

NFPA 70. NEC 2011. ARTICLE 690.Solar Photovoltaic (PV) Systems

690.4 Installation

- (A) **Photovoltaic System.** Photovoltaic Systems shall be permitted to supply a building or other structure in addition to any other electricity supply system(s).
- (B) **Identification and Grouping.** Photovoltaic source circuits and PV output circuits shall not be contained in the same raceway, cable tray, cable, outlet box, junction box, or similar fittings as conductors, feeders, or branch circuits of other non – PV systems, unless the conductors of the different systems are separated by a partition. Photovoltaic system conductors shall be identified and grouped as required by 690.4(B)(1) through (4). The means of identification shall be permitted by separate colour coding, marking tape, tagging, or other approved means.
- (1) **Photovoltaic Source Circuits.** Photovoltaic source circuits shall be identified at all points of termination, connection, and splices.
- (2) **Photovoltaic output and Inverter circuits.** The conductors of PV output circuits and inverter input and output circuits shall be identified at all points of termination, connection and splices.
- (3) **Conductors of multiple systems.** Where the conductors of more than one PV system occupy the same junction box, raceway, or equipment, the conductors of each system shall be identified at all termination, connection, and splice points.

Exception : Where the identification of the conductors is evident by spacing or arrangement, further identification is not required.

- (4) **Grouping.** Where the conductors of more than one PV system occupy the same junction box or raceway with a removable cover(s), the ac and dc conductors of each system shall be grouped separately by wire ties or similar means at least once, and then shall be grouped at intervals not to exceed 1.8m (6 ft)

Exception : The requirement for grouping shall not apply if the circuit enters from a cable or raceway unique to the circuit that makes the grouping obvious.

- (C) **Module Connection Arrangement.** The connection to a module or panel shall be arranged so that removal of a module or panel from a photovoltaic source circuit does not interrupt a grounded conductor to other PV source circuits.
- (D) **Equipment.** Inverters, motor generators, photovoltaic modules, photovoltaic panels, ac photovoltaic modules, source circuit combiners, and charge controllers intended for use in photovoltaic power systems shall be identified and listed for the application.
- (E) **Wiring and Connections.** The equipment and systems in 690.4(A) through (D) and all associated wiring and interconnections shall be installed only by qualified persons.

Informational Note: See Article 100 for the definition of qualified person.

- (F) **Circuit Routing.** Photovoltaic source and PV output conductors, in and out of conduit, and inside of a building or structure, shall be routed along building structural building such as beams, rafters, trusses, and columns where the location of those structural members can be determined by observation. Where circuits are imbedded in built up, laminate, or membrane roofing materials in roof areas not covered by PV modules and associated equipment, the location of circuits shall be clearly marked.

(G) **Bipolar Photovoltaic systems.** Where the sum, without consideration of polarity, of the PV system voltages of the two monopole subarrays exceeds the rating of the conductors and connected equipment, monopole subarrays in a bipolar PV system shall be physically separated, and the electrical output circuits from each monopole subarray shall be installed in separate raceways until connected to the inverter. The disconnecting means and overcurrent protective devices for each monopole subarray output shall be in separate enclosures. All conductors from each separate monopole subarray shall be routed in the same raceway.

Exception: Listed switchgear rated for the maximum voltage between circuits and containing a physical barrier separating the disconnecting means for each monopole subarray shall be permitted to be used instead of disconnecting means in separate enclosures.

(H) **Multiple Inverters.** A PV system shall be permitted to have multiple utility-interactive inverters installed in or on a single building or structure. Where the inverters are remotely located from each other, a directory in accordance with 705.10 shall be installed at each dc PV system disconnecting means, at each ac disconnecting means, and at the main service disconnecting means showing the location of all ac and dc PV system disconnecting means in the building.

Exception: A directory shall not be required where all inverters and PV dc disconnecting means are grouped at the main service disconnecting means.

690.5 Ground – Fault Protection. Grounded dc photovoltaic arrays shall be provided with dc ground-fault protection meeting the requirements of 690.5(A) through (C) to reduce fire hazards. Ungrounded dc photovoltaic arrays shall comply with 690.35.

Exception No. 1: Ground mounted or pole mounted photovoltaic arrays with not more than two paralleled source circuits and with all dc source and dc output circuits isolated from buildings shall be permitted without ground-fault protection.

Exception No. 2: Photovoltaic arrays installed at other than dwelling units shall be permitted without ground-fault protection if each equipment grounding conductor is sized in accordance with 690.45

(A) **Ground fault Detection and Interruption.** The ground-fault protection device or system shall be capable of detecting a ground-fault current, interrupting the flow of fault current, and providing an indication of the fault.

Automatically opening the grounded conductor of the faulted circuit to interrupt the ground fault current path shall be permitted. If a grounded conductor is opened to interrupt the ground-fault current path, all conductors of the faulted circuit shall be automatically and simultaneously opened.

Manual operation of the main PV dc disconnect shall not activate the ground fault protection device or result in grounded conductors becoming ungrounded.

(B) **Isolating Faulted Circuits.** The faulted circuits shall be isolated by one of the two following methods:

- (1) The ungrounded conductors of the faulted circuit shall be automatically disconnected.
- (2) The inverter or charge controller fed by the faulted circuit shall automatically cease to supply power to output circuits.

(C) **Labels and markings.** A warning label shall appear on the utility interactive inverter or be applied by the installer near the ground-fault indicator at a visible location stating the following.