

## Understanding the Code

### Code Requirements for Solar Photovoltaic (PV) Systems for One and Two-Family Dwellings

Based on the 2013 California Building Code (CBC), the 2013 California Residential Code (CRC) and the California Energy Code (CEC)

#### PURPOSE

The purpose of this information bulletin is to clarify requirements of the State Building Standards Codes (Title 24) that pertain to solar PV installations on one- and two-family dwellings. This bulletin can serve as a reference guide for permit applicants and enforcing agencies to clarify how state code requirements are practically applied in the local jurisdiction. It is intended to minimize permitting uncertainty and differing interpretation regarding specific code requirements for solar PV installations. This information bulletin primarily clarifies requirements pertaining to the California Building Code and the California Residential Code, since these codes in their current form require significant local interpretation. This information bulletin does not address local regulations.

The implementation of uniform standards to achieve the timely and cost-effective installation is consistent with the California Solar Rights Act that views solar installation as a matter of statewide concern and prohibits local jurisdictions from adopting unreasonable barriers to the installation of solar energy systems (CA Government Code Section 65850.5).

#### PART I: BUILDING AND RESIDENTIAL CODE REQUIREMENTS

##### 1. Definitions

- 1.1 **Solar photovoltaic system:** The total components and subsystems that, in combination, convert solar energy into electric energy suitable for connection to utilization load (CEC Article 100 and Article 690.2)
- 1.2 **Module:** A complete, environmentally protected unit consisting of solar cells, optics and other components, exclusive of tracker, designed to generate DC power when exposed to sunlight (CEC Article 690.2)
- 1.3 **Panel:** A collection of modules mechanically fastened together, wired and designed to provide a field-installable unit (CEC Article 690.2)
- 1.4 **Building integrated photovoltaics (BIPV):** Photovoltaic cells, devices, modules or modular materials that are integrated into the outer surface or structure of a building and serve as the outer protective surface of the building (CEC Article 690.2)
- 1.5 **Alternating-current (AC) module (alternating-current photovoltaic module):** A complete, environmentally protected unit consisting of solar cells, optics, inverter and other components, exclusive of tracker, designed to generate AC power when exposed to sunlight (CEC Article 690.2)
- 1.6 **Photovoltaic modules/shingles:** A roof covering composed of flat-plate photovoltaic modules fabricated into shingles. (CRC Chapter 2, Section 202)

## 2. Solar Ready Requirements

The California Energy Code (Section 110.10) contains mandatory requirements for solar readiness in certain newly constructed single-family and multifamily residences. Although these requirements apply to new construction only, these requirements are briefly outlined for informational purposes.

- 2.1 **Solar Zone:** Newly constructed homes are required to have an area on the roof or overhang available for future solar installations that meets certain requirements:
  - 2.1.1 **Minimum area:** The solar zone must be a minimum of 250 square feet, subject to certain exceptions outlined in the code (Section 110.10.b.1.[b]).
  - 2.1.2 **Orientation:** All sections of the solar zone located on steep-sloped roofs (defined as a roof whose pitch is greater than 2:12) shall be oriented between 110 degrees and 270 degrees of true north.
  - 2.1.3 **Shading:** The solar zone must be free of obstructions and may not be shaded by certain obstructions outside the zone (Section 110.10.b.3).
- 2.2 **Documentation:** Construction documentation must clearly show the dead and live load for the solar zone. Collateral loads for future solar energy systems do not need to be shown on the construction documents. (Section 110.10[b][4])

Construction documentation must also show pathways for electrical or plumbing interconnections. This includes a location for inverters and metering equipment and a pathway for routing of conduit from the solar zone to the point of interconnection with the electrical service. For single-family residences, the point of interconnection will be the main service panel. (Section 110.10[c])

This information must also be provided to the occupant. (Section 110.10[d])

- 2.3 **Main Electrical Service Panel:** The main electrical service panel shall have a minimum bus bar rating of 200 amps and a marked reserved space for future solar electric installation. (Section 110.10[e])

## 3. Structural Requirements

### 3.1 PV systems positively anchored to the building

- 3.1.1 **Exemption from structural calculations:** The building official may waive the requirement for structural calculations for solar PV installations on top of existing roofs if the official can readily determine that the additional weight of the new solar PV system on the roof does not affect the structural integrity of the building. Some jurisdictions may choose to use the provided Structural Criteria for Flush-Mounted PV and Thermal Systems as a prescriptive approach for when structural calculations can be waived, however, that varies by the enforcing agency.
- 3.1.2 **Structural calculations for non-qualified systems:** When structural calculations are required, calculations shall demonstrate that the primary structure will support the additional vertical and lateral loads from the panels and related equipment.

