CITY OF ROSEVILLE CALIFORNIA

Public Works
Building Inspection
311 Vernon Street
Roseville, California 95678-2649
916.774.5332 fax 916.774.5394

RESIDENTIAL PHOTOVOLTAIC (PV) PACKET

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 310.16 (included for reference)

Roseville Electric Solar Signage Requirements (3 pages)

If you have any questions regarding your PV system, please call the Building Department at (916)-774-5332. Thank You.

Residential Photovoltaic Checklist

Public Works
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311 Vernon Street
Roseville, California 95678-2649
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Based on the 2007 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 NEC 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 Fire)
- ☐ Distance from valley/ hip to array(s) - (minimum of 1.5' by Fire)
- ☐ PV equipment locations

☐ **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
- ☐ Inverter
- ☐ Mounting System (if using substitution parts to any listed/certified system, additional engineering shall be required addressing the withdrawal and lateral capacities)
- ☐ Disconnects
- ☐ Combiner Box (if used)

☐ **Inverter:**

- ☐ Model number
- ☐ Integrated disconnect - Per *CEC 690.17
- ☐ Roseville Electric requires a visible external A/C disconnect at main service

☐ **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 for 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 690.14 (5) & Roseville Electric
- _____ Batteries; number, size and locations (if applicable)
- _____ Point of connect to existing electrical service panel
- _____ Size and number of electrical service meters – Per *CEC 690.64(B) (2) exception)
- _____ Location of required signage (Per Roseville Electric specifications)

☐ **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**

☐ **Fees and Plan Review Information:**

_____ Flat fee for building permit of $155.00

_____ Review time should be no greater than 3 days (depending on backlog and staffing)

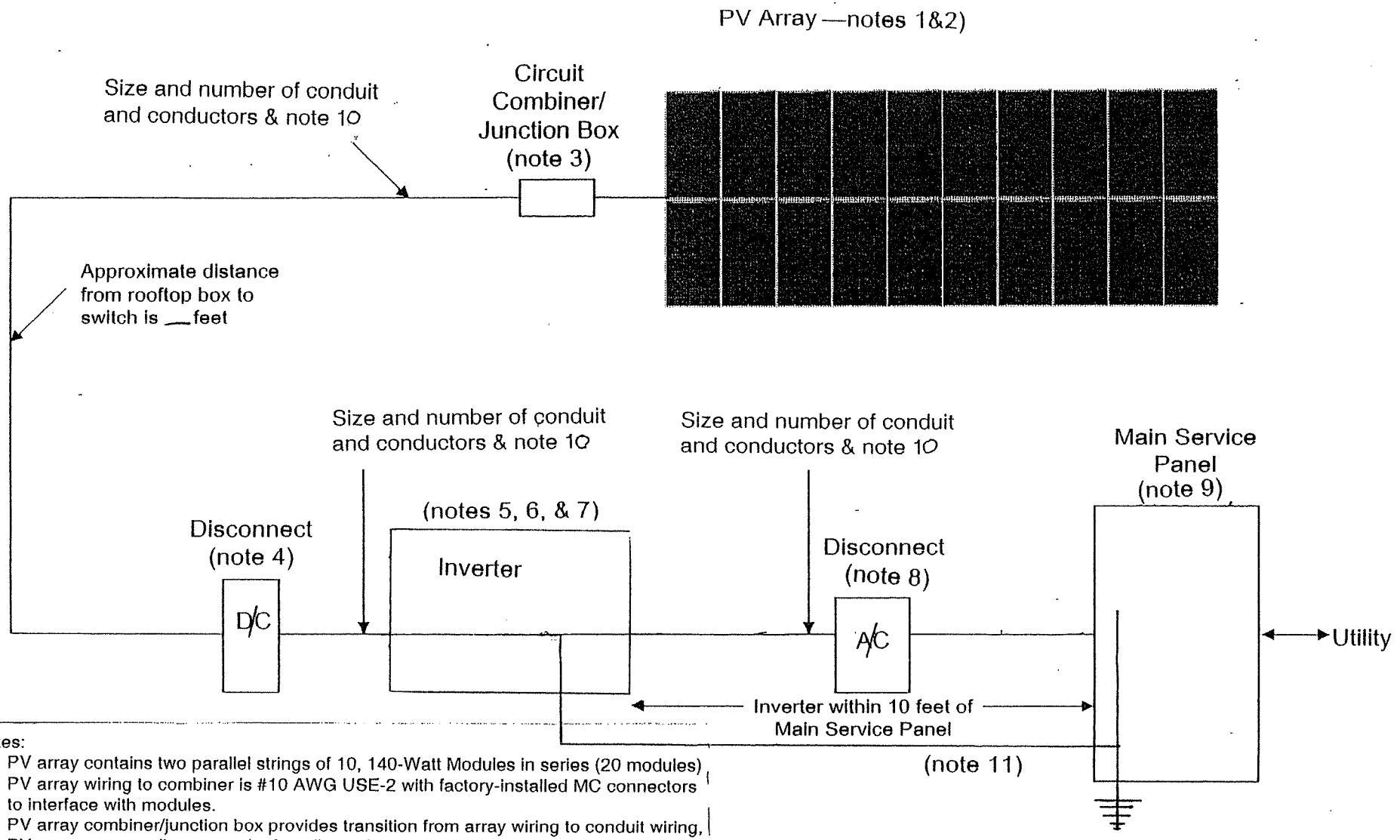
***CEC 690.17 - Switch or Circuit Breaker.** The disconnecting means for ungrounded conductors shall consist of a manually operable switch (es) or circuit breaker(s) complying with all of the following requirements:

