PRINCE GEORGE'S COUNTY, MARYLAND

DEPARTMENT OF PERMITTING, INSPECTIONS AND ENFORCEMENT (DPIE)

GUIDELINES FOR PERMITTING ROOFTOP PHOTOVOLTAIC (PV) SOLAR ARRAY SYSTEMS

(August 17, 2022)

Photovoltaic (PV) solar systems are an alternative way to provide power to a building structure by converting sunlight to electricity using photovoltaic cells arranged in a panel. The PV solar panels are usually attached to the roof of the building or other commercial structure (such as a parking garage). When combined with other panels they form a solar array. They may also be built as a separate structure on the ground in which case the solar array will be treated as a commercial accessory structure. These permitting guidelines pertain to rooftop PV solar arrays on commercial buildings and multi-family structures consisting of apartments and condominiums.

Rooftop solar array projects require two permits: a building permit (for the attachment of the solar panels to the rooftop) and an electrical permit for the connection to the building's electrical service. Both permits must be applied for electronically.

Plans Development

Applicant develops the following plans for the project:

- Concept plan for proposed rooftop photovoltaic (PV) solar array system project noting the project description, site location, site zoning, major system components, and electrical production capacity of the PV solar array.
- Architectural plans – including roof layout and schematic detailing of the solar module array and roof attachment details.
- Site plan showing property location and boundaries, building dimensions and allowable zoning setbacks, and locations and dimensions of proposed solar system components, including modules, inverter(s), disconnects, main electrical service, and meter. The concept plan and site plan may be combined if the site plan also provides the information required by the concept plan if it is readable, clear, and scaled.
- Engineering plans including electrical, fire protection, structural, and mechanical (as applicable) details and associated calculations.

Commercial PV solar array system plans must be designed, stamped, and sealed by a Maryland Professional Engineer. Architectural plans can be stamped by the structural engineer of record if no proposed changes are being made to the architecture of the

building and included schematics are of a structural nature (i.e., array plan, connection details, roof framing plan, and other structural members).

Permit Application and Filing Fee Payment

Applicant applies for a building permit and an electrical permit for the proposed rooftop photovoltaic (PV) solar array system project in ePermits, DPIE's online permitting and licensing system. If the building on which a proposed rooftop PV solar array system will be located is listed under one Maryland State Department of Assessments and Taxation (SDAT) tax account, the permits may be issued by lot or interconnection point, not individual addresses of all units underneath the roof.

Applicant uses "Misc. Commercial" for type of building permit and Commercial Exterior (CE) for case type. Applicant pays the required permit application filing fee through the County's online payment system Govolution via credit card or eCheck. The applicant may also make payment by check at the DPIE Cashier's Office on 9400 Peppercorn Place in Largo, MD.

See below Commercial Rooftop Photovoltaic Solar Panel Permitting Fees:

Minimum fee: $220 + 5% technology fee = $231
Fee calculation: ($55 + (Construction cost x 0.0088)) + 5% technology fee
Construction cost = $2 per watt or $2000 per kilowatt

Plans Submission

After permit application and payment of the appropriate filing fee, the applicant submits the required plans to ePlans, DPIE's project plans review and processing system. These plans include the concept plan, architectural plans, site plan, engineering plans, and manufacturer's cut sheets for the PV solar array project.

- Building permit requirements (includes Structural, Electrical, and Fire & Life Safety Section reviews): manufacturer's specifications, mounting system details, structural analysis, a list of codes for the design, building information, roof layout plan, site plan showing the project's location, signage/marking details and locations, and manufacturer's cut sheets..
- Electrical review requirements: manufacturer specifications, system kilowatt (KW) rating (including the number of arrays), a single line diagram and labelling as per the latest applicable National Electrical Code (NEC) Section 690, grounding details, and wiring method.
- Electrical trade permit is to be obtained on-line by a master electrician licensed with Prince George's County.

For more information, please see Exhibit 1 on page 7.

DPIE Permitting staff screens application and provides task to applicant to upload supporting documents to ePlan (ProjectDox/ProjectFlow).

Plans Review

Building Plan Review Division and Maryland-National Park & Planning Commission (M–NCPPC), as appropriate, review the applicable plan submissions and provide any comments until approved. The plans are reviewed for compliance with applicable sections of the Building Code (whichever is applicable for the project type - 2018 NFPA1, 2018 IBC, 2018 IRC, 2018 IFC and the Prince George's County Subtitle 4, Subtitle 9, and Subtitle 11) and National Electrical Code (NFPA 70, National Electric Code, Article 690).