*Note 1: See the Appendix for additional guidance on structural calculations.*

- 3.1.2.1 **Roof dead load:** The weight of solar PV systems shall be considered as dead load in the design of the structure (CBC Section 1606, CRC Section R301.4).

For installation of conventional (not BIPV) solar PV panels on existing roofs, roof live load is not imposed where PV panels occur, provided the clear distance under the panels to top of the roof is less than 42” and provided the roof design is adequate for the concentrated loads from the solar PV panel support frames. See Structural Engineers Association of California (SEAOC) Solar PV-3 Live Load document for additional information.

When the roof live load is allowed to be reduced, consideration should be given to the possibility that a roof may have more than one layer of existing roofing. For pre-1960 wood-framed construction, structural calculations may be based on actual (field-measured) lumber sizes (typically greater than modern lumber sizes), and Douglas fir Grade 1 may be assumed unless field conditions indicate otherwise.

- 3.1.2.2 Roof live load: Roof live load is not considered in areas covered by roof-mounted panels where there is less than 42” clear under the panels. Roof surfaces not covered by solar PV panels shall be designed for the roof live load (CBC Section 1607, CRC R301.6).

The building official may determine that live load need not be considered for solar PV panels and associated supporting members that are built on grade. Such interpretation is generally based on the assumption that the solar PV panels will not be stepped on or used by anyone to support any live load

- 3.1.2.3 Wind design: Calculations shall demonstrate that the solar PV panels and associated supporting members are designed to resist wind loads. For ballasted PV systems, see Section 2.2 of this information bulletin (CBC Section 1609, CRC R301.2.1).

Photovoltaic modules/shingle packaging shall bear a label to indicate compliance with the procedures in ASTM D 3161 and the required classification from CRC Table R905.2.4.1(2) Classification of Asphalt Shingles Per ASTM D 3161 (CRC Section R905.16.3).

For ballasted PV systems, see Code Requirements for Solar Photovoltaic (PV) Systems – General, Section 2.2 of this information

- 3.1.2.4 Seismic design: Calculations shall demonstrate that the solar PV panels and associated supporting members are designed to resist earthquake loads.

- 3.1.2.5 For wood construction, supports shall be attached with fasteners of sufficient length and size to achieve minimum required embedment into solid wood taking into consideration the plywood and multiple layers of roofing that may exist, unless otherwise approved by the enforcing agency (CRC Section R301.1.3).

- 3.1.2.6 Snow load: When applicable, include snow loads and loads from snowdrift (CBC Section 1608, CRC R301.2.3).

- 3.1.2.7 Requirements for load combinations: The applicable load combinations in CBC 1605 may be applied to all loading conditions, including evaluating the effects of dead load to counteract wind uplift.

- 3.1.2.8 The Division of the State Architect (DSA) Interpretation of Regulations Article 16.8, intended for public schools, provides useful code interpretation guidance to non-DSA code officials regarding several types of solar systems, both ground- and roof-mounted.

**3.2 Structural strength of PV panels:** The structural strength of solar PV panels is not addressed in the code.

UL 1703, Third Edition, published March 15, 2002, requires that solar PV panels be tested to withstand a superimposed load of 30 PSF. Therefore, all solar PV panels that are listed per UL 1703 are considered to meet this requirement.

When used as a building component and depending on the load values that the solar PV panels are subjected to, the enforcing agency may require a test report from an agency recognized by the enforcing agency showing the strength of the solar PV panels.

- 3.3 **Condition of existing roof:** Solar PV systems shall not be installed on an existing roof that is deteriorated to the point where it is not adequate as a base (this interpretation is based on CRC R907).
- 3.4 **Premanufactured support systems:** Premanufactured support systems must support the PV system and allow the system to stay attached to the structure when exposed to wind, snow or seismic load. Compliance of the PV support system with appropriate building codes is accomplished through a design specified by a licensed engineer or architect or through research reports from approved sources as addressed in CBC Section 1703.4.2. Solar support component manufacturers often provide structural engineering design guidelines, worksheets, code compliance reports and Internet website calculators. The manufacturer's engineering guidelines are intended to ensure that the PV system above the roof and its connection to the roof assembly are code compliant. Additional requirements may be imposed by the enforcing agency (CRC Section R301.1.3).

