



Checklist for Residential Roof Mount Photovoltaic/Solar Systems Submittals

DESIGN CRITERIA:

- Seismic Zone D or provide analysis and calculation from California Registered Engineer
- Basic velocity 110 mph, 3 second gust, exposure B or provide wind speed calculations from California Registered Engineer
- 2016 editions of the California Residential Code (CRC) and the California Electrical Code (CEC) Article 690
- Climate Zone 11
- PG & E Greenbook Requirements

DRAWING CRITERIA:

- Drawing sizes shall be a minimum of 11" x 17" inches and all pages shall be the same size. Plans must be clear and legible; non-legible plans **will not be accepted**. Scale shall be ¼" inch per foot for structural and architectural; 1" inch = 20 feet for site plans.
- **Plans must be wet-signed by the preparer on each page. Architects/Engineers must affix their seal and wet-sign (cover sheet of supporting documents to be wet-signed).**
- Two complete stapled plan sets

PLANS PREPARED BY:

- California Registered Architect, California Registered Engineer, Owner, Licensed General, Electrical, Solar Contractor
- Structural Plans Included – Stamped and Signed (original) by a California Registered Engineer

CONTENTS OF PACKET:

- Photovoltaic Checklist (2 pages – complete and submit with permit) **Note: all forms must be signed or initialed (as indicated) by the appropriately authorized party.**
- Sample One-Line Diagram for PV System including derating load calculations
- 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
- PV Roof Clearance drawing
- PG&E Greenbook Figure 2-19 (Minimum Meter Set Clearance Requirements)

If you have any questions regarding your PV system permit, please call the building department at (916) 625-5120

Residential Photovoltaic Checklist

Based on the 2016 California Residential Code (CRC) and the 2016 California Electrical Code (CEC) Article 690
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 18" by CRC)
_____ PV equipment locations, Solar arrays, DC combiner boxes, conduit and conductor location, Inverter, AC combiner box, AC disconnect
- 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.
_____ 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.

Residential PV Checklist

Initials: _____

Photovoltaic/Solar System Submittal Checklist

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
 - _____ 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
 - _____ Complete attached 'verification of wire sizes' sheet
 - _____ Provide Rapid Shutdown of PV per 690.12

Proper Signage and Labeling: Signage (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**

