



PV SOLAR PANEL PLAN GUIDELINES

CITY OF MANHATTAN BEACH COMMUNITY DEVELOPMENT

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General Requirements:

1. **Governing Codes:** All work shall comply with 2022 California Building Code, California Residential Code, California Existing Building Code, California Energy Code, California Electrical Code, California Green Building Standard Code, California Fire Code as well as applicable Current Manhattan Beach Municipal Code and local ordinances/amendments.
2. **Plan Review:** All solar PV submittals are online through our [Citizen Self Service Portal \(CSS\)](#).
3. For **new buildings** that require solar PV, final solar inspection is required to be approved prior to final building or Certificate of Occupancy.
4. For all new single family residences that require PV on a deferred submittal, include the original approved CFIR, NRCC energy calculations report with the application.
5. **Cover Sheet: Project Building Code Information** shall be on cover sheet of the plans including:
 - A complete description of scope of work,
 - Building occupancy type(s),
 - Tabulation of all equipment, and their UL listing approval No,
 - Construction type of building,
 - Is the structure sprinklered or not
 - Building roof area sf, Solar PV area sf and percentage of roof coverage,
 - Roof slopes, roof material(s) for each roof,
 - Number of stories, building height(s),
 - Year building was built,
 - Owners/consultants/designers/contractor's name, address, and contact information,
 - Vicinity map with true north and scale, legible name of access street(s)
6. A **Site Plan** is required: Drawn to scale, true north's direction, distance to property lines, setbacks and lot dimensions, site's point of entry from public way, street name. The site plan also needs to show location of roof access points required in opposite sides of building which is connected to public way. The site plan shall also identify the location of meter(s), equipment, and electrical service panel/sub-panel(s), and rapid shutdown. Panels and equipment cannot be located in the required front or side setbacks, or required parking, driveway or vehicular areas.
7. A **Roof Plan** is required identifying solar photovoltaic array(s) and its access path, roof ridge setbacks, roof material, slopes and directions of slopes, high and low roofs, location of rafters or trusses. Please indicate any differences in roof height(s).

Arrays Access Pathways

- a) Access Pathways: Not fewer than two pathways, on separate roof planes from lowest roof edge, and vertical, to ridge line and minimum 36 inches wide, shall be provided on all buildings. At least one of the pathways shall be on the street or driveway side of the roof. Identify on plans the two minimum roof access points (ladder) on plans. (R324.6)
- b) A pathway minimum 36 inches wide shall be provided perpendicular from the lowest roof edge to ridge on the same roof plane as the photovoltaic array, on an adjacent roof plane, for each roof plane with a PV array. Pathways shall be located in areas without obstructions such as skylight, vent pipes, conduit, or mechanical equipment. (R324.6.1)
- c) Access pathway 36" clear width shall be over load bearing structure. Pathways shall be over areas capable of supporting fire fighters.
- d) A 36" minimum clear path shall be provided and shown on plans where array located on a roof that is bellow an egress window. (R324.6.3)

