ALTERNATIVE ENERGY SYSTEMS

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This Standard has been developed pursuant to the California Fire Code as adopted by ordinance No.1203 of the City of Sausalito and No. 2010-11/18 of the Southern Marin Fire Protection District. It is intended that this standard be used as a guide for installation and placement of appurtenances associated with alternative energy systems in order to provide for firefighter safety.

The use of an electrical power supply, including, but not limited to: photovoltaic (PV), wind, and geothermal, other than that provided by the local public utility company or provider, shall be in accordance with this standard and Article 690 of the currently adopted California Electrical Code.

Document Requirements:

1. Four identical sets of plan drawings shall be made and distributed as follows:

a. One set shall be delivered to the fire prevention office of the Southern Marin Fire Protection District.

b. Three sets shall also be submitted to the local planning and building authority having jurisdiction ('AHJ' hereafter) for the project.

c. All agencies must approve the plans before a permit will be issued by the AHJ.

2. All plans shall be drawn on white paper stock, min. of 11" by 17" in size and drawn to scale (min. 1":20', 1":10' preferred for site plans; min. 1/8":1', 1/4":1' preferred for elevations and plan views; min. 1/2":1' for specific details.

3. Each plan ***set*** shall provide general information for the project on the title page including: name, address & phone number of the owner/applicant; address of project; assessor's parcel number; designer of the system; name, address, license number, phone and fax of the licensed contractor or designer; the size of system being installed in kilowatts, the edition of the code(s) used to design the system. Each plan ***sheet*** shall bear the name and address of the project, the assessor's parcel number of the property, the owner's name and address, the designer's name, the plan scale, as required, and the page number.

4. The designer must sign ***each page*** of the ***designed*** plans. If the system requires the design of an electrical engineer and/or structural engineer, all pages of the respectively designed pages of the system shall be wet-stamped and signed by the respective engineer(s).

5. The plan sets shall consist of the following:

a. Site **Plan:** The site plan(s) shall be drawn to conform to the requirements of the local planning and building AHJ. They shall describe the location of the system components where located on the buildings and/or lands of the particular parcel (as identified by address, adjacent street or road, and assessor's parcel number). Setbacks from the property lines to the buildings and/or ground locations on which the system(s) is built shall be shown. Plans for ground mounted systems shall also show the locations of septic systems, streams and other existing natural features, trees to be removed, easements, slides, access road(s) and accessory buildings. The distances between arrays and buildings and other land features as mentioned above, shall be indicated. Accessory buildings proposed to house electrical equipment related to a PV system shall be clearly identified.

b. Elevations**:** Elevations shall be provided for both roof mounted and ground mounted systems. Building elevations drawn to scale are required for all roof mounted arrays. Indicate the array height above the roof plane and grade elevation, the angles of panels and their support members. Ground mounted systems shall show a side elevation of the array height indicating the height as measured from natural or finished grade, whichever is more restrictive (i.e., higher).

c. Building **Plans:** The plan views shall show the layout of the individual panels and indicate the supporting framework. The plan view shall show the location of all components, including combiner boxes, disconnects, inverters, intermediate panels and main electrical panels and building ground. The supporting roof members shall be indicated and calculations shall justify the size and spacing of the members as necessary to support the imposed load. The plans shall detail the connections of the array framework to the roof, including the type of mounting hardware used, bolt lengths and diameters, and the means of waterproofing the roof penetrations. The framework shall be designed to carry all imposed loads, including wind and seismic. Ground mounted arrays shall also show footings and piers and any additional construction. Auxiliary buildings housing associated electrical equipment shall be detailed on the plans. New buildings shall be subject to all planning and building regulations of the local AHJ and may require separate approvals and permits.

d. Electrical **Plans:** All electrical plan views and details shall be drawn using standard electrical design methods, symbols and nomenclature as found in the

currently approved California Electrical Code. The plans shall include the following:

i. An electrical power design compliant with C.E.C. 690, 702 & 705 including, but not limited to, a 125% over-design of all components. A three-line drawing which specifies all equipment and their locations; wire size, length and type; raceway size, length and type; and source, operating current and voltage tables at each point where the values change or are combined.

ii. If conductors are of such a length as to subject them to voltage line drops **then** provide line loss calculations and compensate with appropriate conductor sizes.

iii. The location, name and current capacity of all related disconnects and overcurrent devices.

iv. The location and panel-board size of all existing and/or newly installed electrical service equipment and sub-panels.