## 4. Fire Safety Provisions

### 4.1 Fire/roof classification of photovoltaic (PV) panels

#### 4.1.1 Solar PV panels installed on top of a building's roof structure

- 4.1.1.1 Solar PV systems installed on top of a roof where the space between the solar PV panels and the roof has no use and no potential use are generally considered equipment. These solar PV panels/models shall comply with the minimum fire/roof classification requirements or roof covering as required by the current CRC Section R902.4

For installations in State Responsibility Areas (SRA) or High Fire Hazard Severity Zones, additional provisions adopted by the local enforcing agency may be applicable. Check with the enforcing agency for any additional requirements.

- 4.1.1.2 Solar PV panels used as roofing on an independent (stand-alone) structure: Solar PV panels/modules that are designed to be on the roof and span to structural supports, and have a use or occupancy underneath, shall comply with the minimum fire/roof classification requirements for roof covering as required by CRC Section R902.4. An example of this type of installation is a carport structure having solar PV panels as the roof.

- 4.1.1.3 Solar PV panels installed as a part of a building's roof structure: Solar PV panels installed as integrated roofing material shall comply with the minimum fire/roof classification requirements for roof covering as required by the current CRC Section R902. An example of this type of installation is PV modules integrated into the roofing shingles (BIPV systems).

- 4.1.2 Solar PV systems installed on grade: Solar PV panels that are part of a stand-alone, ground-mounted solar PV panel structure, with no use and no potential use underneath are generally considered equipment and therefore the fire/roof classification requirements would not apply. The solar PV panels will require a clear, brush-free area of 10 feet around the installation (based on the definition of a roof assembly in CRC Section R202 and R331.5).

- 4.2 **Area, height and story limitations:** Where there is a use between the solar PV panels and the roof/grade underneath, adding such solar PV structures may constitute additional floor area, story and/or height. Solar PV panels supported by framing that has sufficient uniformly distributed and

unobstructed openings throughout the top of the array (horizontal plane) to allow heat and gases to escape, as determined by the enforcing agency, are generally considered equipment.

- 4.3 Location from property line and adjacent buildings:** Solar PV panels and associated framing, with no use and no potential use between the panels and the grade underneath, are generally treated as equipment. When not considered equipment, they may be considered a structure and shall be located and protected based upon the code required fire separation distance to property lines and adjacent buildings. (CRC Section R302.1)
- 4.4 Roof Access and Pathways:** The installation of solar PV systems must allow for fire department smoke ventilation operations. Roof access point, clear access pathways, solar PV systems spacing and layout must comply with the requirements outlined in CRC Section R331.
- 4.5 Markings:** The solar PV systems must be marked or labeled in accordance with CRC Section R331 and CEC Article 690. Markings are to be placed every 10 feet and in other areas as required.
- 4.6 Other fire safety requirements or guidelines:** The installation of solar PV systems may be subject to additional provisions adopted by the local enforcing agency. Check with the enforcing agency for additional requirements.

**5. Roof drainage:** Roof-mounted solar PV systems shall not cause excessive sagging of the roof that results in water ponding. They shall also not block or impede drainage flows to roof drains and scuppers. (CRC Section R903.4; CPC Section 1101.11 also applies)

**6. Roof penetrations:** All roof penetrations shall be sealed using approved methods and products to prevent water leakage. Such methods include but not limited to caulking, roof jacks and sheet metal flashing. (CRC Section R903.2)

**7. Skylights:** Solar PV panels shall maintain a minimum clearance around the perimeter of skylights as not to interfere with the function of the skylight, as determined by the enforcing agency

**8. Plumbing vent, mechanical equipment and mechanical exhaust terminations:** Solar PV panels shall not obstruct or interfere with the function of plumbing vents or mechanical equipment. (CPC Sections 901.1 & 906, CMC Section 304)

## **PART II: ELECTRICAL CODE REQUIREMENTS**

- 1. Product listing (certification):** The solar PV panel/module and other equipment used in the PV system shall be listed/certified by a nationally recognized listing/certification agency in accordance with the applicable standards.
- 2. Installation:** The installation of the solar PV system must conform to the requirements of the California Electrical Code (CEC).
- 3. Signage:** Signage must conform to the requirements of the CEC. Signage requirements and location of certain equipment for solar PV systems may be subject to additional provisions adopted by the enforcing agency.

