



Development Services Department
Building Inspection Division
311 Vernon Street
Roseville, California 95678-2649
(916) 774-5332 • Fax (916) 774-5394

RESIDENTIAL PHOTOVOLTAIC (PV) PACKET

ALL PV Project Applicants:

The Roseville Municipal Code and Roseville Electric require all PV systems to comply with the requirements of:

- City of Roseville Permit – **PERMIT SUBMITTAL REQUIRED**
- Roseville Electric Residential Renewable Energy Program – **SYSTEM INTERCONNECTION APPLICATION REQUIRED**
<http://roseville.ca.us/electric/home/rebates/solar.asp>
- Design & Construction to comply with Roseville Electric 'Specifications for Residential Construction' Section 8.2 (and) Rule 21-(both located in above link).

Net-metering upgrade charges will apply.

Systems may not offset more than 100% of the customer's historical annual load.

Contents of Packet:

- Photovoltaic Checklist (2 pages – complete and submit with permit)
- Sample One-Line Diagram for PV System
- Sample Site Diagram
- Solar Panel Dead Weight Loading Calculation (complete and submit with permit)
- Verification of Wire Size for PV system Calculation form (complete and submit with permit)
- CEC Table 310.15(B)(16) (included for reference)
- Roseville Electric Solar Signage Requirements (3 pages)
- PV Roof Clearance drawing

If you have any questions regarding your PV system permit, please call the building department at (916) 774-5332.

If you have any questions regarding the Roseville Electric Residential Renewable Energy program, please call Roseville Electric at (916) 79-POWER.



Residential Photovoltaic Checklist

Based on the 2016 California Residential Code (CRC) and the 2016 California Electrical Code (CEC) Article 690, Roseville Electric, and Roseville Fire Departments

Residential PV system shall be installed in accordance with the current adopted edition of the (CRC) and CEC Article 690 and any other applicable articles or codes adopted by the jurisdiction.

Simple plot plan showing:

- Lot lines
Structure locations
Main service panel location
PV module array configuration shown on a roof layout (or lot if ground mounted system)
% of coverage of roof area (If more than 50% a review by the fire department is required)
Distance from ridge to array(s) - (minimum of 3' required by CRC)
Distance from valley/ hip to array(s) - (minimum of 1.5' by CRC)
PV equipment locations, Solar arrays, DC combiner boxes, conduit and conductor location, Inverter, AC combiner box.

Roof Information (for roof mounted systems):

- Type of roof structure and slope. If rafters, provide size and spacing of existing roof framing members.
Existing roofing material

PV Equipment Manufacturer's Specifications: Provide cut sheets on all components including but not limited to those shown below; including make, model, listing, size, weight, etc. Highlight project specific information on the cut sheets.

- PV modules UL 1703 listed (R907.5)
Inverter with GFCI & AFCI protection
Mounting System (if using substitution parts to any listed/certified system, or mixing components of different mounting systems, additional engineering shall be required addressing the withdrawal and lateral capacities).
Disconnects
Combiner Box (if used) AC and DC Combiner boxes.

Inverter:

- Model number
Integrated disconnect – Equipped with rapid shutdown.
Roseville Electric requires a visible external A/C disconnect within 5' of the main service panel.

Mounting System for Panel Installation: Highlight project specific information on the cut sheets

- Indicate the style, diameter, length of embedment of bolts into framing members and location of attachments.
Indicate number of bolts per panel.
Provide mounting details and certified engineering or listed mounting installation.
Complete "Solar Panel Dead Weight Loading Calculation" form.
If ground mounted, provide details for the foundation.