The applicant may submit the building and electrical plan documents to qualified Peer Plan Reviewers or Third-Party Plan Reviewers for expedited review and approval.

Remaining Permit Fee Payment and Permit Issuance

After the project plans are finalized and approved, permitting staff issue the permit(s) with a condition: "Subject to Final approval in the Field/3rd Party Certification", after payment of remaining permit fees. Applicant pays the remaining permit fees through the County's online payment system Govolution via credit card or eCheck. Applicant may also make payment by check at the DPIE Cashier's Office on 9400 Peppercorn Place in Largo, MD.

The licensed master electrician can obtain the electrical trade permit online by referring to the DPIE CE building permit number, after which the applicant can begin installation of the Rooftop PV Solar System based on the approved plans.

Solar System Installation

A rooftop photovoltaic (PV) solar array system project and all associated work must be installed in compliance with NFPA 70, National Electric Code, Article 690, and all applicable Electrical Codes currently adopted and enforced under Prince George's County Subtitle 9 and Subtitle 4. See Exhibit 1 for Permit Guidelines for Photovoltaic (PV) Systems 2017 NEC Article 690.

All existing electrical equipment/devices associated with the solar system design/installation shall comply with NEC and Subtitles 9 and 4. Solar system design may include provision to mitigate the existing electrical code violation(s) in the work area.

Solar System Inspection

Following construction, the applicant schedules final building, electrical, and other applicable inspections of the Rooftop PV Solar Array installation with qualified Third-Party Inspectors per the DPIE Third-Party Inspection Program (TPIP) Manual. This is to ensure compliance with the approved plans and Prince George's County Construction Codes. Rooftop PV Solar Array certification shall be provided using Attachment #6SOLARPV adapted from the DPIE Third-Party Inspection Program Manual (shown on the following page) after checking all applicable boxes.

Solar System Activation

Upon passing the final inspection, the Permitting Office issues the Use and Occupancy Permit to the applicant. Thereafter the Rooftop PV Solar Array system is ready for use and the owner or owner’s representative activates the system.

ATTACHMENT #6 SOLAR PV
ROOFTOP PHOTOVOLTAIC (PV) SOLAR SYSTEM
THIRD-PARTY INSPECTION PROGRAM CERTIFICATION FORM

Date _____

To:

- ☐ Building Code Official
- ☐ Electrical Code Official

From: _____

Project Address / Project Location: _____

Case Number / Utility Co. Tracking Number: _____

This transmittal is to advise and certify that the following actions are in accordance with the provisions contained within the Prince George's County Department of Permitting, Inspections and Enforcement (DPIE) Third-Party Inspection Program (TPIP) and associated Statement of Third-Party Inspections for the above-referenced project, as follows (check all applicable boxes):

By the Inspector of Record (IR)

- ☐ Rooftop PV Solar System construction – including but not limited to foundation dimensions, electrical conduit, system mounting equipment.

By the Electrical System(s) Inspector of Record (EIR)

- ☐ Construction project is built according to the construction document(s) and electrical permit(s) issued by Prince George's County and the Electrical Code, as listed in Subtitle 9 of the County Ordinance.
- ☐ Certification as to the electrical systems readiness for the closing of the system before the closing begins.
- ☐ Completion of the electrical system(s) in accordance with the approved plan(s) and document(s) and requirements of the Prince George's County Building Code, that the electrical system(s) is ready for the power company to make the service "hot," and all work has been performed under an electrical permit.
- ☐ Compliance with the PV Solar System manufacturer installation details and specifications.
- ☐ Compliance with NFPA 70, National Electric Code, Article 690, and all applicable Electrical Codes currently adopted and enforced under Prince George's County Subtitle 9.
- ☐ Electrical system(s) installation(s) has valid permit(s).

To the best of my information, knowledge and belief, the inspections specified for this project, have been completed. In my professional opinion, the inspections have been found to follow County-approved plans and the Prince George's County Building Code.