## **PART III: LOCAL ELECTRIC UTILITY REQUIREMENTS**

Check with the local utility for any incentives, interconnection, operating and metering requirements.

## Code Requirements for PV on Buildings other than One- and Two- Family Dwellings

### Based on the 2013 California Building Code (CBC), California Residential Code (CRC) and California Energy Code (CEC)

#### PURPOSE

The purpose of this information bulletin is to clarify requirements of the State Building Standards Codes (Title 24) that pertain to solar PV installations. This bulletin can serve as a reference guide for permit applicants and enforcing agencies to clarify how state code requirements are practically applied in the local jurisdiction. It is intended to minimize permitting uncertainty and differing interpretation regarding specific code requirements for solar PV installations. This information bulletin primarily clarifies requirements pertaining to the California Building Code and the California Residential Code, since these codes in their current form require significant local interpretation. This information bulletin does not address local regulations.

The implementation of uniform standards to achieve the timely and cost-effective installation is consistent with the California Solar Rights Act that views solar installation as a matter of statewide concern and prohibits local jurisdictions from adopting unreasonable barriers to the installation of solar energy systems (CA Government Code Section 65850.5).

#### PART I: BUILDING AND RESIDENTIAL CODE REQUIREMENTS

##### 1. Definitions

- 1.1 **Solar photovoltaic (PV) system:** The total components and subsystems that, in combination, convert solar energy into electric energy suitable for connection to utilization load (CEC Article 100 and Article 690.2)
- 1.2 **Module:** A complete, environmentally protected unit consisting of solar cells, optics and other components, exclusive of tracker, designed to generate DC power when exposed to sunlight (CEC Article 690.2)
- 1.3 **Panel:** A collection of modules mechanically fastened together, wired and designed to provide a field-installable unit (CEC Article 690.2)

Building integrated photovoltaics (BIPV): Photovoltaic cells, devices, modules or modular materials that are integrated into the outer surface or structure of a building and serve as the outer protective surface of the building (CEC Article 690.2).

- 1.4.1 Photovoltaic modules/shingles: A roof covering composed of flat-plate photovoltaic modules fabricated in sheets that resemble three-tab composite shingles (CBC Chapter 2, Section 202).
- 1.5 **Alternating-current (AC) module (alternating-current photovoltaic module):** A complete, environmentally protected unit consisting of solar cells, optics, inverter and other components, exclusive of tracker, designed to generate AC power when exposed to sunlight (CEC Article 690.2).
- 1.6 **Ballasted photovoltaic system:** A roof-mounted system composed of solar photovoltaic panels and supporting members that are unattached or partially attached to the roof and must rely on its weight, aerodynamics and friction to counter the effect of wind and seismic forces (CBC Chapter 16, 1613.5.1 [1.2]).

##### 2. Solar Ready Requirements

The California Energy Code (Section 110.10) contains mandatory requirements for solar readiness in certain newly constructed single-family and multifamily residences. Although these requirements apply to new construction only, they are briefly outlined here for informational purposes.

**2.1 Solar Zone:** Subject to certain exceptions outlined in the code, newly constructed homes are required to have an area designated for future solar installations on the roof or overhang of the building, the roof or overhang of another structure located within 250 feet of the building or covered parking installed with the building project. This area must meet certain requirements. The minimum solar zone area must have the following.

2.1.1 Minimum area: The solar zone must be no less than 15 percent of the total roof area of the building excluding any skylight area.

2.1.2 Orientation: All sections of the solar zone located on steep-sloped roofs (defined as a roof whose pitch is greater than 2:12) shall be oriented between 110 degrees and 270 degrees of true north.

2.1.3 Shading: The solar zone must be free of obstructions and may not be shaded by certain obstructions outside the zone (Section 110.10.b.2).

**2.2 Documentation:** Construction documentation must clearly show the dead and live load for the solar zone. Collateral loads for future solar energy systems do not need to be shown on the construction documents.

