

SYSTEM DESIGN REQUIREMENTS

General Information

User-specified equipment and design elements shall be compliant with current adopted codes and standards, including 2017 FBC, 2014 NEC, 6th Ed FFPC (NFPA 1) and ASCE 7-10.

All equipment shall be listed and installed in accordance with manufacturer's instructions.

All PV systems and associated equipment shall be installed only by licensed contractors and qualified persons.

Comments / Referened Standards

2014 NEC, 2017 FBC, FFPC, ASCE7-10.

NEC 110.3(B)

NEC 690.4(E), FS Ch 489

Disclaimers

User assumes full responsibility for providing accurate and valid input data.

Program results verify minimum requirements for code compliance only.

System performance and design optimization is not considered.

This program does not evaluate impact from shading on arrays.

This program may not consider all aspects of product installation manuals for listed equipment.

AHJs verify compliance with 110.3(B), product installation manuals (and specifications) shall be included in permitting documents for reference.

Limitations

System Restrictions

Simple interactive PV systems only, no battery-based systems.

Program addresses string inverter systems only.

See NEC 690.2 and "Definitions" tab for standard definitions for PV system circuits used in this document.

PV systems using AC modules, microinverters and arrays using dc electronics at the module level are not considered in this initial version. Additional algorithms will be added for systems using module-level electronics (ac modules, microinverters and dc-dc converters).

Building Restrictions

Risk Caterory II structures, single-family residential buildings only.

Installed only on buildings with 2x4 pre-engineered truss systems, 24" OC spacing.

Minimum electrical service requirements 150 A @ 240 V, split-phase.

Interconnections to load side of service disconnecting means only.

Limits structural calculations required

Limits structural calculations required

Limits electrical configurations

Limits electrical configurations

Equipment Restrictions

These restrictions narrow the scope of design complexity and the code calculations required.

Inverters

Shall be listed to UL1741 standard, and identified for use with ungrounded PV arrays.

Shall have integral dc disconnect, source circuit combiner

Shall have integral ground-fault protection

690.4(D) requires inverters listed and identified for interactive PV systems. 690.35(G) requires inverters used in systems with ungrounded photovoltaic source and output circuits to be listed for the purpose.

This limitation assumes all PV source circuits are terminated/parallel at the inverter, and no PV output circuit calculations required.

690.5 and 690.35(C) require ground-fault protection. PV systems requiring ground-fault protection devices are permitted to have the single-point grounding connection made inside the ground-fault protection equipment or inside the utility-interactive inverter and additional external bonding connections are not permitted. Connections are to be made in accordance with markings on the equipment or in the installation instructions.

690.11 (2011) requires dc arc-fault protection for PV arrays on buildings operating over 80 V.

Avoids special labeling and disconnect requirements for inverters installed in not readily accessible locations, such as attics or on rooftops per 690.14(D).

This limitation is based on the maximum inverter overcurrent device rating permitted in a residential load center with 200 A OCPD and 225 A busbar rating for load side interconnections.

PV Modules

Shall be listed to UL1703 standard

Flat-plate crystalline silicon modules only

Minimum Class C fire rating

Load ratings shall be provided in manufacturer's specifications

Required by 690.4(D), 110.3(B)

Industry standard

For installation on rooftops, must have equa to or greater fire classification than rofing materials.

Required for wind calculations.

Other BOS

Racking systems shall be listed to UL 2703 standard and have integrated equipment grounding

Industry standard. Proper bonding between structrual elements required, must use manufacturer approved bonding jumpers and equipment bonding washers as applicable, installed according to manufacturer's instructions. 250.136(A) permits bonded metal racking materials to be used for the equipment grounding conductor, and transition to an appropriate size conductor to be run with the PV output circuits. 690.43(C) also permits structures to be used as the equipment grounding conductor.

Devices listed and identified for grounding the metallic frames of PV modules or other equipment shall be permitted to bond the exposed metal surfaces or other equipment to mounting structures. Metallic mounting structures, other than building steel, used for grounding purposes shall be identified as equipment-grounding conductors or shall have identified bonding jumpers or devices connected between the separate metallic sections and shall be bonded to the grounding system. 690.43(F) Requires equipment grounding conductors for the PV array and structure (where installed) to be contained within the same raceway or cable or otherwise run with the PV array circuit conductors when those circuit conductors leave the vicinity of the PV array.

Shall use minimum 6 AWG CU equipment grounding conductors where exposed, smaller size EGCs shall be installed in raceways

PV module frames are bonded to metal racking with listed equipment bonding washers or piercing clamps.

Listed PV wire shall be used for all exposed single-conductor PV module interconnections

Does not require physical protection for exposed EGC at array per 690.46 and 250.120(C).

Listed PV fuses shall be used for all PV source circuits, if required

All source combiner boxes listed to UL 1741 standard

690.43(D) permits devicesand systems used for mounting PV modules that are also used to provide grounding of the module frames shall be identified for the purpose of grounding PV modules.

Industry standard, USE-2 permitted by 690.31(B) is not permitted as exposed single-conductor for ungrounded arrays per 690.35(D).

PV-rated fuses do not normally require temperature de-rating.

Shall have proper NEMA rating, number of poles, appropriate current and voltage ratings, fuses for both positive and negative circuits (required for ungronded arrays), and be installed according to manufacturer's instructions.

Have appropriate ratings and be installed according to manufacturer's instructions.

Allows 90°C rated conductor ampacities to be used from Tables 310.15(B)(16) and (17). This includes dc combiner boxes and any installer supplied splices or terminations. Inverter ac output circuits used 75 C ampacity based on connection to standard circuit breakers with 75 C terminals.

Other junction boxes and enclosures

All electrical terminals in dc circuits rated for 90°C