

## Expedited Permit Process for Small-Scale PV Systems

The information in this guideline is intended to help local jurisdictions and contractors identify when PV system installations are simple, needing only a basic review, and when an installation is more complex. It is likely that 50%-75% of all residential systems will comply with these simple criteria. For projects that fail to meet the simple criteria, a resolution steps may be suggested to provide a path to permit approval.

### Required Information for Permit:

1. Site plan showing location of major components on the property. This drawing need not be exactly to scale, but it should represent relative location of components at site (see supplied example site plan). PV arrays on dwellings with a 3' perimeter space at ridge and sides may not need separate fire service review.
2. Electrical diagram showing PV array configuration, wiring system, overcurrent protection, inverter, disconnects, required signs, and ac connection to building (see supplied standard electrical diagram).
3. Specification sheets and installation manuals (if available) for all manufactured components including, but not limited to, PV modules, inverter(s), combiner box, disconnects, and mounting system.

### Step 1: Structural Review of PV Array Mounting System

Is the array to be mounted on a defined, permitted roof structure?  Yes  No

*If No due to non-compliant roof or a ground mount, submit completed worksheet for the structure WKS1.*

#### Roof Information:

1. Is the roofing type lightweight (Yes = composition, lightweight masonry, metal, etc...) \_\_\_\_\_  
*If No, submit completed worksheet for roof structure WKS1 (No = heavy masonry, slate, etc...).*
2. Does the roof have a single roof covering?  Yes  No  
*If No, submit completed worksheet for roof structure WKS1.*
3. Provide method and type of weatherproofing roof penetrations (e.g. flashing, caulk). \_\_\_\_\_

#### Mounting System Information:

1. The mounting structure is an engineered product designed to mount PV modules?  Yes  No  
*If No, provide details of structural attachment certified by a design professional.*
2. For manufactured mounting systems, fill out information on the mounting system below:
  - a. Mounting System Manufacturer \_\_\_\_\_ Product Name and Model# \_\_\_\_\_
  - b. Total Weight of PV Modules and Rails \_\_\_\_\_ lbs
  - c. Total Number of Attachment Points \_\_\_\_\_
  - d. Weight per Attachment Point (b÷c) \_\_\_\_\_ lbs (if greater than 40 lbs, see WKS1)
  - e. Maximum Spacing Between Attachment Points on a Rail \_\_\_\_\_ inches (see product manual for maximum spacing allowed based on maximum design wind speed)
  - f. Total Surface Area of PV Modules (square feet) \_\_\_\_\_ ft<sup>2</sup>
  - g. Distributed Weight of PV Module on Roof (b÷f) \_\_\_\_\_ lbs/ft<sup>2</sup>  
*If distributed weight of the PV system is greater than 5 lbs/ft<sup>2</sup>, see WKS1.*

### Step 2: Electrical Review of PV System (Calculations for Electrical Diagram)

In order for a PV system to be considered for an expedited permit process, the following must apply:

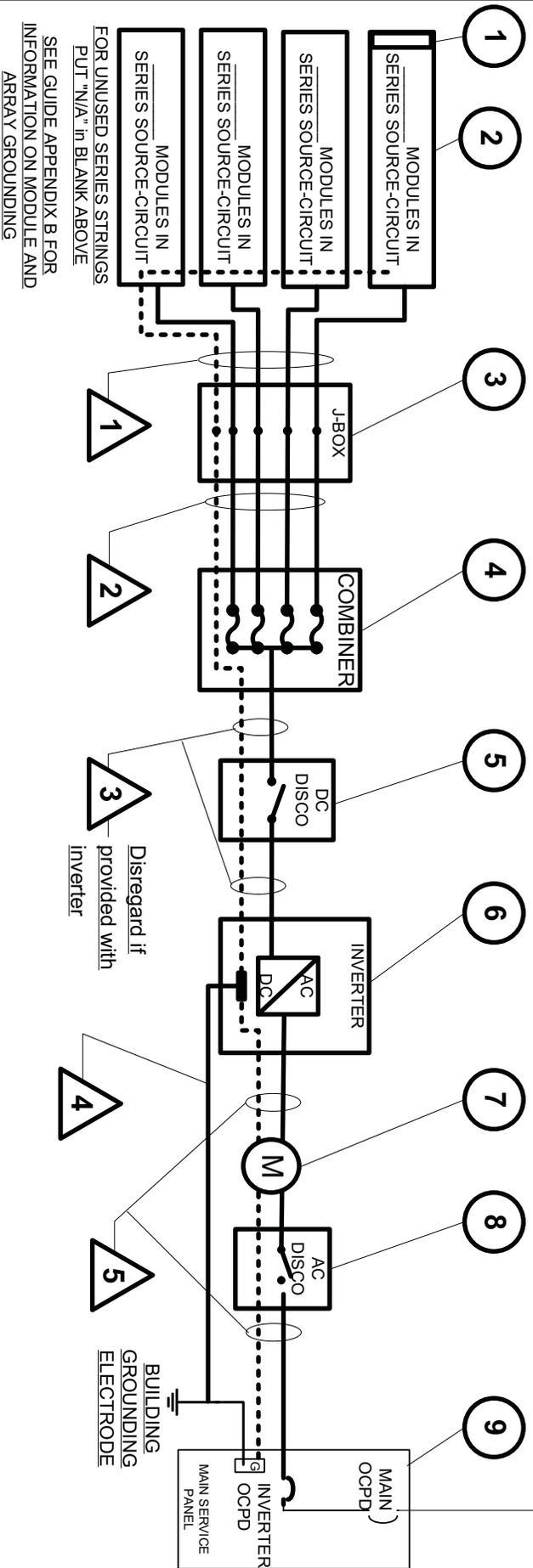
1. PV modules, utility-interactive inverters, and combiner boxes are identified for use in PV systems.
2. The PV array is composed of 4 series strings or less per inverter, and 15 kW<sub>STC</sub> or less.
3. The total inverter capacity has a continuous power output 13,440 Watts or less
4. The ac interconnection point is on the load side of service disconnecting means (690.64(B)).
5. The electrical diagram (E1.1) can be used to accurately represent the PV system.