***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.

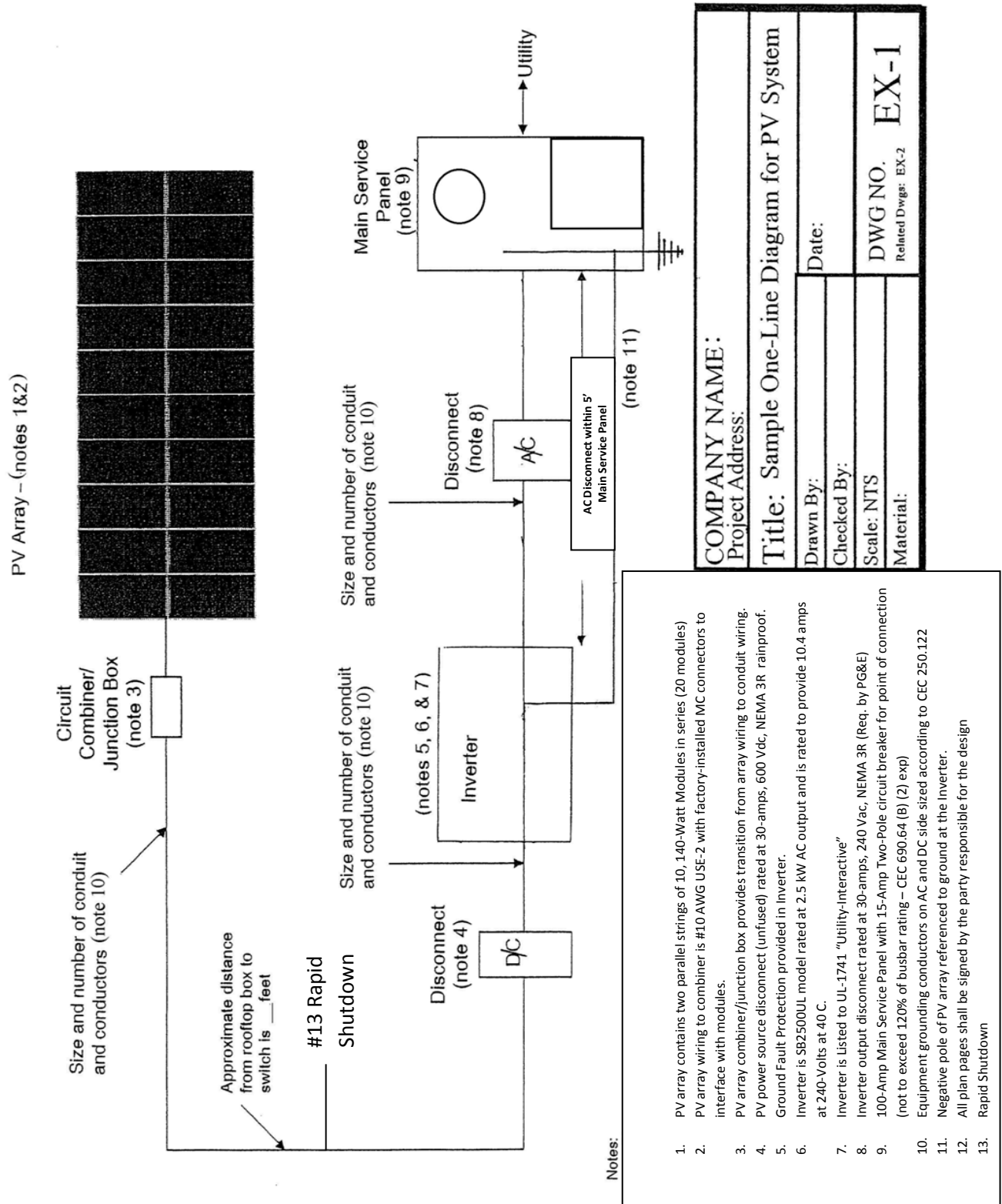
***CEC 690.46 – Grounding for AC/DC Systems.** #6, in conduit or protected from damage

***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 bus bar or conductor. Initials: _____

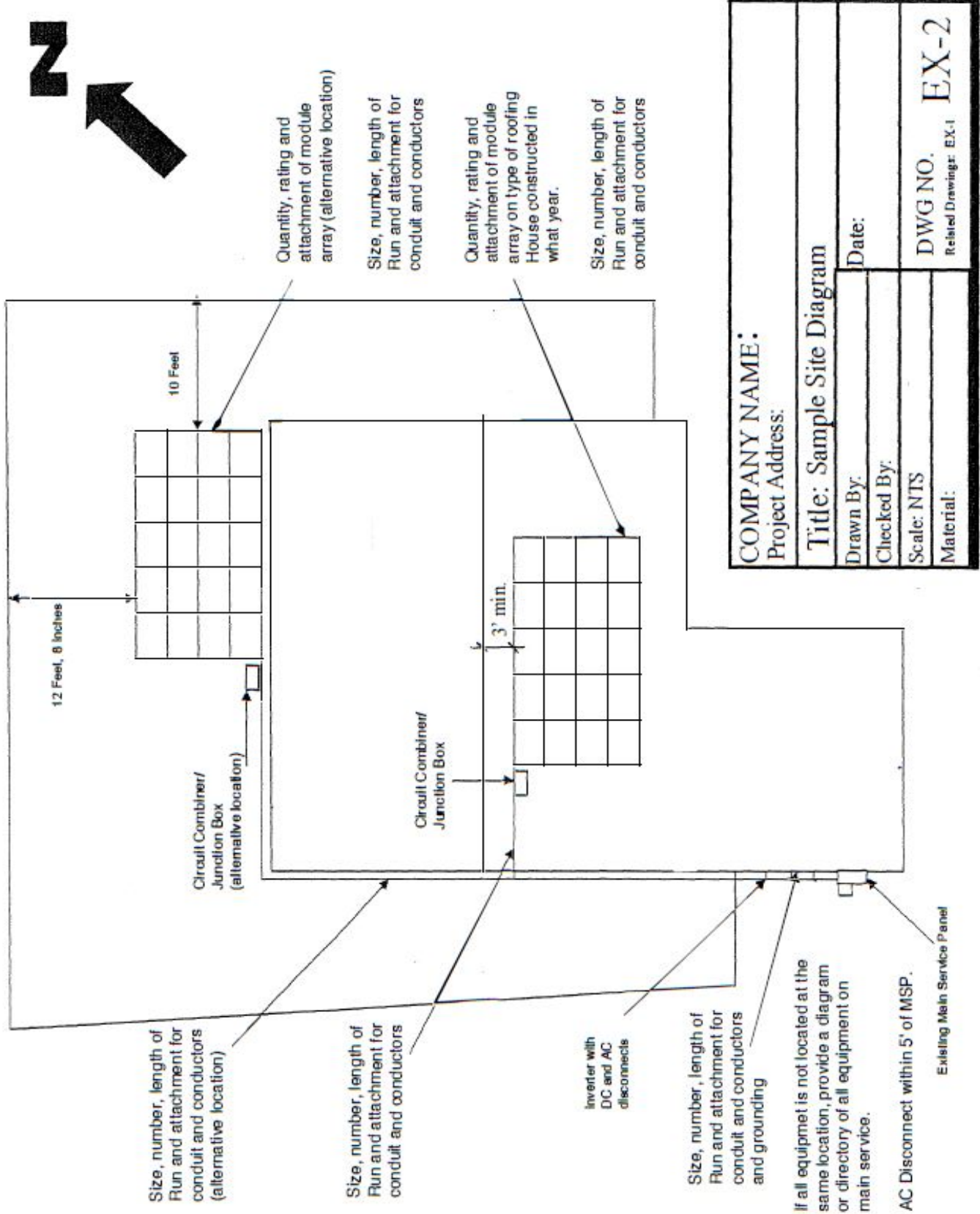
Photovoltaic/Solar System Submittal Checklist

