



Calistoga Planning & Building Department

1232 Washington Street, Calistoga, CA 94515

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Building Permit Requirements for Solar Energy Systems under 10kW in Single-Family and Duplex Dwellings

This summary is intended to guide applicants through a streamlined permitting process for small residential rooftop solar energy systems that meet all of the following:

- A system that is no larger than 10 kilowatts alternating current nameplate rating or 30 kilowatts.
- A system that conforms to all applicable state fire, structural, electrical, and other building codes as adopted or amended by the City and all state and City health and safety standards.
- A system that is installed on a single-family or duplex dwelling.
- A solar panel or module array that does not exceed the maximum legal building height as defined by the Calistoga Municipal Code.

Permit Requirements

A building permit is required to install a solar energy system.

Submittal Requirements

Submittal of the following items to the Calistoga Building Section is required for installation of a solar energy system. Submittal may be made in person or online at the above addresses.

1. A completed Building Permit application form. This form can be downloaded at www.ci.calistoga.ca.us on the Forms & Handouts page of the Planning & Building Department portion of the web site.
2. Two copies of a completed Standard Electrical Plan, which can be downloaded at the same location as above.

If a standard electrical plan is not appropriate for a particular project, an electrical plan shall be submitted that includes the following:

- Locations of main service or utility disconnect
- Total number of modules, number of modules per string, and the total number of strings
- Make and model of inverter(s) and/or combiner box if used
- One-line diagram of system
- Specify grounding/bonding, conductor type and size, conduit type and size, and number of conductors in each section of conduit

- If batteries are to be installed, include them in the diagram and show their locations and venting
 - Equipment cut sheets including inverters, modules, AC and DC disconnects, combiners, and wind generators
 - Labeling of equipment as required by CEC, Sections 690 and 705
 - Site diagram showing the arrangement of panels on the roof, north arrow, lot dimensions, and the distance to adjacent buildings/structures
3. Demonstrated compliance with structural requirements, if a residence has more than one layer of roofing. The applicant may request a pre-installation inspection by the Building Official to determine if structural calculations per the Building Standards Code are required.

Plan Review

The Building Department will issue a building permit within five business days of determining that an application that meets the submittal requirements as outlined above is complete.

Fees

A \$500 fee is due at the time of building permit issuance. This fee covers City review and inspection costs.

Inspections

Following installation of the solar energy system, it must be inspected by the City before final approval is granted. The inspector will verify that the installation is in conformance with applicable code requirements and with the approved plans.

Inspections can be scheduled by contacting the Building Section via phone or email at least 48 hours prior to the desired inspection date. Note that inspections are conducted on Tuesday, Wednesday and Thursday mornings between 9 and 11 AM. An inspection by the Fire Department is also required and every effort will be made to coordinate the two inspections.

Below are common points of inspection with which the applicant should be prepared to show compliance:

- Number of PV modules and model number matches plans, and specification sheets number matches plans and specification sheets
- Array conductors and components are installed in a neat and workman-like manner.
- PV array is properly grounded
- Electrical boxes are accessible and connections are suitable for environment
- Array is fastened and sealed according to attachment detail
- Conductors ratings and sizes match plans
- Appropriate signs are properly constructed, installed, and displayed, including:
 - Sign identifying PV power source system attributes at DC disconnect
 - Sign identifying AC point of connection

- Sign identifying switch for alternative power system
- Equipment ratings are consistent with application and installed signs on the installation, including:
 - Inverter has a rating as high as max voltage on PV power source sign
 - DC-side overcurrent circuit protection devices (OCPDs) are DC rated at least as high as max voltage on sign
 - Switches and OCPDs are installed according to the manufacturer's specifications (i.e. many
 - 600 VDC switches require passing through the switch poles twice in a specific way)
 - Inverter is rated for the site AC voltage supplied and shown on the AC point of connection sign
 - OCPD connected to the AC output of the inverter is rated at least 125% of maximum current on sign, and is no larger than the maximum OCPD on the inverter listing label
 - Sum of the main OCPD and the inverter OCPD is rated for not more than 120% of the bus bar rating

Contact information

For additional information regarding this permit process, please consult the Planning Building Department website at www.ci.calistoga.ca.us or contact us via phone or email.



Project Address: _____

This is a standard electrical plan for the installation of a solar PV system utilizing 2-wire multiple string central inverters not exceeding a total AC output of 10kW, in single-family and duplex dwellings having a 3-wire electrical service not larger than 225 amps at a voltage of 120/240. This plan covers Crystalline- and Multi-Crystalline-type modules where all the modules are mounted on the roof of the dwelling. This plan addresses only the requirements of the 2010 California Electrical Code (CEC).¹

DC WIRING INFORMATION

1. Total number of solar modules being installed: _____	
2. Number of modules per string: _____	3. Total strings: _____
4. Are any strings wired in parallel? _____ Yes _____ No If "Yes", how many are paralleled together? _____ Two _____ Other (specify) _____	
5. Module Voc (from module nameplate): _____	
6. Module Isc (from module nameplate): _____	
7. Maximum DC system voltage _____ X _____ = _____ volts <i>max. no. of modules/string</i> <i>Voc</i>	
8. Maximum DC current per string: _____ X 1.56 = _____ maximum amps carried by conductor <i>module Isc</i>	
9. Source circuit conductor size: # _____ AWG	
10. Is a combiner box with fuses going to be installed? _____ Yes _____ No Size of output circuit conductors from combiner to inverter _____ X _____ = _____ amps Output circuit conductor size: # _____ AWG <i>no. of strings</i> <i>max. amps</i>	
11. Module maximum fuse or circuit breaker size (from module nameplate): _____ Size installed: _____	

AC WIRING INFORMATION

12. Inverter: Make _____ Model # _____ Elec. rating _____ kW	
13. Maximum AC output current _____ X 1.25 = _____ total amps	
14. a. Rated maximum power-point current (mppA) _____ X _____ = _____ amps <i>I_{max} value from module nameplate</i> <i>no. of strings</i>	
b. Rated maximum power-point voltage _____ X _____ = _____ volts <i>V_{max} value from module nameplate</i> <i>no. of modules in largest string</i>	
c. Short circuit current of the PV System _____ X 1.25 = _____ amps <i>module Isc</i>	
15. Does the roof have a single roof covering? _____ Yes _____ No <i>If No, submit plan from structural engineer</i>	

¹ NOTE: This plan is intended for use with standard DC to AC inverters containing an isolation transformer. This plan is NOT intended to be used with micro inverters or transformer-less inverters and is limited to installations where the DC system voltage does not exceed 600 volts. This plan is not intended for systems containing batteries or power optimizer.



