



## Commercial / Multi-Family Residential Solar Panel / Photovoltaic System Permit Instructions and & Guidelines

The Village of Winnetka requires permits for all solar installations, which must be obtained prior to beginning any work. The following checklist is intended to assist by clarifying required submittals in order to streamline the approval process.

Commercial solar roof panel permit applications may be subject to review by the Design Review Board if the installation can be seen from a public street, sidewalk or other public place. Requests for assistance with determination of visibility may be directed to the Village Planner at (847) 716-3525.

### Required Application Forms (attached)

#### I. Building Permit Application Form

- **NOTE #1:** Installation must be completed by a Licensed Electrician, with current license and permit bond on file with Village. [Applicants may phone Community Development Department to verify status of license / bond]

#### II. Solar Panel / Photovoltaic System - System & Structural Design Worksheet

### Additional Required Documents and Information

#### III. Four (4) sets of system plan drawings, recommended size 11" x 17", including the following:

- 1) Plat of Survey, prepared by a licensed Land Surveyor showing property dimensions and location of existing improvements [Applicants may contact Community Development Department to review existing files];
- 2) Site plan, showing location of solar panels and other major components on the property. For ground mounted installations, indicate proximity to property lines;
  - **NOTE #2:** Rooftop solar panels which are not incorporated into the design of the building and all ground-mounted solar panels require application for Special Use (Zoning) Permit. Contact Village Planner: (847) 716-3525
- 3) Rooftop / site plan sheet, identifying all equipment and components, including racking system, PV modules and other equipment. Include the following minimum details:
  - Dimensioned width of access ways and proximity to roof edge, hips and valleys;
  - Accurate to-scale depiction of rooftop elements including all mechanical equipment and screening, rooftop access hatches, dormers, cupolas, penthouses, vent pipe and other roof penetrations and rooftop drains.
  - Proposed location of exterior disconnect switch, electric meter; exterior disconnect must be located within five (5) feet of electric meter
- 4) One line electrical diagram of system wiring and components, including the following details:
  - System components and warning/safety labeling;
  - Wiring conductor types and sizing;
  - Conduit type and sizing;



**[System plan drawing requirements, continued]**

- Ground type and sizing (minimum #8AWG copper);
- Main panel, main disconnect, ampere rating.

5) The Village has adopted the codes listed below which are applicable to commercial rooftop renewable energy systems. Plans should be designed for compliance with the following codes, and shall be listed as applicable on cover page of permit plans.

- a) International Residential Code (2015 Edition), including but not limited to;
  - IRC Chapter 23 – Solar Systems
  - IRC Chapter 9 – Roof Assemblies
- b) National Electrical Code (2014 Edition), including but not limited to;
  - Chapters 1 through 4
  - NEC Article 690 - Solar Photovoltaic Systems
  - NEC Article 705 – Interconnected Electric Power Production Sources
- c) Underwriter’s Laboratory (UL)
  - 17 41 - Inverters, Converters, Controllers, and Interconnection Systems for use with Distributed Energy Resources
- d) National Electric Safety Code (latest edition)
- e) National Fire Protection Association
  - 70E – Standard for Electrical Safety in the Workplace
- f) International Fire Code, (2015 Edition), including but not limited to;
  - IFC Article 605.11.1 – Solar Photovoltaic Power Systems – Access and Pathways
- g) Institute of Electrical & Electronics Engineers Standards:
  - 519-2014 Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
  - 929-2000 Recommended Practice for Utility Interface of Photovoltaic (PV) Systems
  - 1453 Recommended Practice for the Analysis of Fluctuating Installations on Power Systems
  - 1547-2018 Standard for Interconnecting Distributed Resources with Electric Power Systems
  - 1547.1-2020 Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems

**IV. Four (4) sets Manufacturer specifications / cut sheets & installation instructions** for all equipment

**V. For systems designed to supply surplus power to the Village’s electric utility grid, please provide the following additional items**



- An **interconnection application** signed by the property owner(s), which (a) requests connection to the Village's electric utility system, (b) has a system design with a generating capacity of 25kW or less (unless otherwise approved by the Director) and (c) agrees to indemnify the Village and its officers, employees, agents and assigns from all liability and losses of any kind resulting from the customer's operation of the renewable energy source.

A renewable generating system(s) must be properly sized so as not to exceed the customer's expected annual usage based on the customer's current energy needs. The Director of Water and Electric shall analyze a customer's energy usage by using 36-months of historical energy usage to calculate the customer's expected annual usage. Please refer to Village Code Sections 13.08.155 and 13.08.260 for additional details.