Construction documentation must also show pathways for electrical or plumbing interconnections. This includes a location for inverters and metering equipment and a pathway for routing of conduit from the solar zone to the point of interconnection with the electrical service. For single-family residences, the point of interconnection will be the main service panel.

This information must also be provided to the occupant.

### 2.3 Main Electrical Service Panel

The main electrical service panel shall have a minimum bus bar rating of 200 amps and a marked reserved space for future solar electric installation.

## 3. Structural Requirements

### 3.1 PV systems positively anchored to the building

3.1.1 Exemption from structural calculations: The building official may waive the requirement for structural calculations for solar PV installations on top of existing roofs if the official can readily determine that the additional weight of the new solar PV system on the roof does not affect the structural integrity of the building. Some jurisdictions may have a prescriptive approach for when structural calculations can be waived, however, that varies by the enforcing agency.

To help streamline and simplify the permitting process for roof-mounted solar PV systems, it is highly recommended that local jurisdictions develop a prescriptive approach to meeting the structural requirements so that structural calculations are not always required. Some parameters to consider under such prescriptive approach include the following.

- Maximum distributed weight of the solar PV system in PSF
- Maximum perpendicular distance between the solar PV system and the roof below
- Maximum concentrated load imposed by the PV panel support onto the building's roof
- Minimum size and spacing of rafters or joists for portion of the roof that is supporting the solar PV system
- Maximum span of rafters or joists for portion of the roof that is supporting the solar PV system
- Anchoring requirements such as type of fasteners, minimum fastener size, minimum embedment and minimum number of attachment points
- Any limitation on the type of building construction

- 3.1.2 Structural calculations: When structural calculations are required, calculations shall demonstrate that the primary structure will support the additional vertical and lateral loads from the panels and related equipment.

Note 1: See the appendix to this document for additional guidance on structural calculations.

- 3.1.2.1 Roof dead load: The weight of solar PV systems shall be considered as dead load in the design of the structure (CBC Section 1606, CRC Section R301.4).

For installation of conventional (not BIPV) solar PV panels on existing roofs, roof live load is not imposed where PV panels occur, provided the clear distance under the panels to top of the roof is less than 42” and provided the roof design is adequate for the concentrated loads from the solar PV panel support frames. See Structural Engineers Association of California (SEAOC) Solar PV-3 Live Load document for additional information.

When the roof live load is allowed to be reduced, consideration should be given to the possibility that a roof may have more than one layer of existing. For pre-1960 wood-framed construction, structural calculations may be based on actual (field-measured) lumber sizes (typically greater than modern lumber sizes) and Douglas fir Grade 1 may be assumed unless field conditions indicate otherwise.

Section 3403.3 of the CBC states, in part, that “Any existing gravity load-carrying structural element for which an addition and its related alterations cause an increase in design gravity load of more than 5 percent shall be strengthened, supplemented, replaced or otherwise altered as needed to carry the increased load required by this code for new structures.”

- 3.1.2.2 Roof live load: Roof live load is not considered in areas covered by roof-mounted panels where there is less than 42” clear under the panels. Roof surfaces not covered by solar PV panels shall be designed for the roof live load (CBC Section 1607, CRC R301.6).

The building official may determine that live load need not be considered for solar PV panels and associated supporting members that are built on grade. Such interpretation is generally based on the assumption that the solar PV panels will not be stepped on or used by anyone to support any live load

- 3.1.2.3 Wind design: Calculations shall demonstrate that the solar PV panels and associated supporting members are designed to resist wind loads. For ballasted PV systems, see Section 2.2 of this information bulletin (CBC Section 1609, CRC R301.2.1).

Photovoltaic modules/shingle packaging shall bear a label to indicate compliance with the procedures in ASTM D 3161 and the required classification from CBC Table 1507.2.7.1(2) Classification of Asphalt Shingles Per ASTM D 3161 (CBC Section 1507.2.7.1[2]).

The Structural Engineering Association of California has released a white paper titled “Wind Loads on Low-Profile Solar Photovoltaic Systems on Flat Roofs.” This document is available at [http://files.engineering.com/download.aspx?folder=7ae26414-8066-4d06-b001-198e5aaf6d88&file=2012-08\\_SEAOC\\_Solar\\_PV\\_wind\\_document\\_Final.pdf](http://files.engineering.com/download.aspx?folder=7ae26414-8066-4d06-b001-198e5aaf6d88&file=2012-08_SEAOC_Solar_PV_wind_document_Final.pdf).