Certified By: _____ affix signature & seal

Printed Name: _____

MD Reg. No. _____

Company Name: _____

Name of agents/technicians acting on behalf of above:

_____

_____

_____

EXHIBIT 1 – PERMIT GUIDELINES FOR ROOFTOP SOLAR PHOTOVOLTAIC (PV) SYSTEMS 2017 NEC ARTICLE 690

NOTE: Building and Electrical Permits are required for the solar PV Systems projects. The following information must accompany Building and Electrical permit applications. Commercial systems must be designed, stamped, and sealed by a Maryland P.E.

1. The Basic Site Plan is a schematic diagram that shows the location of major system components. The equipment must be clearly shown and identified on the plan. If the PV array is ground-mounted, the site plan must clearly show that system will be mounted within allowable zoned setbacks.
2. The Project Plan must include a description of the basic solar PV energy system requirements.

For the building permit the requirements are:

Manufacturer's Specifications, Mounting System Details, and Structural Analysis.

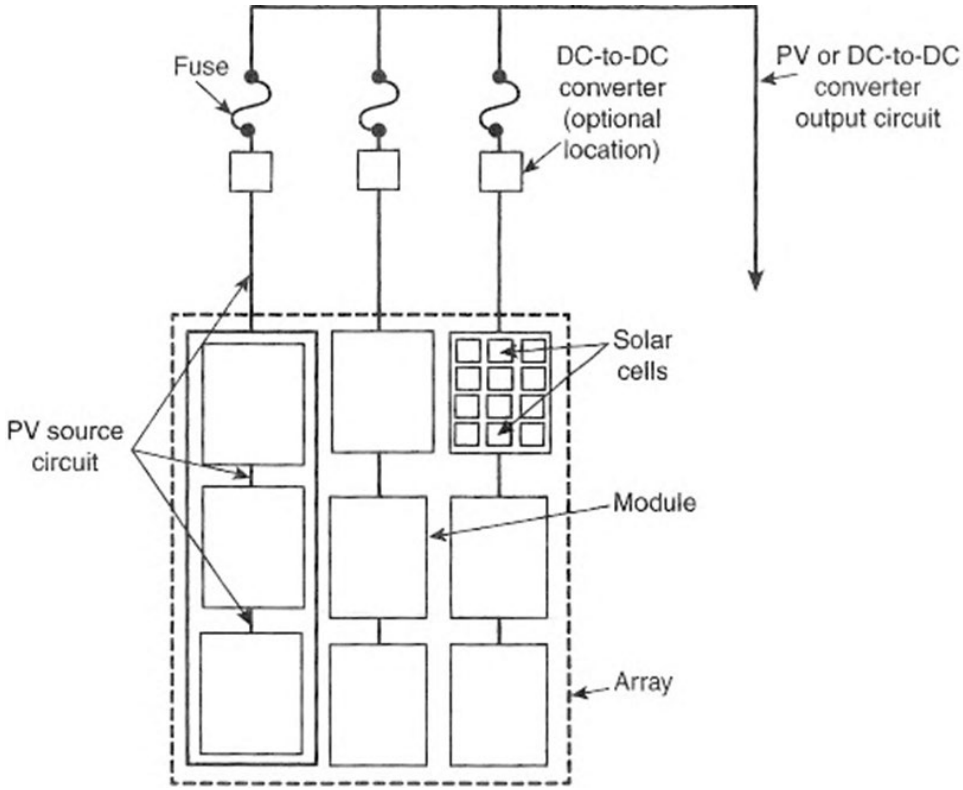
Fire Protection and Life Safety Review Requirements. The rooftop-mounted PV solar array system projects on buildings designed per IBC are classified as commercial projects. The PV system installation and setback requirements shall comply with commercial requirements per 2018 IBC, 2018 NFPA 1, 2018 IFC (the most stringent shall apply), and the Prince George's County Subtitle 4, Section 4-210. The plans set must show: the design codes with editions, the construction type of the building, the use of the building, the fire classification of the roof, the fire classification and UL listing of the solar modules, the gap between the roof surface and the bottom of the solar modules, the roof type/slope, a scaled roof plan showing the solar arrays and required setbacks (roof access, smoke ventilation, and pathway locations and their sizes), a site plan showing the location of the building, marking/signages and their locations including the installer information signage, transformer locations, shutdown switch locations, etc. If the project involves energy storage systems, County adopted codes shall apply to those projects.

