



Fire Marshal's Office
San Mateo County Fire
CAL FIRE

320 Paul Scannell Drive, San Mateo, California 94402 (650) 573-3846

Date: Sep. 26, 2012

Revised: Aug.8, 2015

Number: *CFS-007*

Title: Solar Photovoltaic Systems

Approved: *Mark Mondragon*

Purpose:

This standard detail will identify the requirements for plan submittal and approval for all solar photovoltaic systems.

General:

The San Mateo County Fire Department, (SMCFD) has developed this standard detail to ensure firefighter and public safety for all Solar PV systems. While the environmentally friendly technology these systems bring is appreciated, traditional firefighting techniques, such as roof venting, water extinguishment and fire overhaul will have to be modified to ensure human safety. Roofs that contain Solar Arrays can be difficult for firefighters to vent and delayed roof venting may increase the time necessary for fire containment resulting in a greater extent of fire damage and risk of personal injury. Conventional water extinguishment on roofs with Solar PV systems may not be an option for firefighters if the integrity of any portion of the solar array is threatened as the risk of accidental electrocution may be greatly increased. Fire overhaul will also be a challenge for firefighters, as broken panels or compromised solar conduit may remain energized.

Conditions:

- A.) The following conditions will apply to all roof and ground mount Solar PV systems:
- 1.) All materials used to mount solar arrays shall be equal to or greater than Class "B" fire rating.
 - 2.) Ground mounted solar arrays will be erected in areas clear of combustible vegetation. A minimum vegetation clearance or mowed perimeter of 10' shall be maintained.
 - 3.) All Solar conduits, interior or exterior, will be permanently labeled with weather resistant material.
 - 4.) Battery storage in enclosed rooms to be mounted a minimum of 24" above floor. If contained within cabinet a permanent placard to be posted.
 - 5.) All disconnects shall be accessible to fire department and located together when possible.

Signage:

B.) PV systems must be marked. Marking is needed to provide emergency responders with appropriate warning and guidance with respect to working around and isolating the solar electric system. This can facilitate identifying energized electrical lines that connect the solar modules to the inverter, as these should not be cut when venting for smoke removal.

1.0) Materials used for marking must be weather resistant. It is recommended that Underwriters Laboratories Marking and Labeling System 969 (UL 969) be used as standard to determine weather rating. (UL listing of markings is not required).

1.1) Main Service Disconnect

For residential applications, the marking may be placed within the main service disconnect. If the main service disconnect is operable with the service panel closed, the marking should be placed on the outside cover.

For commercial application, the marking should be placed adjacent to the main service disconnect in a location clearly visible from the location where the lever is operated.

1.1.1) Marking Content and Format

- MARKING CONTENT: WARNING : SOLAR ELECTRIC SYSTEM
- RED BACKGROUND
- WHITE LETTERING
- MINIMUM 3/8" LETTER HEIGHT
- ALL CAPITAL LETTERS
- ARIAL OR SIMILAR FONT, NON-BOLD
- REFLECTIVE, WEATHER RESISTANT MATERIAL SUITABLE FOR THE ENVIRONMENT (durable adhesive materials may meet this requirement)

WARNING: SOLAR ELECTRICAL SYSTEM

1.2) Marking for Direct Current Conduit, Raceways, Enclosures, Cable Assemblies, and Junction Boxes

Marking is required on all interior and exterior DC conduit, raceways, enclosures, cable assemblies, and junction boxes to alert the Fire Service to avoid cutting them. Marking should be placed on all interior and exterior DC conduit, raceways, enclosures, and cable assemblies, every 10 feet, at turns and above and/or below penetrations and all DC combiner and junction boxes.