Photovoltaic Modules:

- _____ Open-circuit voltage (Voc) from listed cut sheet
- _____ Maximum system voltage from listed cut sheet
- _____ Short-circuit current (Isc) from listed cut sheet
- _____ Maximum fuse rating from listed cut sheet
- _____ Maximum power- panel wattage from listed cut sheet

Electrical Schematic:

- _____ System inter-tie with utility company or stand alone
- _____ Indicate the system KW rating
- _____ Indicate if the system has battery backup
- _____ Single line drawing of electrical installation which includes:
 - _____ Array
 - _____ PV power source short circuit rating
 - _____ Conductor size and type
 - _____ Conductor locations and runs
 - _____ Equipment bonding points and sizes – Per *CEC 250.122
 - _____ Inverter location
 - _____ AC & DC disconnect locations – Per *CEC 690.13 & Roseville Electric
 - _____ Batteries; number, size and locations (if applicable)
 - _____ Point of connect to existing main electrical service panel
 - _____ Size and number of electrical service meters – Per *CEC 705.12 (D)(2) exception
 - _____ Location of required signage (Per Roseville Electric specifications)
 - _____ Complete attached 'verification of wire sizes' sheet
 - _____ Provide Rapid Shutdown of PV per 690.12

Proper Signage and Labeling: Signage required per Roseville Electric handout (see attached)

Indicate system type below and show location of each required sign on one line diagram (see electrical):

- SINGLE PV ARRAY SYSTEM**
- PV ARRAY SYSTEM W/ BATTERY BACKUP**
- MULTIPLE PV ARRAY SYSTEMS**

Please contact City of Roseville for current fees.

***CEC 690.17 - Switch or Circuit Breaker.** The disconnecting means for ungrounded conductors shall consist of a manually operable switch (es) or circuit breaker(s) complying with all of the following requirements:

- (1) Located where readily accessible
- (2) Externally operable without exposing the operator to contact with live parts
- (3) Plainly indicating whether in the open or closed position
- (4) Having an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment.

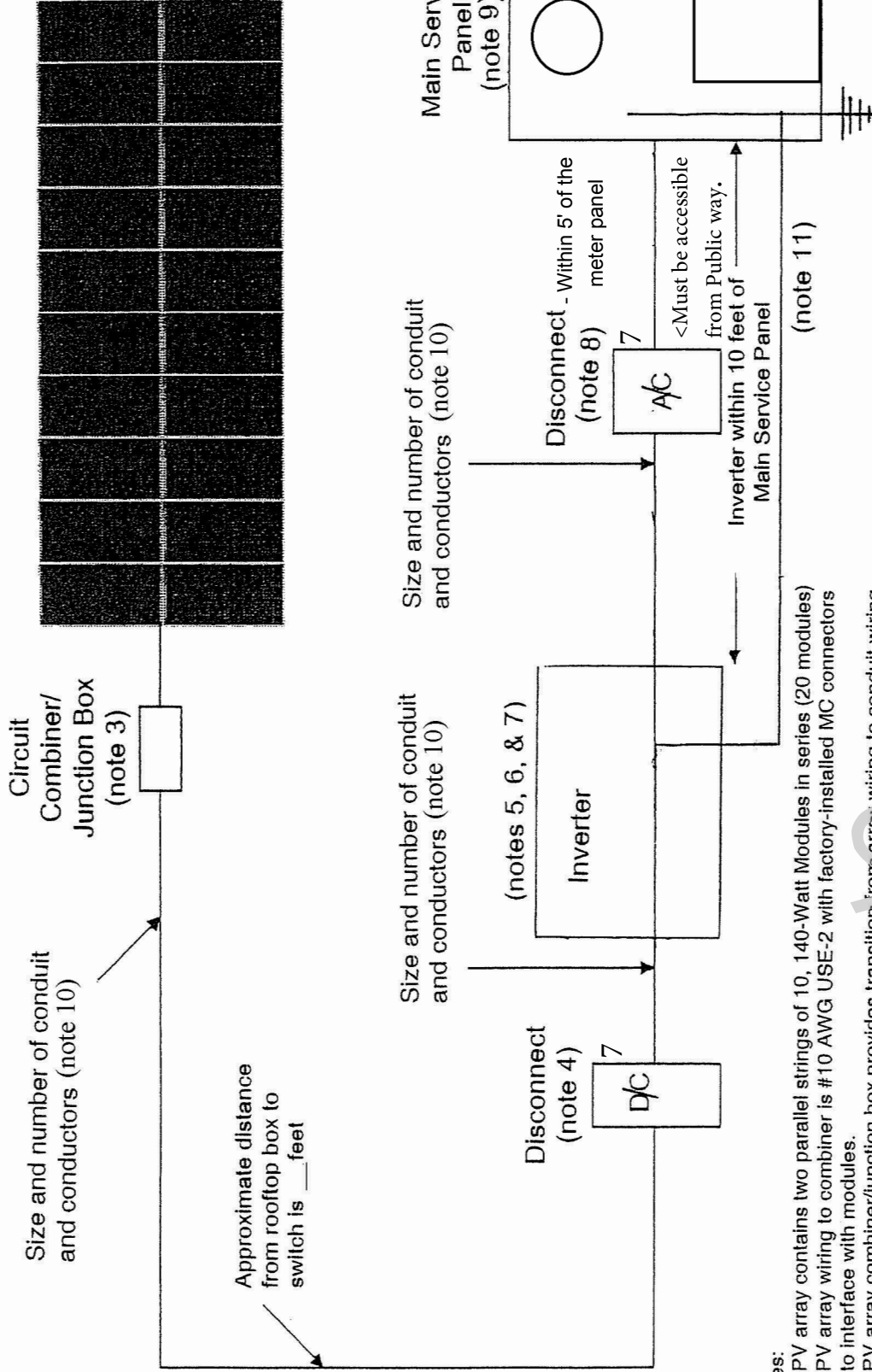
***CEC 250.122 – Size of Equipment Grounding Conductors.** Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122 but shall not be required to be larger than the circuit conductors supplying the equipment.

