

**DEVELOPMENT SERVICES – BUILDING INSPECTION****SUBMITTAL GUIDELINES:
PHOTOVOLTAIC RESIDENTIAL STANDARD SUBMITTAL****SCOPE: RESIDENTIAL****APPLICABLE CODES:** 2016 CBC, CRC, CPC, CMC, CEC, CALGreen, CEnC, and PAMC

The information provided in this document is general and intended as a guide only. Each project is unique and additional requirements may be enforced as deemed appropriate.

IMPORTANT

- Photovoltaic applications are a separate submittal/permit and shall be submitted to the Building Department.
- Field installation shall be per code and approved plans. Changes shall be submitted to the city for approval prior to inspection. The resubmitted revised plan shall have changes clouded and a statement of changes.
- If a new roofing system is going to be installed, a separate roofing permit is required.
- PV systems integrated with energy storage systems (ESS) will require plan review and approval from Fire Department and CPAU Electrical Engineering. Please note that PV systems integrated with ESS cannot be done over the counter. Please review the “Energy storage systems (ESS) – Submittal” for additional information.

BEFORE SUBMITTING – BASIC REQUIREMENTS

- Provide an 8”x11” legible photo of the electrical panel showing the entire enclosure (include sub panel when used to back feed) with the dead front removed. The size of the main breaker must be visible.
- A completed [utility photovoltaic electric load sheet](#) must accompany the submittal.
- The size of the plans shall be 11”x17” minimum and a maximum of 30”x42”.
 - Please note that font size shall be a minimum of 10 for viewing and all information must be suitable and legible for micro filming.
 - Unless submitted electronically, three sets are required for submittal
- Provide a copy of the complete manufacturer’s specification sheets for all equipment:
 - Inverters, modules, combiner boxes, racking systems (including tilt up systems), flashing junction or transition boxes (e.g. Quick Mount), disconnects, battery, battery cabinet.
 - Note that electronic copies or links for complete instructions shall be provided.
- All equipment shall be tested, identified, and listed for the application. (CEC 690.4(B))

SITE AND ROOF PLAN

- Site and roof plans shall clearly show the location of the electrical supply panel, PV array, modules, (each string shall be identified), combiner box, inverter, ac and dc disconnects, conduit, junction boxes and battery banks.
- All equipment, on the roof and at grade requiring servicing, shall meet the required clearances of CEC 110.26. Plans shall show the required clearances.
- Identify ac/dc PV wiring locations on site plan.
- Show property line setback distances to the proposed equipment when not attached to the structure.
- Where DC conductors are installed underground, conductors shall be buried 18" or more below grade and a warning tape installed 12" above the conduit. CEC 300.5 (d) (1).
- Modules should not cover roof or plumbing vents. Provide information on the plans if you will be relocating any vents. If covering roof vents, provide documentation from the roof vent manufacturer that it is permissible to install modules over roof vents.
- For standing seam metal roofs/metal roof shingles:
 - Provide the manufacturer and type/model of the metal roof.
 - Provide location and detail of metal panel grounding method on the plan.
 - When penetrating metal roofs, provide detail, on the plans, from the metal roof manufacturer.
 - If using S-5! clamps, the engineer of record shall specify the frequency and spacing of the attachment points for the PV system to the roof metal panels that is consistent with the intended distribution of loads from the roof metal panels into the building structure. S-5! provides some allowable loads based on the manufacturer and product (e.g., AEP SPAN and Select Seam) which the engineer can use in the design (see below and follow the link provided): <https://www.s-5.com/resources/load-test-results/normal-to-seam/>. The City of Palo Alto advises that the review be done by a qualified licensed engineer who understand wind effects and metal roof design and construction.

AVAILABLE SHORT CIRCUIT CURRENT

- Indicate the available short circuit current on electrical equipment for all supply side taps. This information is available from CPA Electrical Utilities at (650) 566-4551 (Mike Mintz) or at (650) 566-4516 (Gopal Jagannath).

GROUNDING/UNGROUNDING SYSTEMS

- Ungrounded (functionally grounded) systems shall be identify the conductor colors as black, red.

FIRE

- Verify that access pathways and fire setbacks are clearly shown in the drawings per California Fire Code 605.11.1.2.1.

STRUCTURAL**QUANTITY AND SPACING OF ROOF ATTACHMENTS**

- Provide an array layout that clearly shows the quantity and spacing of roof attachments. The arrays shall be on a code compliant structure. Show sizes of roof areas to receive the PV arrays (roof dimensions). Clearly indicate when the roof structural framing is an engineered truss system.
- Provide a table that summarizes the following information:
 - Roof specifications (e.g., structural member sizes, span, spacing, and material)
 - Array specifications (e.g., number of modules, total number of modules, weight of modules and array, weight of racking system, and weight per attachment)
- Provide a clear attachment/mounting detail that shows the following information:
 - Size of the structural member
 - Racking system
- Ballasted systems require a full engineering analysis per CBC 1613.6.