SOLAR PV STANDARD ELECTRICAL PLAN

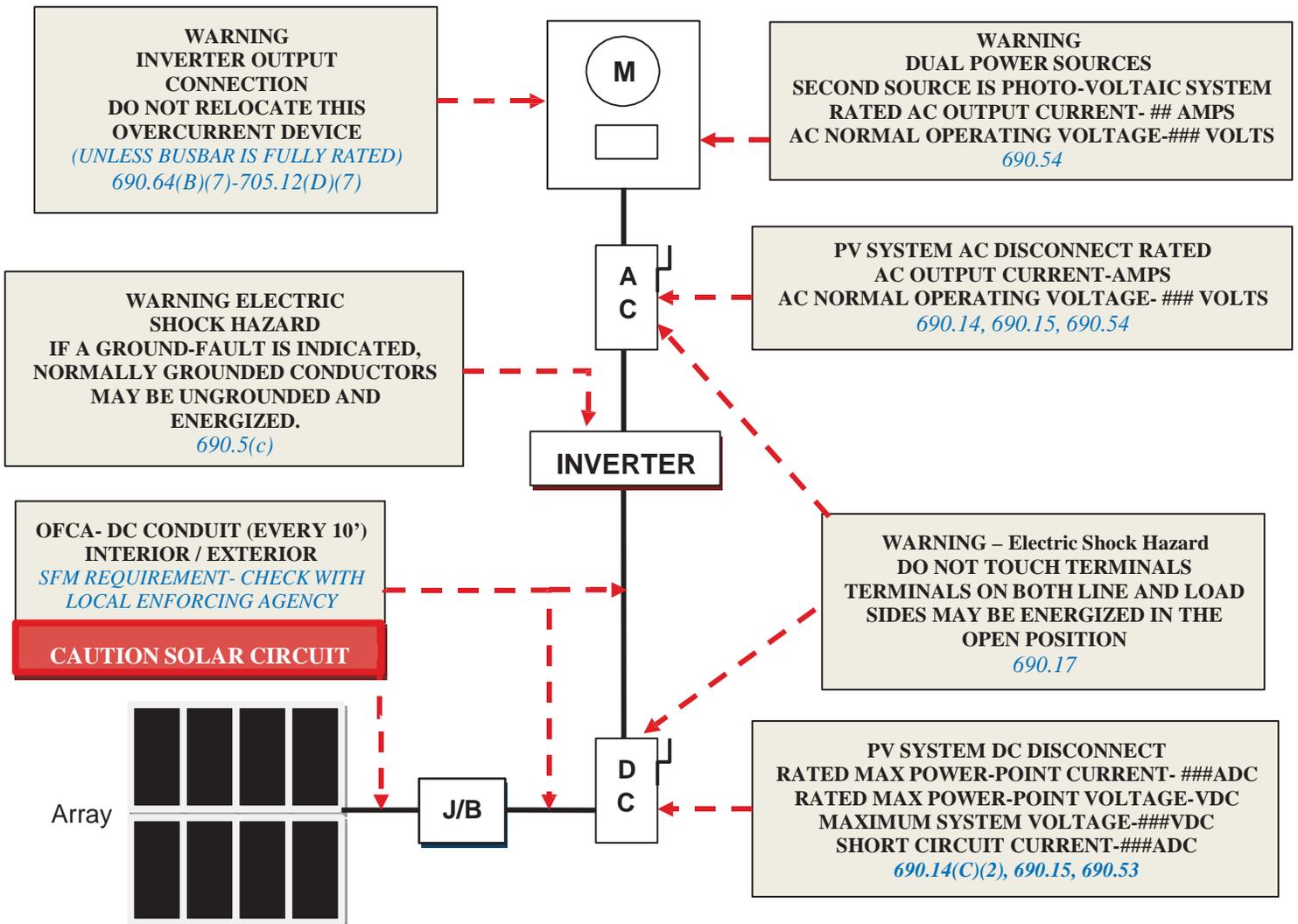
Central Inverter Systems for Single-Family and Duplex Dwellings

Required Signage

1. Per 2010 CEC Section 690.17, where both the line and load side terminals of any disconnect may be live in the "OFF" position, the following warning shall be placed on the front of the disconnect:

"WARNING LINE AND LOAD TERMINALS MAY BE ENERGIZED IN THE OPEN POSITION".

2. Install following signage. Note: Italicized text shown inside the boxes is not required; it is only for reference.



Project Address: _____



SOLAR PV STANDARD PLAN

Central Inverter Systems for Single Family Dwellings

TAG	DESCRIPTION
1	SOLAR PV MODULE
2	DC PV SOURCE CIRCUIT
3	COMBINER BOX (if installed), refer to item 14 on page 3
4	DC PV OUTPUT CIRCUIT
5	DC EQUIPMENT GROUNDING CONDUCTOR per 690.43 NEC
6	INVERTER DC DISCONNECT
7	DC TO AC INVERTER WITH ISOLATION TRANSFORMER
8	GROUND FAULT DETECTION INTERRUPTER
9	AC DISCONNECT
10	SOLAR LOAD CENTER (If installed)
11	UTILITY PERFORMANCE METER (If installed)
12	UTILITY SAFETY SWITCH (If installed)
13	INVERTER DC GROUNDING ELECTRODE CONDUCTOR (MIN #8 AWG COPPER)
14	ELECTRICAL SERVICE PANEL

