

SOLAR PHOTOVOLTAIC (PV) INSTALLATION BALTIMORE COUNTY REQUIREMENTS

- Effective September 1, 2017 Baltimore County adopted the 2017 National Electric Code.
- Effective **July 1, 2015** Baltimore County adopted the **2015** edition of NFPA 1 Section 11.12 concerning PV system installations.

- All electrical work is to be performed under the supervision of the licensed electrical contractor. This includes the bonding of the support structure, setting of the modules, microinverters (if used), all wiring, equipment, grounding, bonding, connections, terminations, boxes, disconnects, fusing, and interconnections with the utility.

- For PV systems up to 10 KW the licensed electrical contractor is responsible for the entire installation and only an electrical permit will be required unless the array is part of a freestanding structure.

- For PV systems installed on a roof having a pitch of less than 4/12 an engineering certificate is required for the PV support structure.

- For PV systems larger than 10KW or for freestanding PV support structures a separate Building permit must be secured for the installation of the PV support structure.

- The licensed electrical contractor must have a qualified employee on the site through the entire installation process.

- A qualified employee of the licensed contractor must be present at each inspection. If the Rapid Shutdown System is included as part of the NRTL seal on the inverter, no technician is required to meet the inspector unless the inspector requires their presence.

All PV circuits permitted to be run inside a building must be installed in a raceway or in a metal jacketed cable. This circuit must be clearly identified wherever accessible.

- Photographs, where required, must be clear and discernable as to what the photograph represents. In some cases macro photography may be required to achieve the desired image. (Most digital cameras have this setting)

- All wiring must be kept off of the roof surface and secured at such intervals that maintain a workmanlike quality. Plastic ties must be sunlight resistant.

- All labeling, marking, and identifying where required by the NEC must be, at a minimum, equal in nature to the labeling on the wiring method, cabinet, equipment, etc., must be able to withstand the conditions encountered, and, effective July **2015**, must be in compliance with the **2015** edition of the NFPA 1 Section 11.12

- Any changes, modifications, additional information, or corrections required by the inspector must be completed in a manner and time frame designated by the inspector.
- All checklist requirements for the final inspection must be complete and presented to the inspector at the final inspection. The items must be checked by the qualified employee of the licensed electrical contractor. The inspector will check to verify that all information is provided and accurate. This completed list will become part of the contractor's certification.
- Any changes, modifications, additional information, or corrections required by the inspector must be completed before the installation can be deemed finalized.
- The contractor's completed certification must be provided at final inspection. The certification must be signed by the master electrician (and the structural support installer if applicable).

2015 CHANGES TO THE NFPA 1 REQUIREMENTS

1. Where a single 4 feet wide clear pathway is installed in the center third of the roof length and is not located over a window or door opening and with no overhead obstructions such as tree limbs, wires, or signs, the single pathway shall be allowed in lieu of the two required pathways on each end of the array.
2. A minimum 3 feet clear space shall be provided around all solid fuel burning chimneys for emergency access. Chimneys used for gas or oil venting are considered to be vents and are permitted to be in the pathway.
3. All wiring shall be allowed to cross pathways and shall be designed to take the shortest path from the array to the DC combiner box, be clearly identified, and be protected in rigid metal conduits, schedule 80 PVC, or EMT. All raceways must be kept as close as possible to the roof surface so as not to present a tripping hazard while still permitting water to flow underneath the raceway. Chimney vents and plumbing vents within a pathway will not affect a measurement of setback.
4. Where there is more than one pathway on a roof surface, only one of the roof access points must be in a location where fire department ladders are not required to be placed over the building openings such as windows or doors. Where there is a single pathway in the center third of the roof length, the access point shall not be located over a door or roof opening. Whether single or multiple pathways, the access point must be free of obstructions such as tree limbs, wires, or signs

INSPECTION CHECK LIST

THIS DOCUMENT IS PART OF THE REQUIRED CERTIFICATION. IT MUST BE COMPLETED BY A QUALIFIED REPRESENTATIVE OF THE LICENSED ELECTRICAL CONTRACTOR AND SUBMITTED WITH THE CERTIFICATION OF SOLAR PHOTOVOLTAIC INSTALLATION

Contractor Inspector

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Site plan provided (Includes description and location of Major components) |
| <input type="checkbox"/> | <input type="checkbox"/> | Electrical diagram provided (Includes wire size of <u>PV Source</u> circuits, <u>PV output</u> circuit, and the <u>inverter output</u> Circuit) |
| <input type="checkbox"/> | <input type="checkbox"/> | Provide evidence of compatibility of the equipment Grounding clips, if used, with the rack system |
| <input type="checkbox"/> | <input type="checkbox"/> | Provide evidence of compatibility of microinverters (if Used) with the PV modules |
| <input type="checkbox"/> | <input type="checkbox"/> | Provide photographs of rack system equipment bonding Connections and an overall view of the equipment bonding System. |
| <input type="checkbox"/> | <input type="checkbox"/> | Provide any engineered drawings <u>or</u> drawings of the Structural support to the building. If roof pitch is less than 4/12, provide engineering certificate. |
| <input type="checkbox"/> | <input type="checkbox"/> | Provide photographs of the method used to attach the rack System to the roof, <u>the distance between racks</u> , and subsequent sealing method. |
| <input type="checkbox"/> | <input type="checkbox"/> | Calculations providing the <u>ampacity</u> of the PV source Circuits and the <u>voltage</u> of the PV output circuit are Provided keeping in mind conduit fill, ambient Temperature, and temperature coefficients |