## Solar Panel / Photovoltaic System System & Structural Design Worksheet

### Property Information

Property Address: \_\_\_\_\_  
Street Address

<b>Winnetka</b>	<b>IL</b>	<b>60093</b>
<small>City</small>	<small>State</small>	<small>ZIP Code</small>

Property type:  Single Family Residential  
 Multiple Family Residential  
 Commercial / Institutional

### I. Roof information

Structure type where modules to be attached:  Principal building (residence, etc.)  
 Accessory building (garage, etc.)

Roof covering material:  Composition asphalt shingle (common)  
 EPDM (used in flat/low-slope applications)  
 Lightweight steel  
 Masonry, Slate or other heavyweight materials – *use of "heavyweight" materials requires review of Roof Structural details - Please complete **Section 4***

Does the roof currently have a single layer?  Yes  No *If "NO", please complete **Section 4***

Is the proposed installation located within 200 feet of the shoreline of Lake Michigan?  Yes  No *If "YES" please complete **Section 4**.*

### II. Mounting System Design Details

A. Is the mounting structure an engineered product designed to mount PV modules with no more than an 18" gap beneath the module frame?  Yes  No  
*If "No", provide details of structural attachment certified by a design professional.*

B. *For manufactured mounting systems, fill out information on mounting system below and attached copy of specifications and installation instructions:*

- 1) Mounting system manufacturer: \_\_\_\_\_ Product Name and Model # \_\_\_\_\_
- 2) Total weight of PV Modules and Rails: \_\_\_\_\_ lbs.
- 3) Total number of attachment points: \_\_\_\_\_
- 4) Weight per attachment point: \_\_\_\_\_ lbs. *(If greater than 45 lbs., complete **Section 4**)*  
[(#2) divided by (#3)]
- 5) Maximum spacing between attachment points on a rail: \_\_\_\_\_ in. *(See product manual for maximum spacing allowed)*
- 6) Total surface area of PV modules: \_\_\_\_\_ sq. ft.
- 7) Distributed weight of PV module on roof: \_\_\_\_\_ lbs. /sq. ft. *(If distributed weight of PV system greater than 5 lbs. /sq.ft, complete **Section 4**)*  
[(#2) divided by (#6)]



### III. System Electrical Design Details

- A. *Panelboard ampere rating:* \_\_\_\_\_ amps  
*Main breaker:* \_\_\_\_\_ amps  
*Backfeed breaker:* \_\_\_\_\_ amps
- B. *Connection to utility grid:*  Supply side connection  
 Load side connection
- C. *System configuration:*  Positive ground  
 Negative ground  
 Ungrounded
- D. *Are batteries being installed?*  Yes  
 No
- E. *Number of rooftop modules to be installed:* \_\_\_\_\_
- F. *System generating capacity:* \_\_\_\_\_ kW (*may not exceed 10 kW*)

### IV. Structural Worksheet

- A. *Roof framing:*  Wood frame rafters  
 Trusses  
 Other: \_\_\_\_\_
- B. Describe site built rafter or site built truss system:
- 1) Rafter size: \_\_\_ x \_\_\_ inches
  - 2) Rafter spacing: \_\_\_\_\_ inches
  - 3) Maximum unsupported space \_\_\_\_\_ feet, \_\_\_ inches
  - 4) Are rafters over-spanned? (See IRC span tables)  Yes  No **If yes, complete the rest of this section.**
- C. If the roof system has:
- 1) Over-spanned rafters or trusses,
  - 2) The array over 5 lbs. / sq. ft. on any roof construction, or
  - 3) The attachments with a dead load exceeding 45 lbs. per attachment
- Please provide one of the following:
- i) A framing plan that shows details for how you will strengthen the rafters, using the IRC span tables.
  - ii) Confirmation certified by a design professional that the roof structure will support the array.
- D. If the proposed installation is located within 200 feet of the shoreline of Lake Michigan, please provide:
- i) Confirmation certified by a design professional that; (a) the roof structure will support the array and (b) that the proposed equipment and installation methods will resist forces of wind uplift.



Village of Winnetka  
Community Development  
510 Green Bay Rd.  
Winnetka IL 60093  
(847) 716-3520

## Building Permit Application

Permit #: \_\_\_\_\_

Permit Address \_\_\_\_\_ Winnetka, IL 60093

Description of Work \_\_\_\_\_

**Estimated Construction Cost \$ \_\_\_\_\_ (required)**

CONSTRUCTION COST includes cost of material and labor; we may request submittal of a signed contract. The applicant hereby certifies that the total value of construction as stated above is an accurate and truthful estimate of the total value of all labor and materials for the new construction or improvement, including all finish work, painting, roofing, electrical, plumbing, HVAC, paving as well as any general contractor's fee. The general contractor's fee shall be included even if the owner and general contractor are the same.

