

ARTICLE 690

SOLAR PHOTOVOLTAIC (PV) SYSTEMS

Introduction to Article 690—Solar Photovoltaic (PV) Systems

You have seen, or maybe own, devices powered by photovoltaic cells, such as night lights, car coolers, and toys. These generally consist of a small solar module powering a small device running on a few volts and a fraction of an ampere. A solar PV system that powers a building or interconnects with an electric utility operates on the same principals but on a much larger scale.

Solar PV systems that provide electrical power to an electrical system are complex. There are many issues that require expert knowledge in electrical, structural, and architectural issues.

The purpose of the *NEC* is to safeguard persons and property from the hazards arising from the use of electricity [90.1(A)]. Article 690 is focused on the electrical hazards that may arise from installing and operating a PV system. It consists of eight parts.

The general *Code* requirements of Chapters 1 through 4 also apply to these installations, except as specifically modified by this article [90.3].

690.12 Rapid Shutdown



Scan this QR code for a video of Mike explaining this topic; it's a sample from the videos that accompany this textbook. www.MikeHolt.com/20PVvideos

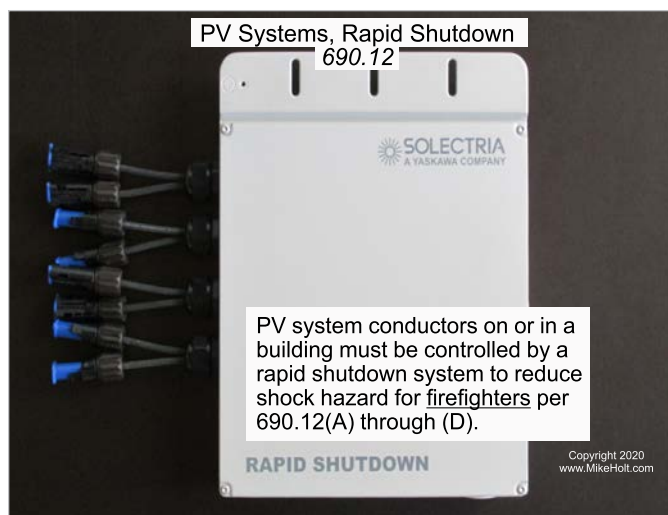
PV system conductors on or in a building must be controlled by a rapid shutdown system to reduce shock hazard for firefighters in accordance with 690.12(A) through (D). ▶ **Figure 690–52**

Ex: A rapid shutdown system is not required for ground-mounted PV system conductors that enter buildings whose sole purpose is to house PV system equipment.

(A) Controlled Conductors. PV system conductors controlled by the rapid shutdown system include:

- (1) PV system dc circuit conductors.
- (2) Inverter output ac circuits originating from inverters located within the array boundary.

Note: The ac output conductors from PV systems will be either de-energized after shutdown initiation or remain energized if supplied by a utility service. To prevent PV systems with ac output conductors from remaining energized, they must be controlled by the rapid shutdown system after shutdown initiation.



▶ **Figure 690–52**

(B) Controlled Limits. For the purpose of rapid shutdown, the array boundary is defined as the area 1 ft outside the perimeter of the PV array.

(1) Outside the Array Boundary. PV system circuit conductors located outside the PV array boundary or more than 3 ft from the point of entry inside a building must be limited to 30V within 30 seconds of rapid shutdown initiation.

(2) Inside the Array Boundary. The PV system rapid shutdown system must comply with one of the following:

- (1) A PV hazard control system listed for the purpose must be installed in accordance with the manufacturer's installation instructions. Where a hazard control system requires initiation to transition to a controlled state, the rapid shutdown initiation device [690.12(C)] must perform this initiation.

Note: A listed or field-labeled hazard PV control system is comprised of either an individual piece of equipment that fulfills the necessary functions, or multiple pieces of equipment coordinated to perform the functions as described in the manufacturer's installation instructions.

- (2) PV system circuit conductors located inside the PV array boundary must be limited to 80V within 30 seconds of rapid shutdown initiation.
- (3) PV arrays must have no exposed wiring methods or exposed conductive parts and be installed more than 8 ft from exposed conductive parts.

(C) Initiation Device. A rapid shutdown initiation device is required to initiate the rapid shutdown function of the PV system. When the rapid shutdown initiation device is placed in the "off" position, this indicates that the rapid shutdown function has been initiated.

For one- and two-family dwellings, the rapid shutdown initiation device must be located outside the building at a readily accessible location.

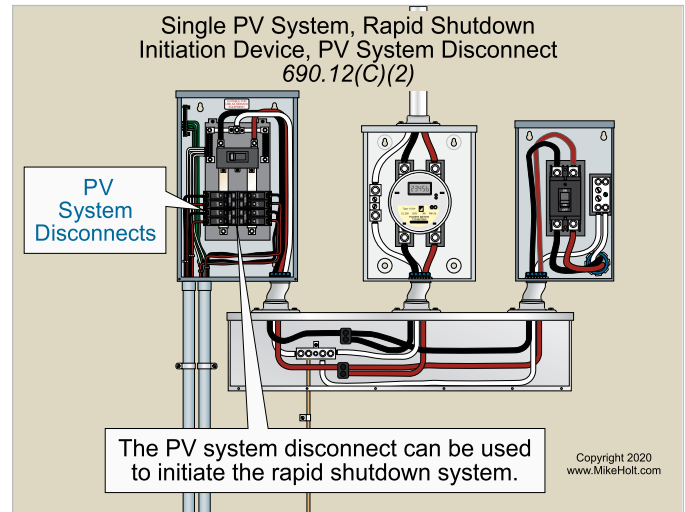
For a single PV system, the rapid shutdown initiation must occur by the operation of any single device that must be at least one of the following types:

- (1) The service disconnect. ▶Figure 690-53



▶Figure 690-53

- (2) The PV system disconnect. ▶Figure 690-54



▶Figure 690-54

- (3) A readily accessible switch that plainly indicates whether it is in the "off" or "on" position.

Note: An example of where a rapid shutdown initiation device that complies with 690.12(C)(3) would be used is where a PV system is connected to an optional standby or stand-alone system.

Where multiple PV systems are on a single service, the rapid shutdown initiation device(s) for the multiple PV systems must consist of not more than six switches or six sets of circuit breakers, or a combination of not more than six switches and sets of circuit breakers.

(D) Equipment. