

National Simplified Residential Roof Photovoltaic Array Permit Guidelines

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The information in this guideline is intended to provide a format whereby local jurisdictions and contractors can permit simple photovoltaic (PV) system installations where only a basic review is necessary. It is likely that most residential PV systems will comply with these simple criteria, which address the requirements for PV systems in the International Building, Residential, and Electrical codes, published by the International Code Council (ICC) The Structural and Electrical Commentaries provide background explanations for these guidelines.

Required Information for Permit:

1. Permit application required by the local jurisdiction: Permit applications normally include information about the project scope, project location, and the installer.
2. Site plan showing location of major components on the property: This drawing need not be exactly to scale, but it should represent relative location of components at site (see supplied example site plan). PV arrays in compliance with IRC fire setback requirements need no separate fire service review (with Fire Service MOU).
3. Electrical worksheets showing PV array configuration, wiring system, overcurrent protection, inverter, disconnects, required signs, and ac connection to building (see supplied standard electrical diagram).
4. Specification sheets and installation manuals (if available) for all major PV system components such as, PV modules, dc-to-dc converters, inverters, and mounting systems.

Step 1: Structural PV Array Mounting Requirements Checklist

Both Member-Attached and Sheathing-Attached Provisions

A. General Site and Array Requirements (all square boxes must be checked; where slanted check box sub-options occur, one sub-option must be checked):

- 1. Wind Exposure and Design Wind Speed (as defined by ASCE 7-10, select one below):
 - a. Member-Attached System: Exposure B or C, and design wind speed does not exceed 180mph.
 - b. Sheathing-Attached System: see section G.7 for wind exposure and wind speed limits.
- 2. The structure is not in Wind Exposure D (within 200 yards of a water body wider than a mile).
- 3. The structure is not on a hill with a grade steeper than 5%, where topographic effects can significantly increase wind loads.
- 4. Ground snow loads do not exceed 60 psf.
- 5. Distributed weight of the PV array is less than 4 lbs/ft² (less than 5 lbs/ft² for thermal systems).

B. Roof Information (all must apply):

- 1. Array is mounted on a permitted, one- or two-family roof structure or similar structure. *For a roof without a building permit, show compliance with International Residential Code (IRC) span tables.*
- 2. Roof is framed with wood rafters or trusses at no greater than 48" on center. Roof framing members run upslope/downslope (not horizontal purlins).
- 3. Roof structure appears to be structurally sound, without signs of alterations or significant structural deterioration or sagging.
- 4. Sheathing is at least 7/16" or thicker plywood, or 7/16" or thicker oriented strand board (OSB).
- 5. If composition-shingle, roof has a single roof overlay (no multiple-shingle layers). *If not, show compliance with IRC span tables.*
- 6. Mean roof height is not greater than 40 ft (member-attached), 30 ft (sheathing-attached).
- 7. In areas of significant seismic activity (Seismic Category C, D, E or F), PV array covers no more than half the total area of the roof (all roofs included).

C. Array Mounting Equipment Information (all must be defined):

- 1. Mounting Equipment Manufacturer _____
- 2. Product Name and Model Number _____
- 3. UL2703 fire rating for the PV modules used in the project. Fire rating Class ____ (A, B, or C).
- 4. Specify anchor-to-roof sealing (e.g. flashing, or sealant compatible with roofing):

If any structural item cannot be checked off, the building official may require the installer to provide structural calculations and/or details, stamped and signed by a design professional, addressing the unchecked item.

Wind Exposure Definitions:

Exposure B = urban, suburban and wooded areas more than 500 yards from open terrain

Exposure C = open terrain such as fields, grasslands or lakes

Exposure D = within 200 yards of a body of water wider than a mile

Member-Attached Additional Provisions

D. General Member-Attached Array Requirements (design wind speed does not exceed 150 mph)

- 1. Array is set back from all roof edges and ridge by at least twice the gap under the modules (or more, where fire access pathways are required).
- 2. Array does not cantilever over the perimeter anchors by more than 19".
- 3. Gap under modules (roof surface to underside of module) is no greater than 10".
- 4. Gaps between modules are (select one below):
 - a. at least 0.25" on both short and long sides of modules, or
 - b. 0" on short side, and at least 0.50" on long sides.
- 5. Mounting rail orientation or rail-less module long edges run perpendicular to rafters or trusses.
- 6. Anchor/mount/stand-off spacing perpendicular to rafters or trusses does not exceed 4'-0", and anchors in adjacent rows are staggered where rafters or trusses are at 24" or less on center.
- 7. Upslope/downslope anchor spacing follows manufacturer's instructions.
- 8. Anchor fastener is (select one below):
 - a. 5/16" diameter lag screw with 2.5" embedment into structural member; or
 - b. fastener other than (a.), embedded in structural members in accordance with manufacturer's structural attachment details. Manufacturer's anchor layout requirements must not exceed the anchor spacing requirements shown in Items 5 and 6 above.