(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 690.14 (5) – 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.

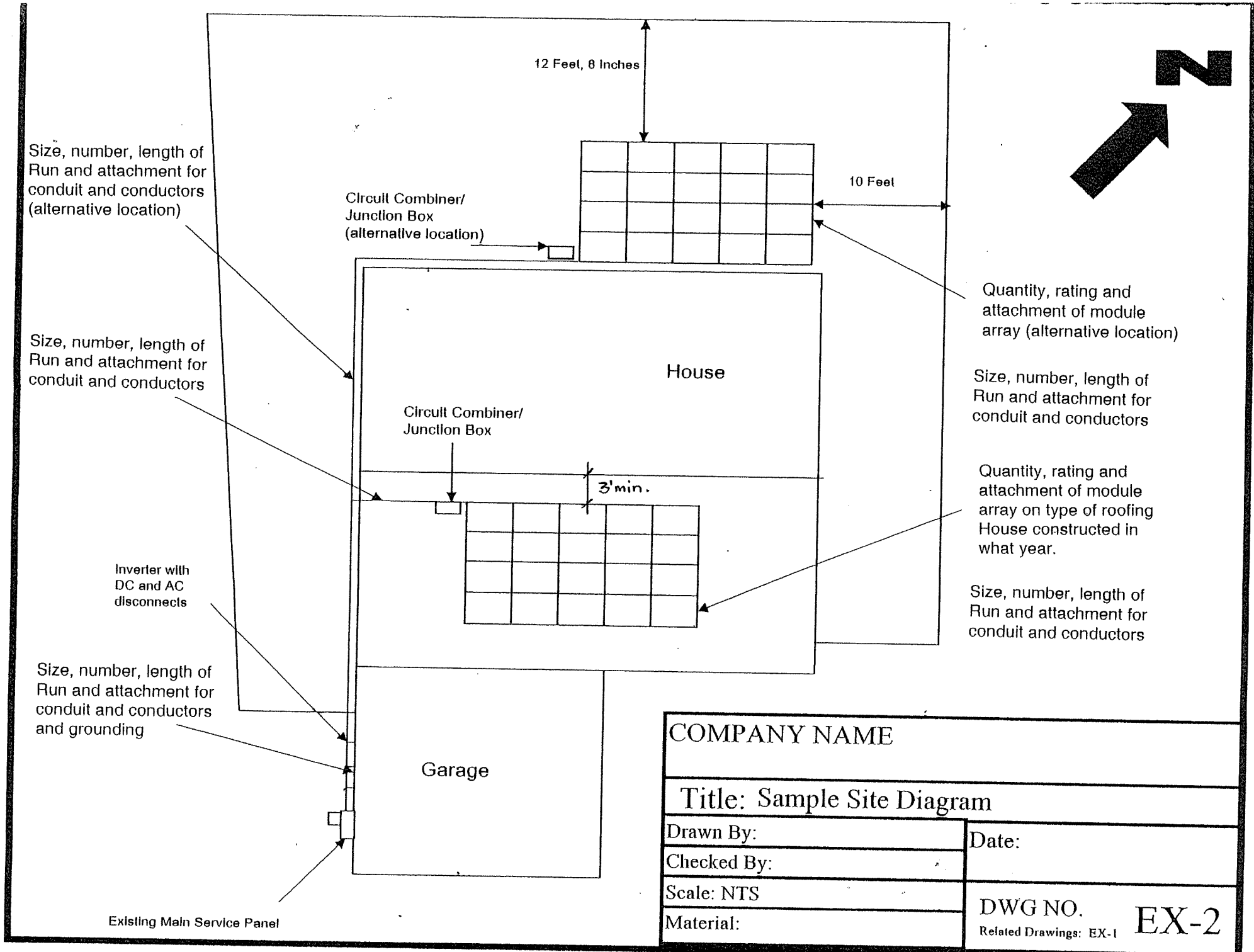
***CEC 690.64(B)(2)exception)** - **Load Side**. A photovoltaic power source shall be permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment on the premises, provided that (exception) the sum of the ampere ratings of the overcurrent devices shall not exceed 120% of the rating of the busbar or conductor.