Residential PV EX-1 drawing



<Must be accessible from Public way. <Do Not Locate Aux metering equipment on Utility side of Panel.

Residential PV EX-1 drawing



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

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

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

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.

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

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

COMPANY NAME:	
Project Address:	
Title: Sample Site Diagram	Date:
Drawn By:	
Checked By:	
Scale: NTS	DWG NO. EX-2
Material:	Related Drawing: 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 = (total panel wt.) _____
 _____ = _____ (lbs.)
 (# of points of connection) _____

Distributed Load Calculation:

Solar Module Area = length" x width" = _____ x _____ = _____ ft2
 _____ = _____
 144 144

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) = _____ x _____ x _____ = _____ ft2

 144 144

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

Distributed Load = (total panel wt.) _____
 _____ = _____ lbs./ft2
 (total panel area) _____

The point loading and distributed loading should be below building department requirements for structural analysis. Distributed loading - Max. 5 lbs/ft2

Residential PV Dead Weight Loading Calculation form

Initials: _____

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)

$$= \underline{\hspace{2cm}} \times \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ Watts}$$

Max. PV System Voltage: = (Voc (v) off cut sheet) x (# of modules) x CEC Factor

$$= \underline{\hspace{2cm}} \times \underline{\hspace{2cm}} \times 1.13 = \underline{\hspace{2cm}} \text{ Volts}$$

Max. Circuit Current: = CEC Factor x (Total system wattage/ total system voltage)

$$= 1.25 \times \underline{\hspace{2cm}} / \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ Amps}$$

Using CEC Table 310.15(B)(16): In temperature column copper, 75° C, find the amperage allowed, then read over the size column for the minimum wire size. **Minimum 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 Output off cut sheet)

$$= \underline{\hspace{2cm}} \text{ Watts}$$

Max Service Voltage: = (110/240 V)

$$= \underline{\hspace{2cm}} \text{ Volts}$$

Max Circuit Current: = CEC Factor x (max inverter AC Power Output / 240)

$$= 1.25 \times \underline{\hspace{2cm}} / \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ Amps}$$

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

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

Initials:

Photovoltaic/Solar System Submittal Checklist

ARTICLE 310 - CONDUCTORS FOR GENERAL WIRING

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, THiiil, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XIIBW, 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-I