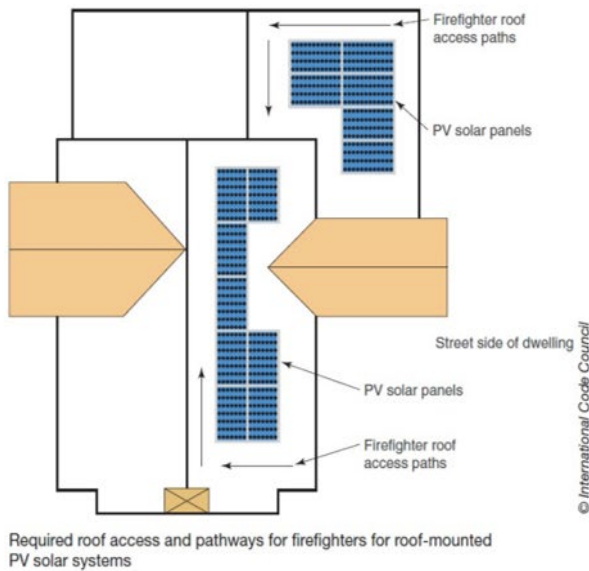
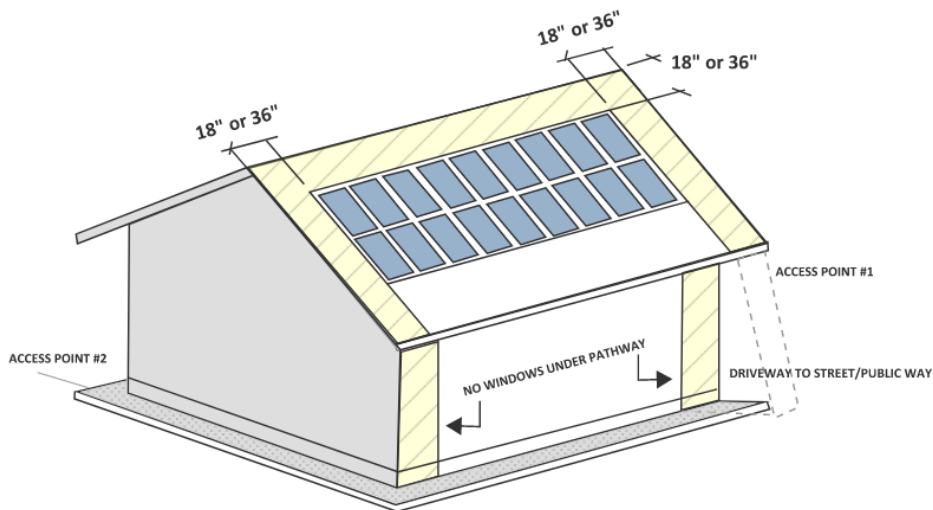


TABLE 3-1 Minimum Ridge Setback

Array Percent of Roof Area	Fire Sprinkler System	Minimum Setback on Both Sides of Ridge (inches)
≤ 33 %	No	18
> 33%	No	36
≤ 66 %	Yes	18
> 66%	Yes	36

Example Array Access Pathways (exception apply):



Ridge Setbacks

Plans shall indicate the roof pitch (s), building sprinkler system, and the total percentage of roof coverage by Solar PV on each roof in order to identify the ridge setback requirements.

The minimum required setback for the roof ridge on a steep roof is 36 inches (slope over 2:12, 16.7% or 10 degrees). Exception: The ridge setback may be reduced to 18 inches if one of the conditions below occurs per R324.6.2, as follows:

- ✚ Automatic Fire Sprinklered Buildings, if PV arrays occupy less than 66% of total roof area the minimum RIDGE setback is 18 inches on each side of the ridge. If PV arrays occupy more than 66% of total roof area the minimum ridge setback is 36 inches on each side.
- ✚ Non-Sprinklered Buildings, If PV arrays occupy less than 33% of the total roof area the minimum setback is 18 inches on each side of ridge. If PV arrays occupy more than 33% of the total roof area the minimum setback is 36 inches on each side of ridge.

Please note that the reductions of width from 36" to 18", is limited only to ridge setback as an exceptions and it is NOT applicable to access pathway. (CRC R324)