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,
4. PV power source disconnect (unfused) rated at 30-amps, 600 Vdc, NEMA 3R rainproof.
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.

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


12 Feet, 8 Inches
10 Feet
N
Size, number, length of Run and attachment for conduit and conductors (alternative location)
Circuit Combiner/ Junction Box (alternative location)
Quantity, rating and attachment of module array (alternative location)
Size, number, length of Run and attachment for conduit and conductors
House
Circuit Combiner/ Junction Box
3'min.
Quantity, rating and attachment of module array on type of roofing House constructed in what year.
Inverter with DC and AC disconnects
Size, number, length of Run and attachment for conduit and conductors
Size, number, length of Run and attachment for conduit and conductors and grounding
Garage
Existing Main Service Panel
COMPANY NAME
Title: Sample Site Diagram
Drawn By:
Checked By:
Scale: NTS
Material:
Date:
DWG NO.
Related Drawings: EX-1
EX-2

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 = (total panel wt.) / (# of points of connection) = ____ / ____ = ____ lbs.

Distrubuted Load Calculation:

Solar Module Area = (length" x width") / 144 = ____ x ____ / 144 = ____ ft2

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

Inter-module Spacing = ____ in.

Total Spacing Area = ((# spaces bet. modules) x (inter-mod spacing) x (panel length or width)) / 144 = ____ x ____ x ____ / 144 = ____ ft2

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

Distributed Load = (total panel wt.) / (total panel area) = ____ / ____ = ____ 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 310.16: In temperture column copper, 7° C, find the amperage allowed, then read over to the size column for the minimum wire size

Min. wire size from Table 310.16 # [ ]

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 310.16: In temperture column copper, 7° C, find the amperage allowed, then read over to the size column for the minimum wire size

Min. wire size from Table 310.16 # [ ]

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

Table 310.16 Allowable Ampacities of Insulated Conductors Rated 0 Through 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 310.13.)						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	Amps 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*	20	20	25	—	—	—	—
12*	25	25	30	20	20	25	12*
10*	30	35	40	25	30	35	10*
8	40	50	55	30	40	45	8
6	55	65	75	40	50	60	6
4	70	85	95	55	65	75	4
3	85	100	110	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	150	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	190	230	255	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	355	420	475	285	340	385	600
700	385	460	520	310	375	420	700
750	400	475	535	320	385	435	750
800	410	490	555	330	395	450	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	520	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	560	665	750	470	560	630	2000