E _____
PERMIT NUMBER

B _____
PERMIT NUMBER

_____ _____

Provide information regarding location and type of PV
Source circuit overcurrent protection

_____ _____

Provide PV module nameplate information

_____ _____

Qualified employee of the electrical contractor on site if
Required by the inspector

_____ _____

Access points, access pathways, and ventilation
Opportunities provided in compliance with the 2015 NFPA
1 Section 11.12 and amended by Baltimore County in 2015

E _____
PERMIT NUMBER

B _____
PERMIT NUMBER

_____ _____

Provide photographs showing all wiring properly secured

_____ _____

Provide photographs of rooftop disconnecting means
(If required)

_____ _____

Verify that wiring between last module and combiner box
Is in a raceway (if not directly adjacent)

_____ _____

Provide photograph of interior connections of the
Combiner (or junction) box

_____ _____

The rating of the overcurrent device protecting the panel
Combined with the rating of the breaker providing the
solar PV interconnection with the utility together do not
exceed 120% of the rating of the panel buss.

- _____ _____ Backfed breaker is secured in compliance with Art. 690.10 (E) (if stand alone system)
- _____ _____ Verify the Rapid Shutdown System operates effectively.
- _____ _____ Verify equipment grounding connections in electrical Panel and disconnects
- _____ _____ If free standing system, DC connections guarded against Access by unqualified persons
- _____ _____ Contractor's Certification is completed, signed by Master Electrician, and submitted to inspector
- _____ _____ Verify that all labeling and marking is in compliance with Art. 690 and Art. 705, and the 2015 NFPA Section 11.12; and is suitable for the prevailing conditions.

E _____
PERMIT NUMBER

B _____
PERMIT NUMBER

CERTIFICATION OF SOLAR PHOTOVOLTAIC SYSTEM INSTALLATION

Property location: _____ District: _____

Permit Number: E _____ ; B _____

Size of PV system: _____ KW

Undersigned certifies that the Solar Photovoltaic System, as installed, meets the manufacturer's installation guidelines, product specifications and compatibilities, all articles of the 2015 International Building Code, the 2017 National Electric Code, the 2015 NFPA 1 (Section 11.12) and all Baltimore County requirements as required by the attached checklist. A qualified employee of the licensed electrical contractor was on site through all phases of the installation.

MASTER ELECTRICIAN

**(FOR FREESTANDING SYSTEMS AND
FOR SYSTEMS EXCEEDING 10KW)
STRUCTURAL INSTALLER**

Name: _____

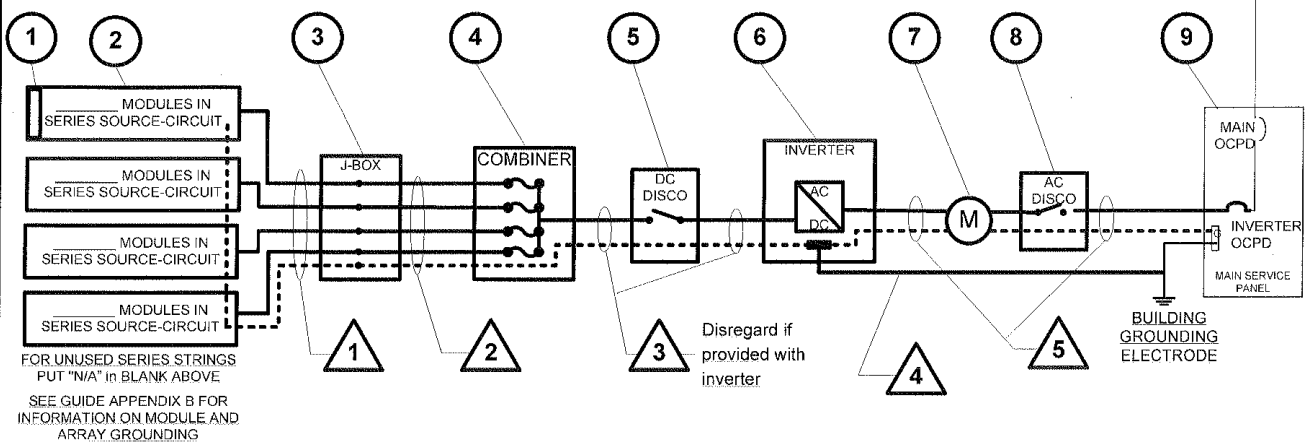
Address: _____

Phone: _____

Lic. #: _____

Signature: _____

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:

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

Site Name: _____
Site Address: _____
System AC Size: _____

Drawn By:	SIZE	FSCM NO	DWG NO	REV
Checked By:	SCALE	NTS	Date:	E 1.1 SHEET

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:

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

Site Name: _____
 Site Address: _____
 System AC Size: _____

Drawn By:	SIZE	FSCM NO	DWG NO	REV
Checked By:	SCALE	NTS	Date:	SHEET
			E1.2	

FORMULAS FOR CALCULATING MAXIMUM SYSTEM VOLTAGE

The following formulas must be used for calculating the maximum system voltage for PV Source Circuits and PV Output Circuits

According to ASHRAE the coldest design temperature for the Baltimore area is -15° Centigrade

Manufacturer's V_{TCOEFF} Method:

**Maximum System Voltage =
Module Voc @STC + [(25 - coldest design temp) x V_{TCOEFF}] x # of modules in series**

OR if V_{TCOEFF} is not known: (Use NEC table 690.7)

**Maximum System Voltage =
Module Voc @STC x NEC Factor (at coldest design temp) x # of modules in series**