### **Property Owner Information**

Name \_\_\_\_\_

Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_

Daytime Phone \_\_\_\_\_ Email \_\_\_\_\_

### **Primary Contact** *(Note: all correspondence will be with the primary contact)*

Name \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Email \_\_\_\_\_

### **Architect's Information** **Not Applicable**

Name \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Email \_\_\_\_\_

### **General Contractor's Information**

Name \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Email \_\_\_\_\_



**Submittal Requirements:**

Please refer to the appropriate checklist for your particular type of permit work for application submittal requirements. All items identified on the checklist(s) must be submitted with this application form in order for the application to be deemed complete.

**Disclosure & Signatures:**

*The information submitted in this Building Permit Application may be used by the Village of Winnetka and/or any of its contractors or consultants. By signing below you certify that:*

- the information and exhibits herewith are true and correct;*
- you are the owner of record of the named property, the proposed work is authorized and that the registered professional or contractor submitting the application is authorized to do so;*
- you agree to conform to all applicable laws, statutes, ordinances, and codes of this jurisdiction, including those adopted by reference; and*
- if the permit sought is approved, the permit work will be completed in accordance with the Village Codes and within the scope of work described in the application and the approved construction documents*

*Application for a permit shall constitute the owner's consent to all inspections of the permit work that may be required pursuant to the Village Codes and to the right of all building officers to enter onto the premises during reasonable hours to conduct such inspections.*

Signature of Property Owner: \_\_\_\_\_ Date: \_\_\_\_\_

Print Name: \_\_\_\_\_

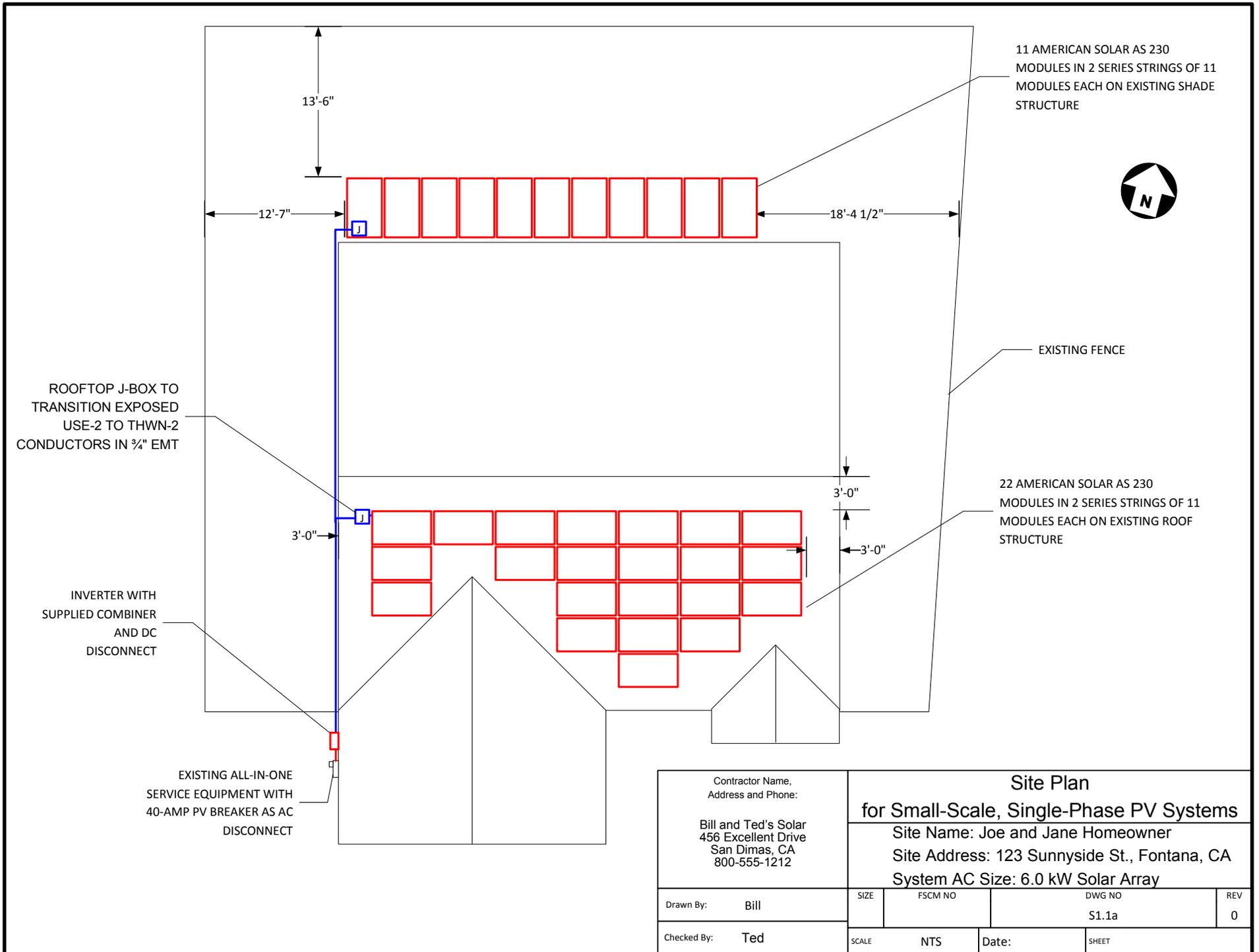
Signature of Owner's Authorized Designee: \_\_\_\_\_ Date: \_\_\_\_\_