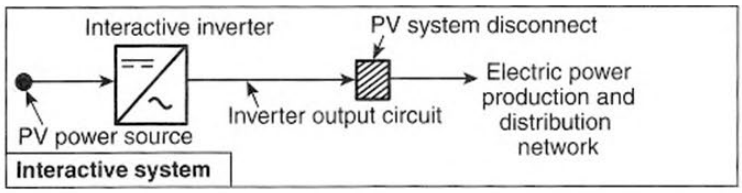
For the electrical permit the requirements are:

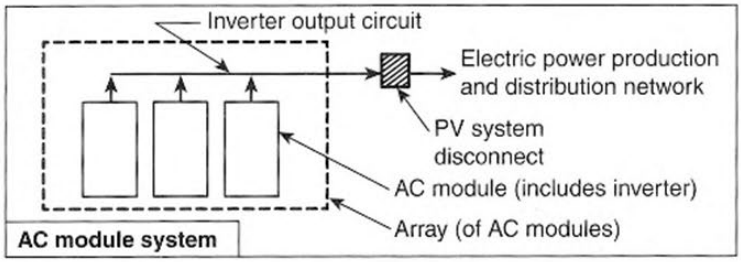
Manufacturer Specifications, System Kilowatt (kW) Rating (including the number of arrays), a Single Line Diagram as per the latest applicable National Electrical Code Section 690, Labelling as per the latest applicable National Electrical Code Section 690, Grounding Details, and Wiring Method. Available Fault Current values at the service equipment shall be obtained from the electric utility company. This is critical piece of information for the electrical distribution systems.

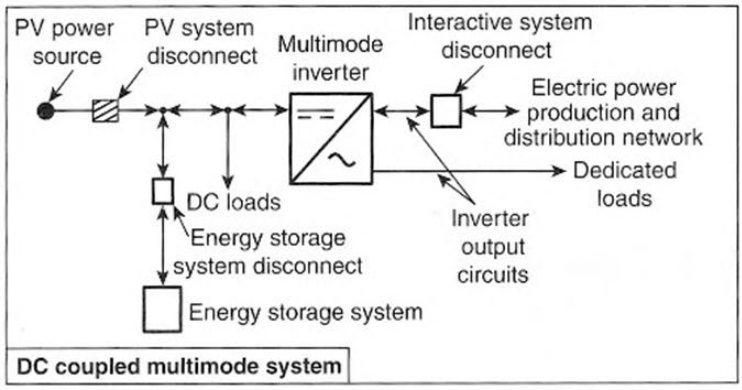
3. Electrical Schematic Diagram showing all major field-installed electrical components, wire identification and sizing, and grounding. This diagram needs to have sufficient detail to call out the electrical components, the wire types and sizes, number of conductors, and conduit type and size where needed. This will typically include detailed module information, series/parallel configuration of modules, details of the Photovoltaic Output Circuit, wire type and size of module wiring, type and size of any junction or combiner boxes, approximate length of conductors in PV array, approximate length of conductors from junction box to the photovoltaic power source disconnecting means. Other important information includes equipment grounding of the PV array and system grounding of the inverter. It will also include specific information on the PV inverter and all associated wire in and out of the inverter. The utility disconnect type and location and the means of connection to the building electrical system should be clearly identified. For Grounding and Bonding refer to the Prince George's County Subtitle 9-Sec 9-106 for additional requirements. In addition to distribution diagram, provide Grounding details for the PV system. All equipment grounding conductors, grounding electrode conductors and bonding jumpers shall be connected by Exothermic welding process.

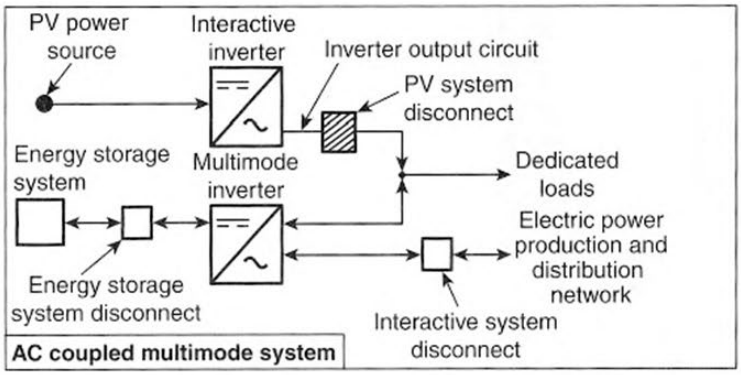
Sample Diagrams From NEC:

