Eligibility Checklist for Expedited Solar Photovoltaic Permitting for One and Two Family Dwellings

Effective October 1, 2015

Date: _____ Applicant Name: _____

Site Address: _____

Phone Number: _____ E-Mail Address: _____

Streamline? Yes _____ No _____ Permit Number: _____ Valuation: _____

GENERAL REQUIREMENTS

A. System size is 10 kW AC CEC rating or less — Yes ☐ No ☐

B. The solar array is roof-mounted on one-or two-family dwelling or accessory structure — Yes ☐ No ☐

C. The solar panel/module arrays will not exceed the maximum legal building height — Yes ☐ No ☐

D. Solar system is utility interactive and without battery storage — Yes ☐ No ☐

E. Permit application is completed and attached — Yes ☐ No ☐

ELECTRICAL REQUIREMENTS

A. No more than four photovoltaic module strings are connected to each Maximum Power Point Tracking (MPPT) input where source circuit fusing is included in the inverter. — Yes ☐ No ☐

1) No more than two strings per MPPT input where source circuit fusing is not included — Yes ☐ No ☐

2) Fuses (if needed) are rated to the series fuse rating of the PV module — Yes ☐ No ☐

3) No more than one noninverter-integrated DC combiner is utilized per inverter — Yes ☐ No ☐

B. For central inverter systems: No more than two inverters are utilized — Yes ☐ No ☐

C. The PV system is interconnected to a single-phase AC service panel of nominal 120/220 Vac with a bus bara rating of 225 A or less — Yes ☐ No ☐

D. The PV system is connected to the load side of the utility distribution equipment — Yes ☐ No ☐

E. A Solar PV Standard Plan and supporting documentation is completed and attached — Yes ☐ No ☐

STRUCTURAL REQUIREMENTS

A. A completed Structural Criterial and supporting documentation is attached (if required) — Yes ☐ No ☐

Continue to page 2 for additional requirements

FIRE SAFETY REQUIREMENTS

A.	Plans clearly show the roof layout including panels, modules, access pathways, and ventilation areas, locations of electrical disconnecting means, conduit and roof access points.	Yes ☐	No ☐
B.	Clear access pathways are provided with dimensions per CFC 605.11.3.2.1 through 605.11.3.2.3	Yes ☐	No ☐
C.	Three foot unobstructed fire ventilation area is provided at the ridge and dimensioned on the plans per CFC 605.11.3.2.4	Yes ☐	No ☐
D.	Examples of required markings and labels are provided per CFC 605.11.1	Yes ☐	No ☐
E.	Conduit shall not be installed in access pathways or within 3 feet of the ridge (interior or exterior).	Yes ☐	No ☐

NOTES:

1) ***Provide two (2) sets of plans.***
2) ***Plans must include Panel size and location.***
3) ***These criteria are intended for expedited solar permitting process.***
4) ***You can email you plans to solarpermits@cityofnapa.org, or fax to 707-257-9522***
5) ***If any items are checked NO, revise design to fit within Eligibility Checklist, otherwise permit application may go through standard process.***
6) ***For questions related to design requirements, contact the City of Napa Building Division at 707-257-9540, Fax 707-257-9522.***
7) ***For Fire District design requirements (access, pathways and ventilation area clearances) contact the Fire Prevention Division at 707-257-9590.***

Plan Submittal Checklist

1. All PV system plans shall show and/or specify in the following order.
   - ❑ A. Basic site plan provided showing location of structure and equipment
   - ❑ B. Array configuration and placement of equipment and modules on roof with dimensioned access and pathways.
   - ❑ C. Electrical single line drawing includes
     - ☐ showing size and location of the main electrical panel and sub panels
     - ☐ equipment grounding
     - ☐ combiner/junction box location
     - ☐ the AC/DC disconnect box
     - ☐ conduit size from the array to the power source
     - ☐ inverter string sizing or micro inverter branch circuit details
     - ☐ conductor wiring methods and insulation rating, system and solar panel grounding methods as per inverter and solar panel manufacturer's listings, and PV systems DC and AC disconnects
     - ☐ listing information, including mounting, wire type, method of grounding, of PV modules and mounting racks
   - ❑ D. Signage (on panel(s), disconnects and transmission line conductors)
   - ❑ E. Provide cut sheets for all PV equipment and mounting systems including, but not limited to:
     - ☐ PV modules
     - ☐ rack mounting system
     - ☐ mounting brackets
     - ☐ grounding hardware
     - ☐ inverters or micro inverters
   - ❑ F. Equipment type, listing, testing agency approvals, etc
   - ❑ G. Permanent labels and signage with red background and white lettering resistant to fading pursuant to UL 969 California Electrical Cod Article 690 and permanently affixed.
   - ❑ H. Plans must show compliance with California Fire Code.
   - ❑ I. Roof Design

CITY OF NAPA

COMMUNITY DEVELOPMENT DEPARTMENT
BUILDING DIVISION

Photovoltaic (PV) Systems Standard Inspection Checklist

Make sure all PV system AC/DC disconnects and circuit breakers are in the **open** position and verify the following:

	YES	NO
1. All work done in a neat and workmanlike manner (CEC 110.12).		
2. PV module model number, quantity and location according to the approved plan. Module manufacturer, make, model and number, fire classifications of modules and brackets match the approved plans.		
3. Array mounting system and structural connections according to the approved plan. Modules are attached to the mounting structure according to the manufacturer's instructions and the approved plans.		
4. Roof penetrations/attachments are properly flashed.		
5. Conduit installation according to: CRC R331.3, CEC 690.4(F) Article 358.10 (**The use of EMT in interior locations only**). *Conduit shall not be installed in access pathways or within 3 feet of the ridge (interior and exterior).*		
6. Roof access pathway clearances shall comply with CFC 605.11.3.2.1 through 605.11.3.2.3. Hip Roof: 3 foot path eave to ridge on each roof slope. Single Ridge: Two 3 foot paths from eave to ridge on each roof slope. Hip & Valley Roof: Panels no closer than 18 inches from the hip or valley when panels/modules are placed on both sides of the hip or valley.		
7. No panels, modules, conduit or other obstruction shall be installed within 3 feet of the ridge to provide a clear area for fire district smoke ventilation operations per CFC 605.11.3.2.4.		
8. Grounding/bonding of rack and modules according to the manufacturer's installation instructions that are approved and listed.		
9. PV system operating at 80 volts or greater shall be protected by a listed DC arc fault protection. (CEC 690.11).		
10. AC and DC modules, converters, combiners, inverters, disconnects, load centers and electrical service equipment are properly marked and labeled. (CEC 110.3, 690.4[D], 690.51 & 690.52).		
11. For grid-connected systems, inverter is marked "utility interactive."		
12. For ungrounded inverters, installation complies with CEC 690.35 requirements.		
13. Conductors and overcurrent devices are the type and size according to the approved plan.		

	YES	NO
14. Inverter output circuit breaker is located at opposite end of bus from utility supply at load center and/or service panel board (not required if the sum of the inverter and utility supply circuit breakers is less than or equal to the panel board bus rating).		
15. Modules and Racking systems are bonded and grounded in accordance with the manufacturer's installation instructions, that are listed and approved, using the supplied hardware or listed equipment specified in the instructions and identified for the environment. (CEC 690.43 & 110.3[B]).		
16. Properly sized equipment grounding conductor is routed with the circuit conductors. (CEC 690.45, 250.134[B] & 300.3[B]).		
17. Access and working space for operation and maintenance of PV equipment such as inverters, disconnecting means and panel boards (not required for PV modules) (CEC 110.26).		
18. Provide markings per CFC 605.11.1 including 3/8-inch (9.5 mm) minimum-sized white letters on a red background. The signs are made of reflective weather resistant material and installed every 10' and within 1 foot of turns and bends and within 1 foot above and below penetrations.		