1.2.1) Marking Content and Format

- MARKING CONTENT: CAUTION: SOLAR CIRCUIT
- RED BACKGROUND
- WHITE LETTERING
- MINIMUM 3/8" LETTER HEIGHT
- ALL CAPITAL LETTERS
- ARIAL OR SIMILAR FONT, NON-BOLD
- REFLECTIVE, WEATHER RESISTANT MATERIAL SUITABLE FOR THE ENVIRONMENT (durable adhesive materials meet this requirement)

CAUTION: SOLAR CIRCUIT

1.3) Inverters

The inverter is a device used to convert DC electricity from the solar system to AC electricity for use in the building's electrical system or the grid

No markings are required for the inverter

2.0) ACCESS, PATHWAYS AND SMOKE VENTILATION

Access and spacing requirements should be observed in order to:

- Ensure access to the roof
- Provide pathways to specific areas of the roof
- Provide for smoke ventilation opportunities area
- Provide emergency egress from the roof

San Mateo County Fire may entertain exceptions to this requirement where access, pathway or ventilation requirements are reduced due to:

- Proximity and type of adjacent exposures
- Alternative access opportunities (as from adjoining roofs)
- Ground level access to the roof area in question
- Adequate ventilation opportunities beneath solar array (as with significantly elevated or widely-spaced arrays)
- Adequate ventilation opportunities afforded by module set back from other rooftop equipment (example: shading or structural constraints may leave significant areas open for ventilation near HVAC equipment)
- Automatic ventilation device
- New technology, methods, or other innovations that ensure adequate fire department access, pathways and ventilation opportunities

Designation of ridge, hip, and valley does not apply to roofs with 2-in-12 or less pitch. All roof dimensions are measured to centerlines.

Roof access points should be defined as areas where ladders are not placed over openings (i.e., windows or doors) and are located at strong points of building construction and in locations where they will not conflict with overhead obstructions (i.e., tree limbs, wires, or signs).

2.1) Residential Systems—Single and Two-Unit Residential Dwellings

Plan review is required if a system is to be installed that will occupy more than 50% of the roof area of a residential building.

Examples of these requirements appear at the end of this guideline.

2.1.1) Access/Pathways

a.) Residential Buildings with hip roof layouts: Modules should be located in a manner that provides one (1) three-foot (3') wide clear access pathway from the eave to the ridge on each roof slope where modules are located. The access pathway should be located at a structurally strong location on the building (such as a bearing wall).

b.) Residential Buildings with a single ridge: Modules should be located in a manner that provides two (2) three-foot (3') wide access pathways from the eave to the ridge on each roof slope where modules are located.

c.) Hips and Valleys: Modules should be located no closer than one and one half (1.5) feet to a hip or a valley if modules are to be placed on both sides of a hip or valley. If the modules are to be located on only one side of a hip or valley that is of equal length then the modules may be placed directly adjacent to the hip or valley.

2.1.2) Smoke Ventilation

The modules should be located no higher than three feet (3') below the ridge.

2.2) Commercial Buildings and Residential Housing Comprised of Three (3) or More Units

Exception: If the San Mateo County Fire Department determines that the roof configuration is similar to residential (such as in the case of townhouses, condominiums, or single family attached buildings), the local fire department may make a determination to apply the residential access and ventilation requirements.

Examples of these requirements appear at the end of this guideline.

2.2.1) Access

There should be a minimum six foot (6') wide clear perimeter around the edges of the roof.

Exception: If either axis of the building is 250 feet or less, there should be a minimum four feet (4') wide clear perimeter around the edges of the roof.

2.2.2) Pathways

Pathways should be established in the design of the solar installation. Pathways should meet the following requirements:

- a.) Should be over structural members
- b.) Centerline axis pathways should be provided in both axis of the roof. Centerline axis pathways should run on structural members or over the next closest structural member nearest to the center lines of the roof
- c.) Should be straight line not less than 4 feet (4') clear to skylights and/or ventilation hatches
- d.) Should be straight line not less than 4 feet (4') clear to roof standpipes
- e.) Should provide not less than 4 feet (4') clear around roof access hatch with at least one, not less than 4 feet (4') clear, pathway to parapet or roof edge

2.2.3) Smoke Ventilation

- a) Arrays should be no greater than 150 by 150 feet in distance in either axis
- b.) Ventilation options between array sections should be either:
 - 1. A pathway 8 feet (8') or greater in width
 - 2. 4 feet (4') or greater in width pathway **and** bordering on existing roof skylights or ventilation hatches
 - 3. 4 feet (4') or greater in width pathway **and** bordering four feet (4') x 8 feet 8' "venting cutouts" every 20 feet (20') on alternating sides of the pathway

3.0) LOCATION OF DIRECT CURRENT (DC) CONDUCTORS

Conduit, wiring systems, and raceways for photovoltaic circuits should 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 should use design guidelines that minimize total amount of conduit on the roof by taking the shortest path from the array to the DC combiner box. The DC combiner boxes are to be located such that conduit runs are minimized in the pathways between arrays.