E. High Wind Member-Attached Array Additional Requirements (all of A. through D. complies and design wind speed does not exceed 180 mph)

- 1. Edge of array is more than 3 feet from any roof edge (Wind Zone 1).
- 2. Mean roof height is not greater than 30 ft.
- 3. Array does not cantilever over the perimeter anchors by more than 6".
- 4. Anchor/mount/stand-off spacing does not exceed 2'-0"

F. Low Wind and Low Snow Reduced Member-Attached Array Requirements (design wind speed does not exceed 120 mph and ground snow load no greater than 10 psf)

- 1. Mounting rail orientation are run parallel to rafters and are spaced no more than 4'-0" apart. (exception to D. 5. allows for mounting rails run parallel to rafters)
- 2. Anchor/mount/stand-off spacing perpendicular to rafters or trusses (exception to D. 6.—select one below):
 - a. does not exceed 4'-0", anchor layout is orthogonal, roof slope is 6:12 or less, ground snow load is no greater than 10 psf, and design wind speed does not exceed 120 mph; or
 - b. does not exceed 6'-0", anchor layout is orthogonal, roof slope is 6:12 or less, ground snow load is zero, and design wind speed does not exceed 120 mph.

If any structural item cannot be checked off, the building official may require the installer to provide structural calculations and/or details, stamped and signed by a design professional, addressing the unchecked item.

Sheathing-Attached Additional Provisions

G. Sheathing-Attached Array Requirements (all square boxes must be checked; where slanted check box sub-options occur, at least one sub-option must be checked):

- 1. Array is set back from all roof edges and ridge by at least twice the gap under the modules (or more, where fire access pathways are required).
- 2. Array does not cantilever over the perimeter anchors by more than 19".
- 3. Gap under modules (roof surface to underside of module) is no greater than 5".
- 4. Gap between modules is at least 0.75" on both short and long sides of modules.
- 5. Roof slope is 2:12 (9 degrees) or greater.
- 6. Roof framing and sheathing nailing options (select a or b below):
 - a. *Initially Dry Wood Rafters, or Manufactured Wood Trusses [lumber grade stamps visible and state "SD", "S-DRY" (Surfaced Dry) or "KD" (Kiln-Dried)]; or*
 - b. *Initially Wet Wood Rafters, meeting one of the following field-verified sheathing nail options. (select I or ii below):*

Note: If lumber stamps are not visible, or if lumber stamps state "S-GRN" (Surfaced Green), lumber shall be assumed to have been initially "wet" (MC > 19%) at time of sheathing installation

 - i. *Deformed shank nails, 6d or greater; or*
 - ii. *6d or 8d smooth shank common or box nails, nailed into dense lumber, either Douglas Fir (stamp: DF or DF-L) or Southern Pine (stamp: SPIB).*

(NOTE: sheathing-attached arrays are not allowed with initially wet lower density lumber such as Spruce-Pine-Fir (stamp: S-P-F) and Hem-Fir (stamp: HF).)
- 7. Anchor location restrictions—all anchors must comply with at least one of the options below. Anchors verified to be in "bands of strength" are attached in the middle 16-inch-wide strip centered between the long edges of sheathing panels (at least 16" from sheathing long edges). Check all boxes that apply to anchors in the array:
 - a. *Some anchors are not within bands of strength, and all the following (i., ii. & iii.) apply:*
 - i. *Edge of array is more than 3 feet from any roof edge (Wind Zone 1), and*
 - ii. *Tributary area is 9 ft² or less (up to half the area of a 60 cell PV module), and*
 - iii. *Wind Exposure B only, and design wind speed does not exceed 120 mph.*
 - b. *All anchors are within bands of strength, and all of the following (i., ii. & iii.) apply:*
 - i. *Edge of array is more than 3 feet from any roof edge (Wind Zone 1), and*
 - ii. *Tributary area is 14 ft² or less (40"x48").*
 - iii. *One of the two wind cases below (x. or y.) applies:*
 - x. *Exposure B, and design wind speed does not exceed 140 mph, or*
 - y. *Exposure C, and design wind speed does not exceed 120 mph.*
 - c. *All anchors are within bands of strength, and all the following (i., ii. & iii.) apply:*
 - i. *Edge of array meets E.1 and is within 3 feet of a roof edge (Wind Zone 2), and*
 - ii. *Tributary area including cantilevers is 9 ft² or less (32.5"x40").*
 - iii. *Wind Exposure B only, and design wind speed does not exceed 120 mph.*
 - d. *All anchors are within bands of strength, and all the following (i., ii. & iii.) apply:*
 - i. *Edge of array meets E.1 and is within 3 feet of a roof corner (Wind Zone 3), and*
 - ii. *Tributary area, including cantilevers, is 4.5 ft² or less (32.5"x20").*
 - iii. *Wind Exposure B only, and design wind speed does not exceed 120 mph.*