The project shall be installed in accordance with the requirements set forth in the 2013 California Code of Regulations, Title 24, and local code amendments. For questions related to installation requirements, contact the City of Napa Building Division at 707-257-9540. For Fire District related requirements (access, pathways and ventilation area clearance contact the Fire Protection District Prevention Division at 707-257-9590.

NOTE:_____

Photovoltaic Systems Checklist Approved:

Permit #: _____

By: _____ Date: _____

SOLAR PV STANDAR PLAN

Roof Layout Diagram for One- and Two-Family Dwellings

Items required: roof layout of all panels, modules, clear access pathways and approximate locations of electrical disconnecting means and roof access points.

Solar PV Standard Plan – Simplified
Central/String Inverter System for One- and Two-Family Dwellings

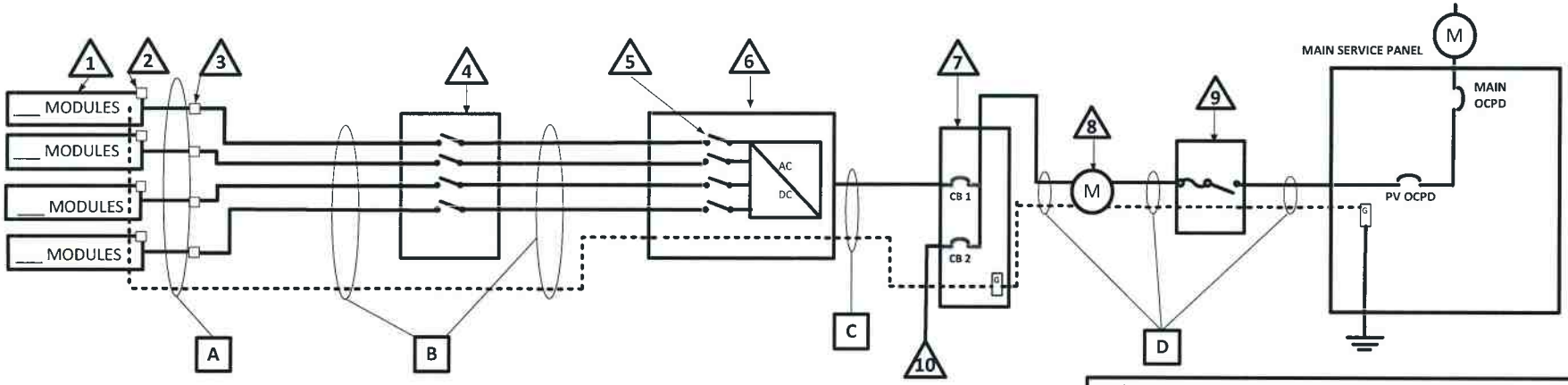
TAG	DESCRIPTION
1	SOLAR PV MODULE / STRING
2	DC/DC CONVERTERS INSTALLED? YES / NO (IF YES, STEPS 6 & 8 REQUIRED)
3	SOURCE CIRCUIT JUNCTION BOX INSTALLED?: YES / NO
4	SEPARATE DC DISCONNECT INSTALLED?: YES / NO
5	INTERNAL INVERTER DC DISCONNECT: YES / NO
6	CENTRAL INVERTER
7	LOAD CENTER INSTALLED?: YES / NO
8	PV PRODUCTION METER INSTALLED?: YES / NO
9	*SEPARATE AC DISCONNECT INSTALLED?: YES / NO
10	CONNECT TO INVERTER #2 (USE LINE DIAGRAM 2)

* Consult with your local AHJ and /or Utility

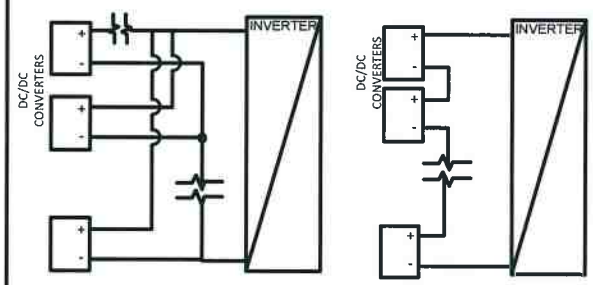
SINGLE-LINE DIAGRAM #1 – NO STRINGS COMBINED PRIOR TO INVERTER

CHECK A BOX FOR WHETHER SYSTEM IS GROUNDED OR UNGROUNDED: ☐ GROUNDED (INCLUDE GEC) ☐ UNGROUNDED

FOR UNGROUNDED SYSTEMS:
- DC OCPD MUST DISCONNECT BOTH CONDUCTORS OF EACH SOURCE CIRCUIT
- UNGROUNDED CONDUCTORS MUST BE IDENTIFIED PER 210.5(C). WHITE-FINISHED CONDUCTORS ARE NOT PERMITTED.



IF DC/DC CONVERTERS ARE USED, CHECK THE BOX BELOW THE CORRESPONDING CONFIGURATION



☐ PARALLEL DC/DC CONVERTERS ON ONE SOURCE CIRCUIT (FIXED UNIT VOLTAGE DC/DC CONVERTERS)

☐ DC/DC CONVERTERS ARE ALL RUN IN SERIES (FIXED SOURCE CIRCUIT VOLTAGE DC/DC CONVERTERS)

CONDUCTOR/CONDUIT SCHEDULE

☐ TAG	DESCRIPTION AND CONDUCTOR TYPE	CONDUCTOR SIZE	NUMBER OF CONDUCTORS	CONDUIT/CABLE TYPE	CONDUIT SIZE
A	USE-2 ☐ OR PV-WIRE ☐				
	EGC/GEC:				
B					
	EGC/GEC:				
C					
	EGC/GEC:				
D					
	EGC/GEC:				

ENTER "N/A" WHERE SUITABLE FOR WHEN NOT USING CONDUIT OR CABLE AS PERMITTED BY CODE

Solar PV Standard Plan – Simplified
Central/String Inverter System for One- and Two-Family Dwellings