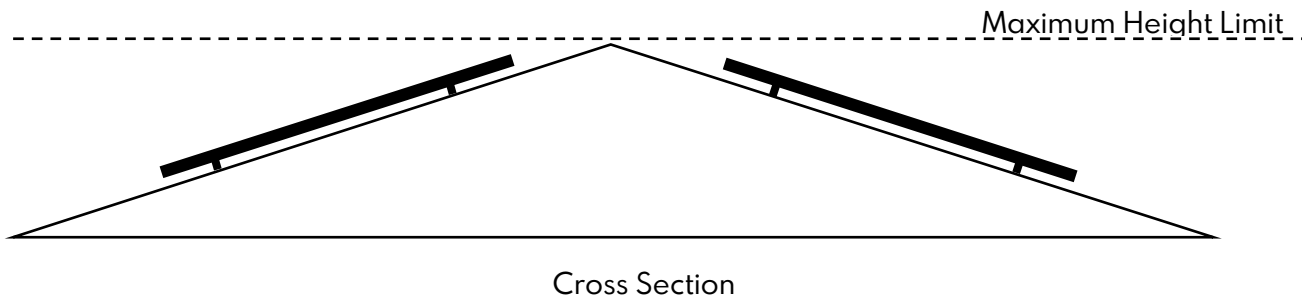
8. **Structural:** Provide engineered calculations and details demonstrating method of attachment of panels and adequacy of supporting members, include wind uplift effects. Per ASCE 7-16, all designs, calculations, roof layout, and connection details to be stamped and signed by the CA licensed engineer of record. Design shall comply with CRC 324.4.1.
 - ✚ Exception: If the solar panels are 4_{psf} or less with a 1-6 inch gap between the underside of the module and the roof surface, structural calculations are not required.
 - ✚ Structural calculations by a licensed engineer or architect may be required at plan check if determined by the Plan Check Engineer.
9. **Equipment:** In addition to the equipment list, provide a tabulation on the cover sheet with the third party approval listing numbers. Manufacturers' specification cut sheets shall be attached to the plans for all equipment, connections, and conductors, wiring or cables, etc. (R324.3.1)
 - Photovoltaic panels and modules shall be listed and labeled in accordance with UL 1703 or with both UL 61730-1 and UL 61730-2.
 - Inverters shall be listed and labeled in accordance with UL 1741.
 - Systems connected to the utility grid shall use inverters listed for utility interaction.
 - Mounting systems listed and labeled in accordance with UL 2703.
 - Type of wire or cable (UL 4703) and distributed generation cable (UL 3003), shall be listed according to CEC 690.13(C).
10. Add a note that Smoke alarms and Carbon Monoxide alarms are required to be installed and maintained at all required locations. For location and requirements please see the Smoke Detector/ Carbon Monoxide Alarm handout on the City's website.(CRC R314 and R315)

Planning Division Solar Panel Height Requirements:

MBMC Section 10.60.060

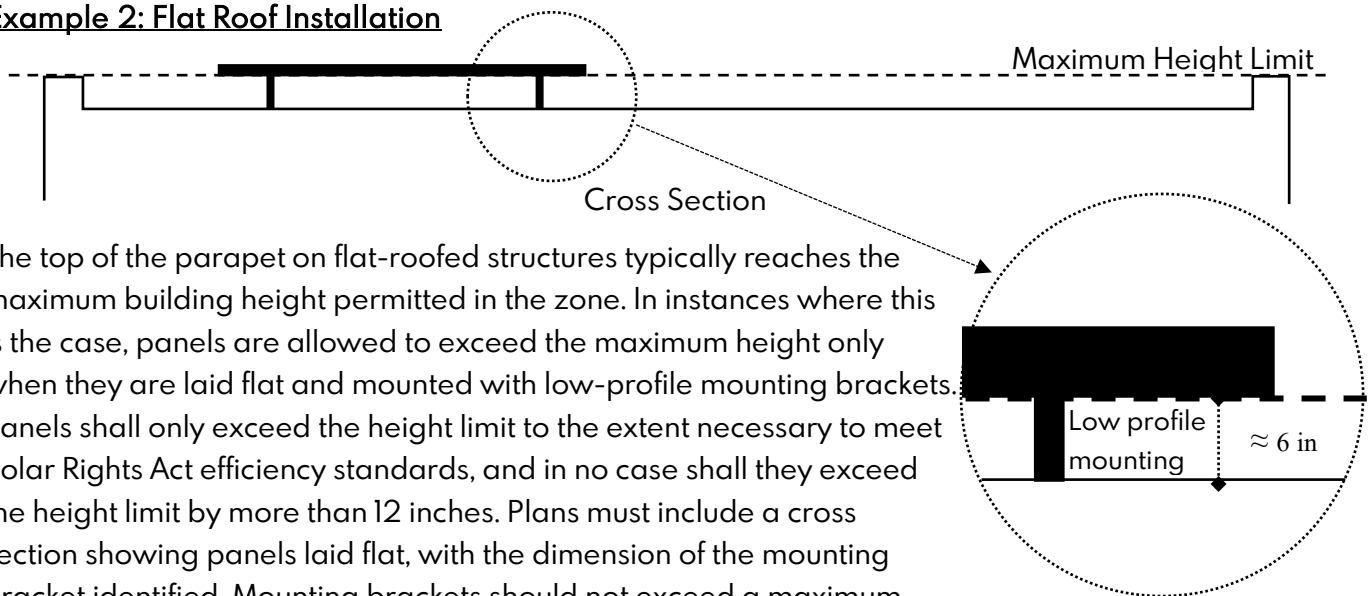
Solar energy systems may exceed the maximum permitted height by no more than twelve inches (12") as needed to meet Solar Rights Act efficiency standards. The Director of Community Development may make exemptions where fire-life safety and access issues are mitigated.