(Must attach Designee Form)

Print Name: \_\_\_\_\_

Relationship to Property Owner: \_\_\_\_\_

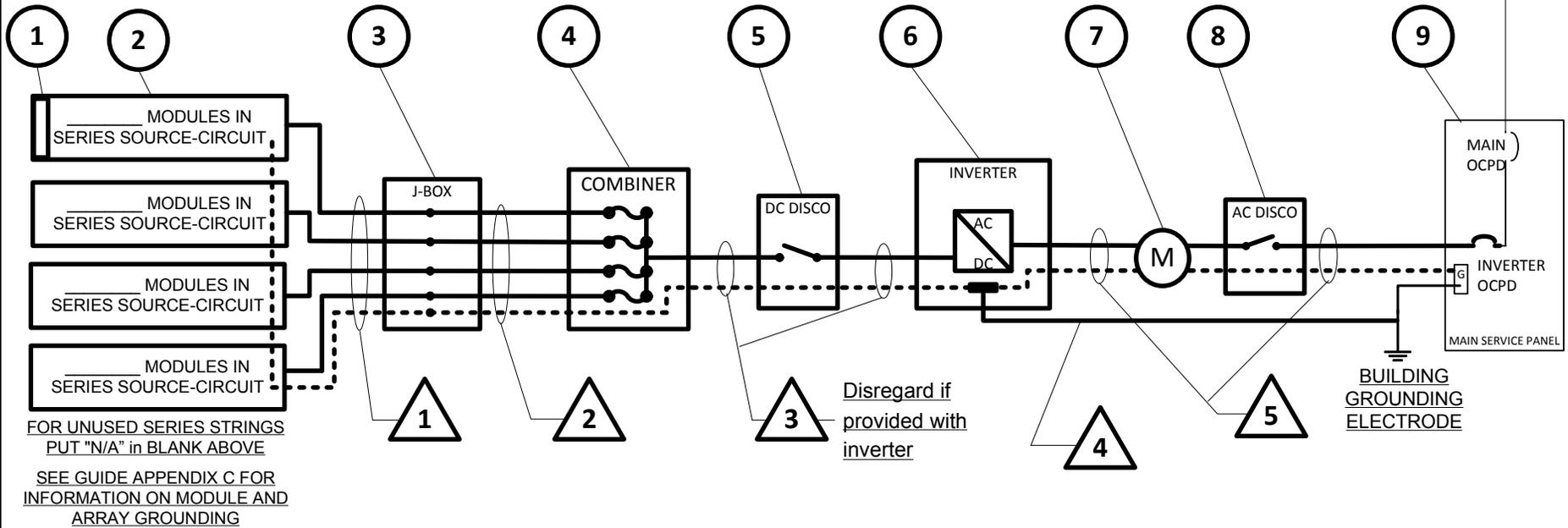
# SITE PLAN



Contractor Name, Address and Phone:		<b>Site Plan</b>		
Bill and Ted's Solar 456 Excellent Drive San Dimas, CA 800-555-1212		<b>for Small-Scale, Single-Phase PV Systems</b>		
		Site Name: Joe and Jane Homeowner		
		Site Address: 123 Sunnyside St., Fontana, CA		
		System AC Size: 6.0 kW Solar Array		
Drawn By: Bill	SIZE	FSCM NO	DWG NO	REV
			S1.1a	0
Checked By: Ted	SCALE	NTS	Date:	SHEET

# STANDARD ELECTRICAL DIAGRAM

○	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)



△	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"/> BARE COPPER EQ. GRD. COND. (EGC)			N/A	N/A
2	THWN-2 <input type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/>				
3	THWN-2 <input type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/> INSULATED EGC				
4	DC GROUNDING ELECTRODE COND.				
5	THWN-2 <input type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/> INSULATED EGC				

Contractor Name, Address and Phone: _____ _____ _____		<b>One-Line Standard Electrical Diagram for Small-Scale, Single-Phase PV Systems</b>		
Site Name: _____		Site Address: _____		
System AC Size: _____		Date: _____		
Drawn By: _____	SIZE	FSCM NO	DWG NO E1.1	REV
Checked By: _____	SCALE	NTS	SHEET	