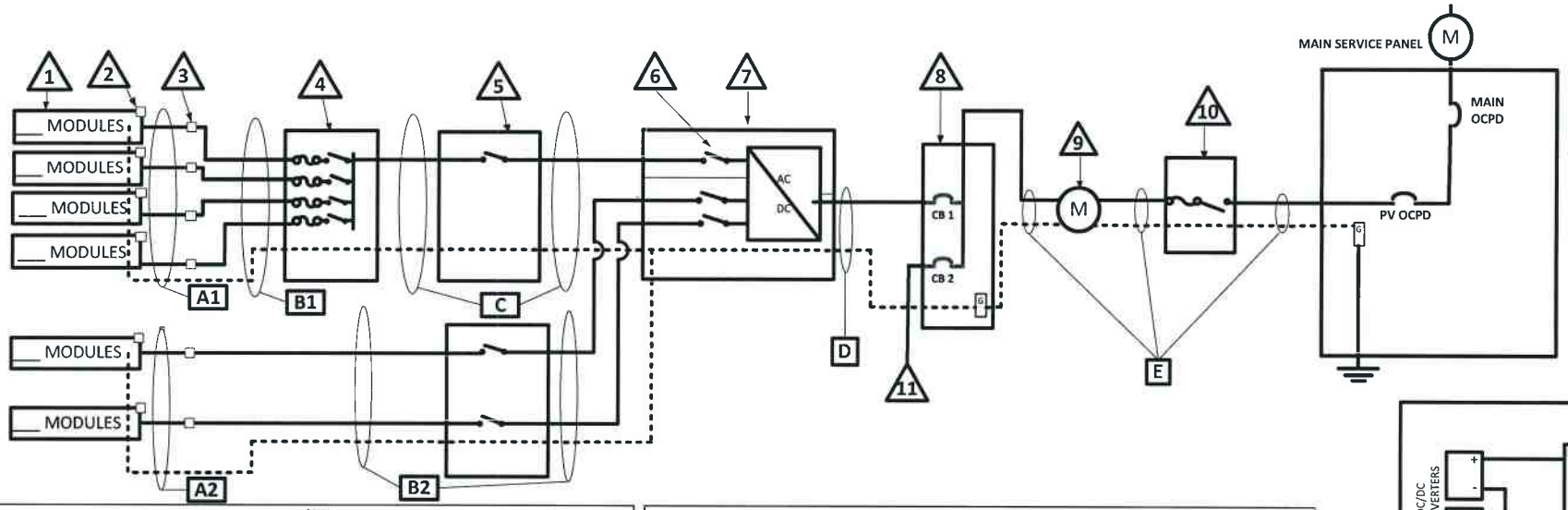
TAG	DESCRIPTION
1	SOLAR PV MODULE / STRING
2	DC/DC CONVERTERS INSTALLED? YES / NO (IF YES, STEPS 6 & 8 REQUIRED)
3	SOURCE CIRCUIT JUNCTION BOX INSTALLED?: YES / NO
4	COMBINER BOX (STEPS 11 & 12 REQUIRED)
5	SEPARATE DC DISCONNECT INSTALLED?: YES / NO
6	INTERNAL INVERTER DC DISCONNECT: YES / NO
7	CENTRAL INVERTER
8	LOAD CENTER INSTALLED?: YES / NO
9	PV PRODUCTION METER INSTALLED?: YES / NO
10	*SEPARATE AC DISCONNECT INSTALLED?: YES / NO
11	CONNECT TO INVERTER #2 (USE LINE DIAGRAM 4)

* Consult with your local AHJ and /or Utility

SINGLE-LINE DIAGRAM #2 – COMBINING STRINGS PRIOR TO INVERTER

CHECK A BOX FOR WHETHER SYSTEM IS GROUNDED OR UNGROUNDED: ☐ GROUNDED (INCLUDE GEC) ☐ UNGROUNDED

FOR UNGROUNDED SYSTEMS:
- DC OCPD MUST DISCONNECT BOTH CONDUCTORS OF EACH SOURCE CIRCUIT
- UNGROUNDED CONDUCTORS MUST BE IDENTIFIED PER 210.5(C). WHITE-FINISHED CONDUCTORS ARE NOT PERMITTED.



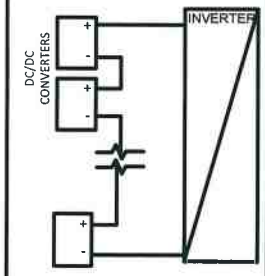
COMBINER CONDUCTOR/CONDUIT SCHEDULE

☐ TAG	DESCRIPTION AND CONDUCTOR TYPE	CONDUCTOR SIZE	NUMBER OF CONDUCTORS	CONDUIT/CABLE TYPE	CONDUIT SIZE
A1	USE-2 ☐ OR PV-WIRE ☐				
	EGC/GEC:				
B1					
	EGC/GEC:				
C					
	EGC/GEC:				
D					
	EGC/GEC:				
E					
	EGC/GEC:				

NON-COMBINED STRINGS CONDUCTOR/CONDUIT SCHEDULE (IF APPLICABLE)

☐ TAG	DESCRIPTION AND CONDUCTOR TYPE	CONDUCTOR SIZE	NUMBER OF CONDUCTORS	CONDUIT/CABLE TYPE	CONDUIT SIZE
A2	USE-2 ☐ OR PV-WIRE ☐				
	EGC/GEC:				
B2					
	EGC/GEC:				

ENTER "N/A" WHERE SUITABLE FOR WHEN NOT USING CONDUIT OR CABLE AS PERMITTED BY CODE



IF DC/DC CONVERTERS ARE USED, THEY ARE RUN IN SERIES (FIXED SOURCE CIRCUIT VOLTAGE DC/DC CONVERTERS)

Solar PV Standard Plan — Simplified
Central/String Inverter Systems for One- and Two-Family Dwellings

Supplemental Calculation Sheets for Inverter #2
(Only include if second inverter is used)

DC Information:

Module Manufacturer: _____ Model: _____

S2) Module V_{oc} (from module nameplate): _____Volts | S3) Module I_{sc} (from module nameplate): _____Amps

S4) Module DC output power under standard test conditions (STC) = _____ Watts (STC)

S5) DC Module Layout

Identify each source circuit (string) for inverter 1 shown on the roof plan with a Tag (e.g., A, B, C ...)	Number of modules per source circuit for inverter 1	Identify, by tag, which source circuits on the roof are to be paralleled (if none, put N/A)
		Combiner 1:
		Combiner 2:
Total number of source circuits for inverter 1:		

S6) Are DC/DC Converters used? ☐ Yes ☐ No If No, skip to STEP#S7. If Yes, enter info below.

DC/DC Converter Model #: _____

Max DC Output Current: _____ Amps

Max # of DC/DC Converters in a source circuit: _____

DC/DC Converter Max DC Input Voltage: _____Volts

Max DC Output Voltage: _____Volts

DC/DC Converter Max DC Input Power: _____Watts

S7) Max. System DC Voltage – Use A1 or A2 for systems without DC/DC converters, and B1 or B2 with DC/DC converters.

☐ A1. Module V_{OC} (STEP S2) = _____ x # in series (STEP S5)_____x 1.12 (If $-1 \leq T_L \leq -5°C$, STEP S1) = _____ V

☐ A2. Module V_{OC} (STEP S2) = _____ x # in series (STEP S5)_____x 1.14 (If $-6 \leq T_L \leq -10°C$, STEP S1) = _____ V

Table 1. Maximum Number of PV Modules in Series Based on Module Rated VOC for 600 Vdc Rated Equipment (CEC 690.7)

Max. Rated Module VOC (*1.12) (Volts)	29.76	31.51	33.48	35.71	38.27	41.21	44.64	48.70	53.57	59.52	66.96	76.53	89.29
Max. Rated Module VOC (*1.14) (Volts)	29.24	30.96	32.89	35.09	37.59	40.49	43.86	47.85	52.63	58.48	65.79	75.19	87.72
Max # of Modules for 600 Vdc	18	17	16	15	14	13	12	11	10	9	8	7	6

Use for DC/DC converters. The value calculated below must be less than DC/DC converter max DC input voltage (STEP #S6).

☐ B1. Module V_{OC} (STEP#S2) _____ x # of modules per converter (STEP S6) ____x 1.12 (If $-1 \leq T_L \leq -5°C$, STEP S1) = _____ V

☐ B2. Module V_{OC} (STEP#S2) _____ x # of modules per converter (STEP S6) ____x 1.14 (If $-6 \leq T_L \leq -10°C$, STEP S1) = ____ V

Table 2. Largest Module VOC for Single-Module DC/DC Converter Configurations (With 80V AFCI Cap) (CEC 690.7 and 690.11)

Max. Rated Module VOC (*1.12) (Volts)	30.4	33.0	35.7	38.4	41.1	43.8	46.4	49.1	51.8	54.5	57.1	59.8	62.5	65.2	67.9	70.5
Max. Rated Module VOC (*1.14) (Volts)	29.8	32.5	35.1	37.7	40.4	43.0	45.6	48.2	50.9	53.5	56.1	58.8	61.4	64.0	66.7	69.3
DC/DC Converter Max DC Input (STEP #6) (Volts)	34	37	40	43	46	49	52	55	58	61	64	67	70	73	76	79

S8) Maximum System DC Voltage from DC/DC Converters to Inverter – Only required if Yes in STEP S6

Maximum System DC Voltage = _____ Volts

S9) Maximum Source Circuit Current

Is Module ISC below 9.6 Amps (STEP S3)? ☐ Yes ☐ No (if No, use Comprehensive Standard Plan)

S10) Sizing Source Circuit Conductors:

Source Circuit Conductor Size = Min. #10 AWG copper conductor, 90°C wet (USE-2, PV Wire, XHHW-2, THWN-2, RHW-2)

For up to 8 conductors in roof-mounted conduit exposed to sunlight at least ½" from the roof covering (CEC 310)

Note: For over 8 conductors in the conduit or mounting height of lower than ½"from the roof, use Comprehensive Plan.