Example 1: Typical Pitched Roof Installation



The peak of a pitched-roof structure typically reaches the maximum building height permitted in the zone. Plans must include a cross section demonstrating that the proposed panels do not exceed the maximum height, except as described below.

Example 2: Flat Roof Installation



The top of the parapet on flat-roofed structures typically reaches the maximum building height permitted in the zone. In instances where this is the case, panels are allowed to exceed the maximum height only when they are laid flat and mounted with low-profile mounting brackets. Panels shall only exceed the height limit to the extent necessary to meet Solar Rights Act efficiency standards, and in no case shall they exceed the height limit by more than 12 inches. Plans must include a cross section showing panels laid flat, with the dimension of the mounting bracket identified. Mounting brackets should not exceed a maximum height of approximately six inches.

Exceedance of Maximum Height:

In instances where it can be demonstrated that the performance of the solar panels drops below 90% of the performance achieved at maximum efficiency, as defined by the State Solar Rights Act (CA Civil Code 714), such solar panels may exceed the maximum height limit by more than 12 inches per MBMC Section 10.60.060. (Efficiency calculations must be provided.) In no case shall panels exceed the maximum height limit by more than 12 inches.

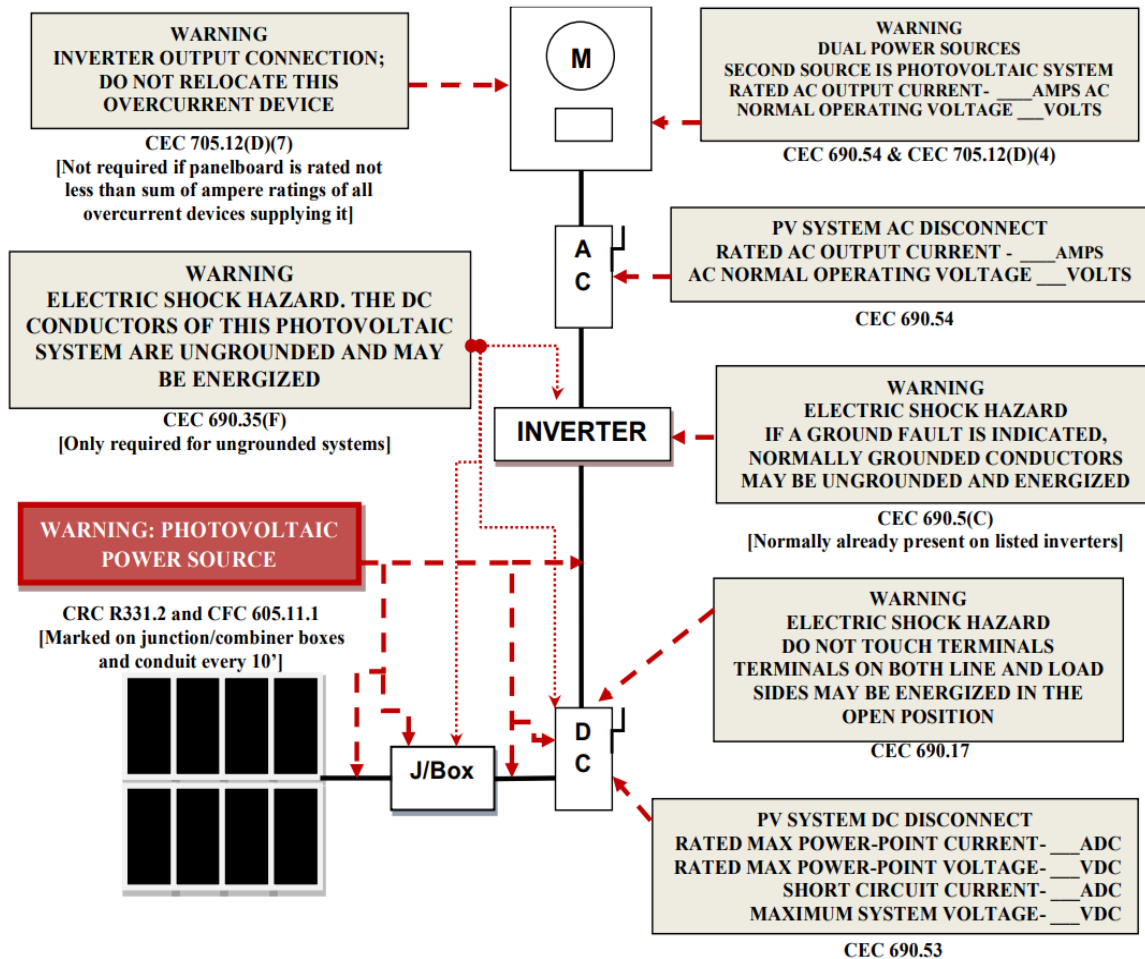
Electrical Requirements

1. Provide an electrical linear diagram. Identify grounding and rapid shutdown on a diagram.
2. Add note to plans: *“Exterior Remote Disconnect and at Inverter/Panel: DC and AC array conductors that are routed and installed completely on the exterior of the building shall be contained in galvanized rigid steel conduit from any PV array rooftop “J” box, fusible combiner box. These DC/AC array conductors installed in galvanized rigid steel conduit need to be run entirely on the exterior of the building.”*
3. Add note to plans: *“Interior Remote Disconnect: DC array conductors that are routed through the building are required to be in galvanized rigid steel conduit from any PV array rooftop “J” box, fusible combiner box through any attic. Conduit run through the interior of the building shall be installed a minimum of 18” below the roof surface.”*
Exception: conductors contained in metal raceways and Type MC metal-clad cable that complies with CEC250.118(10) conduit is not approved for exterior use or the interior attic space 18” below the roof surface and lower. Install with appropriate labels. (AC circuits may be ran in NM, NMC and MNS in one and two family dwellings per Section CEC334.10 uses permitted).