CORRECTION FACTORS

Ambient Temp. (°C)	For ambient temperatures other than 30°C (86°F), multiply the allowable ampacities shown above by the appropriate factor shown below.						Ambient Temp. (°F)
21–25	1.08	1.05	1.04	1.08	1.05	1.04	70–77
26–30	1.00	1.00	1.00	1.00	1.00	1.00	78–86
31–35	0.91	0.94	0.96	0.91	0.94	0.96	87–95
36–40	0.82	0.88	0.91	0.82	0.88	0.91	96–104
41–45	0.71	0.82	0.87	0.71	0.82	0.87	105–113
46–50	0.58	0.75	0.82	0.58	0.75	0.82	114–122
51–55	0.41	0.67	0.76	0.41	0.67	0.76	123–131
56–60	—	0.58	0.71	—	0.58	0.71	132–140
61–70	—	0.33	0.58	—	0.33	0.58	141–158
71–80	—	—	0.41	—	—	0.41	159–176

* See 240.4(D).

REQUIRED LABELS FOR SOLAR ELECTRIC (PV) SYSTEMS <10KW

(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 OR RED BACKGROUND MATERIAL WITH WHITE LETTERING MADE OF DURABLE ADHESIVE, REFLECTIVE WEATHER RESISTANT MATERIAL SUITABLE FOR THE ENVIRONMENT; TO ALERT FIRE SERVICE TO AVOID CUTTING THEM OFF.

WARNING!
DUAL POWER SUPPLY
SOLAR ELECTRIC SYSTEM

THIS TAG IS TO BE ATTACHED TO METER PANEL

WARNING!
DUAL POWER SUPPLY
SOLAR ELECTRIC SYSTEM
DISCONNECT

THIS TAG IT 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

Roseville Electric

ELECTRIC SUPERINTENDENT	REVIEW COMMITTEE		
POWER ENG. MANAGER	DR. N.E.B.	DATE 07/15/09	DR. NO.
ELECTRONICS MANAGER	NEW SERVICES MANAGER		PAGE 7.4.2

CONSTRUCTION STANDARD

SOLAR ELECTRIC METERING REQUIREMENTS

REQUIRED LABELS FOR SOLAR ELECTRIC (PV) SYSTEMS W/ BATTERY BACK-UP <10KW

(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 OR RED BACKGROUND MATERIAL WITH WHITE LETTERING MADE OF DURABLE ADHESIVE, REFLECTIVE WEATHER RESISTANT MATERIAL SUITABLE FOR THE ENVIRONMENT; TO ALERT FIRE SERVICE TO AVOID CUTTING THEM OFF.

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

THIS TAG IS TO BE ATTACHED TO METER PANEL

WARNING!
DUAL POWER SUPPLY SOLAR
ELECTRIC SYSTEM
DISCONNECT

THIS TAG IT 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

REQUIRED LABELS FOR MULTI - SOLAR ELECTRIC (PV) SYSTEMS <10KW

(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 OR RED BACKGROUND MATERIAL WITH WHITE LETTERING MADE OF DURABLE ADHESIVE, REFLECTIVE WEATHER RESISTANT MATERIAL SUITABLE FOR THE ENVIRONMENT; TO ALERT FIRE SERVICE TO AVOID CUTTING THEM OFF.

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

THIS TAG IS 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 IT 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

CITY OF ROSEVILLE CALIFORNIA

Roseville Electric

ELECTRIC SUPERINTENDENT	REVIEW COMMITTEE		
POWER ENG. MANAGER	DR N.E.B.	DATE 07/15/09	DR NO.
ELECTRONICS MANAGER	NEW SERVICES MANAGER		PAGE 7.4.6

CONSTRUCTION STANDARD

SOLAR ELECTRIC METERING REQUIREMENTS