S11) Are PV source circuits combined prior to the inverter? ☐Yes ☐No

If No, use Single Line Diagram 1 with Single Line Diagram 3 and proceed to STEP S13.

If Yes, use Single Line Diagram 2 with Single Line Diagram 4 and proceed to STEP S12.

Is source circuit OCPD required? ☐ Yes ☐ No

Source circuit OCPD size (if needed): 15 Amps

S12) Sizing PV Output Circuit Conductors – If a Combiner box will NOT be used from [STEP#S11],

Output Circuit Conductor Size = Min. #6 AWG copper conductor

S13) Inverter DC Disconnect

Does the inverter have an integrated DC disconnect? ☐ Yes ☐ No If yes, proceed to STEP S14.

If No, the external DC disconnect to be installed is rated for _____ Amps (DC) and _____Volts (DC)

S14) Inverter information:
Manufacturer: _____ Model: _____
Max. Continuous AC Output Current Rating: _____ Amps
Integrated DC Arc-Fault Circuit Protection? ☐ Yes ☐ No (If No is selected, Comprehensive Standard Plan)
Grounded or Ungrounded System: ☐GROUNDED ☐ UNGROUNDED

AC Information:

S15) Sizing Inverter Output Circuit Conductors and OCPD:
Inverter Output OCPD rating = _____ Amps (Table 3)
Inverter Output Circuit Conductor Size = _____ AWG (Table 3)

Table 3. Minimum Inverter Output OCPD and Circuit Conductor Size

Inverter Continuous Output Current Rating (Amps) (STEP 14)	12	16	20	24	28	32	36	40	48
Minimum OCPD Size (Amps)	15	20	25	30	35	40	45	50	60
Minimum Conductor Size (AWG, 75°C, Copper)	14	12	10	10	8	8	6	6	6

Load Center Calculations
(Omit if a load center will not be installed for PV OCPDs)

S20) Load Center Output:
Calculate the sum of the maximum AC outputs from each inverter.
Inverter #1 Max Continuous AC Output Current Rating[STEP S14] _____ × 1.25 = _____ Amps
Inverter #2 Max Continuous AC Output Current Rating[STEP S14] _____ × 1.25 = _____ Amps
Total inverter currents connected to load center (sum of above) = _____ Amps

Conductor Size: _____ AWG
Overcurrent Protection Device: _____ Amps
Load center bus bar rating: _____ Amps
The sum of the ampere ratings of overcurrent devices in circuits supplying power to a bus bar or conductor shall not exceed 120 percent of the rating of the bus bar or conductor.

Solar PV Standard Plan – Simplified
Central/String Inverter System for One- and Two-Family Dwellings

TAG	DESCRIPTION
1	SOLAR PV MODULE / STRING
2	DC/DC CONVERTERS INSTALLED? YES / NO (IF YES, STEPS 6 & 8 REQUIRED)
3	SOURCE CIRCUIT JUNCTION BOX INSTALLED?: YES / NO
4	SEPARATE DC DISCONNECT INSTALLED?: YES / NO
5	INTERNAL INVERTER DC DISCONNECT: YES / NO
6	CENTRAL INVERTER
7	*SEPARATE AC DISCONNECT INSTALLED?: YES / NO
8	TO LOAD CENTER ON LINE DIAGRAM 1

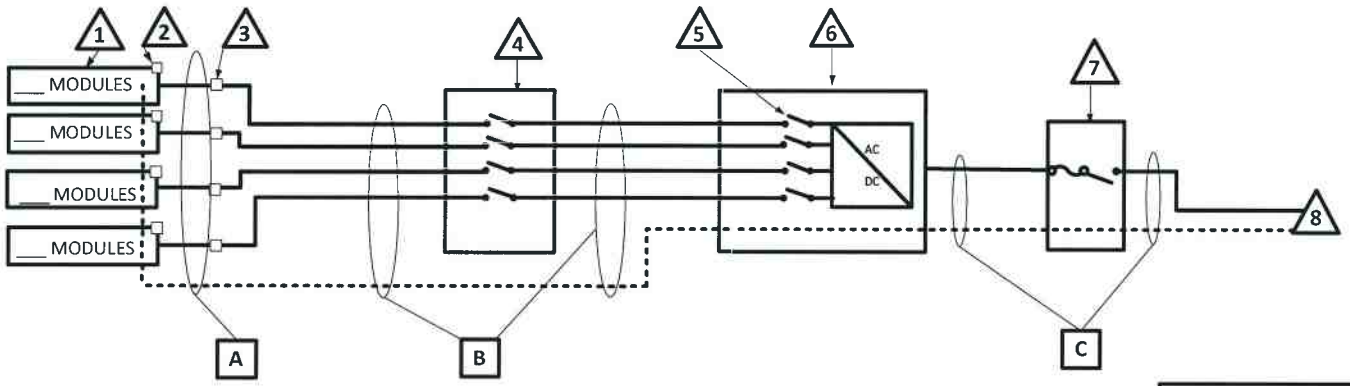
* Consult with your local AHJ and /or Utility

SINGLE-LINE DIAGRAM #3 – ADDITIONAL INVERTER FOR DIAGRAM #1

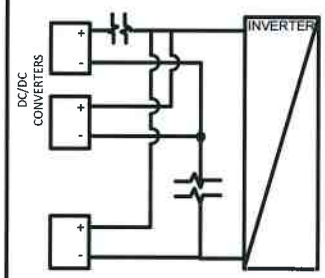
INVERTER # 2

CHECK A BOX FOR WHETHER SYSTEM IS GROUNDED OR UNGROUNDED: ☐ GROUNDED (INCLUDE GEC) ☐ UNGROUNDED

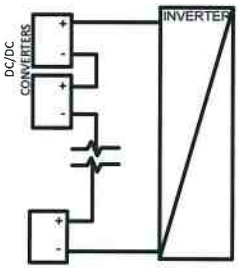
FOR UNGROUNDED SYSTEMS:
- DC OCPD MUST DISCONNECT BOTH CONDUCTORS OF EACH SOURCE CIRCUIT
- UNGROUNDED CONDUCTORS MUST BE IDENTIFIED PER 210.5(C). WHITE-FINISHED CONDUCTORS ARE NOT PERMITTED.