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

**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

WARNING!
DUAL POWER SUPPLY
SOLAR ELECTRIC
SYSTEM DISCONNECT 2

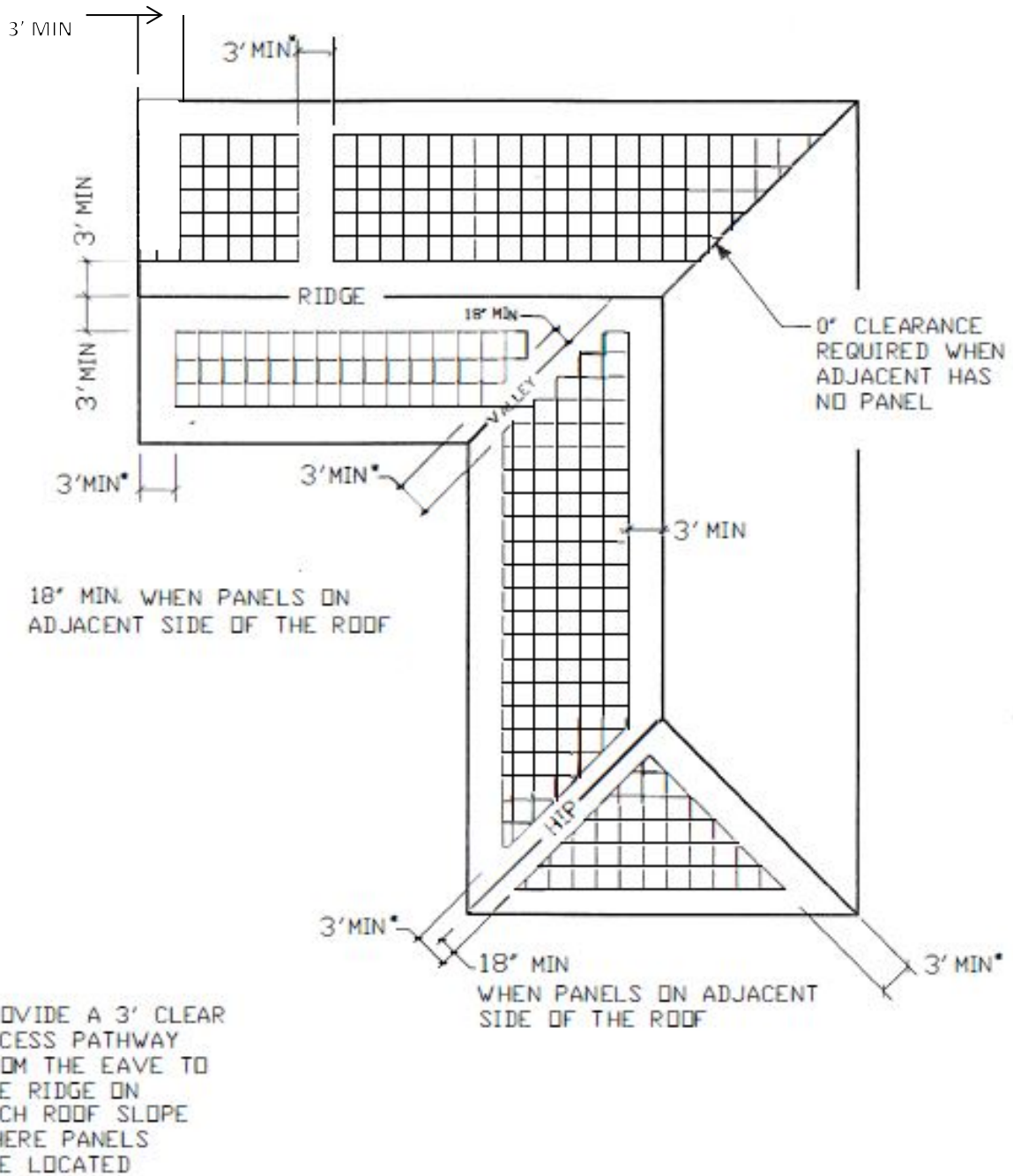
THIS TAG TO BE ATTACHED TO PV DISCONNECT DEVICES

CAUTION:
SOLAR ELECTRIC CIRCUIT

THIS TAG TO BE ATTACHED TO AC AND DC CIRCUIT EQUIPMENT

DRAWING PVT-3

Residential Photovoltaic



Minimum Meter Set Clearance Requirements

- Figure 2-19, “Electric and Gas Meter Set Separation Dimensions and Clearance,” below; Figure 2-20, “Gas Meter Set Clearance From Building Openings,” on Page 2-32; and figure 2-21, “Gas Regulator Set Clearance Requirement From Sources of Ignition,” on Page 2-33, all represent various metering facilities’ clearance requirements. If applicants install enclosures on their premises, the enclosures must meet the specifications provided in these illustrations.