# NOTES FOR STANDARD ELECTRICAL DIAGRAM

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

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

### NOTES FOR ALL DRAWINGS:

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

### 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

### SIGNS—SEE GUIDE SECTION 7

#### 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	
AC OUTPUT CURRENT	A
NOMINAL AC VOLTAGE	V

THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)

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

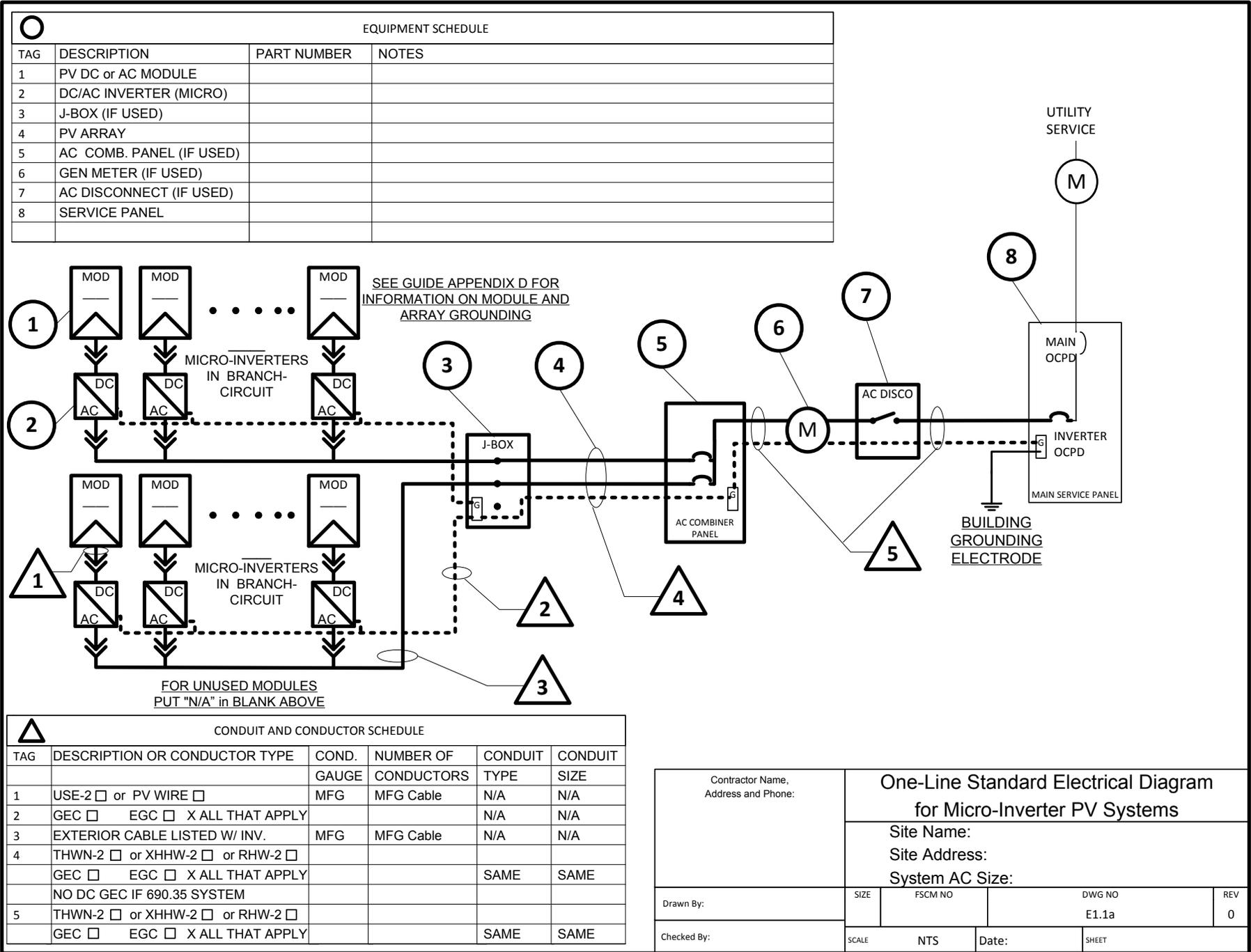
- 1.) LOWEST EXPECT AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION. LOWEST EXPECTED AMBIENT TEMP \_\_\_\_\_°C
- 2.) HIGHEST CONTINUOUS AMBIENT TEMPERATURE BASED ON ASHRAE HIGHEST MONTH 2% DRY BULB TEMPERATURE FOR 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

Contractor Name, Address and Phone:  _____ _____ _____	<b>Notes for One-Line Standard Electrical Diagram for Single-Phase PV Systems</b>			
	Site Name: _____			
Site Address: _____				
System AC Size: _____				
Drawn By:	SIZE	FSCM NO	DWG NO	REV
			E1.2	
Checked By:	SCALE	NTS	Date:	SHEET