- 3.1.2.4 Seismic design: Calculations shall demonstrate that the solar PV panels and associated supporting members are designed to resist earthquake loads. For ballasted PV systems, see Section 2.2 of this information bulletin (CBC Section 1613, CRC 301.2.2).



Note that Section 3404.4 of the CBC states, in part, that “Any existing lateral load-carrying structural element whose demand-capacity ratios with alteration considered is no more than 5 percent greater than its demand-capacity ratio with the alteration ignored shall be permitted to remain unaltered. . . .”

- 3.1.2.5 For wood construction, supports shall be attached with fasteners of sufficient length and size to achieve minimum required embedment into solid wood taking into consideration the plywood and multiple layers of roofing that may exist, unless otherwise approved by the enforcing agency (ASCE/SEI 7 Section 13.4, CRC Section R301.1.3).
- 3.1.2.6 Snow load: When applicable, include snow loads and loads from snowdrift (CBC Section 1608, CRC R301.2.3).
- 3.1.2.7 Requirements for load combinations: The applicable load combinations in CBC 1605 shall be applied to all loading conditions, including evaluating the effects of dead load to counteract wind uplift for ballasted and anchored systems (CBC Section 1605, CRC Section R301.1.3).
- 3.1.2.8 Alterations, additions and repairs: Sections 3403, 3404, and 3405 of the CBC shall apply to additions, alterations and repairs associated with PV systems. Roof structural components, their connections, additions, alterations and repairs shall be designed to support the loads from the PV panel support frames
- 3.1.2.9 The Division of the State Architect (DSA) Interpretation of Regulations Article 16.8, intended for public schools, provides useful code interpretation guidance to non-DSA code officials regarding several types of solar systems, both ground- and roof-mounted.

**3.2 Ballasted PV system:** PV panels in a ballasted system are typically not attached to the roof and rely on their weight, aerodynamics and friction to counter the effect of wind and seismic forces. In some cases, ballasted systems have few attachment points to supplement the friction forces. Ballasted systems have low ratios of height-to-base width or length, which makes them inherently stable against overturning.

Section 13.4 of ASCE/SEI 7-10 requires that nonstructural components and their supports be attached (or anchored) to the structure. Ballasted solar PV systems are not addressed in the ASCE/SEI 7 and not part of the 2010 CBC.

During the 2012 Triennial Code Adoption Cycle, the Department of Housing and Community Development and the Building Standards Commission proposed an amendment in CBC Section 1613.5, which provides a definition for ballasted photovoltaic systems and allows local governments to approve such systems if they are inclined to accept the weight and friction methodology. This amendment was developed by the Structural Engineers Association of California – Solar Photovoltaic Systems Committee and was based on recently approved Item S72-12 at the ICC Code Development Hearing.

This new language, as written, provides building officials with additional criteria under which a ballasted solar system can be permitted.

Note 1: Electrical connections and wiring in a ballasted system should be designed to accommodate movements within the system.

Note 2: The Structural Engineering Association of California is in the process of developing a white paper, titled “Structural Seismic Requirements and Commentary for Rooftop Solar Photovoltaic Systems,” addressing the seismic design of ballasted systems. Once available, a link to the white paper will be included in this document.

**3.3 Structural strength of PV panels:** The structural strength of solar PV panels is not addressed in the code.

UL 1703, Third Edition, published March 15, 2002, requires that solar PV panels be tested to withstand a superimposed load of 30 PSF. Therefore, all solar PV panels that are listed per UL 1703 are considered to meet this requirement. When used as a building component and depending on the load values that the solar PV panels are subjected to, the enforcing agency may require a test report from an agency recognized by the enforcing agency showing the strength of the solar PV panels.

**3.4 Condition of existing roof:** Solar PV systems shall not be installed on an existing roof that is deteriorated to the point where it is not adequate as a base. (This interpretation is based on CBC Section 1510 and CRC R907.)