*Fill out the standard electrical diagram completely. A guide to the electrical diagram is provided to help the applicant understand each blank to fill in. If the electrical system is more complex than the standard electrical diagram can effectively communicate, provide an alternative diagram with appropriate detail.*

EQUIPMENT SCHEDULE

TAG	DESCRIPTION	PART NUMBER	NOTES
1	SOLAR PV MODULE		
2	PV ARRAY		
3	J-BOX (IF USED)		
4	COMBINER (IF USED)		
5	DC DISCONNECT		
6	DC/AC INVERTER		
7	GEN METER (IF USED)		
8	AC DISCONNECT (IF USED)		
9	SERVICE PANEL		

VAC. \_\_\_\_\_ A MAIN. \_\_\_\_\_ A BUS. \_\_\_\_\_ A INVERTER OCPD  
(SEE NOTE 5 FOR INVERTER OCPDs, ALSO SEE GUIDE SECTION 9)



FOR UNUSED SERIES STRINGS PUT "N/A" IN BLANK ABOVE

SEE GUIDE APPENDIX B FOR INFORMATION ON MODULE AND ARRAY GROUNDING

CONDUIT AND CONDUCTOR SCHEDULE

TAG	DESCRIPTION OR CONDUCTOR TYPE	COND. GAUGE	NUMBER OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
1	USE-2 <input type="checkbox"/> or PV WIRE <input type="checkbox"/>			N/A	N/A
2	BARE COPPER EQ. GRD. COND. (EGC)			N/A	N/A
3	THWN-2 <input type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/>				
4	INSULATED EGC				
5	DC GROUNDING ELECTRODE COND.				
6	THWN-2 <input type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/>				
7	INSULATED EGC				

One-Line Standard Electrical Diagram for Small-Scale, Single-Phase PV Systems

Contractor Name, Address and Phone:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Site Name: \_\_\_\_\_  
Site Address: \_\_\_\_\_  
System AC Size: \_\_\_\_\_

Drawn By: \_\_\_\_\_  
Checked By: \_\_\_\_\_

SIZE \_\_\_\_\_ FSCM NO \_\_\_\_\_ DWG NO E1.1  
SCALE \_\_\_\_\_ NTS \_\_\_\_\_ Date: \_\_\_\_\_ SHEET \_\_\_\_\_

**SIGNS-SEE GUIDE SECTION 7**

**NOTES FOR ALL DRAWINGS:**

OCPPD = OVERCURRENT PROTECTION DEVICE  
 NATIONAL ELECTRICAL CODE® REFERENCES  
 SHOWN AS (NEC XXX.XX)

**SIGN FOR DC DISCONNECT**

PHOTOVOLTAIC POWER SOURCE	
RATED MPP CURRENT	A
RATED MPP VOLTAGE	V
MAX SYSTEM VOLTAGE	V
MAX CIRCUIT CURRENT	A
WARNING: ELECTRICAL SHOCK HAZARD--LINE AND LOAD MAY BE ENERGIZED IN OPEN POSITION	

**SIGN FOR INVERTER OCPD AND AC DISCONNECT (IF USED)**

SOLAR PV SYSTEM	
AC POINT OF CONNECTION	A
AC OUTPUT CURRENT	A
NOMINAL AC VOLTAGE	V
THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)	