**STANDARD PV PLAN FOR SINGLE FAMILY DWELLING
CENTRAL INVERTER**

**MAXIMUM 10 KW
MAXIMUM 225 AMP SERVICE**

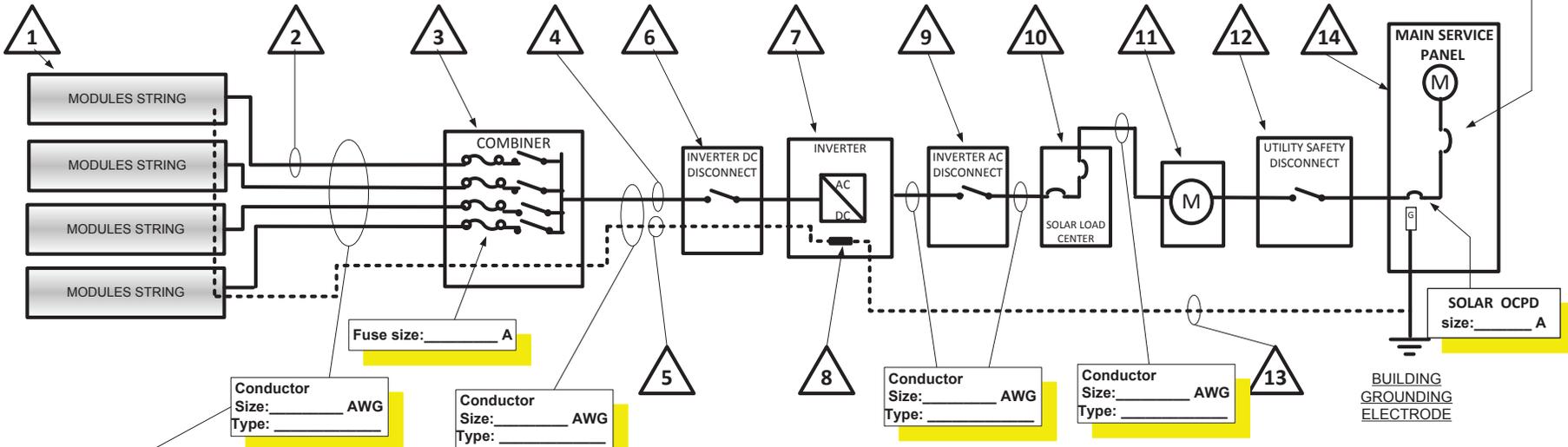
THIS PLAN MUST BE PROVIDED TO THE FIELD INSPECTOR

MAIN BREAKER / FUSE Size: _____ A

SOLAR BREAKER/ FUSE Size: _____ A

MAIN PANEL BUS Size: _____ A

MAIN OVERCURRENT PROTECTIVE DEVICE size: _____ A



Provide required information in these boxes

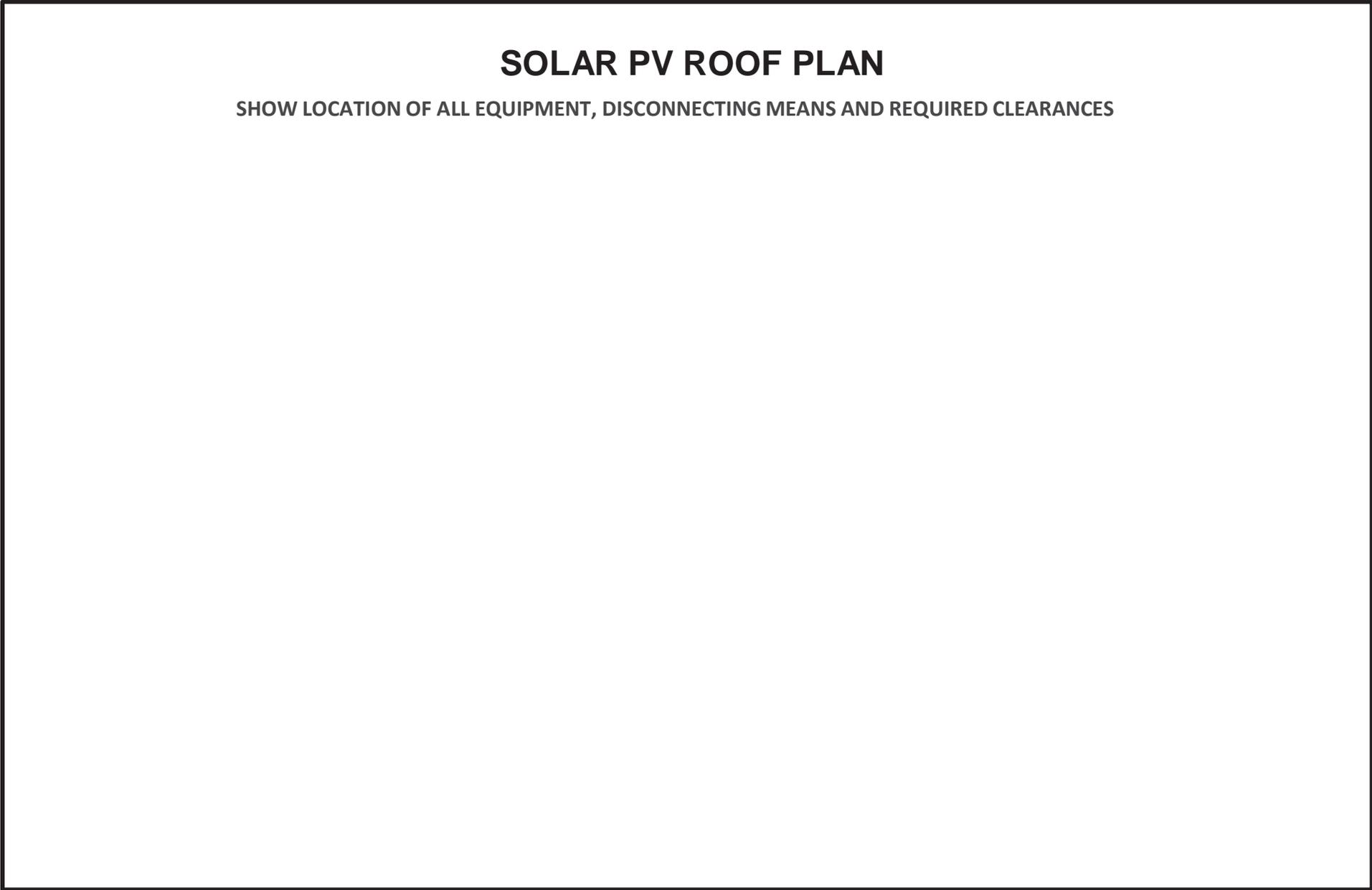
Note: This plan is **Not** intended to be used with micro inverters or transformer-less inverters. Permitted DC conductor types are USE-2, PV Wire or equivalent listed cables. Conductors for DC and AC circuits, where installed in raceways outdoors, shall be "W" rated and have an insulation rating of 90 degrees Centigrade.