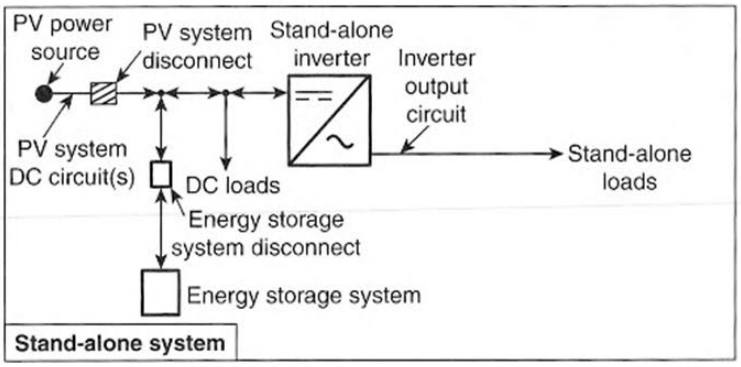



Interactive inverter
PV system disconnect
PV power source
Inverter output circuit
Electric power production and distribution network
Interactive system


Inverter output circuit
Electric power production and distribution network
PV system disconnect
AC module (includes inverter)
Array (of AC modules)
AC module system

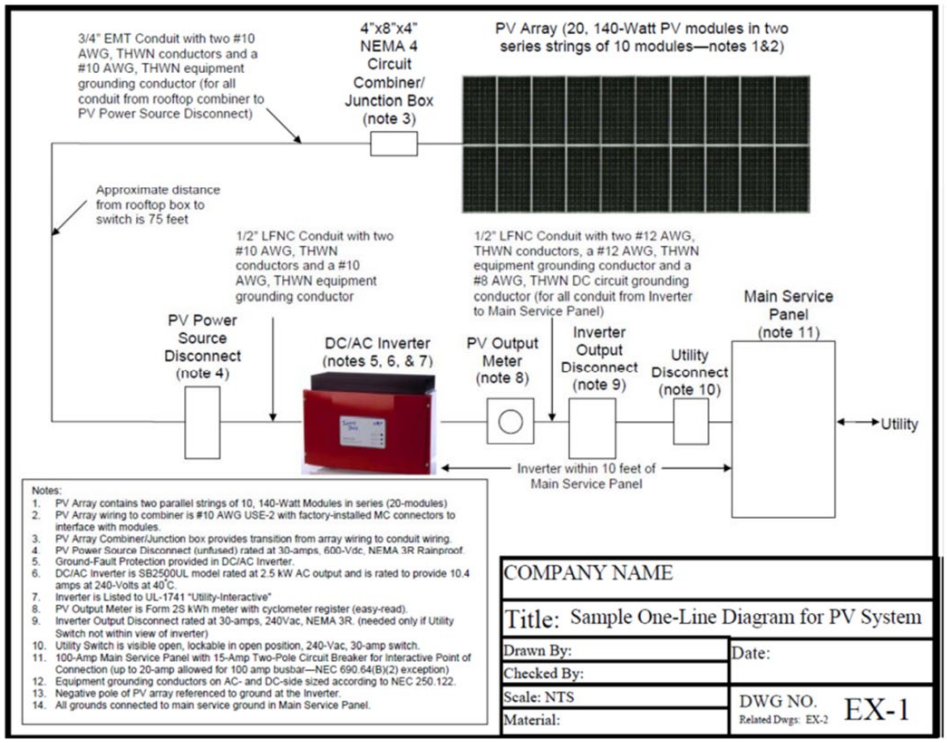

PV power source
PV system disconnect
Multimode inverter
Interactive system disconnect
Electric power production and distribution network
Dedicated loads
DC loads
Energy storage system disconnect
Inverter output circuits
Energy storage system
DC coupled multimode system


PV power source
Interactive inverter
Inverter output circuit
PV system disconnect
Energy storage system
Multimode inverter
Dedicated loads
Electric power production and distribution network
Energy storage system disconnect
Interactive system disconnect
AC coupled multimode system

