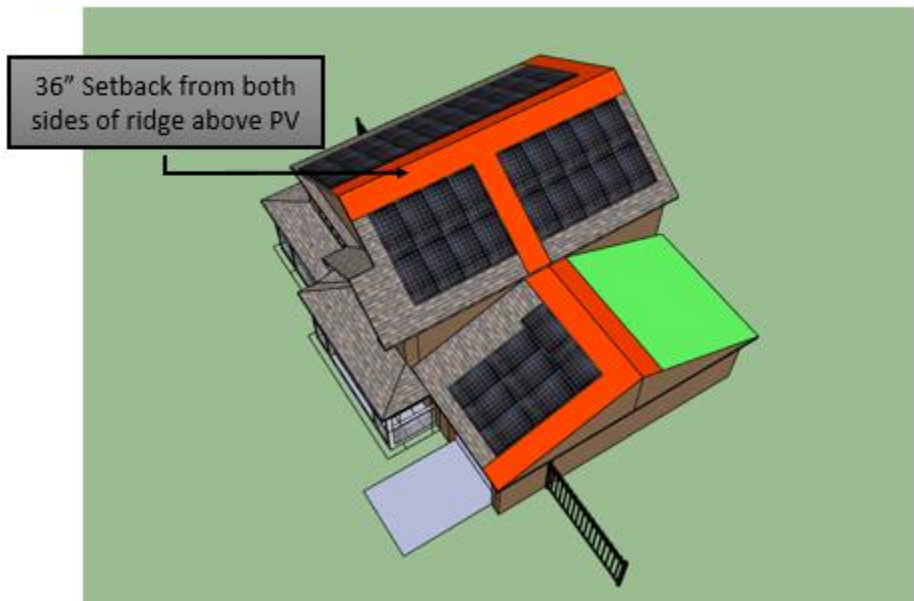
Codes 2022  
1/1/23-12/31/25  
*Effective Date*

## Ridge Setbacks – >33% Total Roof Area

*“At least one pathway shall be provided on the street or driveway side of the roof.”*



## Ridge Setbacks – >33% Total Roof Area



**Rooftop Setback Requirements Continued:**



# CITY OF OCEANSIDE

Building Division  
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Codes 2022

1/1/23-12/31/25  
*Effective Date*

**R324.6.4 Emergency escape and rescue opening.** Panels and modules installed on dwellings shall not be placed on the portion of a roof that is below an emergency escape and rescue opening. A 36-inch-wide (914 mm) pathway shall be provided to the emergency escape and rescue opening.

## Emergency Escape and Rescue Opening Access



**R324.7.3 Locations of DC conductors.** Conduit, wiring systems, and raceways for photovoltaic circuits shall be located as close as possible to the ridge or hip or valley and from the hip or valley as directly as possible to an outside wall to reduce trip hazards and maximize ventilation opportunities. Conduit runs between sub arrays and to DC combiner boxes shall be installed in a manner that minimizes the total amount of conduit on the roof by taking the shortest path from the array to the DC combiner box. The DC combiner boxes shall be located such that conduit runs are minimized in the pathways between arrays. DC wiring shall be installed in metallic conduit or raceways when located within enclosed spaces in a building. Conduit shall run along the bottom of load bearing members.