Project Address: _____

Permit Number: _____

SOLAR PV ROOF PLAN

SHOW LOCATION OF ALL EQUIPMENT, DISCONNECTING MEANS AND REQUIRED CLEARANCES



Project Address: _____



SOLAR PV STANDARD ELECTRICAL PLAN

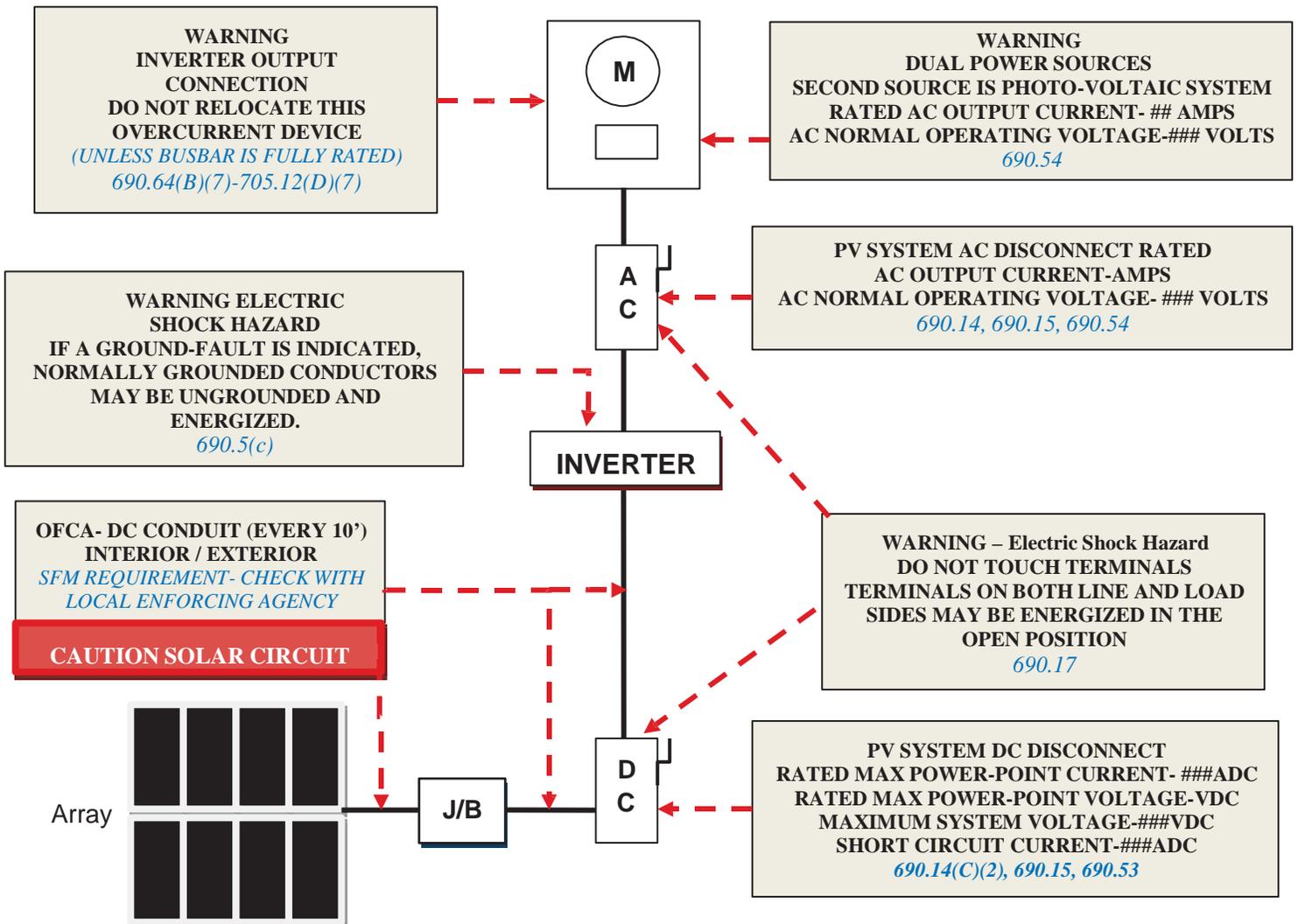