IF DC/DC CONVERTERS ARE USED, CHECK THE BOX BELOW THE CORRESPONDING CONFIGURATION



☐ PARALLEL DC/DC CONVERTERS ON ONE SOURCE CIRCUIT (FIXED UNIT VOLTAGE DC/DC CONVERTERS)



☐ DC/DC CONVERTERS ARE ALL RUN IN SERIES (FIXED SOURCE CIRCUIT VOLTAGE DC/DC CONVERTERS)

CONDUCTOR/CONDUIT SCHEDULE

☐ TAG	DESCRIPTION AND CONDUCTOR TYPE	CONDUCTOR SIZE	NUMBER OF CONDUCTORS	CONDUIT/CABLE TYPE	CONDUIT SIZE
A	USE-2 ☐ OR PV-WIRE ☐				
	EGC/EGC:				
B					
	EGC/EGC:				
C					
	EGC/EGC:				

ENTER "N/A" WHERE SUITABLE FOR WHEN NOT USING CONDUIT OR CABLE AS PERMITTED BY CODE

Solar PV Standard Plan – Simplified
Central/String Inverter System for One- and Two-Family Dwellings

TAG	DESCRIPTION
1	SOLAR PV MODULE / STRING
2	DC/DC CONVERTERS INSTALLED? YES / NO (IF YES, STEPS 6 & 8 REQUIRED)
3	SOURCE CIRCUIT JUNCTION BOX INSTALLED?: YES / NO
4	COMBINER BOX (STEPS 11 & 12 REQUIRED)
5	SEPARATE DC DISCONNECT INSTALLED?: YES / NO
6	INTERNAL INVERTER DC DISCONNECT: YES / NO
7	CENTRAL INVERTER
8	*SEPARATE AC DISCONNECT INSTALLED?: YES / NO
9	TO LOAD CENTER ON LINE DIAGRAM 3

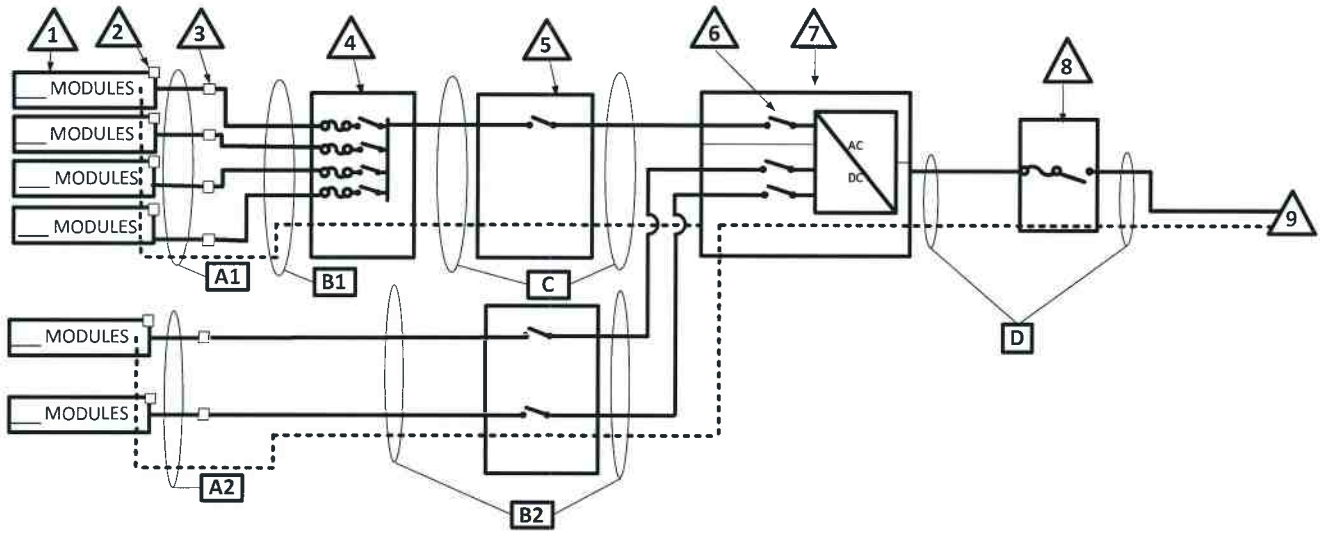
* Consult with your local AHJ and /or Utility

SINGLE-LINE DIAGRAM #4 – ADDITIONAL INVERTER FOR DIAGRAM #2

INVERTER # 2

CHECK A BOX FOR WHETHER SYSTEM IS GROUNDED OR UNGROUNDED: ☐ GROUNDED (INCLUDE GEC) ☐ UNGROUNDED

FOR UNGROUNDED SYSTEMS:
- DC OCPD MUST DISCONNECT BOTH CONDUCTORS OF EACH SOURCE CIRCUIT
- UNGROUNDED CONDUCTORS MUST BE IDENTIFIED PER 210.5(C). WHITE-FINISHED CONDUCTORS ARE NOT PERMITTED.



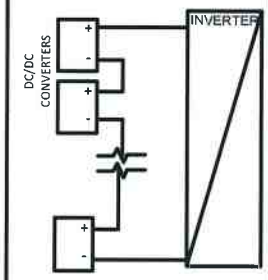
COMBINER CONDUCTOR/CONDUIT SCHEDULE

☐ TAG	DESCRIPTION AND CONDUCTOR TYPE	CONDUCTOR SIZE	NUMBER OF CONDUCTORS	CONDUIT/CABLE TYPE	CONDUIT SIZE
A1	USE-2 ☐ OR PV-WIRE ☐				
	EGC/GEC:				
B1					
	EGC/GEC:				
C					
	EGC/GEC:				
D					
	EGC/GEC:				

NON-COMBINED STRINGS CONDUCTOR/CONDUIT SCHEDULE (IF APPLICABLE)

☐ TAG	DESCRIPTION AND CONDUCTOR TYPE	CONDUCTOR SIZE	NUMBER OF CONDUCTORS	CONDUIT/CABLE TYPE	CONDUIT SIZE
A2	USE-2 ☐ OR PV-WIRE ☐				
	EGC/GEC:				
B2					
	EGC/GEC:				

ENTER "N/A" WHERE SUITABLE FOR WHEN NOT USING CONDUIT OR CABLE AS PERMITTED BY CODE



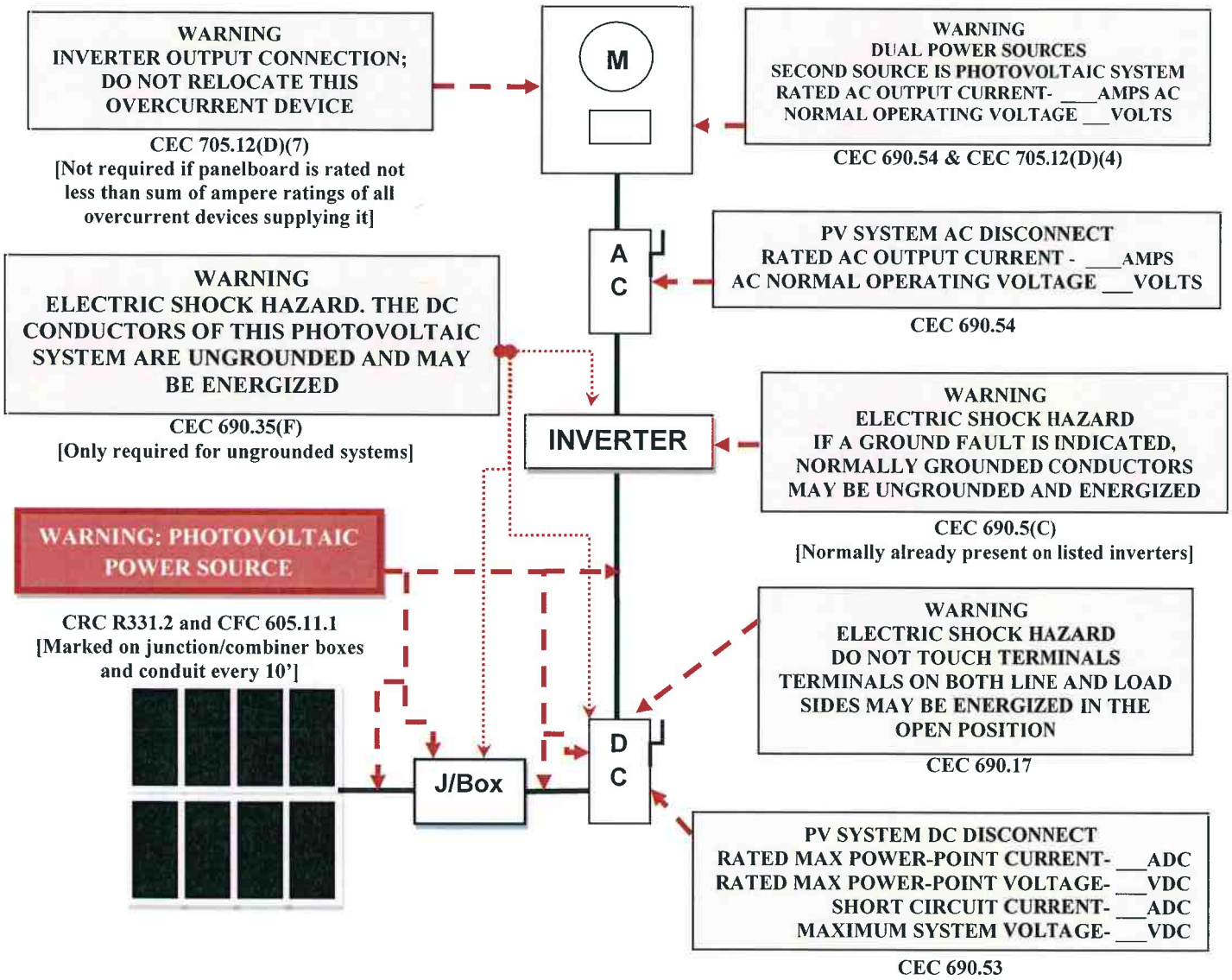
IF DC/DC CONVERTERS ARE USED, THEY ARE RUN IN SERIES (FIXED SOURCE CIRCUIT VOLTAGE DC/DC CONVERTERS)