**PV MODULE RATINGS @ STC (Guide Section 5)**

MODULE MAKE	
MODULE MODEL	
MAX POWER-POINT CURRENT ( $I_{MPP}$ )	A
MAX POWER-POINT VOLTAGE ( $V_{MPP}$ )	V
OPEN-CIRCUIT VOLTAGE ( $V_{OC}$ )	V
SHORT-CIRCUIT CURRENT ( $I_{SC}$ )	A
MAX SERIES FUSE (OCPPD)	A
MAXIMUM POWER ( $P_{MAX}$ )	W
MAX VOLTAGE (TYP 600V <sub>DC</sub> )	V
VOC TEMP COEFF (mV/°C <input type="checkbox"/> or %/°C <input type="checkbox"/> )	
IF COEFF SUPPLIED, CIRCLE UNITS	

**INVERTER RATINGS (Guide Section 4)**

INVERTER MAKE	
INVERTER MODEL	
MAX DC VOLT RATING	V
MAX POWER @ 40°C	W
NOMINAL AC VOLTAGE	V
MAX AC CURRENT	A
MAX OCPD RATING	A

**NOTES FOR ARRAY CIRCUIT WIRING (Guide Section 6 and 8 and Appendix D):**

- 1.) LOWEST EXPECT AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION. LOWEST EXPECTED AMBIENT TEMP \_\_\_\_\_°C
- 2.) HIGHEST CONTINUOUS AMBIENT TEMPERATURE BASED ON ASHRAE HIGHEST MONTH 2% DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION. HIGHEST CONTINUOUS TEMPERATURE \_\_\_\_\_°C
- 2.) 2005 ASHRAE FUNDAMENTALS 2% DESIGN TEMPERATURES DO NOT EXCEED 47°C IN THE UNITED STATES (PALM SPRINGS, CA IS 44.1°C). FOR LESS THAN 9 CURRENT-CARRYING CONDUCTORS IN ROOF-MOUNTED SUNLIT CONDUIT AT LEAST 0.5" ABOVE ROOF AND USING THE OUTDOOR DESIGN TEMPERATURE OF 47°C OR LESS (ALL OF UNITED STATES),
  - a) 12 AWG, 90°C CONDUCTORS ARE GENERALLY ACCEPTABLE FOR MODULES WITH  $I_{SC}$  OF 7.68 AMPS OR LESS WHEN PROTECTED BY A 12-AMP OR SMALLER FUSE.
  - b) 10 AWG, 90°C CONDUCTORS ARE GENERALLY ACCEPTABLE FOR MODULES WITH  $I_{SC}$  OF 9.6 AMPS OR LESS WHEN PROTECTED BY A 15-AMP OR SMALLER FUSE.

**NOTES FOR INVERTER CIRCUITS (Guide Section 8 and 9):**

- 1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? YES  NO  N/A
- 2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? YES  NO  N/A
- 3) SIZE PHOTOVOLTAIC POWER SOURCE (DC) CONDUCTORS BASED ON MAX CURRENT ON NEC 690.53 SIGN OR OCPD RATING AT DISCONNECT
- 4) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Guide Section 9)
- 5) TOTAL OF \_\_\_\_\_ INVERTER OCPD(S). ONE FOR EACH INVERTER. DOES TOTAL SUPPLY BREAKERS COMPLY WITH 120% BUSBAR EXCEPTION IN 690.64(B)(2)(a)? YES  NO

**Notes for One-Line Standard Electrical Diagram for Single-Phase PV Systems**

Contractor Name: \_\_\_\_\_  
 Address and Phone: \_\_\_\_\_

Site Name: \_\_\_\_\_  
 Site Address: \_\_\_\_\_  
 System AC Size: \_\_\_\_\_

Drawn By:	SIZE	FSCOM NO	DWG NO	REV
Checked By:	SCALE	NTS	Date:	SHEET

# APPENDIX B: STRUCTURAL

## STRUCTURE WORKSHEET WKS1

If array is roof mounted:

This section is for evaluating roof structural members that are site built. This includes rafter systems and site built trusses. Manufactured truss and roof joist systems, when installed with proper spacing, meet the roof structure requirements covered in item 2 below.