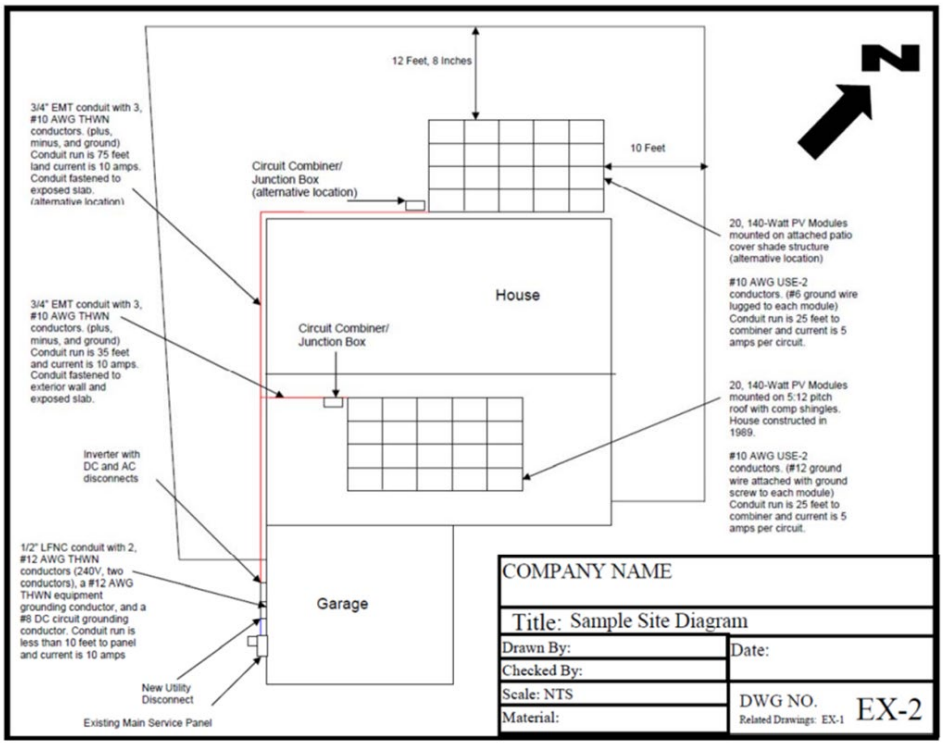

PV power source
PV system disconnect
Stand-alone inverter
Inverter output circuit
PV system DC circuit(s)
DC loads
Stand-alone loads
Energy storage system disconnect
Energy storage system
Stand-alone system

NOTES:

1. These diagrams are intended to be a means of identification for photovoltaic system components, circuits, and connections.
2. Disconnecting means and over current protection required by NEC Article 690, Part III is not indicated on these schematics.
3. System grounding and equipment grounding are not shown. Please see NEC Article 690, Part V.
4. Custom designs occur in each configuration, and some components are optional.



SAMPLE SINGLE LINE DIAGRAM



SAMPLE SITE PLAN

4. Major component information:

a. Inverter information:

I. Model number and manufacturer's "cut sheets" for the specific model.

II. Listing. Is the inverter listed by a Nationally Recognized Testing Laboratory (NRTL) such as UL 1741 and labeled "Utility-Interactive"? If the utility interactive labeling is not provided, does the device comply with the requirements of IEEE Std. 929-2000 (ANSI) as verified by the instruction manual and validated by the listing agency?

III. Maximum continuous output power at 40º C.

IV. DC input voltage range.

V. AC output voltage range.

b. Module information:

I. Manufacturer's "cut sheets" for the specific model.

II. Listing. The module(s) should be listed to UL 1703. Explanation: All electrical devices and components must be listed to UL® (Underwriters Laboratories) North American Standards.

III. Open-circuit voltage.

IV. Maximum permissible system voltage per NEC article 690.7

V. Short-circuit current rating.

VI. Maximum series fuse rating.

VII. Maximum power at Standard Test Conditions.

VIII. Operating voltage.

IX. Operating current.

Alternating-Current Photovoltaic Modules:

Alternating-current modules shall be marked with identification of terminals or leads and with identification of the following ratings:

I. Nominal operating ac voltage.

II. Nominal operating ac frequency.

III. Maximum ac power.

IV. Maximum ac current.

V. Maximum overcurrent device rating for ac module protection.

c. Battery information (if used):

I. Manufacturer's "cut sheets" for the specific model. Note storage and venting requirements.

II. Nominal battery voltage for the system.

5. Array information:

a. Number of modules in series, number of parallel source circuits, and total number of modules.

b. Operating voltage (sum of series modules operating voltage in source circuit).

c. Operating current (sum of parallel source circuit operating currents). [690.8].

d. Maximum system voltage. [690.7]

e. Short-circuit current rating. [110.10].