v. If a line side tap is necessary **then** use the appropriate tap rule and provide adequately sized conductors and over-current protection (min. 60 Amp).

vi. If the system includes a back-up battery bank and/or a standby generator **then** note the size and capacity of those components and specify the transfer equipment and other related controls and panel-boards. Show also the structural means of supporting the battery bank. (New standby generators and transfer switches shall be subject to the regulations of the local AHJ and may require separate approvals and permits.)

vii. If the building is supplied with additional sources of power (i.e., generators, wind turbines, fuel cell generators, etc,) **then** locate these systems on the appropriate plan pages and show their respective controls, transfer switches and integration into the building power system.

viii. The methods of grounding and the size, length and type of equipment grounding conductors, grounding electrode conductors, existing and new grounding electrodes. The plans shall show a continuous ground path from the individual panels to the electrode(s). A separate electrode is

required at ground mounted arrays for protection from lightning strikes and to meet CEC 250.32.

ix. The manufacturer's specification sheets for all installed equipment, including grounding devices. All components shall be compatible with related equipment and shall be listed and approved for the uses they are intended.

x. A statement specifying the text and location of required signage on electrical equipment both for warning signs and electrical design summaries stating source and operating currents. Locate the signage to be posted at all equipment in compliance with CEC 690.5(c); 690.14(c)2; and 690.51-56.

e. **Hazard Signage Plans:** The plan views of the system should locate the signage provided as required by the Marin County Fire Department, as specified below.

f. Specifications **& Manuals:** The owner shall be provided with all the documentation and training necessary to safely operate and maintain the system.

General Requirements:

1. The electrical service A/C disconnect for the alternative power supply shall be located within 8 feet (measured horizontally) from the P. G. & E. electrical service disconnect on the same or an adjacent exterior wall. The system disconnect shall be accessible to emergency personnel from the exterior without the use of ladders or other special equipment. The main electrical service A/C disconnecting means shall be designed to shut off all power (both solar and P.G. & E.) and effectively isolate the building's electrical system from those sources of power

2. Each disconnect for an array portion shall state the maximum possible kW at which voltage and/or amperage of power generated by that portion of the array.

3. A mechanism shall be provided to allow safe installation or servicing of portions of the PV array or the entire array (California Electrical Code, Article 690.18). The systems must be capable of being electrically isolated, i.e. "disabled," to allow safe access to the photovoltaic system.

4. A durable and permanent sign shall be located directly below the alternative power supply disconnect stating "Alternative Power Disconnect". The sign shall be red with white lettering and shall have minimum 40 point font letters.

5. All wiring that may contain electrical potential when the alternate service disconnect has been activated, (such as the wiring between the solar arrays and the DC electrical disconnect on a photovoltaic system) shall be completely contained in metal conduit.(C.E.C. 690.31(E))

6. The electrical conduit from the array to the disconnect/inverter shall be surface mounted.

    a. Exception: If an array disconnect is installed on the roof (subject to approval by the Fire Official) mounted directly adjacent to the array, and appropriately marked, the electrical conduit is not required to be surface mounted.

7. The alternate energy supply system construction and materials shall be of equal or greater fire resistive and class rating as required for roofs and walls.

8. Solar Panels shall not be placed on roof locations that will impede fire service emergency operations including but not limited to: laddering; access to chimney outlets; and vertical venting operations (see reference, below).

Location of Conductors

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 designed such 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 are to be located such that conduit runs are minimized in the pathways between the arrays.

To limit the hazard of cutting live conduit in venting operations, DC wiring shall be run in metallic conduit or raceways when located within the enclosed spaces in a building (required by CEC 690.31(E) and shall be run, to the maximum extent possible, along the bottom of load-bearing members.

Ground Mounted Photovoltaic Arrays

Building setback requirements do not apply to ground-mounted, free standing photovoltaic arrays. A clear brush area of 10' is required for ground mounted photovoltaic arrays.

Protection of Emergency Responders

The following conditions shall be verified and apply to all roof and ground mount solar PV systems:

1. All sharp edges and fastener tips shall be covered or crimped over to eliminate sharp edges. This will minimize the risk of injury to emergency responders (or any other individual accessing the roof top).

2. All roof surface mounted conduits, pipes, braces, etc crossing the pathways are to be clearly identifies by a red/white reflective tape, or other approved identifying material.