ENGINEERED DRAWING AND CALCULATIONS

- An engineered drawing and calculations are required for tilt-up panels with more than 18" from the surface of the roof.
- At the request of the plan checker, an engineered drawing and calculations may be required for other systems.

RACKING SYSTEM AND MAXIMUM SPAN

- Provide a table from the racking manufacturer that clearly shows that maximum span; the maximum span shall be less than the maximum spacing between attachment points.

WATERPROOFING DETAIL

- Provide an applicable waterproofing detail and installation instructions; the detail shall include flashing and counter flashing for all roof types per CRC Chapter 9 Roof Assemblies.

MODULE/RACKING SYSTEM FIRE CLASSIFICATION

- Verify that the module and racking system are compatible by following this formula:
Module Fire Type + Rack Tested in Combination with Module Fire Type = Fire Rated Assembly
- Make sure that the module specs and the racking system clearly show the module fire type and class system fire rating, both per UL 1703.

MODULE RAIL/RACKING SYSTEM AND GROUNDING

- If modules are bonded through the racking/rail system, the racking/rail system must be listed to UL2703 and the installation instructions must be on site for the inspection.
 - Where equipment listed to UL 2703 is not installed, verify grounding lugs, at the module frames, are installed per the module manufacturer's installation instructions. The grounding method must be located at the ground to earth symbol on the module frame.

MICRO-INVERTERS

- Include the following documents in the submittal:
 - Manufacturers' module, inverter, and racking compatibility information.
- Clearly indicate on the plan whether the micro inverters are integrated grounding type or the earlier generation type which requires a grounding electrode conductor connection.
- Equipment shall be identified and listed for the application. (CEC 690.4(D))

THREE LINE DIAGRAM

- Provide a three line diagram showing:
 - All system components, wire sizes, conductor insulation type, method of protection (e.g. EMT, RNC), wire distances between each piece of equipment, grounding electrode system, equipment grounding system (conductor size) and disconnects.
 - Clearly indicate the number of modules per string, strings per array and number of modules total.
- Show size and location of all overcurrent protection devices.
- Show the ac/dc grounding electrode system per CEC 250.50, 250.56, 690.47(C) and include on the plan. Where an existing grounding electrode system is a driven ground rod and also an in ground main metallic water pipe, an additional ground rod shall be driven to comply with CEC 250.56.
 - The grounding electrode system must be illustrated on the plans.
 - Where the grounding electrode system is an Ufer (concrete encased electrode), each grounding electrode conductor (GEC) shall attach separately to the UFER with a continuous grounding electrode conductor. Attachments to an Ufer require a listed rebar clamp per attachment.

CALCULATIONS

- Submit complete calculations for maximum system voltage (module coefficients must be used when provided by module manufacturer) or use 1.12 factor, system string current, fuse and or circuit breaker sizing, total system wattage, conduit fill, voltage drop, ambient temperature correction factors and roof ambient temperature adjustment factor calculations, per CEC 310.15 (B)(3). Calculations shall show all integers not just the end result.
- Provide calculations to verify the ac/dc conductor size and type.
- Provide calculations showing the ac overcurrent device is 125% of the rated continuous output (CEC 705.60).

POINT OF INTERCONNECTION AND BUS RATING

- Point of interconnection shall comply with CEC 705.12 (D). Provide calculations per CEC 705.12(D)(2)(3) showing that the bus rating is sufficient for PV distribution.
- City of Palo did not adopt TIA #14-12 2016 National Electrical Code, Article 705, Section 705.12(D)(2)(3)(e), which allows interconnection in center-fed panels in dwellings.

DISCONNECTING MEANS

- Indicate on the plan compliance with CPAU Electrical Engineering's ac disconnect requirement. An ac disconnect shall be located within 10 feet of the main electrical service panel and be readily accessible with visible-blades, lockable, and labeled.
- The City of Palo Alto requires separate ac/dc disconnects located within sight and not less than 25' from each inverter.
- NOTE: Per CPAU Electrical Engineering and WGW, equipment shall not be installed in the required working clearances around gas meters. (See document ([SR-CN-0-1009](#))).

MARKING AND LABELS

- Follow the matrix found in the "Photovoltaic – Residential" inspection checklist.

RAPID SHUTDOWN

- Clearly show how the project is achieving rapid shutdown.
- Provide testing for micro-inverters.