***CEC 690.46 – Grounding for AC/DC Systems. #6,** in conduit or protected from damage

***CEC 690.13 (E) – Grouping.** The photovoltaic system disconnecting means shall be grouped with other disconnecting means for the system to comply with 690.14(C)(4). A Photovoltaic disconnecting means shall not be required at the photovoltaic module or array location.

***CEC 705.12 (D)(2)exception - Load Side.** A photovoltaic power source shall be permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment on the premises, provided that (exception) the sum of the ampere ratings of the overcurrent devices shall not exceed 120% of the rating of the busbar or conductor.

PV Array -- (notes 1&2)



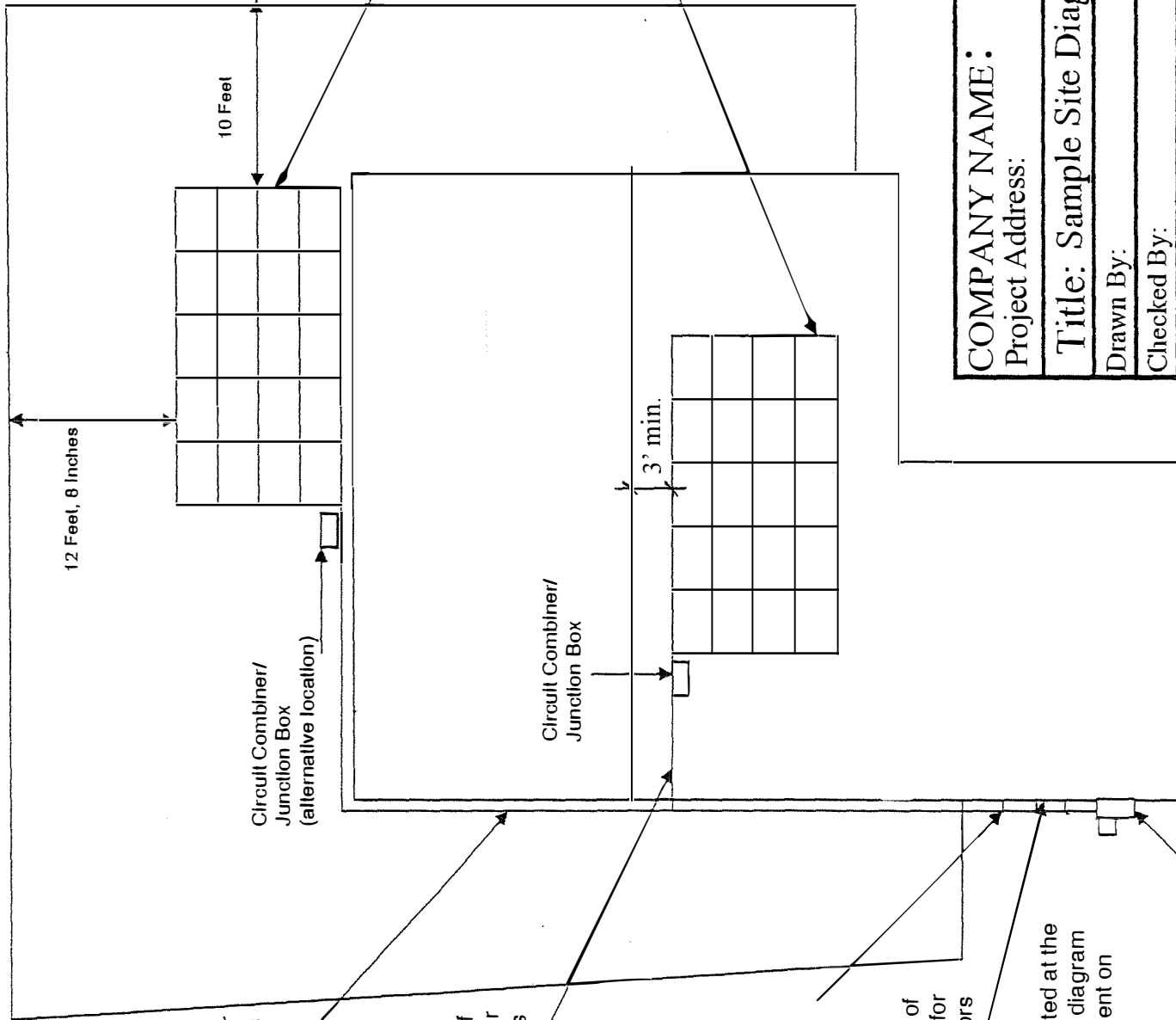
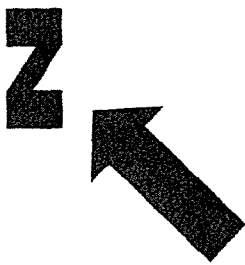
Size and number of conduit and conductors (note 10)