**3.5 Premanufactured support systems:** Premanufactured support systems must support the PV system and allow the system to stay attached to the structure when exposed to wind, snow or seismic loads. Compliance of the PV support system with appropriate building codes is accomplished through a design specified by a licensed engineer or architect or through research reports from approved sources as defined in CBC Section 1703.4.2. Solar support component manufacturers often provide structural engineering design guidelines, worksheets, code compliance reports and Internet website calculators. The manufacturer's engineering guidelines are intended to ensure that the solar array above the roof and its connection to the roof are code compliant. Additional requirements may be imposed by the enforcing agency (CRC Section R301.1.3, CBC Section 1703.4.2).

## 4. Fire Safety Provisions

### 4.1 Fire/roof classification of photovoltaic (PV) panels

4.1.1 Solar PV panels installed on top of a building's roof structure

4.1.1.1 Solar PV systems installed on top of a roof where the space between the solar PV panels and the roof has no use and no potential use are generally considered to be equipment. These solar PV panels/modules shall comply with the minimum fire/roof classification requirements for roof covers as required by CBC Section 1505.

For installations in State Responsibility Areas (SRA) or High Fire Hazard Severity Zones, additional provisions adopted by the local enforcing agency may be applicable. Check with the enforcing agency for any additional requirements.

4.1.1.2 Solar PV panels used as roofing on an independent (stand-alone) structure: Solar PV panels/modules that are designed to be on the roof and span to structural supports, and have a use or occupancy underneath, shall comply with the minimum fire/roof classification requirements for roof covering as required by CRC Section R902. An example of this type of installation is a carport structure having solar PV panels as the roof.

4.1.1.3 Solar PV panels installed as a part of a building's roof structure: Solar PV panels installed as integrated roofing material shall comply with the minimum fire/roof classification requirements for roof covering as required by the current CRC Section R902. An example of this type of installation is PV modules integrated into the roofing shingles (BIPV systems).

4.1.2 Solar PV systems installed on grade: Solar PV panels that are part of a stand-alone, ground-mounted solar PV panel structures, with no use and no potential use underneath are generally considered equipment and therefore the fire/roof classification requirements would not apply. The solar PV panels will require a clear, brush free area of 10 feet around the installation. (Based on the definition of a roof assembly in CRC Section R202/CBC Section 1502.)

- 4.2 Area, height, and story limitations:** Where there is a use between the solar PV panels and the roof/ grade underneath, adding such solar PV structures may constitute additional floor area, story and/or height. Solar PV panels supported by framing that has sufficient uniformly distributed and unobstructed openings throughout the top of the array (horizontal plane) to allow heat and gases to escape, as determined by the enforcing agency, are generally considered equipment. Provisions relating to solar PV height and area requirements are contained in CBC Section 503 and Table 503.
- 4.3 Location from property line and adjacent buildings:** Solar PV panels and associated framing, with no use and no potential use between the panels and the grade underneath, are generally treated as equipment. When not considered equipment, they may be considered a structure and shall be located and protected based upon the code required fire separation distance to property lines and adjacent buildings (CRC Section R302.1, CBC Section 602).
- 4.4 Fire proofing of structural support:** Depending on the type of building, support structures of solar PV systems that have a use or have potential for use underneath (such as carports) may be required to be fire proofed in accordance with CBC Section 602.
- 4.4.1 The following installations are generally considered equipment and are not subject to this requirement provided that the structural members are noncombustible.
- Stand-alone PV panel structures with no use and no potential use underneath (based on definition of a roof assembly in CBC Section 202).
- Solar PV panels supported by framing that has sufficient uniformly distributed and unobstructed openings throughout the top of the array (horizontal plane) to allow heat and gases to escape, as determined by the enforcing agency (based on definition of a roof assembly in CBC Section 202).
- 4.4.2 Alternate designs can be considered when approved by the enforcing agency as an alternative material, design or method of construction pursuant to CBC Sections 1.2.2, 1.8.7, or 1.11.2.4 as applicable.
- 4.5 Rooftop structures:** Unenclosed rooftop structures supporting solar PV systems with no use underneath are generally not subject to CBC Section 1509.2.
- 4.6 Fire sprinklers:** In buildings that are required to be provided with fire sprinklers, the CBC requires that all parts of the building have sprinkler coverage except where an exemption is specifically required. See amendments to NFPA section 8.15.7.6 in Chapter 35 of the CBC.
- 4.6.1 Solar photovoltaic (PV) panels supported by framing that have sufficient uniformly distributed and unobstructed openings throughout the top of the array (horizontal plane) to allow heat and gases to escape, as determined by the enforcing agency, are generally not subject to this requirement (CBC Section 903.3.3).
- 4.6.2 Solar PV panels placed above the roof, with no use and no potential use between the panels and the roof, are generally not subject to this requirement (based on definition of a roof assembly in CBC Section 1502 and CRC Section R202).
- 4.6.3 Existing exemptions in the code may be used for a solar PV installation if it meets the intent of the exemption. This will be subject to approval by the enforcing agency.
- 4.7 Roof Access and Pathways:** The installation of solar PV systems must allow for fire department smoke ventilation operations. Roof access point, clear access pathways, solar PV systems spacing and layout must comply with the recruitments outlined in CRC Section R331
- 4.8 Markings:** The solar PV systems must be marked or labeled in accordance with CRC Section R331 and CEC Article 690. Markings are to be placed every 10 feet and in other areas as required.

