SOLAR STANDARD PLAN – SIMPLIFIED
Central/String Inverter Systems for One and Two Family Dwellings

SCOPE: Use this plan ONLY for utility-interactive central/string inverter systems not exceeding a system ac inverter output rating of 10kW on the roof of a one- or two-family dwelling or accessory structure. The photovoltaic system must interconnect to the load side of a single-phase ac service panel of nominal 120/240Vac with a busbar rating of 225A or less. This plan is not intended for bipolar systems, hybrid systems, or systems that utilize storage batteries, charge controllers, trackers, more than two inverters, or more than one dc combiner (non-inverter-integrated) per inverter. Systems must be in compliance with current California Building Standards Codes and local amendments of the authority having jurisdiction (AHJ). Other Articles of the California Electrical Code (CEC) shall apply as specified in 690.3.

MANUFACTURER’S SPECIFICATION SHEETS MUST BE PROVIDED for proposed inverter, modules, combiner/junction boxes, and racking systems. Installation instructions for bonding and grounding equipment shall be provided, and local AHJs may require additional details. Listed and labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling (CEC 110.3). Equipment intended for use with PV system shall be identified and listed for the application (CEC 690.4(D)).

Job Address: ____________________________ Permit #: ____________________________

Contractor/Engineer Name: ____________________________ License # and Class: ____________

Signature: ____________________________ Date: ____________ Phone Number: ____________________________

Total # of inverters installed: _________ (If more than one inverter, complete and attach the “Supplemental Calculation Sheets” on pages 7 and 8 and the “Load Center Calculations” on page 8 if a new load center is to be used)

| Inverter 1 AC Output Power Rating: | _________ Watts |
| Inverter 2 AC Output Power Rating (if applicable): | _________ Watts |
| Combined Inverter Output Power Rating: | _________ ≤ 10,000 Watts |

Location Ambient Temperatures (Check box next to which lowest expected temperature is used):

1) ☐ Lowest expected ambient temperature for the location \( T_L = \) Between -6 to -10 \(^\circ\text{C} \)
☐ Lowest expected ambient temperature for the location \( T_L = \) Between -7 to -5 \(^\circ\text{C} \)
Average ambient high temperature (\( T_H = \)) = _______ \(^\circ\text{C} \)

Note: For a lower \( T_L \) or a higher \( T_H \), use the Comprehensive Standard Plan

DC Information:

<table>
<thead>
<tr>
<th>Module Manufacturer:</th>
<th>Model:</th>
</tr>
</thead>
</table>

2) Module \( V_{oc} \) (from module nameplate): _______ Volts
3) Module \( I_{sc} \) (from module nameplate): _______ Amps
4) Module dc output power under standard test conditions (STC) = _______ Watts (STC)
5) 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:
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6) Are DC/DC Converters used? Yes / No  If “No,” skip to STEP #7. If “Yes,” enter info below.
DC/DC Converter Model #: ________ Amps DC/DC Converter Max DC Input Voltage: ________ Volts
Max DC Output Current: ________ Volts Max DC Output Voltage: ________ Watts
Max # of DC/DC Converters in an Input Circuit: ________ DC/DC Converter Max DC Input Power: ________ Watts

7) 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<sub>oc</sub> (STEP #2) = ________ x # in series (STEP #5) x 1.12 (if -15°C ≤ T<sub>s</sub> ≤ 5°C, STEP #1) = ________ V
   □ A2. Module V<sub>oc</sub> (STEP #2) = ________ x # in series (STEP #5) x 1.14 (if -6°C ≤ T<sub>s</sub> ≤ 10°C, STEP #1) = ________ V

8) Maximum System DC Voltage from DC/DC Converters to Inverter – Only required if “Yes” in STEP #6.
   Maximum System DC Voltage = ________ Volts

9) Maximum Source Circuit Current
   Is Module I<sub>sc</sub> below 9.6 Amps (STEP #3)? Yes / No (if “No,” use Comprehensive Standard Plan)

10) 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.

11) 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 #13.
    If Yes, use Single Line Diagram 2 with Single Line Diagram 4 and proceed to STEP #12.
    Is source circuit OCPD required? Yes / No
    Source circuit OCPD size (if needed): ________ Amps

12) Sizing PV Output Circuit Conductors – If a Combiner box will NOT be used from [STEP #11],
    Output Circuit Conductor Size = Min. #6 AWG copper conductor

13) Inverter DC Disconnect
    Does the inverter have an integrated dc disconnect? Yes / No
    If yes, proceed to STEP #14.
    If no, the external dc disconnect to be installed is rated for ________ Amps (dc) and ________ Volts (dc)

14) 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
**SOLAR PV STANDARD PLAN – SIMPLIFIED**

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### AC Information:

#### 15) Sizing Inverter Output Circuit Conductors and OCPD

<table>
<thead>
<tr>
<th>Inverter Continuous Output Current Rating (Amps) [STEP#14]</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>28</th>
<th>32</th>
<th>36</th>
<th>40</th>
<th>48</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum OCPD Size (Amps)</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Minimum Conductor Size (AWG, 75°C, Copper)</td>
<td>14</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

#### 16) Point of Connection to Utility

Only load side connections are permitted with this plan. Otherwise, use Comprehensive Standard Plan.

Is the PV OCPD positioned at the opposite end from input feeder location or main OCPD location? Yes / No

**If Yes**, circle the Max Combined PV System OCPD(s) at 120% value as determined from STEP 15 (or STEP S20), Busbar Rating, and Main OCPD as shown in Table 4.

**If No**, circle the Max Combined PV System OCPD(s) at 100% value as determined from STEP 15 (or STEP S20), Busbar Rating, and Main OCPD as shown in Table 4.