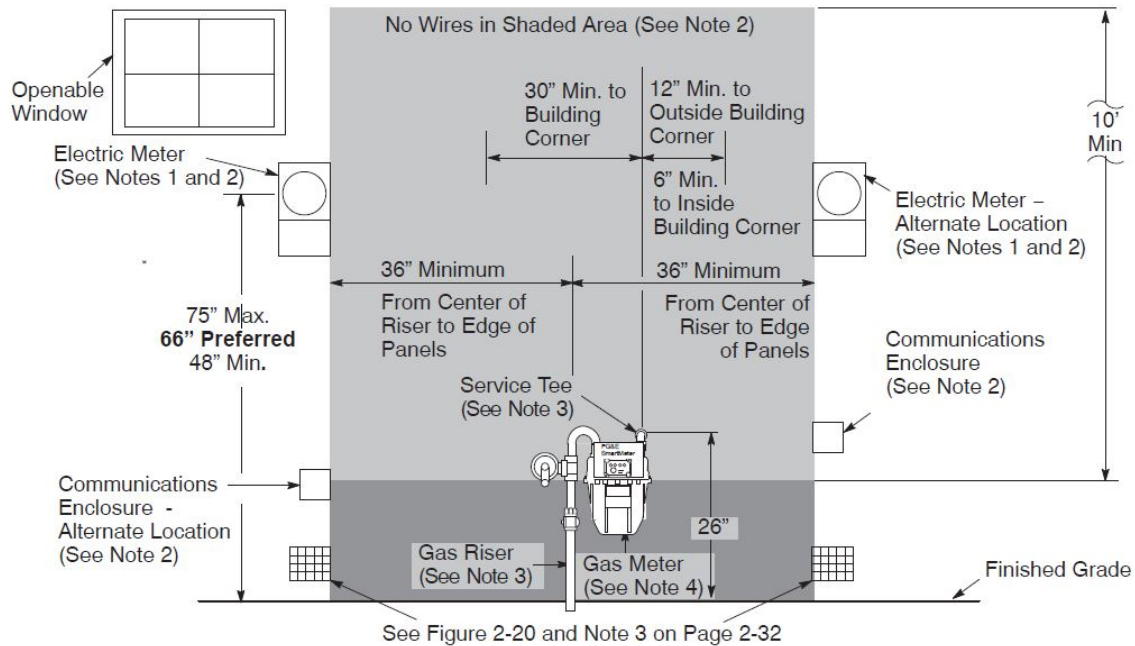


Figure 2-19
Electric and Gas Meter Set Separation Dimensions and Clearances

Notes in Reference to Figure 2-19.

- Electric meter panel locations are subject to utility approval and must comply with the applicable code requirements. PG&E does **not** have specific requirements for the distance from the electric panel to the outside building corner. See Section 5, “Electric Metering: General,” for properly locating the electric meters. See Subsection 5.4.4, “Working Space,” on Page 5-11, for electric meter working space.
- Applicants must **not** install any electrical devices or equipment, including wires, cables, metering enclosures, telecommunication enclosures, bond wires, clamps, or ground rods within the shaded area around the gas meter. The 36-inch distance can be reduced to 18 inches for electrical devices or equipment certified for NEC Class I, Division 2 locations.
- Place the gas service riser 6 inches to 9 inches from the finished wall. The completed customer houseline at the service delivery point must extend a minimum of 4 to 6 inches from the finished wall where the meter is to be set, and must be 26 inches above the finished grade. See Figure 2-14 on Page 2-26, Figure 2-15 on Page 2-27, and Subsection 2.5 on Page 2-42.
- The minimum dimensions and clearances in figure 2-19 are good for gas meters up to the 1,000 class. See Figure 2-15 on Pages 2-26 and 2-27 for illustrations of clear and level working space in front of the gas meter.