1. Roof construction:  Rafters  Trusses  Other:  
\_\_\_\_\_
2. Describe site-built rafter or or site-built truss system.
  - a. Rafter Size: \_\_\_ x \_\_\_ inches
  - b. Rafter Spacing: \_\_\_\_\_ inches
  - c. Maximum unsupported span: \_\_\_\_\_ feet, \_\_\_\_\_ inches
  - d. Are the rafters over-spanned? (see the IRC span tables in B.2.)  Yes  No
  - e. If **Yes**, complete the rest of this section.
3. If the roof system has:
  - a. over-spanned rafters or trusses,
  - b. the array over 5 lbs/ft<sup>2</sup> on any roof construction, or
  - c. the attachments with a dead load exceeding 40 lbs per attachment;it is recommended that you provide one of the following:
  - i. A framing plan that shows details for how you will strengthen the rafters using the supplied span tables in B.2.
  - ii. Confirmation certified by a design professional that the roof structure will support the array.

If array is ground mounted:

1. Show array supports, framing members, and foundation posts and footings.
2. Provide information on mounting structure(s) construction. If the mounting structure is unfamiliar to the local jurisdiction and is more than six (6) feet above grade, it may require engineering calculations certified by a design professional.
3. Show detail on module attachment method to mounting structure.

## B.2 SPAN TABLES

A framing plan is required *only* if the combined weight of the PV array exceeds 5 pounds per square foot (PSF or lbs/ft<sup>2</sup>) *or* the existing rafters are over-spanned. The following span tables from the 2003 International Residential Code (IRC) can be used to determine if the rafters are over-spanned. For installations in jurisdictions using different span tables, follow the local tables.

### Span Table R802.5.1(1),

Use this table for rafter spans that have conventional light-weight dead loads and do *not* have a ceiling attached.

<b>10 PSF Dead Load</b>							
Roof live load = 20 psf, ceiling not attached to rafters, L/Δ=180							
Rafter Size			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
Spacing (inches)	Species	Grade	The measurements below are in feet-inches (e.g. 9-10 = 9 feet, 10 inches).				
16	Douglas Fir-larch	#2 or better	9-10	14-4	18-2	22-3	25-9
16	Hem-fir	#2 or better	9-2	14-2	17-11	21-11	25-5
24	Douglas Fir-larch	#2 or better	7-10	11-9	14-10	18-2	21-0
24	Hem-fir	#2 or better	7-3	11-5	14-8	17-10	20-9

Use this table for rafter spans that have heavy dead loads and do *not* have a ceiling attached.

<b>20 PSF Dead Load</b>							
Roof live load = 20 psf, ceiling not attached to rafters, L/Δ=180							
Rafter Size			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
Spacing (inches)	Species	Grade	The measurements below are in feet-inches (e.g. 9-10 = 9 feet, 10 inches).				
16	Douglas Fir-larch	#2 or better	8-6	12-5	15-9	19-3	22-4
16	Hem-fir	#2 or better	8-5	12-3	15-6	18-11	22-0
24	Douglas Fir-larch	#2 or better	6-11	10-2	12-10	15-8	18-3
24	Hem-fir	#2 or better	6-10	10-0	12-8	15-6	17-11

Span Table R802.5.1(2),

Use this table for rafter spans *with* a ceiling attached and conventional light-weight dead loads.

<b>10 PSF Dead Load</b>							
Roof live load = 20 psf, ceiling attached to rafters, L/Δ=240							
Rafter Size			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
Spacing (inches)	Species	Grade	The measurements below are in feet-inches (e.g. 9-10 = 9 feet, 10 inches).				
16	Douglas Fir-larch	#2 or better	8-11	14-1	18-2	22-3	25-9
16	Hem-fir	#2 or better	8-4	13-1	17-3	21-11	25-5
24	Douglas Fir-larch	#2 or better	7-10	11-9	14-10	18-2	21-0
24	Hem-fir	#2 or better	7-3	11-5	14-8	17-10	20-9

Use this table for rafter spans *with* a ceiling attached and where heavy dead loads exist.

<b>20 PSF Dead Load</b>							
Roof live load = 20 psf, ceiling attached to rafters, L/Δ=240							
Rafter Size			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
Spacing (inches)	Species	Grade	The measurements below are in feet-inches (e.g. 9-10 = 9 feet, 10 inches).				
16	Douglas Fir-larch	#2 or better	8-6	12-5	15-9	19-3	22-4
16	Hem-fir	#2 or better	8-4	12-3	15-6	18-11	22-0
24	Douglas Fir-larch	#2 or better	6-11	10-2	12-10	15-8	18-3
24	Hem-fir	#2 or better	6-10	10-0	12-8	15-6	17-11

Use the conventional light-weight dead load table when the existing roofing materials are wood shake, wood shingle, composition roofing or light-weight tile roofs. (The rationale for allowing these tables to be used is that the installation of a PV system should be considered as part of the live load, since additional loading will not be added to the section of the roof where a PV array is installed.)

Where heavy roofing systems exist (e.g. clay tile or heavy concrete tile roofs), use the 20 lbs/ft<sup>2</sup> dead load tables.