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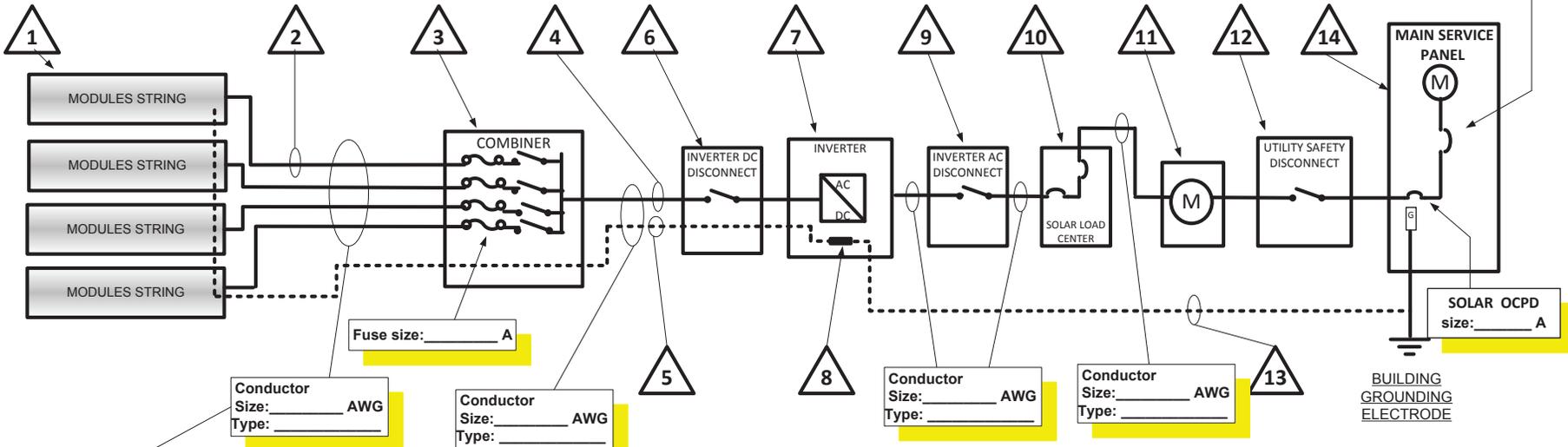
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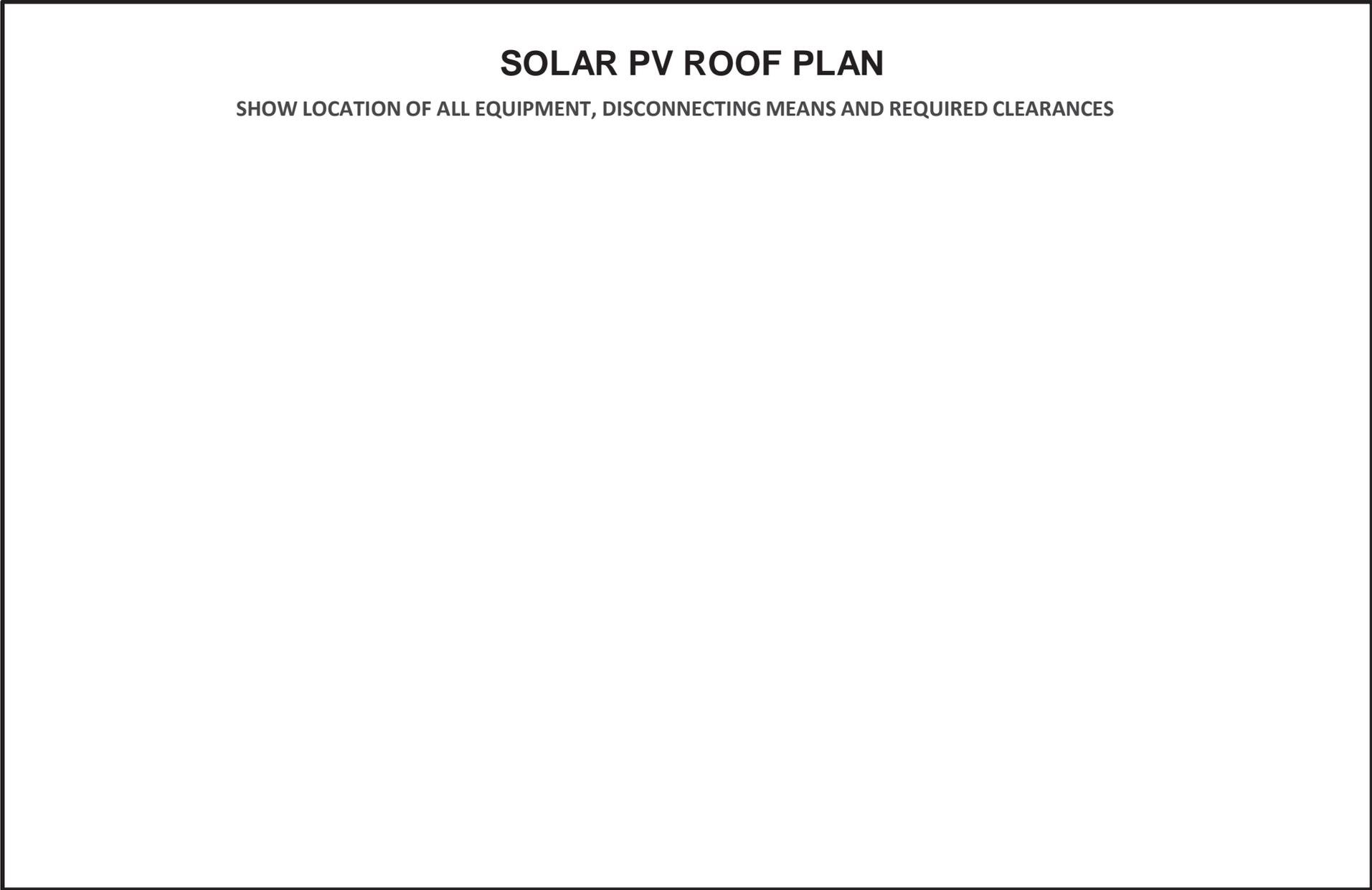
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SHOW LOCATION OF ALL EQUIPMENT, DISCONNECTING MEANS AND REQUIRED CLEARANCES