Solar PV Standard Plan – Simplified

Central/String Inverter Systems for One- and Two-Family Dwellings

Markings

CEC Articles 690 and 705 and CRC Section R331 require the following labels or markings be installed at these components of the photovoltaic system:



Code Abbreviations:
California Electrical Code (CEC)
California Residential Code (CRC)
California Fire Code (CFC)

Informational note: ANSI Z535.4 provides guidelines for the design of safety signs and labels for application to products. 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.

CEC 705.12 requires a permanent plaque or directory denoting all electric power sources on or in the premises.

STRUCTURAL CRITERIA FOR RESIDENTIAL FLUSH-MOUNTED SOLAR ARRAYS

1. ROOF CHECKS

A. Visual Review/Contractor's Site Audit of Existing Conditions:

1) Is the roof a single roof without a reroof overlay? ☐ Y ☐ N

2) Does the roof structure appear structurally sound, without signs of alterations or significant structural deterioration or sagging, as illustrated in Figure 1? ☐ Y ☐ N

B. Roof Structure Data:

1) Measured roof slope (e.g. 6:12): _____:12

2) Measured rafter spacing (center-to-center): _____ inch

3) Type of roof framing (rafter or manufactured truss): ☐ Rafter ☐ Truss

2. SOLAR ARRAY CHECKS

A. Flush-mounted Solar Array:

1) Is the plane of the modules (panels) parallel to the plane of the roof? ☐ Y ☐ N

2) Is there a 2" to 10" gap between underside of module and the roof surface? ☐ Y ☐ N

3) Modules do not overhang any roof edges (ridges, hops, gable ends, eaves)? ☐ Y ☐ N

B. Do the modules plus support components weigh no more than: 4 psf for photovoltaic arrays or 5 psf for solar thermal arrays? ☐ Y ☐ N

C. Does the array cover no more than half of the total roof area (all roof planes)? ☐ Y ☐ N

D. Are solar support component manufacturer's project-specific completed worksheets, tables with relevant cells circled, or web-based calculator results attached? ☐ Y ☐ N

E. Is a roof plan of the module and anchor layout attached? (see Figure 2) ☐ Y ☐ N

F. Downward Load Check (Anchor Layout Check):

1) Proposed anchor horizontal spacing (see Figure 2): ____' - ____"ft-in

2) Horizontal anchor spacing per Table 1: ____' - ____"ft-in

3) Is proposed anchor horizontal spacing less than Table 1 spacing? ☐ Y ☐ N

G. Wind Uplift Check (Anchor Fastener Check):

1) Anchor fastener data (see Figure 3):

a. Diameter of lag screw, hanger bolt or self-drilling screw: _____ inch

b. Embedment depth of rafter: _____ inch

c. Number of screws per anchor (typically one): _____

d. Are 5/16" diameter lag screws with 2.5" embedment into the rafter used, OR does the anchor fastener meet the manufacturer's guidelines? ☐ Y ☐ N

3. SUMMARY

A. All items above are checked YES. No additional calculations are required.

B. One or more items are checked NO. Attach project-specific drawings and calculations stamped and signed by a California-licensed Civil or Structural Engineer.

Job Address: _____ Permit #: _____

Contractor/Installer: _____ License # & Class: _____

Signature: _____ Date: _____ Phone #: _____

Optional Additional Rafter Span Check Criteria

[At option of CBO, insert rows (4) to (7) below into table above after row 1.B.(3)]

1. ROOF CHECKS

B. Roof Structure Data:

4) Measured rafter size (e.g. 13/4 x 33/4, not 2x4): ____ x ____ inch

5) Measured rafter horizontal span (see Figure 4): ____' - ____"ft-in

6) Horizontal rafter span per Table 2: ____' - ____"ft-in

7) Is measured horizontal rafter span less than Table 2 span? ☐ Y ☐ N ☐ Truss

Table 1: Maximum Horizontal Anchor Spacing				
Roof Slope		Rafter Spacing		
		16" o.c.	24" o.c.	32" o.c.
Photovoltaic Arrays (4 psf max)				
Flat to 6:12	0° to 26°	5'-4"	6'-0"	5'-4"
7:12 to 12:12	27° to 45°	1'-4"	2'-0"	2'-8"
13:12 to 24:12	46° to 63°	1'-4"	2'-0"	2'-8"
Solar Thermal Arrays (5 psf max)				
Flat to 6:12	0° to 26°	4'-0"	4'-0"	5'-4"
7:12 to 12:12	27° to 45°	1'-4"	2'-0"	2'-8"
13:12 to 24:12	46° to 63°	Calc. Req'd	Calc. Req'd	Calc. Req'd

Solar support component manufacturer's guidelines may be relied upon to ensure the array above the roof is properly designed, but manufacturer's guidelines typically do NOT check to ensure that the roof itself can support the concentrated loads from the solar array. Table 1 assumes that the roof complied with the building code in effect at the time of construction, and places limits on anchor horizontal spacing to ensure that a roof structure is not overloaded under either downward loads or wind uplift loads. Note 4 below lists the basic assumptions upon which this table is based.

Table 1 Notes:

1. Anchors are also known as "stand-offs", "feet", "mounts" or "points of attachment". Horizontal anchor spacing is also known as "cross-slope" or "east-west" anchor spacing (see Figure 2).
2. If anchors are staggered from row-to-row going up the roof, the anchor spacing may be twice that shown above, but no greater than 6'-0".
3. For manufactured plated wood trusses at slopes of flat to 6:12, the horizontal anchor spacing shall not exceed 4'-0" and anchors in adjacent rows shall be staggered.
4. This table is based on the following assumptions:
   - The roof structure conformed to building code requirements at the time it was built.
   - The attached list of criteria are met.
   - Mean roof height is not greater than 40 feet.
   - Roof sheathing is at least 7/16" thick oriented strand board or plywood. 1x skip sheathing is acceptable.
   - If the dwelling is in Wind Exposure B (typical urban, suburban or wooded areas farther than 500
   - yards from large open fields), no more than one of the following conditions apply:
     - The dwelling is located in a special wind region with design wind speed between 115 and 130
   - mph per ASCE 7-10, or
     - The dwelling is located on the top half of a tall hill, provided average slope steeper is less than 15%.
   - If the dwelling is In Wind Exposure C (within 500 yards of large open fields or grasslands), all of the
   - following conditions apply:
     - Design wind speed is 110 mph or less (not in a Special Wind Region), and
     - The dwelling is not located on the top half of a tall hill.
   - The solar array displaces roof live loads (temporary construction loads) that the roof was originally
   - designed to carry.
   - The Structural Technical Appendix provides additional information about analysis assumptions.