- 8. Anchor-to-sheathing connection has an allowable stress design (ASD) uplift capacity of at least 166 lbs. under short duration loading, which corresponds to a mean ultimate tested uplift capacity of at least 520 lbs.

If any structural item cannot be checked off, the building official may require the installer to provide structural calculations and/or details, stamped and signed by a design professional, addressing the unchecked item.

Step 2: Electrical PV System Requirements Checklist

- 1. Major electrical components including PV modules, dc-to-dc converters, and inverters, are identified for use in PV systems.
- 2. Array mounting system UL2703 certified for bonding and grounding. Alternatively, the array mounting system may incorporate UL2703 grounding devices to bond separate exposed metal parts together or to the equipment grounding conductor.
- 3. The PV array consists of no more than 2 series strings per inverter input and no more than 4 series strings in total per inverter.
- 4. Field Installed PV array wiring meets the following requirements (all boxes must be checked):
 - a. All exposed PV source circuit wiring is no smaller than 12 AWG PV Wire or MFG Cable.
 - b. All PV source circuit wiring in raceway is no smaller than 12 AWG THWN-2, XHHW-2, or RHW-2.
 - c. Any field-installed PV output circuit wiring is 6 AWG THWN-2, XHHW-2, or RHW-2.
 - d. PV system circuits on buildings meet requirements for controlled conductors in 690.12.
- 5. The total inverter capacity has a continuous ac power output 15,360 Watts or less and meets the requirements of 705.12(B) where installed on the load side of the service disconnecting means (complies with Table 705.12 in the Electrical Commentary). (choose one below)
 - Load-side connection complying with Table 705.12(B)
 - Supply-side connection complying with 705.12(A)
- 6. Equipment is rated for the maximum dc voltage applied to the equipment (put N/A in all blanks that do not apply to the specific installation):
 - a. ASHRAE Extreme Annual Mean Minimum Design Dry Bulb Temperature (one source is www.solarabcs.org/permitting) = _____; Table 690.7 (NEC) value _____
 - b. Max (temp adjusted) module Voc:
Rated Voc _____ V x Table 690.7 value _____ = _____ V
 - c. Dc-to-dc converter(s) or microinverter rated maximum input voltage: _____ V
(must be greater than Max module Voc in (b.))
 - d. Maximum number of dc-to-dc converters allowed in series (up to 600Vdc): _____
 - e. Maximum voltage of dc-to-dc converter circuit with maximum number in (C.): _____ V
 - f. Inverter(s) rated maximum input voltage: _____ V (must be greater than i to iv below)
 - i) Inverter 1 input 1: Max module Voc (b.) _____ V x # in series _____ = _____ V
 - ii) Inverter 1 input 2: Max module Voc (b.) _____ V x # in series _____ = _____ V
 - iii) Inverter 1 input 3: Max module Voc (b.) _____ V x # in series _____ = _____ V
 - iv) Inverter 2 input 1: Max module Voc (b.) _____ V x # in series _____ = _____ V
 - v) Inverter 2 input 2: Max module Voc (b.) _____ V x # in series _____ = _____ V
 - vi) Inverter 2 input 3: Max module Voc (b.) _____ V x # in series _____ = _____ V
- 7. One of the standard electrical diagrams (E1.1a, E1.1b, E1.1c, or E1.1d) can be used to accurately represent the PV system. Diagrams can be found in the electrical commentary document.

Fill out the standard electrical diagram completely. If the electrical system is more complex than the standard electrical diagram can effectively communicate, the project does not meet the requirements for a simplified permit application and additional information may be necessary for the jurisdiction to process the permit application.