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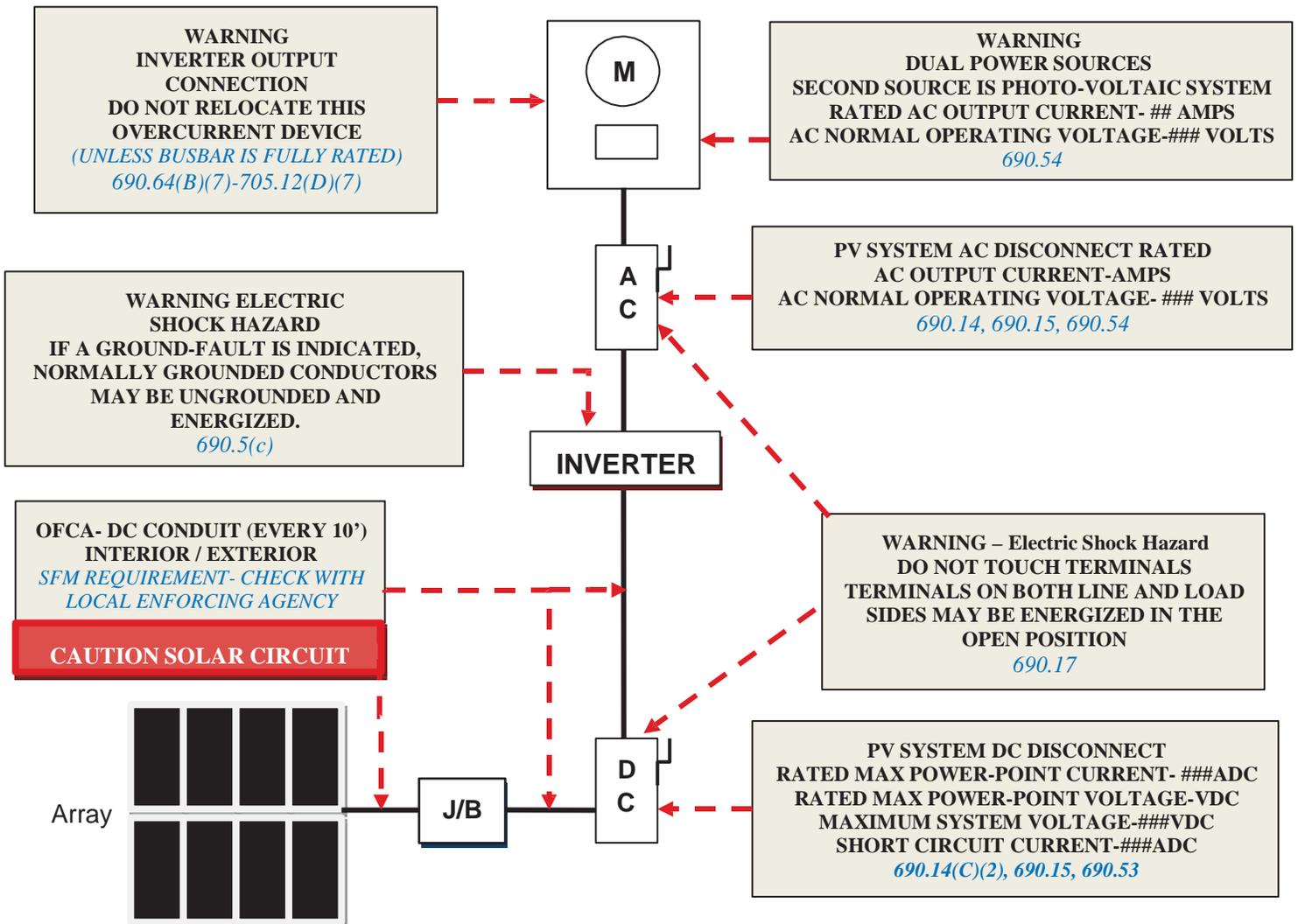
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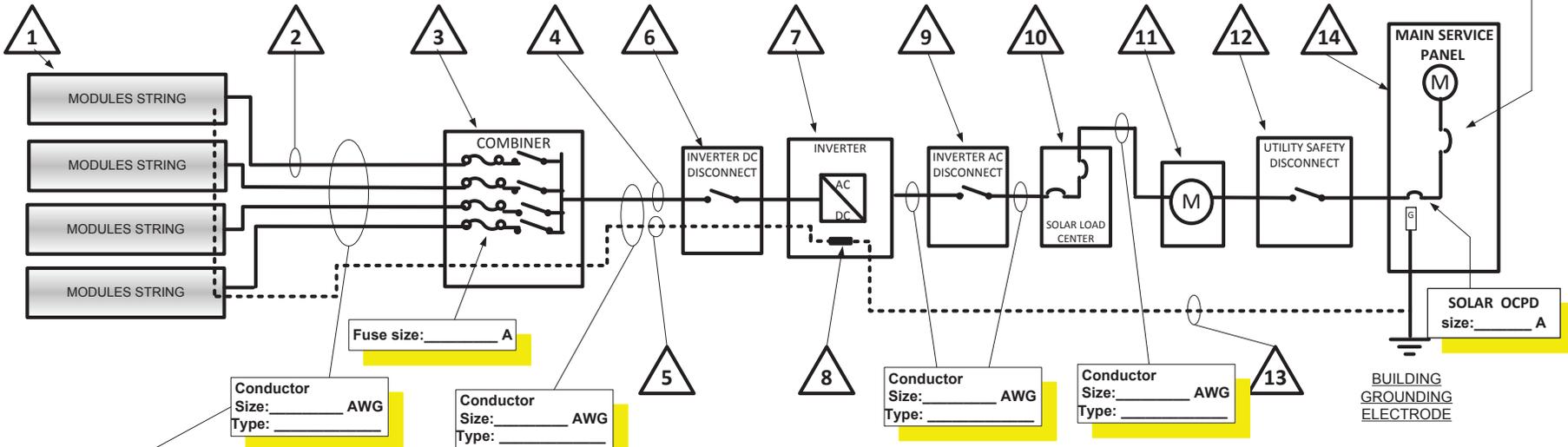
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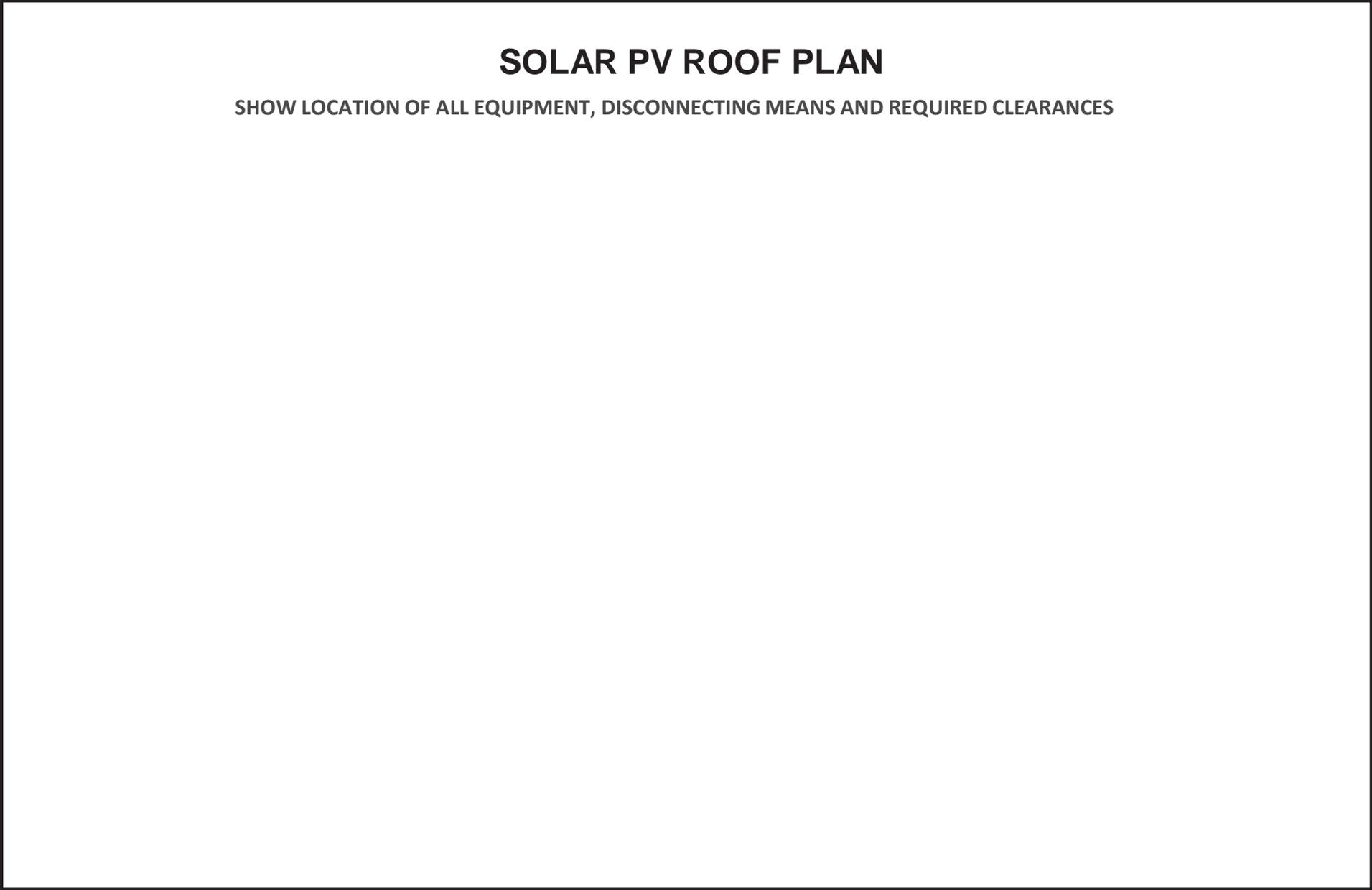