To limit the hazard of cutting live conduit in venting operations, DC wiring should be run in metallic conduit or raceways when located within enclosed specs in a building and should be run, to the maximum extent possible, along the bottom of load-bearing members.

4.0) NON-HABITABLE BUILDINGS

The access portion of this standard detail does not apply to non-habitable structures. Examples of non-habitable structures include, but are not limited to, parking shade structures, solar trellises, etc.

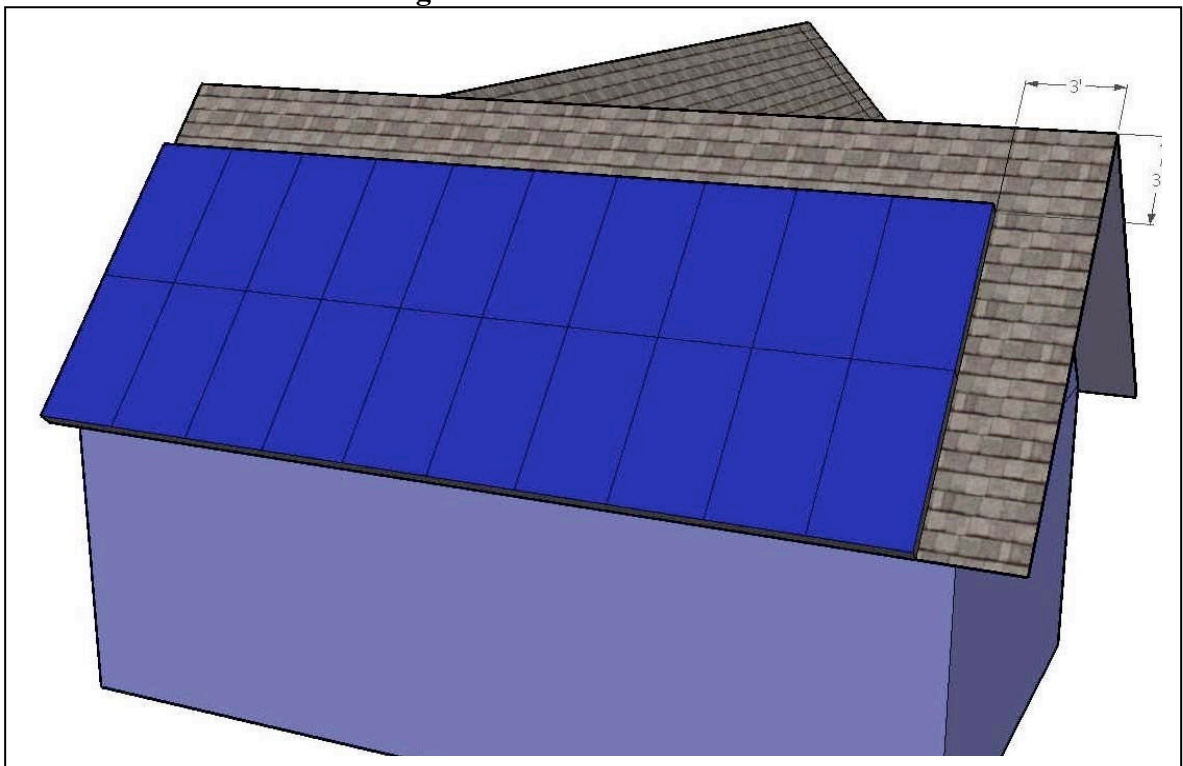
5.0) GROUND MOUNTED PHOTOVOLTAIC ARRAYS

Setback requirements do not apply to ground-mounted, freestanding photovoltaic arrays. A clear brush area of ten feet (10') is required for ground mounted photovoltaic arrays.