# MICRO-INVERTER ELECTRICAL DIAGRAM



# NOTES FOR MICRO-INVERTER ELECTRICAL DIAGRAM

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

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

### NOTES FOR ALL DRAWINGS:

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

### INVERTER RATINGS (Guide Section 4)

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

### SIGNS--SEE GUIDE SECTION 7

#### SIGN FOR DC DISCONNECT

No sign necessary since 690.51 marking on PV module covers needed information

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

<b>SOLAR PV SYSTEM AC POINT OF CONNECTION</b>	
AC OUTPUT CURRENT	
NOMINAL AC VOLTAGE	
<b>THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)</b>	

### NOTES FOR ARRAY CIRCUIT WIRING (Guide Section 6 and 8 and Appendix E):

- 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.) 2009 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.

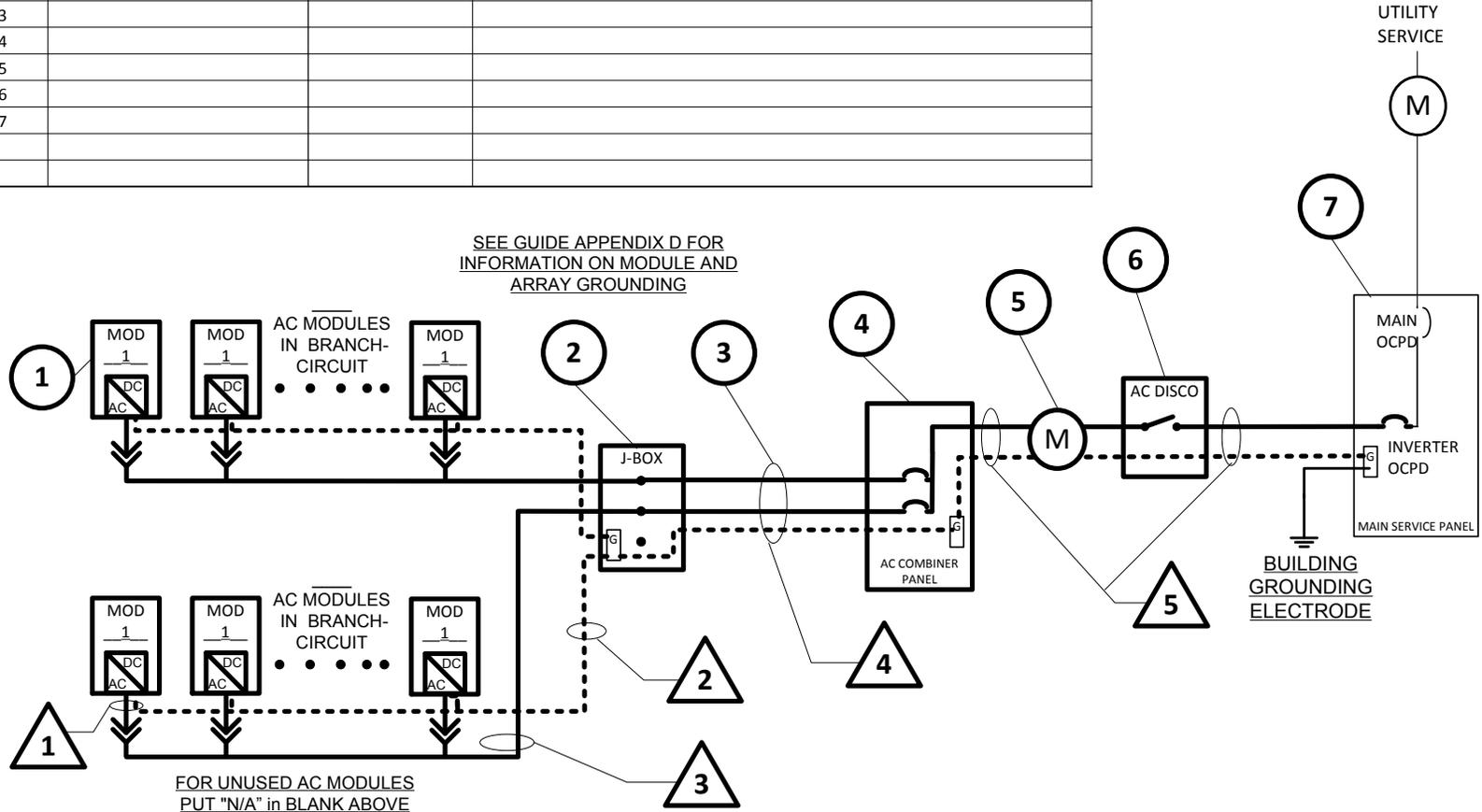
### NOTES FOR INVERTER CIRCUITS (Guide Section 8 and 9):