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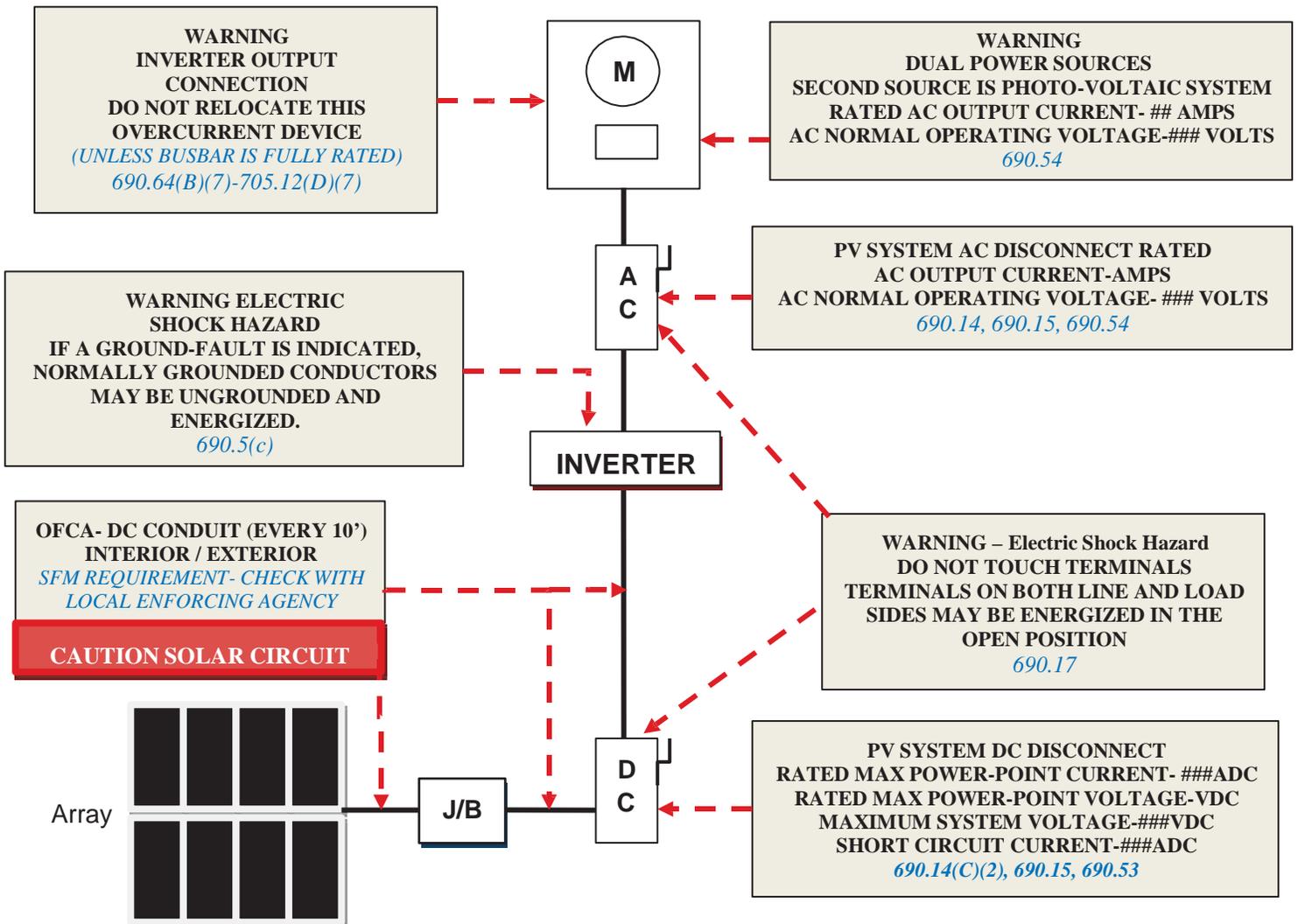
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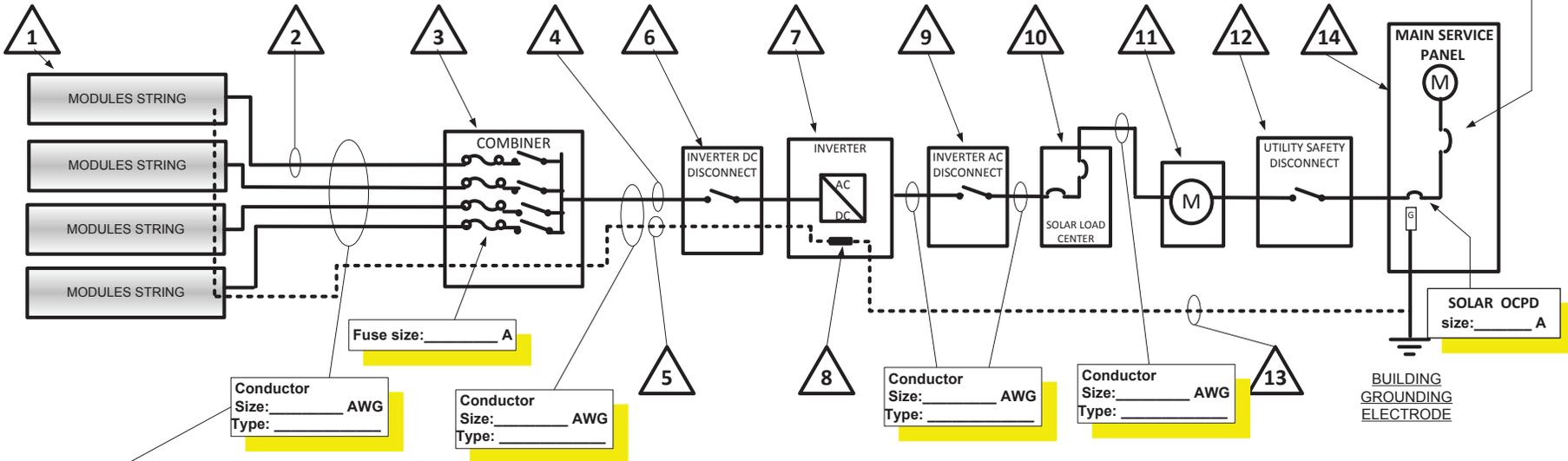
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SOLAR PV STANDARD ELECTRICAL PLAN