*****SEE PAGES 6 – 9 FOR EXAMPLES*****

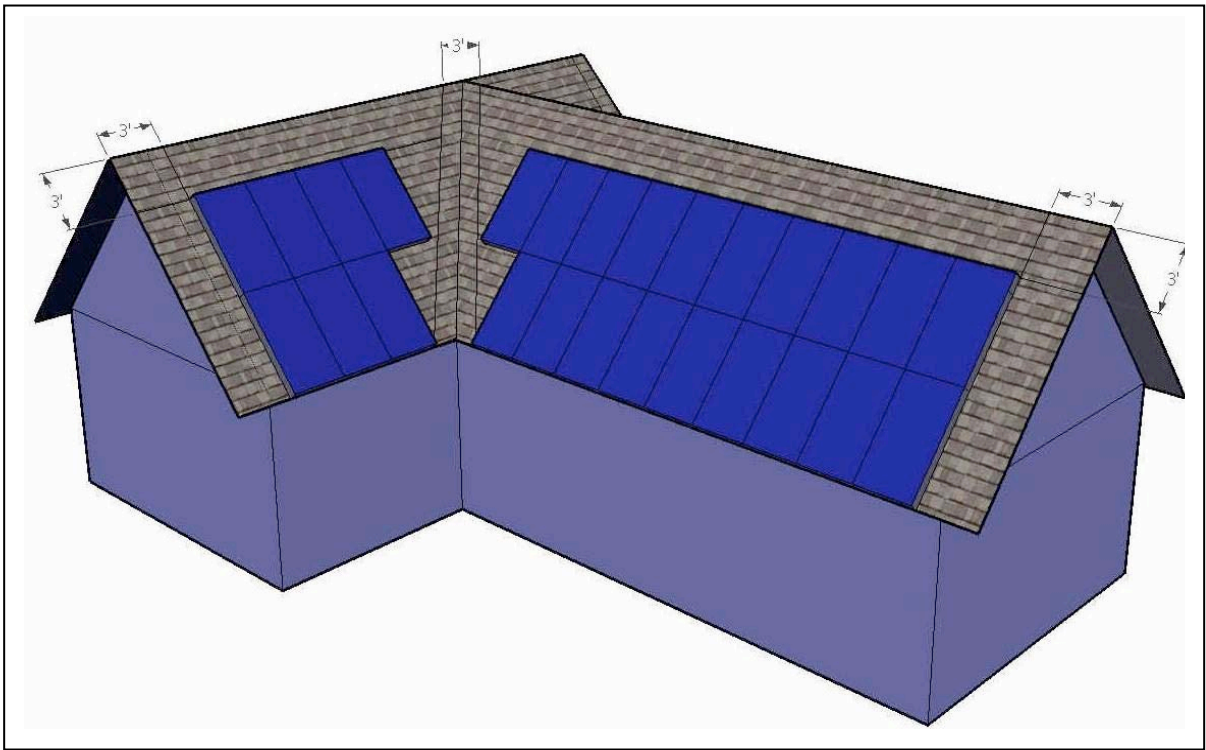
EXAMPLE 1

Diagram 1: Cross Gable Roof



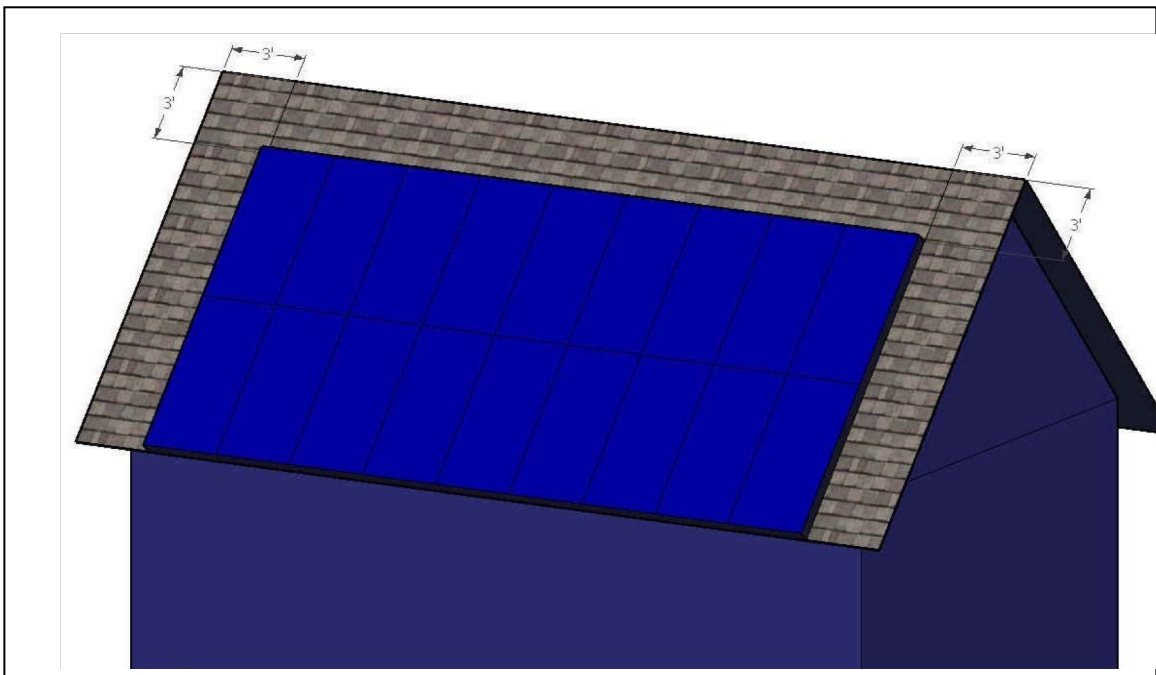
EXAMPLE 2