- 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 OUTPUT CIRCUIT OCPD(S), ONE FOR EACH MICRO-INVERTER CIRCUIT. DOES TOTAL SUPPLY BREAKERS COMPLY WITH 120% BUSBAR EXCEPTION IN 690.64(B)(2)(a)? YES  NO

Contractor Name, Address and Phone:	<b>Notes for One-Line Standard Electrical Diagram for Single-Phase PV Systems</b>			
	Site Name:			
Site Address:				
System AC Size:				
Drawn By:	SIZE	FSCM NO	DWG NO	REV
		E1.2a		
Checked By:	SCALE	NTS	Date:	SHEET

# AC MODULE ELECTRICAL DIAGRAM

EQUIPMENT SCHEDULE			
TAG	DESCRIPTION	PART NUMBER	NOTES
1			
2			
3			
4			
5			
6			
7			



CONDUIT AND CONDUCTOR SCHEDULE					
TAG	DESCRIPTION OR CONDUCTOR TYPE	COND.	NUMBER OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
1	USE-2 <input type="checkbox"/> or PV WIRE <input type="checkbox"/>	MFG	MFG Cable	N/A	N/A
2	GEC <input type="checkbox"/> EGC <input type="checkbox"/> X ALL THAT APPLY			N/A	N/A
3	EXTERIOR CABLE LISTED W/ INV.	MFG	MFG Cable	N/A	N/A
4	THWN-2 <input type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/> GEC <input type="checkbox"/> EGC <input type="checkbox"/> X ALL THAT APPLY NO DC GEC IF 690.35 SYSTEM				
5	THWN-2 <input type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/> GEC <input type="checkbox"/> EGC <input type="checkbox"/> X ALL THAT APPLY				

Contractor Name, Address and Phone:		<b>One-Line Standard Electrical Diagram for AC Module PV Systems</b>		
		Site Name: Site Address: System AC Size:		
Drawn By:	SIZE	FSCM NO	DWG NO	REV
			E1.1b	
Checked By:	SCALE	NTS	Date:	SHEET

# NOTES FOR AC MODULE ELECTRICAL DIAGRAM

**NOTES FOR ALL DRAWINGS:**

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

**AC MODULE RATINGS (Guide Appendix C)**

AC MODULE MAKE	
AC MODULE MODEL	
NOMINAL OPERATING AC VOLTAGE	
NOMINAL OPERATING AC FREQUENCY	
MAXIMUM AC POWER	
MAXIMUM AC CURRENT	
MAXIMUM OCPD RATING	

**SIGNS--SEE GUIDE SECTION 7**

**SIGN FOR DC DISCONNECT**

N/A since no dc wiring

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

<b>SOLAR PV SYSTEM AC POINT OF CONNECTION</b>	
AC OUTPUT CURRENT	
NOMINAL AC VOLTAGE	
<b>THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)</b>	