Size and number of conduit and conductors (note 10)

Notes:

1. PV array contains two parallel strings of 10, 140-Watt Modules in series (20 modules)
2. PV array wiring to combiner is #10 AWG USE-2 with factory-installed MC connectors to interface with modules.
3. PV array combiner/junction box provides transition from array wiring to conduit wiring rainproof.
4. PV power source disconnect (unfused) rated at 30-amps, 600 Vdc, NEMA 3R
5. Ground Fault Protection provided in Inverter.
6. Inverter is SB2500UL model rated at 2.5 kW AC output and is rated to provide 10.4 amps at 240-Volts at 40 C.
7. Inverter is Listed to UL-1741 "Utility-Interactive"
8. Inverter output disconnect rated at 30-amps, 240Vac, NEMA 3R (Req. by Roseville Electric)
9. 100-Amp Main Service Panel with 15-Amp Two-Pole circuit breaker for point of connection (not to exceed 120% of busbar rating - CEC 690.64 (B) (2) exp)
10. Equipment grounding conductors on AC and DC side sized according to CEC 250.122.
11. Negative pole of PV array referenced to ground at the Inverter.
12. All plan pages shall be sighted by the party responsible for the design.

COMPANY NAME:	
Project Address:	
Title: Sample One-Line Diagram for PV System	
Drawn By:	Date:
Checked By:	
Scale: NTS	
Material:	
DWG NO. EX-1	Related Dwgs: EX-2



Size, number, length of Run and attachment for conduit and conductors (alternative location)

Size, number, length of Run and attachment for conduit and conductors

Inverter with DC and AC disconnects

Size, number, length of Run and attachment for conduit and conductors and grounding

If all equipment is not located at the same location, provide a diagram or directory of all equipment on main service.

AC Disconnect within 5' of MSP.

Existing Main Service Panel

Quantity, rating and attachment of module array (alternative location)

Size, number, length of Run and attachment for conduit and conductors

Quantity, rating and attachment of module array on type of roofing House constructed in what year.