6. Wiring and Overcurrent Protection:

a. Wire Type:

PV module interconnections should be 90º C wet-rated conductors. Allowable wire types are as follows: USE-2 single conductor cable for exposed applications and single conductor cable listed and labeled for PV use. Type TC multiconductor cable for exposed applications with THWN-2 or XHHW-2 or RHW-2 or equivalent 90º C wet-rated conductors in the cable. Type THWN-2 or XHHW-2 or RHW-2 or equivalent 90º C wet-rated conductors in high temperature conduit (conduit rated for a minimum of 75º C wet conditions).

b. Conductor Ampacity:

Correct maximum current and ampacity calculations should be provided for each circuit. (Ampacity of conductors must be sufficient for application) [690.8].

I. The maximum PV source circuit current is the sum of parallel module rated short circuit currents multiplied by 125 percent [690.8(A)(1)].

II. The minimum source circuit conductor ampacity is 125 percent of the maximum PV source circuit current [690.8(B)(1)].

III. Minimum photovoltaic output circuit conductor ampacity is the sum of the maximum current of the parallel source circuits X1.25 [690.8(B)(1)]. Calculating ampacity of conductors used for the PV output circuit can be an involved process.

IV. Minimum inverter output circuit conductor ampacity must be equal to or greater than the inverter continuous output current rating times 1.25. [690.8 (A)] Informational note: Where the requirements of [690.8(A)(1) & (B)(1)] are both applied.

c. Overcurrent Protection: Necessary fuses or circuit breakers must be properly sized and specified for each circuit.

I. PV source circuit, PV output circuit, inverter output circuit, overcurrent protection must be sized so that both the PV module and the conductor from the module to the overcurrent device are properly protected [690.9 (A), 240.15 (A)]. PV modules must be protected so that the maximum series fuse rating, printed on the listing label, is not exceeded. The module may be protected either by installing fuses or circuit breakers in a series string of modules or by the design of the PV system. Inverters listed with a Maximum utility back feed current that is well above 1 amp (typically equal to the maximum allowable output overcurrent protection) must be assumed to provide back feed current to the PV array. Each source circuit must have overcurrent protection that is greater than or equal to the minimum PV Source Circuit current rating and less than or equal to the maximum series fuse rating.

For an inverter listed with a Maximum utility back feed current that is zero, two source circuits can be connected to the inverter without requiring overcurrent protection on either circuit. [690.9 (A) exceptions (1) & (2)].

II. Storage Battery (if used) 690.71 and 690.72. PV System installation shall be in accordance with the Article 706.

III. For requirements of Point of Connection of a utility interactive PV inverter to the building electrical system see [705.12].

7. Rapid Shutdown of PV Systems on Buildings:

PV system circuits installed on or in buildings shall include a rapid shutdown function that controls specific conductors in accordance with [690.12].

8. Provisions for the Photovoltaic Power Source Disconnecting Means:

Article 690.13 addresses the disconnecting means related requirements, such as the NEC states in [690.13A], “Location. The photovoltaic disconnecting means shall be installed at a readily accessible location either inside or outside of a building.” Readily accessible—[Article 100] states, “Accessible, Readily (Readily Accessible). Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, and so forth.”

9. Ground Fault Protection and Grounding:

Ground Fault Protection:

a. Direct current ground-fault protection is required to be installed, per 690.41(B), to reduce fire hazards in PV arrays. Ground-fault protection is permitted to take the form of onboard circuitry in an inverter or combiner box that is listed as providing ground-fault protection and it is also permitted to be installed as a device or system that is separate from the inverter or combiner box. When isolating inverters were installed, the grounded dc conductor was brought to ground potential by being connected to the grounding system through a fuse. A fuse with a value of one ampere was often used because the value was high enough to allow a harmlessly low amount of fault current to flow yet low enough to isolate the grounded conductor from ground when a ground-fault of harmful amperage occurred. Ground-fault protective devices (GFPDs) must meet four requirements:

i. Detect ground-faults in the dc conductors of a PV system, including functionally grounded conductors.

ii. Isolate faulted circuits from ground reference.

iii. Indicate the occurrence of ground-faults.

iv. Be listed for providing PV ground fault protection.