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

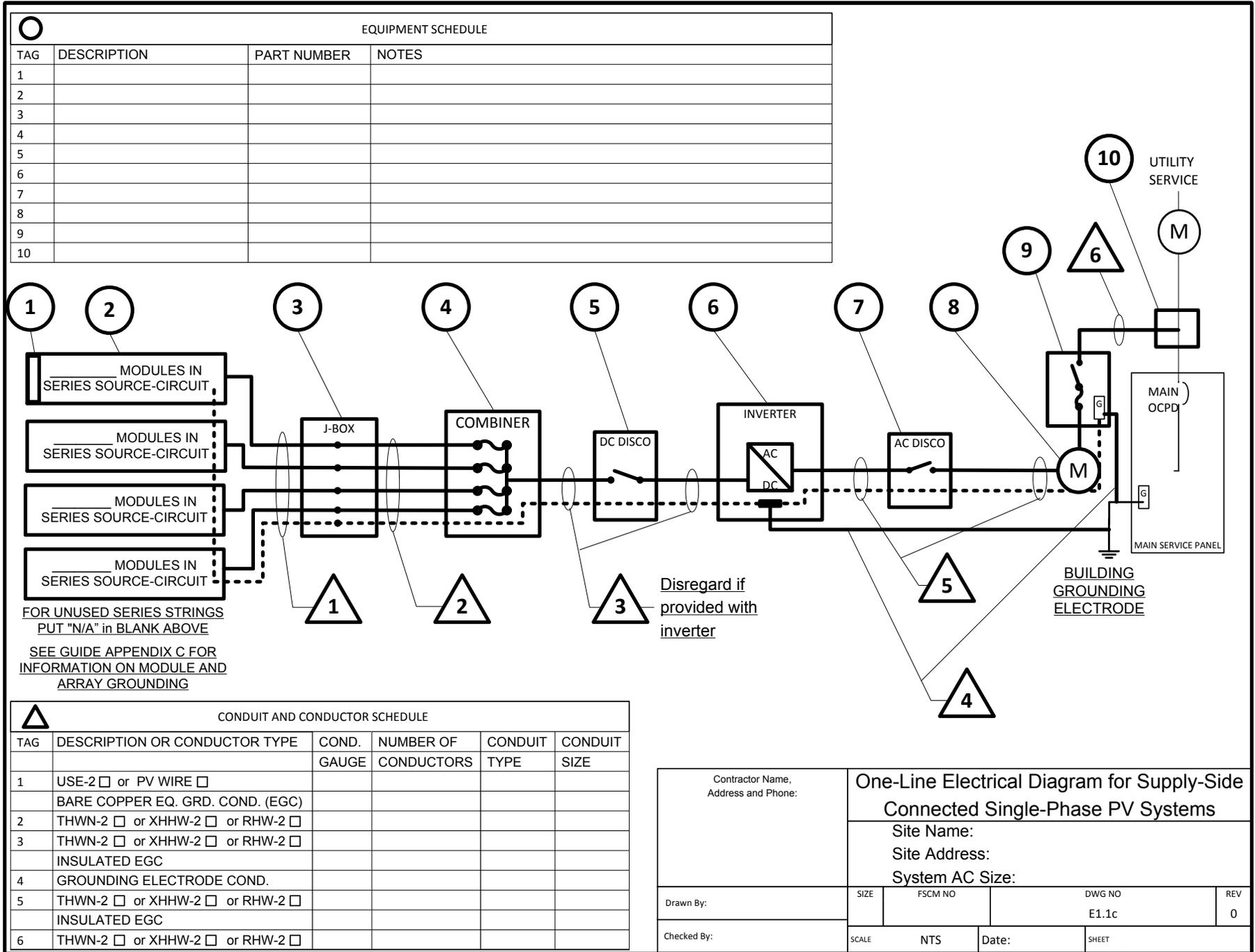
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- 2.) HIGHEST CONTINUOUS AMBIENT TEMPERATURE BASED ON ASHRAE HIGHEST MONTH 2% DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION. HIGHEST CONTINUOUS TEMPERATURE \_\_\_\_°C
- 2.) 2009 ASHRAE FUNDAMENTALS 2% DESIGN TEMPERATURES DO NOT EXCEED 47°C IN THE UNITED STATES (PALM SPRINGS, CA IS 44.1°C). FOR 6 OR LESS 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 AC MODULES INVERTER OUTPUT CIRCUITS WITH 12 AMPS OR LESS WHEN PROTECTED BY A 15-AMP OR SMALLER OCPD.
  - b) 10 AWG, 90°C CONDUCTORS ARE GENERALLY ACCEPTABLE FOR AC MODULES INVERTER OUTPUT CIRCUITS WITH 16 AMPS OR LESS WHEN PROTECTED BY A 20-AMP OR SMALLER OCPD.

**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 (N/A)
- 4) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Guide Section 9)
- 5) TOTAL OF \_\_\_\_\_ INVERTER OUTPUT CIRCUIT OCPD(S), ONE FOR EACH AC MODULE CIRCUIT. DOES TOTAL SUPPLY BREAKERS COMPLY WITH 120% BUSBAR EXCEPTION IN 690.64(B)(2)(a)? YES  NO

Contractor Name, Address and Phone:	<b>Notes for One-Line Standard Electrical Diagram for Single-Phase PV Systems</b>			
	Site Name:			
	Site Address:			
	System AC Size:			
Drawn By: <b>Bill</b>	SIZE	FSCM NO	DWG NO	REV
			E1.2b	0
Checked By: <b>Ted</b>	SCALE	NTS	Date:	SHEET

# SUPPLY-SIDE CONNECTED ELECTRICAL DIAGRAM



# NOTES FOR SUPPLY-SIDE CONNECTED ELECTRICAL DIAGRAM

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

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

### NOTES FOR ALL DRAWINGS:

OCPD = OVERCURRENT PROTECTION DEVICE

NATIONAL ELECTRICAL CODE® REFERENCES SHOWN AS (NEC XXX.XX)

### 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

### SIGNS-SEE GUIDE SECTION 7

#### 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	
AC OUTPUT CURRENT	A
NOMINAL AC VOLTAGE	V
THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)	

### 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

Contractor Name, Address and Phone:  _____ _____ _____ _____	<b>Notes for One-Line Standard Electrical Diagram for Single-Phase PV Systems</b>			
	Site Name: _____ Site Address: _____ System AC Size: _____			
Drawn By:	SIZE	FSCM NO	DWG NO	REV
			E1.2	
Checked By:	SCALE	NTS	Date:	SHEET