Size, number, length of Run and attachment for conduit and conductors

COMPANY NAME:

Project Address:

Title: Sample Site Diagram

Drawn By:

Checked By:

Scale: NTS

Material:

Date:

DWG NO. **EX-2**

Related Drawings: EX-1

SOLAR PANEL DEAD WEIGHT LOADING CALCULATION

System:

Solar panel consists of _____ solar modules

Mounting system has _____ points of connection with the roof

Panel Weight Calculation:

Solar Module Weight = _____ lbs.

Mounting System Weight = _____ lbs.

Total Panel Weight = ((# of modules)x(module wt.))+(mounting system wt. = (x) + = lbs.

Point Load Calculation:

Point Load = $\frac{(\text{total panel wt.})}{(\text{\# of points of connection})}$ = $\frac{\text{}}{\text{}}$ = lbs.

Distributed Load Calculation:

Solar Module Area = $\frac{\text{length" x width"}}{144}$ = $\frac{\text{ x }}{144}$ = ft²

Total Solar Module Area = (# of modules) x (solar mod. area) = x = ft²

Inter-module Spacing = in.

Total Spacing Area = $\frac{(\text{\# spaces bet. modules}) \times (\text{inter-mod spacing}) \times (\text{panel length or width})}{144}$ = $\frac{\text{} \times \text{} \times \text{}}{144}$ = ft²

Total Panel Area = (total solar modular area) + (total spacing area) = + = ft²

Distributed Load = $\frac{(\text{total panel wt.})}{(\text{total panel area})}$ = $\frac{\text{}}{\text{}}$ = lbs./ft²

The point loading and distributed loading should be below building department requirements for structural analysis.

Distributed loading - Max. 5 lbs/ft²

Verification of Wire Sizes for PV System Calculation Form

Checking the wire size from the modules to the inverter (D/C):

Total PV System Rating: = (module wattage off cut sheet)x(# of modules in array) = x = Watts

Max. PV System Voltage: = (Voc(V) off cut sheet) x (# of modules) x CEC factor = x x 1.13 = Volts

Max. Circuit Current: = CEC factor x (total system wattage / total system voltage) = 1.25 x

 = Amps

Using CEC Table 310.15(B)(16): In temperature column copper, 75 ° C, find the amperage allowed, then read over to the size column for the minimum wire size

Min. wire size from Table 310.15(B)(16) #

Checking the wire size from the inverter to the service panel (A/C):

Max Inverter AC Power Output: = (Max AC power output off cut sheet) = Watts

Max. Service Voltage: = 110/240 V = 240 Volts

Max. Circuit Current: = CEC factor x (max inverter AC power output /240) = 1.25 x

240

 = Amps

Using CEC Table 310.15(B)(16): In temperature column copper, 75 ° C, find the amperage allowed, then read over to the size column for the minimum wire size

Min. wire size from Table 310.15(B)(16) #

Note: The smaller the wire size number the larger the wire thickness.

Table 310.15(B)(16) (formerly Table 310.16) Allowable Ampacities of Insulated Conductors Rated Up to and Including 2000 Volts, 60°C Through 90°C (140°F Through 194°F), Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F)*

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.104(A).]						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW- 2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	
COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM				
18**	—	—	14	—	—	—	—
16**	—	—	18	—	—	—	—
14**	15	20	25	—	—	—	—
12**	20	25	30	15	20	25	12**
10**	30	35	40	25	30	35	10**
8	40	50	55	35	40	45	8
6	55	65	75	40	50	55	6
4	70	85	95	55	65	75	4
3	85	100	115	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	145	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0
250	215	255	290	170	205	230	250
300	240	285	320	195	230	260	300
350	260	310	350	210	250	280	350
400	280	335	380	225	270	305	400
500	320	380	430	260	310	350	500
600	350	420	475	285	340	385	600
700	385	460	520	315	375	425	700
750	400	475	535	320	385	435	750
800	410	490	555	330	395	445	800
900	435	520	585	355	425	480	900
1000	455	545	615	375	445	500	1000
1250	495	590	665	405	485	545	1250
1500	525	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	555	665	750	470	560	630	2000

*Refer to 310.15(B)(2) for the ampacity correction factors where the ambient temperature is other than 30°C (86°F).