**4.9 Other fire safety requirements or guidelines:** The installation of solar PV systems may be subject to additional provisions adopted by the local enforcing agency. Check with the enforcing agency for additional requirements.

**5. Roof drainage:** Roof-mounted solar PV systems shall not cause excessive sagging of the roof that results in water ponding. They shall also not block or impede drainage flows to roof drains and scuppers. See CBC Section 1503.4 and CRC Section R903.4. CPC Section 1101.11 also applies.

**6. Roof penetrations:** All roof penetrations shall be sealed using approved methods and products to prevent water leakage. Such methods include but not limited to caulking, roof jacks and sheet metal flashing (CBC Section 1503.2, CRC Section R903.2).

**7. Skylights:** Solar PV panels shall maintain a minimum clearance around the perimeter of skylights as not to interfere with the function of the skylight, as determined by the enforcing agency.

**8. Plumbing vent, mechanical equipment and mechanical exhaust terminations:** Solar PV panels shall not obstruct or interfere with the function of plumbing vents or mechanical equipment (CPC Sections 901.1 & 906, CMC Section 304).

**9. Guard rails:** When required by the enforcing agency, guard rails may apply to solar PV systems (CBC Section 1013.6).

## 10. Disabled access requirements

### 10.1 Nonresidential, hotel, motel buildings, facilities or structures (See CBC Chapter 11B)

10.1.1 Scope: Accessibility to solar PV support structures that create a use or occupancy shall be provided for all occupancy classifications in accordance with Chapter 11B.

10.1.2 General: When alterations, structural repairs or additions are made to existing buildings or facilities for the purpose of installing a solar PV system, they shall comply with Chapter 11B.

Note: New solar PV systems that do not create or expand a use or occupancy and consist only of installation of the solar PV system and related electrical work that does not affect disabled access requirements for existing buildings regulated by Chapter 11B are not considered alterations for the purpose of accessibility and should not be subject to accessibility upgrades.

### 10.2 Residential buildings, facilities or structures

10.2.1 Scope: New solar PV systems serving covered multifamily dwellings that create a use or occupancy shall comply with the provisions of Chapter 11A.

10.2.2 Existing buildings: The building standards contained in Chapter 11A do not apply to the installation of solar PV systems serving privately funded multifamily dwellings constructed for first occupancy prior to March 13, 1991.

**10.3 Parking:** Required accessible parking spaces shall be provided and maintained in accordance with the applicable provisions of Chapter 11A, Sections 1109A and Chapter 11B.

Note: Alterations: Where parking lots, parking structures or parking facilities are re-striped or otherwise altered to accommodate solar PV systems, required accessible parking spaces shall be maintained or shall be provided in accordance with the applicable provisions of Section 1109A and Chapter 11B.

## **PART II: ELECTRICAL CODE REQUIREMENTS**

- 1. Product listing (certification):** The solar PV panel/module and other equipment used in the PV system shall be listed/certified by a nationally recognized listing/certification agency in accordance with the applicable standards.
- 2. Installation:** The installation of the solar PV system must conform to the requirements of the California Electrical Code (CEC).
- 3. Signage:** Signage must conform to the requirements of the (CEC). Signage requirements and location of certain equipment for solar PV systems may be subject to additional provisions adopted by the enforcing agency.

## **PART III: LOCAL ELECTRIC UTILITY REQUIREMENTS**

Check with the local utility for any incentives, interconnection, operating and metering requirements.