Grounding:

a. A two-wire PV array with one functionally grounded conductor, as permitted, per 690.41(A)(1), is where one of the dc conductors from the array is grounded while the other is left ungrounded. In this configuration, the grounded conductor references ground through the inverter's electronic circuitry, which also provides the ground-fault protection.

b. A bi-polar PV array with a functionally grounded reference (center-tapped conductor), as permitted, per 690.41(A)(2), is where one conductor, that is common to each of the array's monopole sub-arrays, is grounded while the other conductors, one from each of the array's monopole sub-arrays, are left ungrounded. In this configuration, the grounded conductor, being functionally grounded, references ground through the inverter's electronic circuitry. In this case, as above, the inverter's electronic circuitry provides the ground-fault protection.

c. A PV array that is not isolated from the grounded inverter output, as permitted, per 690.41(A)(3), is where the grounded dc conductor from the PV array is directly coupled to the inverter's grounded ac conductor. In this configuration, ground-fault protection is provided through a device or system installed outboard of the inverter, which may be accomplished by installing the GFPD in its own enclosure or installing a combiner box that features an onboard GFPD.

d. An ungrounded PV array, as permitted, per 690.41(A)(4), is where neither of the dc conductors from the array is grounded, which is the most popular of all the array configurations in the U.S. today. In such a configuration, it is especially important to provide ground-fault protection because there would, otherwise, be no way of detecting a ground-fault in the array, which underscores the importance of the GFPD's functions in a solar PV system.

e. A solidly grounded PV array, as permitted, in 690.41(B), as permitted, per 690.41(A)(5), is a special case where the PV array contains no more than two source circuits, i.e., two strings of modules, the PV system circuitry is not located in or on a building, and the system is solidly grounded. These types of systems are often used to supply power to traffic signs and in small, remote water pumping stations for livestock. In such a configuration, one of the dc conductors from the array is grounded while the other is left ungrounded; and the grounded conductor is solidly connected to a grounding electrode system.

f. If ground-fault protection is installed outboard of the inverter or combiner box, it is permitted to be installed in its own enclosure; and the standard requirements of grounding and bonding the enclosure are enforced. Many GFPDs are designed to be mounted on DIN rail, and they take-on the general appearance of a circuit breaker. Even those that are designed as part of a combiner box take this form. Those GFPDs that are integral to an inverter, on the other hand, may not be

recognizable as such, where the only way one would know of its inclusion in the inverter's circuitry is a label or mark on the inverter itself or by a ground-fault indicator that appears on the inverter's user display. As with GFCIs, GFPDs have separate, supply-side- and load-side terminations; and care must be taken to see that the device is installed correctly. If a GFPD is installed in a utility-interactive PV system, the system's output conductors are required to be terminated to the device's supply-side terminals per 705.32. Where a GFPD is installed in a combiner box, the combiner box's finger bus carries the combined input current of the array. The finger bus would then be required to terminate to the supply-side of the device.

10. Array Mounting Information: You will need this information to obtain your building permit:

I. Provide the site plan showing the location of the building and PV equipment.

Provide array layout and the supporting structure. If roof mounted, show anchorage to the roof and framing structure and schematic elevations. Identify methods of sealing all roof penetrations. The plans showing the supporting structure details must include rapid shutdown of PV systems on buildings, provisions for the photovoltaic power source disconnecting means, grounding, and array mounting information. You will need this information to obtain your building permit signed and sealed by a Maryland Licensed Professional Engineer certifying the design is in accordance with the applicable codes in Prince George's County, MD.

11. PV System Marking shall be provided as per NEC 690 requirements.

12. Stormwater Permitting Requirements:

DPIE does not require site/road approval for roof-mounted solar panels, parking lot installations of solar panels, or ground-mounted solar arrays under 5,000 square feet area of disturbance.

DPIE requires site/road approval of ground-mounted solar arrays at or over 5,000 square feet area of disturbance. For these projects the applicant first needs to submit and secure a site development concept approval from DPIE site/road. Subsequently the permittee needs to submit and secure a site development fine grading permit for these projects. Stormwater management requirements for Solar Array projects are sometimes minimal if the solar arrays are designed in accordance with MDE Stormwater Design Guidance for Solar Panel Installations.