**Refer to 240.4(D) for conductor overcurrent protection limitations

REQUIRED LABELS FOR RESIDENTIAL SOLAR ELECTRIC (PV) SYSTEMS

(SEE DRAWING PV-1)

- LABELS SHALL BE MADE OF RED PLASTIC MATERIAL WITH ENGRAVED WHITE LETTERS.
- LETTERS SHALL BE A MINIMUM 3/8" IN SIZE.
- THE LABELS SHALL BE PERMANENTLY ATTACHED TO THE APPROPRIATE PANEL.
- AC & DC CONDUIT, RACEWAY, ENCLOSURES, CABLE ASSEMBLIES AND JUNCTION BOXES SHALL BE RED BACKGROUND MATERIAL WITH WHITE LETTERING MADE OF DURABLE ADHESIVE, REFLECTIVE, WEATHER RESISTANT MATERIAL SUITABLE FOR THE ENVIRONMENT PER UL 969; TO ALERT FIRE SERVICE TO AVOID CUTTING THEM OFF.

WARNING!
DUAL POWER SUPPLY
SOLAR ELECTRIC SYSTEM

THIS TAG TO BE ATTACHED TO METER PANEL


WARNING!
DUAL POWER SUPPLY
SOLAR ELECTRIC SYSTEM
DISCONNECT

THIS TAG TO BE ATTACHED TO PV DISCONNECT DEVICE

CAUTION:
SOLAR ELECTRIC CIRCUIT

THIS TAG TO BE ATTACHED TO AC AND DC CIRCUIT EQUIPMENT

DRAWING PVT-1

 CITY OF ROSEVILLE CALIFORNIA <hr/> Roseville Electric	ENGINEERING MANAGER <i>[Signature]</i>	REVIEW COMMITTEE						
	OPERATIONS MANAGER <i>[Signature]</i>	<i>NEB</i>	<i>CP</i>	<i>Rm</i>	<i>Jon</i>	<i>Mad</i>	<i>[Signature]</i>	<i>[Signature]</i>
	ENG. TECH SUPERVISOR <i>[Signature]</i>	DR.	DATE	DR. NO.				
		N.E.B.	08/18/09	PAGE 8.2.3				
		CONSTRUCTION STANDARD						
RESIDENTIAL SOLAR ELECTRIC METERING REQUIREMENTS								

REQUIRED LABELS FOR RESIDENTIAL SOLAR ELECTRIC (PV) SYSTEMS W/ BATTERY BACK-UP

(SEE DRAWING PV-2)

- LABELS SHALL BE MADE OF RED PLASTIC MATERIAL WITH ENGRAVED WHITE LETTERS.
- LETTERS SHALL BE A MINIMUM 3/8" IN SIZE.
- THE LABELS SHALL BE PERMANENTLY ATTACHED TO THE APPROPRIATE PANEL.
- AC & DC CONDUIT, RACEWAY, ENCLOSURES, CABLE ASSEMBLIES AND JUNCTION BOXES SHALL BE RED BACKGROUND MATERIAL WITH WHITE LETTERING MADE OF DURABLE ADHESIVE, REFLECTIVE, WEATHER RESISTANT MATERIAL SUITABLE FOR THE ENVIRONMENT PER UL 969; TO ALERT FIRE SERVICE TO AVOID CUTTING THEM OFF.