Table 2. Roof Rafter Maximum Horizontal Span (feet - inches) [1]								
Assumed Vintage	Nominal Size	Actual Size	Non-Tile Roof [2]			Tile Roof [3]		
			Rafter Spacing					
			16" o.c.	24" o.c.	32" o.c.	16" o.c.	24" o.c.	32" o.c.
Post-1960	2x4	1½"x3½"	9'-10"	8'-0"	6'-6"	8'-6"	6'-11"	5'-6"
	2x6	1½"x5½"	14'-4"	11'-9"	9'-6"	12'-5"	10'-2"	8'-0"
	2x8	1½"x7¼"	18'-2"	14'-10"	12'-0"	15'-9"	12'-10"	10'-3"
Pre-1960	2x4	1¾"x3¾"	11'-3"	9'-9"	7'-9"	10'-3"	8'-6"	6'-9"
	2x6	1¾"x5¾"	17'-0"	14'-0"	11'-3"	14'-9"	12'-0"	9'-9"
	2x8	1¾"x7¾"	22'-3"	18'-0"	14'-6"	19'-0"	15'-6"	12'-6"

Beyond a visual review by the Contractor checking for unusual sagging or deterioration, some CBOs may want additional assurance that the roof structure complies with structural building code requirements. Table 2 is an optional table some CBOs may elect to use to provide additional assurance by requiring a check of existing roof rafter spans, and supports optional criteria 1.B.5 and 1.B.6. For post-1960 construction, these span tables match the rafter span tables found in the 2013 California Building and Residential codes. For pre-1960 construction, the rafter span tables are based on structural calculations with lumber sizes and wood species & grade appropriate for older construction. Note 5 below lists the basic assumptions upon which this table is based.

Table 2 Notes:

1. See Figure 4 for definition of roof rafter maximum horizontal span.
2. "Non-tile Roof " = asphalt shingle, wood shingle & wood shake, with an assumed roof assembly weight of 10 psf.
3. "Tile Roof " = clay tile or cement tile, with an assumed roof assembly weight of 20psf
4. Unaltered manufactured plated-wood trusses may be assumed to be code compliant and meet intent of Table 2.
5. This table is based on the following assumptions:
    - Span/deflection ratio is equal to or greater than 180.
    - For post-1960 construction, wood species and grade is Douglas Fir-Larch No. 2.
    - For pre-1960 construction, wood species and grade is Douglas Fir-Larch No. 1.
    - Other wood species and/or grade are also acceptable if allowable bending stress is equal or greater to that listed above.

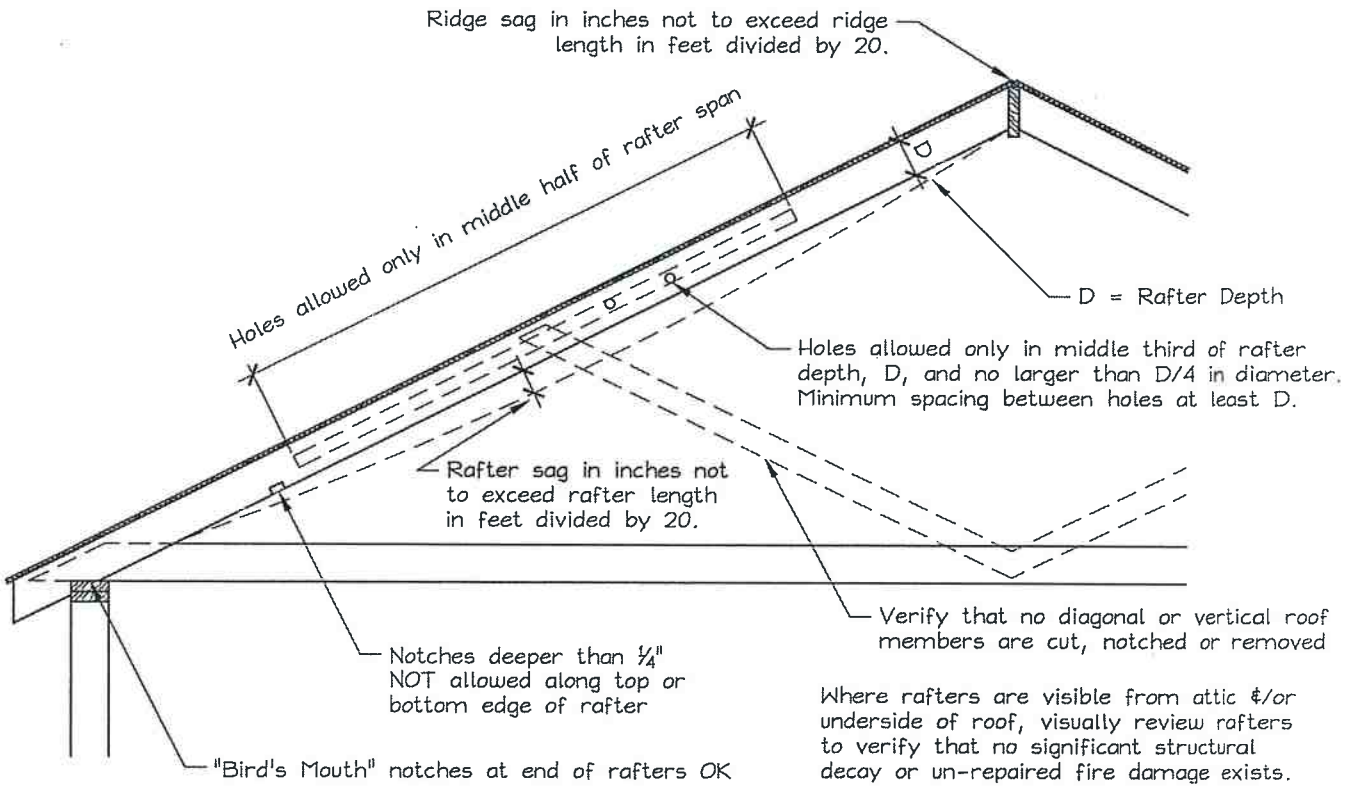


Figure 1. Roof Visual Structural Review (Contractor's Site Audit) of Existing Conditions.

The site auditor should verify the following:

6. No visually apparent disallowed rafter holes, notches and truss modifications as shown above.
7. No visually apparent structural decay or un-repaired fire damage.
8. Roof sag, measured in inches, is not more than the rafter or ridge beam length in feet divided by 20.

Rafters that fail the above criteria should not be used to support solar arrays unless they are first strengthened.