4. Provide a listed arc fault circuit interrupter, AFCI, protection for D/C circuits and listed for PV systems.
5. Show all conduit and conductor listing and sizes, include derating of conductors. Provide complete inverter and solar module manufacturer specification sheet with UL approval.
6. Inverter integral AC/ DC disconnects are permitted. The AC disconnect shall be a listed.
7. AC disconnect between inverter AC output and connection to utility to be a visible blade, lockable type disconnect listed for its use. Required DC/AC disconnects and at entrance of ground mounted inverters, A/C to be visible blade-type listed for its use, maximum 36” from panel.
8. Rapid shutdown, RSD, of PV systems required on building and shall comply with CEC 690.12(A) through (D). Add notes to plans that rapid shutdown shall be UL approved and installed in visible location max 36” from panel per CRC. Show location of RSD on Site Plan and site placard, and electrical linear diagram, clearly.
9. Distance between inverter and next downstream AC over current protection device to be maximum 25'. AC over current device is required prior to entering the building (line of sight).
10. Verify main electrical service over current device and buss rating, minimum 225 amp. For a dwelling unit the sum of the ampere ratings of the over current devices shall not exceed 120% or the rating of the bus bar or conductor. At feeder taps downstream of the main service disconnect 125% may be utilized per section 705.12B (2).

Solar PV Standard Plan – Simplified Central/String Inverter Systems for One- and Two-Family Dwellings

Markings

CEC Articles 690 and 705 and CRC Section R331 require the following labels or markings be installed at these components of the photovoltaic system:



Code Abbreviations:

California Electrical Code (CEC)
California Residential Code (CRC)
California Fire Code (CFC)

Informational note: ANSI Z535.4 provides guidelines for the design of safety signs and labels for application to products. A phenolic

11. Show the existing main electric service equipment, ground electrode system, conduit, and conductor size. If the solar PV installation is requiring a panel/subpanel change or relocation, provide electrical panel load calculations, specifications, and UL listing per Electrical code requirements. (CEC 690.4)
12. Provide all signage required per California Electrical Code – Article 690.1(a) (see following Pages).
13. Provide ground electrode system from the inverter to the existing main service ground electrode per CEC Articles 250.50 through 250.86.