**WARNING!
DUAL POWER SUPPLY
SOLAR ELECTRIC SYSTEM
CRITICAL LOAD MUST BE
DISCONNECTED SEPARATELY**

THIS TAG TO BE ATTACHED TO METER PANEL

**WARNING!
DUAL POWER SUPPLY SOLAR
ELECTRIC SYSTEM
DISCONNECT**

THIS TAG TO BE ATTACHED TO PV DISCONNECT DEVICE

**CAUTION:
SOLAR ELECTRIC CIRCUIT**

THIS TAG TO BE ATTACHED TO AC AND DC CIRCUIT EQUIPMENT

CRITICAL LOAD DISCONNECT

THIS TAG TO BE ATTACHED TO BATTERY BANK DISCONNECT

DRAWING PVT-2



ENGINEERING MANAGER <i>[Signature]</i> OPERATIONS MANAGER <i>[Signature]</i> ENG. TECH SUPERVISOR <i>[Signature]</i>	REVIEW COMMITTEE <table style="width: 100%; text-align: center;"> <tr> <td style="width: 12.5%;"><i>NEB</i></td> <td style="width: 12.5%;"><i>CP</i></td> <td style="width: 12.5%;"><i>Rm</i></td> <td style="width: 12.5%;"><i>Jon</i></td> <td style="width: 12.5%;"><i>Mad</i></td> <td style="width: 12.5%;"><i>[Signature]</i></td> <td style="width: 12.5%;"><i>[Signature]</i></td> </tr> <tr> <td colspan="2">DR.</td> <td colspan="2">DATE</td> <td colspan="3">DR.NO.</td> </tr> <tr> <td colspan="2">N.E.B.</td> <td colspan="2">08/18/09</td> <td colspan="3">PAGE 8.2.5</td> </tr> <tr> <td colspan="7" style="text-align: center;">CONSTRUCTION STANDARD</td> </tr> </table>	<i>NEB</i>	<i>CP</i>	<i>Rm</i>	<i>Jon</i>	<i>Mad</i>	<i>[Signature]</i>	<i>[Signature]</i>	DR.		DATE		DR.NO.			N.E.B.		08/18/09		PAGE 8.2.5			CONSTRUCTION STANDARD						
<i>NEB</i>	<i>CP</i>	<i>Rm</i>	<i>Jon</i>	<i>Mad</i>	<i>[Signature]</i>	<i>[Signature]</i>																							
DR.		DATE		DR.NO.																									
N.E.B.		08/18/09		PAGE 8.2.5																									
CONSTRUCTION STANDARD																													

RESIDENTIAL SOLAR ELECTRIC METERING REQUIREMENTS

REQUIRED LABELS FOR RESIDENTIAL MULTI - SOLAR ELECTRIC (PV) SYSTEMS

(SEE DRAWING PV-3)

- LABELS SHALL BE MADE OF RED PLASTIC MATERIAL WITH ENGRAVED WHITE LETTERS.
- LETTERS SHALL BE A MINIMUM 3/8" IN SIZE.
- THE LABELS SHALL BE PERMANENTLY ATTACHED TO THE APPROPRIATE PANEL.
- AC & DC CONDUIT, RACEWAY, ENCLOSURES, CABLE ASSEMBLIES AND JUNCTION BOXES SHALL BE RED BACKGROUND MATERIAL WITH WHITE LETTERING MADE OF DURABLE ADHESIVE, REFLECTIVE, WEATHER RESISTANT MATERIAL SUITABLE FOR THE ENVIRONMENT PER UL 969; TO ALERT FIRE SERVICE TO AVOID CUTTING THEM OFF.

WARNING!
DUAL POWER SUPPLY
2 - SOLAR ELECTRIC SYSTEMS
2 - DISCONNECT DEVICES

THIS TAG TO BE ATTACHED TO METER PANEL

WARNING!
DUAL POWER SUPPLY
SOLAR ELECTRIC SYSTEM
DISCONNECT 1 OF 2


WARNING!
DUAL POWER SUPPLY
SOLAR ELECTRIC SYSTEM
DISCONNECT 2 OF 2

THIS TAG TO BE ATTACHED TO PV DISCONNECT DEVICES

CAUTION:
SOLAR ELECTRIC CIRCUIT

THIS TAG TO BE ATTACHED TO AC AND DC CIRCUIT EQUIPMENT

DRAWING PVT-3

 Roseville Electric	ENGINEERING MANAGER <i>[Signature]</i>	REVIEW COMMITTEE		
	OPERATIONS MANAGER <i>[Signature]</i>	DR. <i>NEB</i> <i>CP</i> <i>Rm</i> <i>Jon</i> <i>Mid</i> <i>[Signature]</i> <i>[Signature]</i>	DATE	DR.NO.
	ENG. TECH SUPERVISOR <i>[Signature]</i>	N.E.B.	08/18/09	PAGE 8.2.7
	CONSTRUCTION STANDARD			
RESIDENTIAL SOLAR ELECTRIC METERING REQUIREMENTS				