Access Requirements and Array Configurations

All arrays shall be mounted per the listing installation instructions of the system.
Pathways should be established in the design of the solar installation and clearly indicated on the plans. Any modifications to access pathways require approval of the Fire Official. Arrays should be located in a manner that provided access pathways for the following conditions:

1) **Residential Buildings with hip roof layouts.**
   Modules should be located in a manner that provided on three-foot (3') 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).

2) **Residential Buildings with a single roof ridge (Gable Roof).**
   Modules shall be located in a manner that provides two three-foot (3') wide access pathways from the eave the ridge on each roof slope where arrays are located.

3) **Hips and Valleys**
   Modules should be located no closer than one and one half feet (1 ½') to a hip of valley if the 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 the modules may be placed directly adjacent to the hip or valley. Designation of ridge, hip, and valley does not apply to roofs with 2 in 12 or less pitch. Arrays should be located no higher than two feet (2') below the ridge.

4) Commercial Buildings and Residential Housing comprised of three (3) or more units

Exception: When the jurisdiction determines that the roof configuration is similar to residential (such as in the case of townhouse, condominiums, or single family dwellings) the residential requirements may be applied.
Access: There shall be a minimum of four-foot (4') wide clear perimeter around the edges of the roof. Pathways should be established in the design of solar installation. Pathways should meet the following requirements:

a) Shall be over structural members
b) Center line axis pathways shall be provided in both axis of the roof. Center line axis pathways shall run on structural members or over the next closest structural member nearest to the centerline of the roof.
c) Shall be straight line not less than four feet (4') clear to skylights and/or ventilations hatches.
d) Shall be straight line not less than four feet (4') clear to roof standpipes.
e) Shall provide not less than four feet (4') clear around roof access hatch with at least one (1'), but not less than four feet (4') clear pathway to parapet or roof edge.

Non-Habitable Structures

Non-habitable structures are not subject to the requirements in this section.
Examples of non-habitable structures include, but are not limited to: parking shade structures, solar trellises, etc.

Signage Requirements for PV Systems

Three forms of signage are required for Solar PV Systems. Permanently affixed labels shall have a red background with white lettering. Printed material shall be resistant to fading per UL 969. Use UL969 as standard to weather rating (UL listing of markings is not required).

1) **Exterior/interior Conduit signage:** The label shall state, "CAUTION: SOLAR SYSTEM CIRCUIT"
   - **a.** Required "shut off" warning markings are required on all interior and exterior DC conduit, raceways, enclosures, cable assemblies, and junction boxes to alert the fire service to avoid cutting them.
   - **b.** Marking shall be placed every 10 feet, at turns and above and/or below penetrations and at all DC combiner and junction boxes.
   - **c.** Vertical conduits shall be provided with a minimum of one label to be affixed 66" above clear standing surface.
   - **d.** Exterior/interior conduit signage shall be:
     - **i.** Red background with white lettering.
     - **ii.** Reflective, weather resistant printed material shall be resistant to fading per UL 969.
     - **iii.** Letters shall be "Arial" font or similar, non-bold, a minimum of 3/8" height lettering, and be all capital letters.

2) **Exterior/Interior Electrical Panel signage:** Exterior/Interior of Electrical Panel signage: Signs are required on all interior and exterior over-current devices (electrical panels, etc.). (See C.E.C. 690.5 & .14 & .17 & .51-56)
   - **a.** A permanent placard with fade resistant material per UL 969 shall be installed on exterior and interior of main electrical panel stating: "CAUTION: SOLAR ELECTRIC SYSTEM CONNECTED"
   - **b.** Exterior/Interior over-current device signage shall be:
     - **i.** Red background with white lettering
     - **ii.** Of durable non-fading weather resistant material attached or adhered to panel or directly adjacent to panel.
     - **iii.** Letter shall be "Arial" font or similar, non-bold, a minimum of 3/8" height lettering, and be all capital letters.
     - **iv.** Where all terminals of the disconnecting means may be energized in the open position, a warning sign shall be posted, mounted on, or adjacent to the disconnecting means.

WARNING:
ELECTRICAL SHOCK HAZARD.
DO NOT TOUCH TERMINALS. TERMINALS
ON BOTH THE LINE AND LOAD SIDES MAY
BE ENERGIZED IN THE OPEN POSITION

c. Direct Current Photovoltaic Power Source labeled as follows at an accessible location at the disconnecting means:

- **i.** Operating Current
- **ii.** Operating Voltage
- **iii.** Maximum System Voltage
- **iv.** Short-circuit Current

References: Solar Photovoltaic Installation Guideline, Office of the California Sate Fire Marshal, April 22, 2008