Central Inverter Systems for Single-Family and Duplex Dwellings

Further Information on Standard Electrical Plan Items

8. This formula is intended to provide a close approximation of the maximum DC system voltage possible at the job location under the lowest ambient temperature condition. This result will always be slightly higher than when using the module manufacturer supplied temperature coefficient. The intent is to alert the installer that the 600 volt limit is close to being exceeded and is not intended to provide as accurate a result as the calculation employing the manufacturer-supplied coefficient. Where the installer chooses to use the manufacturer-supplied coefficient, approval by the City is required. The maximum DC system voltage shall not exceed the inverter maximum DC input voltage or 600 volts.
9. Where Type USE-2 or other listed PV conductors are run in free air from the module locations to a junction box or combiner box, the minimum size permitted shall be #12 AWG per the module manufacturers' installation instructions and the conductor material shall be copper.

If any part of the wiring from the modules to the combiner box or inverter is to be installed in a raceway, reductions in the amount of current the conductors can carry may have to be made. Conductors to be installed in a raceway shall be Type THWN-2 or equivalent and the conductor material shall be copper. Note: USE-2 shall not be used for interior wiring.

To select the correct conductor size for the PV source circuits from the modules to the combiner box or to the inverter, use Table A below. Select how many conductors you will have in the raceway and how high above the roof surface the raceway will be mounted. Select the number from the column in the table that matches the result you entered in item #8. (The number in Table A may be the same or larger than the number in item #8, but it shall not be less). Move to the top of the column to see the minimum size conductor needed for this part of the installation.

Table A

Maximum Allowable Ampacity of Conductors
Installed in a Circular Raceway, Exposed to Sunlight, On or Above Rooftops

No. of current-carrying conductors in raceway	Height above rooftop	Highest ambient temperature: 40°C to 45°C				
		Minimum Conductor Size				
		12 AWG	10 AWG	8 AWG	6 AWG	4 AWG
Up to 3 conductors	0 to 0.5"	12	16	23	31	39
	above 0.5" to 3.5"	17	23	32	44	55
	above 3.5" to 12"	17	23	32	44	55
	above 12"	20	28	39	53	67

No. of current-carrying conductors in raceway	Height above rooftop	Highest ambient temperature: 40°C to 45°C				
		Minimum Conductor Size				
		12 AWG	10 AWG	8 AWG	6 AWG	4 AWG
4 to 6 conductors	0 to 0.5"	10	13	18	25	31
	above 0.5" to 3.5"	14	19	26	35	44
	above 3.5" to 12"	14	19	26	35	44
	above 12"	17	23	31	43	54
7 to 9 conductors	0 to 0.5"	9	11	16	22	27
	above 0.5" to 3.5"	12	16	22	30	39
	above 3.5" to 12"	12	16	22	30	39
10 to 20 conductors	above 12"	15	20	27	37	47
	0 to 0.5"	6	8	11	15	19
	above 0.5" to 3.5"	9	12	16	22	28
	above 3.5" to 12"	9	12	16	22	28
	above 12"	11	14	20	27	34

10. If a combiner box is to be installed to connect the string circuits together, then the size of the "Output circuit" conductors from the combiner to the inverter must be determined. To do this, multiply the number of strings that are to be combined (from item #3) with the "Max amps" (from item #8). Using Table A, repeat the process used to select the conductor size for the source circuits.
11. Where a combiner box is installed, or where more than two strings of modules are electrically connected together in "parallel", each individual string shall be protected by its own over current protection or feeders to be sized for sum of all short circuit current of all strings. The fuse or breaker shall be listed as being suitable for use in a DC circuit and shall meet or exceed the maximum voltage of the circuit. The rating of the fuse or circuit breaker shall not be larger than the maximum size specified on the lowest rated module in the string. All combiner boxes shall be listed by a recognized listing agency and labeled as such.

Note: Where the module specifies "Max fuse size" a circuit breaker shall not be substituted. Where the module specifies "Max overcurrent protective device" (Max OCPD), then either a fuse or DC rated circuit breaker may be used.

Note: DC wiring can only be run inside of the house if it is installed in a listed metallic raceway or enclosure.
12. The inverter shall be listed and labeled by a recognized testing agency and be identified as "Utility interactive". Ground fault protection (GFP) shall comply with the California Electric Code.
13. Each inverter shall be protected by an overcurrent device on the AC output side of the inverter. This can be a fuse or a circuit breaker. To correctly size the overcurrent device, locate the maximum AC output of the inverter (in amps) on the inverter nameplate, and multiply by 1.25 (This is required because the unit will continuous use

for more than three hours). Where the “Maximum AC output” is shown only in Watts, divide that number by 240 and then multiply by 1.25 to get the correct size breaker or fuse.

If the maximum AC output is between standard breaker or fuse sizes, the next higher size can be used so long as the inverter output conductors are sized sufficiently large enough for the amount of current produced by the inverter.

Important note: Where a fused disconnect switch is installed, the output conductors from the inverter will connect to the “LOAD” side (bottom) terminals of the switch and the wiring from the utility will connect to the “LINE” side (top) terminals. This meets the requirement of Section 404.6(C) and will reduce the risk of electrical shock hazards when changing a fuse with the system still energized by the utility electrical supply.

General Notes

Grounding the DC side of the inverter

A minimum #8 copper Grounding Electrode conductor must be run un-spliced from the factory identified system grounding terminal of the inverter to the grounding electrode system of the house. The grounding electrode system may consist of one or more of the following: Ground rod(s), Ufer ground, or metallic water pipe with a minimum of 10 feet in the ground.

Disconnect switches

Where disconnect switches (with or without fuses) are installed in the circuit from the inverter output terminals to the house electrical panel, the wiring originating at the inverter(s) shall always connect to the “LOAD” side terminals of ANY disconnect that has been installed.

Breakers

The connection to the breaker panel shall be through a dedicated circuit breaker that connects to the panel bus bars in an approved manner. “Load side taps” where the inverter AC wiring does not terminate using a dedicated breaker or set of fuses are prohibited under ANY condition.

The sum of all overcurrent protective devices supplying power to the busbar or conductor shall not exceed 120% of their rating. In most PV installations, the breakers feeding the busbar are the main breaker and the backfed PV breaker. To utilize the 120% rule, the PV backfed breaker must be at the opposite end of the main breaker location. For a 100 amp-rated bus, this means that the main breaker and the PV backfed breaker shall not add up to more than 120 amps. For a 200 amp-rated bus, the combined ampacity of the two breakers (the main breaker and the PV breaker) shall not exceed 240 amps and so on. The location of the PV backfed breaker must be identified with the following wording: “WARNING: INVERTER OUTPUT CONNECTION. DO NOT RELOCATE THE OVERCURRENT DEVICE.”

Where it is not possible to locate the breakers at opposite ends of the panel bus, the sum of the two breakers is not permitted to exceed 100% of the bus rating.

Note: In some cases it may be possible to reduce the size of the main circuit breaker to accommodate the addition of a PV breaker and still not exceed the bus bar rating. This requires that a “load calculation” of the house electrical power consumption be made in order to see if this is an acceptable solution.

DC power source label

A permanent label for the DC power source shall be installed at the PV DC disconnecting means. This label shall show the following:

- (a) Rated maximum power-point current (the actual current in amps produced by the PV system)
- (b) Rated maximum power-point voltage (the highest operating voltage of the PV system)
- (c) Maximum system voltage (from Step 7)
- (d) Short circuit current of the PV system.

Note: A phenolic plaque with contrasting colors between the text and background would meet the intent of the code for permanency. No type size is specified, but 20 point (3/8”) should be considered the minimum.