Diagram 2: Cross Gable with Valley



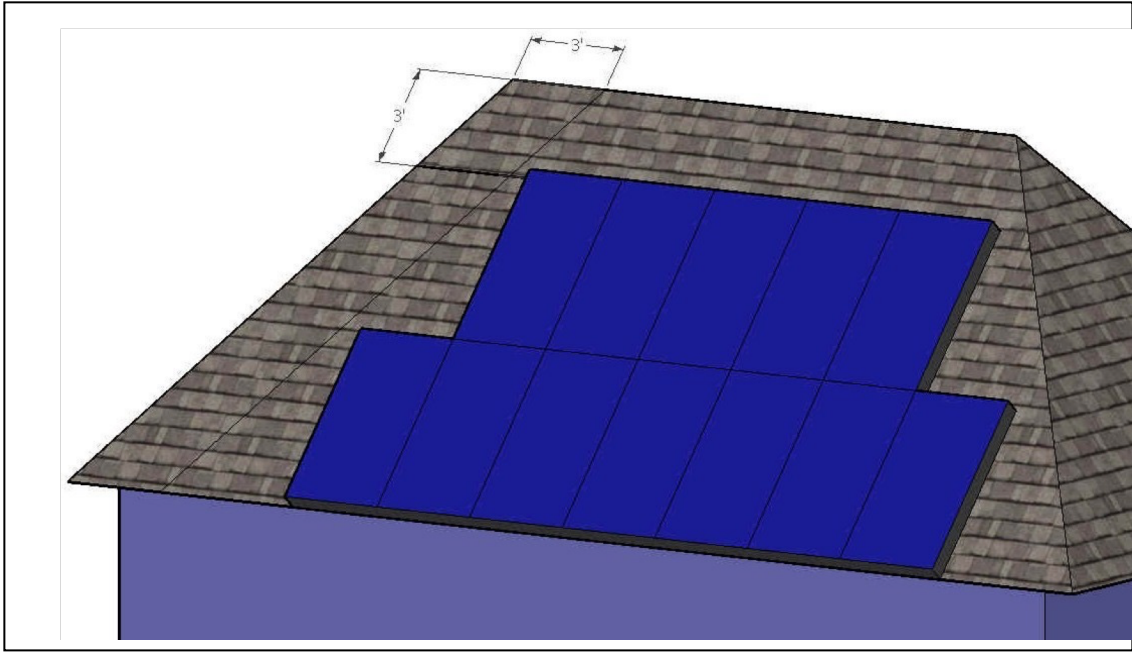
EXAMPLE 3

Diagram 3: Full Gable



EXAMPLE 4

Example 4: Full Hip Roof



Example 5

SOLAR RAY EXAMPLE - LARGE COMMERCIAL
8' WALLYS