14. 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. (CFC 1205.2.4)
15. Disconnects: central inverter systems and optimizers shall have an AC disconnect at the inverter in the area of the main service panel (utility/safety disconnect) for the purpose of de-energizing the PV system as much as possible. Listed Knife Edge type only.
Micro Inverter Systems shall have an AC disconnect Switch at the Main Electrical Service.
Where buildings have multiple power sources (including PV or ESS), electrical disconnects for all sources must be within 3 feet and in view of main electrical service panel.
Exception – When an existing building alteration does not exceed 50% of the floor area placards/directories to be placed at the main electrical panel showing disconnect location. (CEC 690.15)
16. Solar Roof or Integrated Solar PV Roof System require a solar PV permit. Requirements of Roof Solar PV applies to solar roofs except access pathway and ridge setbacks. Fire classification of solar roof material is required and UL listing shall be provided.
17. Required Marking, Labels, Warning Signs and Placard Solar PV Systems < 10kw (CEC 690, 705, CRC 331.2, CFC 605, ANZI Z535.4)
Provide emergency responders or maintenance crew with appropriate warning and guidance with respect to isolating the solar electrical system. This can facilitate identifying energized electrical lines that connect the solar panels to the inverter, as these should not be cut when venting for smoke removal.
Markings are required on interior and exterior AC conduit, DC conduit, enclosures, raceways, cable assemblies, junction boxes, combiner boxes and disconnects (utility/safety disconnect at main electrical panel and rooftop emergency disconnect).
The warning labels or signs to be made of RED weather resistant material / plastic material with engraved white letters. The markings shall be permanent and readily visible from any direction of approach per code.
White letters shall be a minimum 3/8" in size. The warning labels shall be permanently attached to the appropriate panel.
PV systems with battery back-ups shall be labeled for multiple-power sources. Site placard/sign required showing locations of all PV arrays, equipment, disconnects, Service panel, and rapid shutdowns.

SEE NEXT PAGE FOR SAMPLE

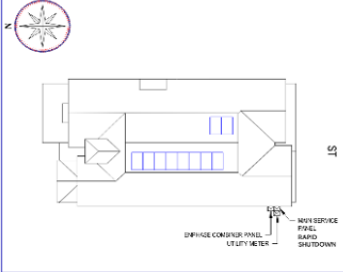
SIGNAGE FORMAT:

All signage shall fall within the following format:

- ✓ White lettering on a red background
- ✓ Minimum 3/8" letter height
- ✓ All letters shall be capitalized
- ✓ Arial or similar font, non-bold

CAUTION:

POWER TO THIS BUILDING IS ALSO SUPPLIED FROM THE FOLLOWING SOURCES WITH DISCONNECTS LOCATED AS SHOWN

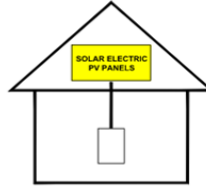


Marking, Labels, Warning Signs

Signage material shall be Reflective and Weather-Resistant suitable for the environment.

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN THE ARRAY.



LABEL LOCATION: ON OR NO MORE THAN 1 M (3 FT) FROM THE SERVICE DISCONNECTING MEANS TO WHICH THE PV SYSTEMS ARE CONNECTED.
PER CODE(S): CEC 2022: CEC 690.56(C), CFC 1204.5.1

WARNING!
DUAL POWER SUPPLY
SOLAR ELECTRIC SYSTEM

ATTACH THIS TAG TO METER PANEL

WARNING!
DUAL POWER SUPPLY
SOLAR ELECTRIC SYSTEM
DISCONNECT

ATTACH THIS TAG TO PV DISCONNECT DEVICE

CAUTION:
SOLAR ELECTRIC CIRCUIT

ATTACH THIS TAG TO AC & DC CIRCUIT EQUIPMENT

WARNING
ELECTRICAL SHOCK HAZARD
TERMINALS ON LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION

LABEL LOCATION: INVERTER(S), AC DISCONNECT(S), AC COMBINER PANEL (IF APPLICABLE).
PER CODE(S): CEC 2022: CEC 706.15 (C)(4) & CEC 690.13(B)

RAPID SHUTDOWN FOR SOLAR PV SYSTEM

LABEL LOCATION: UTILITY SERVICE ENTRANCE/METER, INVERTER/DC DISCONNECT IF REQUIRED BY LOCAL AHJ, OR OTHER LOCATIONS AS REQUIRED BY LOCAL AHJ.
PER CODE(S): CEC 2022: 690.56(C)(2)