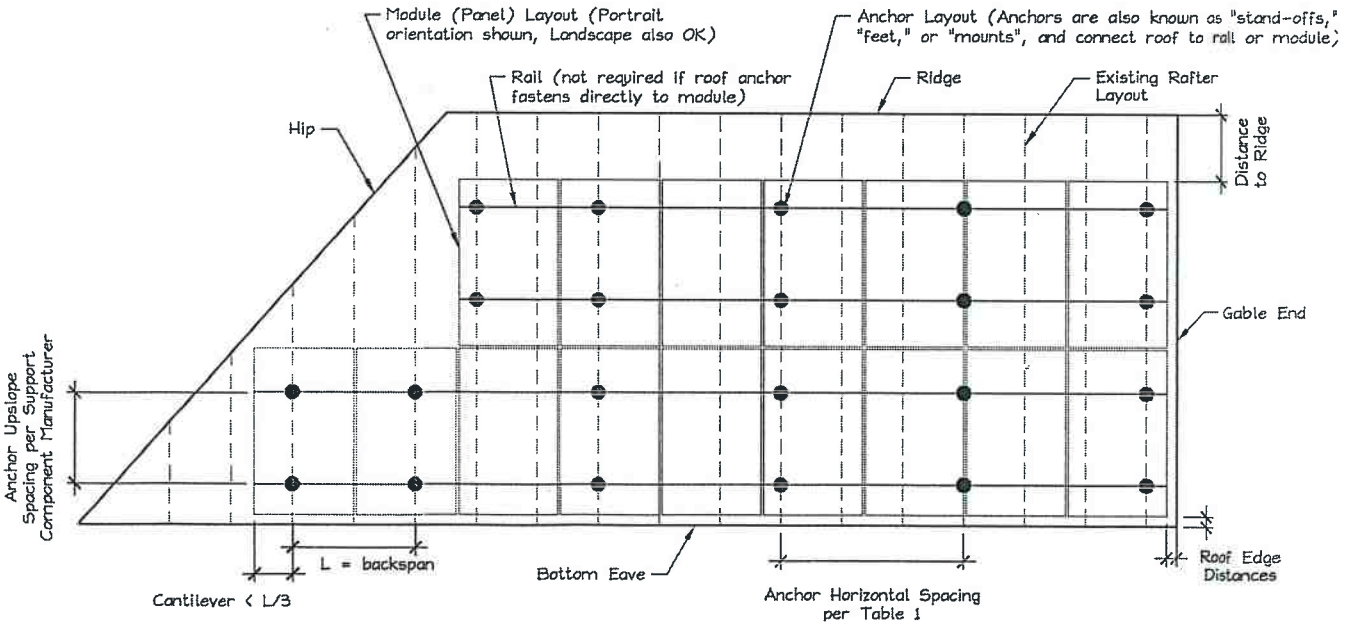


Figure 2. Sample Solar Panel Array and Anchor Layout Diagram (Roof Plan).

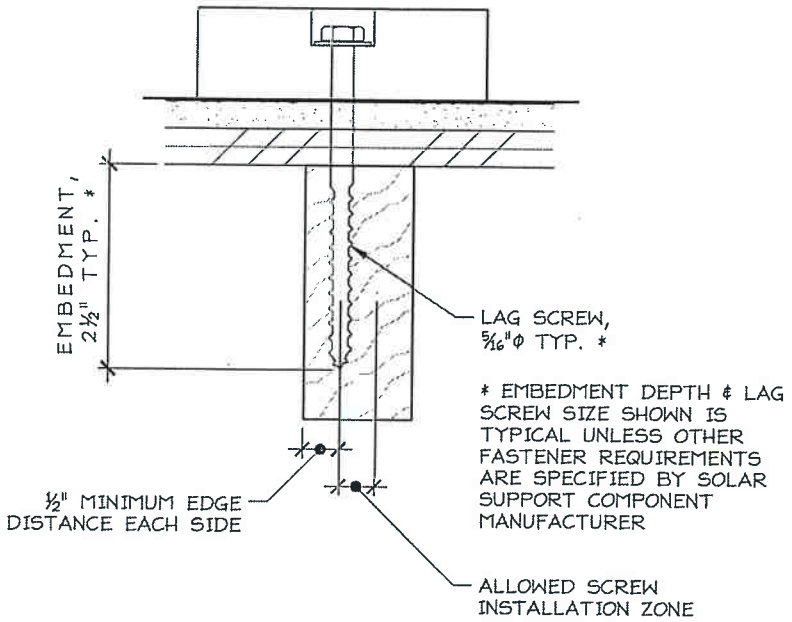


Figure 3. Typical Anchor with Lag Screw Attachment.

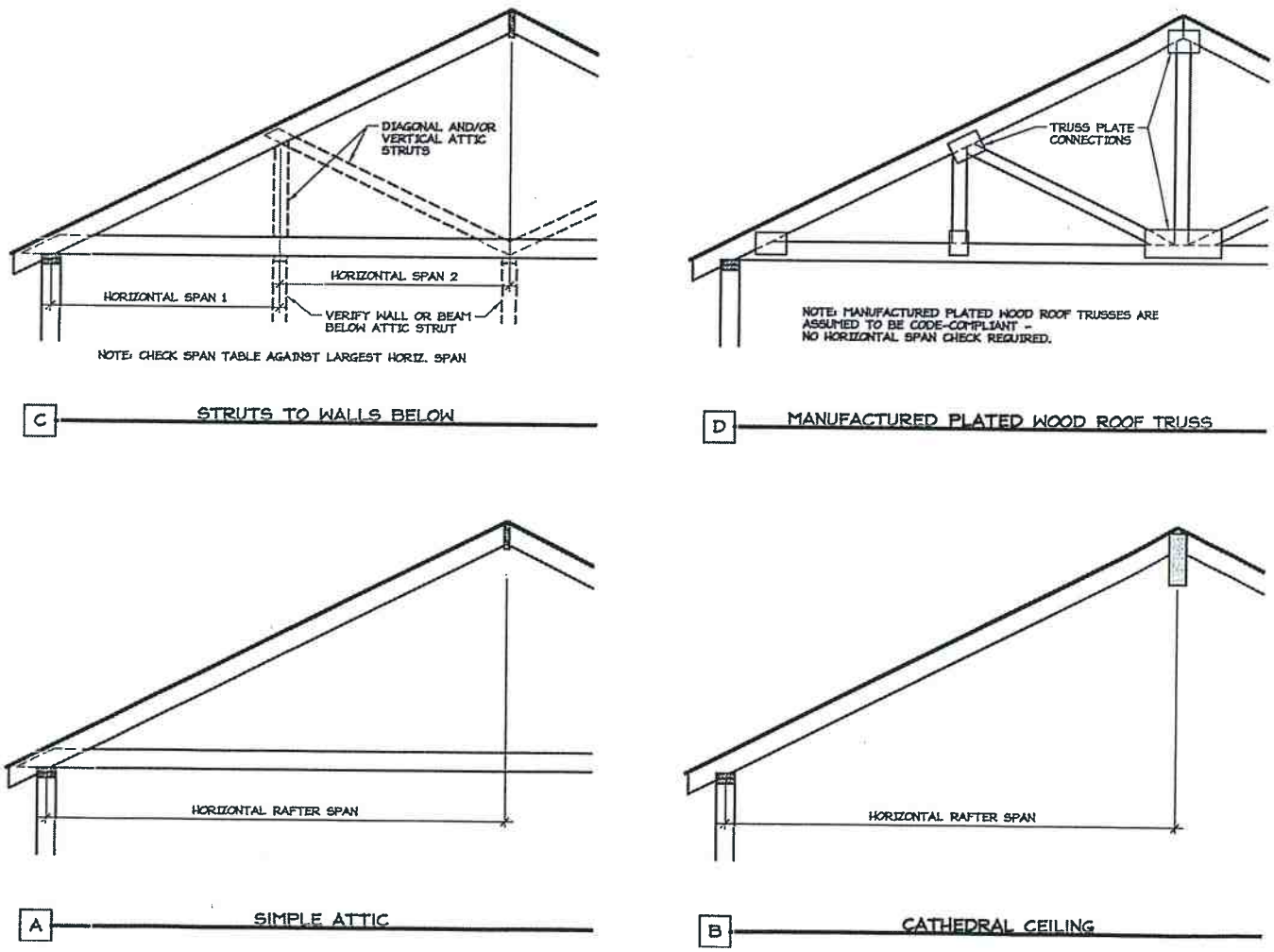


Figure 4. Definition of Rafter Horizontal Span.