Per 705.12(D)(2): [Inverter output OCPD size [STEP #15 or S20] + Main OCPD Size] x [Bus size x {100% or 120%}]

<table>
<thead>
<tr>
<th>Busbar Rating</th>
<th>100</th>
<th>125</th>
<th>125</th>
<th>200</th>
<th>200</th>
<th>200</th>
<th>225</th>
<th>225</th>
<th>225</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main OCPD</td>
<td>100</td>
<td>100</td>
<td>125</td>
<td>150</td>
<td>175</td>
<td>200</td>
<td>175</td>
<td>200</td>
<td>225</td>
</tr>
<tr>
<td>Max Combined PV System OCPD(s) at 120% of Busbar Rating</td>
<td>20</td>
<td>50</td>
<td>25</td>
<td>60*</td>
<td>50*</td>
<td>40</td>
<td>60*</td>
<td>60*</td>
<td>45</td>
</tr>
<tr>
<td>Max Combined PV System OCPD(s) at 100% of Busbar Rating</td>
<td>0</td>
<td>25</td>
<td>0</td>
<td>50</td>
<td>25</td>
<td>0</td>
<td>50</td>
<td>25</td>
<td>0</td>
</tr>
</tbody>
</table>

*This value has been lowered to 60A from the calculated value to reflect 10kW ac size maximum.

Reduction of the main breaker is not permitted with this plan. Otherwise, use Comprehensive Standard Plan.

#### 17 & 18 & 19) Labels and Grounding and Bonding

This content is covered by the labels on Page 4 and the Single Line Diagram(s). For background information, refer to the Comprehensive Standard Plan.
Markings

CEC Articles 690 and 705 and CRC Section R3311 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.
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Supplemental Calculation Sheets for Inverter #2
(Only include if no more than one additional inverter is used)

DC Information:

<table>
<thead>
<tr>
<th>Module Manufacturer:</th>
<th>Model:</th>
</tr>
</thead>
</table>

S2) Module V_{oc} (from module nameplate): _____ Volts

S3) Module I_{dc} (from module nameplate): _____ Amps

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

S5) DC Module Layout

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

Total number of source circuits for Inverter 1:

S6) Are DC/DC Converters used? Yes / No

If “No,” skip to STEP#7. If “Yes,” enter info below.

<table>
<thead>
<tr>
<th>DC/DC Converter Model #:</th>
<th>DC/DC Converter Max DC Input Voltage: _____ Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max DC Output Current:</td>
<td>Max DC Output Voltage: _____ Volts</td>
</tr>
<tr>
<td>Max # of DC/DC Converters in a source circuit:</td>
<td>DC/DC Converter Max DC Input Power: _____ Watts</td>
</tr>
</tbody>
</table>

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_{dc} (STEP#5) = _______ x # in series (STEP#5) x 1.12 (if -15°C ≤ 5°C, STEP#5) = _______ V
- A2. Module V_{dc} (STEP#5) = _______ x # in series (STEP#5) x 1.14 (if -65°C ≤ 10°C, STEP#5) = _______ V

<table>
<thead>
<tr>
<th>Table 1. Maximum Number of PV Modules in Series Based on Module Rated V_{dc} for 600Vdc Rated Equipment (CEC 690.7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Rated Module V_{dc} (STEP#5) (Volts)</td>
</tr>
<tr>
<td>Max. Rated Module V_{dc} (STEP#5) (Volts)</td>
</tr>
<tr>
<td>Max # of Modules for 600Vdc</td>
</tr>
<tr>
<td>18 17 16 15 14 13 12 11 10 9 8 7 6</td>
</tr>
</tbody>
</table>

Use for dc/dc converters. The value calculated below must be less than dc/dc converter max dc input voltage (STEP #5).

- B1. Module V_{dc} (STEP#5) x # of modules per converter (STEP#6) x 1.12 (if -15°C ≤ 5°C, STEP#5) = _______ V
- B2. Module V_{dc} (STEP#5) x # of modules per converter (STEP#6) x 1.14 (if -65°C ≤ 10°C, STEP#5) = _______ V

<table>
<thead>
<tr>
<th>Table 2. Largest Module V_{dc} for Single-Module DC/DC Converter Configurations [With 60V AFCI Cap] (CEC 690.7 and 690.11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Rated Module V_{dc} (STEP#5) (Volts)</td>
</tr>
<tr>
<td>Max. Rated Module V_{dc} (STEP#5) (Volts)</td>
</tr>
<tr>
<td>DC/DC Converter Max DC Input (STEP#5) (Volts)</td>
</tr>
<tr>
<td>34 37 40 43 46 49 52 55 58 61 64 67 70 73 76 79</td>
</tr>
</tbody>
</table>
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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 I_sc 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, THWN-2, RHW-2)
For up to 8 conductors in roof-mounted conduit exposed to sunlight at least 1/3" from the roof covering (CEC 310)
Note: For over 8 conductors in the conduit or mounting height of lower than 1/3" from the roof, use Comprehensive Plan.

S11) Arc 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): _______ 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>
<thead>
<tr>
<th>Inverter Continuous Output Current Rating (Amps)</th>
<th>12</th>
<th>15</th>
<th>20</th>
<th>24</th>
<th>28</th>
<th>32</th>
<th>40</th>
<th>48</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum OCPD Size (Amps)</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td>Minimum Conductor Size (AWG, 75°C, Copper)</td>
<td>14</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

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] _______ \( \times \) 1.25 = _______ Amps
Inverter #2 Max Continuous AC Output Current Rating[STEP#S14] _______ \( \times \) 1.25 = _______ Amps
Total inverter currents connected to load center (sum of above) = _______ Amps

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