WARNING
POWER SOURCE OUTPUT CONNECTION
DO NOT RELOCATE THIS OVERCURRENT DEVICE

LABEL LOCATION: SERVICE PANEL IF SUM OF BREAKERS EXCEEDS PANEL RATING
CEC 705.12 (B)(3)(2)

WARNING DUAL POWER SOURCE
SECOND SOURCE IS PHOTOVOLTAIC SYSTEM

LABEL LOCATION: POINT OF INTERCONNECTION
PRODUCTION METER
CEC 705.12(B)(3)(3) & CEC 690.59)

NOTES AND SPECIFICATIONS:

- SIGNS AND LABELS SHALL MEET THE REQUIREMENTS OF THE 2022 ARTICLE 110.21(B), UNLESS SPECIFIC INSTRUCTIONS ARE REQUIRED BY SECTION 690, OR IF REQUESTED BY THE LOCAL AHJ.
- SIGNS AND LABELS SHALL ADEQUATELY WARN OF HAZARDS USING EFFECTIVE WORDS, COLORS AND SYMBOLS.
- LABELS SHALL BE PERMANENTLY AFFIXED TO THE EQUIPMENT OR WIRING METHOD AND SHALL NOT BE HAND WRITTEN.
- LABEL SHALL BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED.
- SIGNS AND LABELS SHALL COMPLY WITH ANSI Z535.4-2011, PRODUCT SAFETY SIGNS AND LABELS, UNLESS OTHERWISE SPECIFIED.
- DO NOT COVER EXISTING MANUFACTURER LABELS.

PHOTOVOLTAIC AC DISCONNECT
MAXIMUM AC OPERATING CURRENT: 16.0 AMPS
NOMINAL OPERATING AC VOLTAGE: 240 VAC

LABEL LOCATION: AC DISCONNECT(S), PHOTOVOLTAIC SYSTEM POINT OF INTERCONNECTION.
PER CODE(S): CEC 2022: 690.54

PHOTOVOLTAIC POWER SOURCE

LABEL LOCATION: CONDUIT, COMBINER BOX
(PER CODE: CEC690.31(D)(2))

CAUTION
PHOTOVOLTAIC SYSTEM CIRCUIT IS BACKFEED

LABEL LOCATION: MSP (PER CODE: CEC 705.12(D) & CEC 690.59)

MAIN PHOTOVOLTAIC SYSTEM DISCONNECT

LABEL LOCATION: MAIN SERVICE DISCONNECT / UTILITY METER
(PER CODE: CEC 690.13(B))

WARNING
THIS EQUIPMENT FED BY MULTIPLE SOURCES:
TOTAL RATING OF ALL OVERCURRENT DEVICES EXCLUDING MAIN POWER SUPPLY SHALL NOT EXCEED AMPACITY OF BUSBAR

LABEL LOCATION: POINTS OF CONNECTION/BREAKER
CODE: CEC 705.12(B)(3)(3)

WARNING
ELECTRIC SHOCK HAZARD
TERMINALS ON BOTH LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION
DC VOLTAGE IS ALWAYS PRESENT WHEN SOLAR MODULES ARE EXPOSED TO SUNLIGHT

LABEL LOCATION: DC DISCONNECT, POINT OF INTERCONNECTION
(PER CODE: CEC 690.13(B))

WARNING
THE DISCONNECTION OF THE GROUNDING CONDUCTOR(S) MAY RESULT IN OVERVOLTAGE ON THE EQUIPMENT

LABEL LOCATION: INVERTER
PER CODE: CEC 690.31(E)

RATED MAXIMUM POWER-POINT CURRENT (Imp)	11.58	A
RATED MAXIMUM POWER-POINT VOLTAGE (Vmp)	380	V
MAXIMUM SYSTEM VOLTAGE (VOC)	480	V
MAXIMUM CIRCUIT CURRENT (Isc)	15	A

LABEL LOCATION: DC DISCONNECT, INVERTER#
(PER CODE: CEC 690.53)

WARNING
ELECTRIC SHOCK HAZARD
TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION
The warning sign(s) or label(s) shall comply with 110.21(B)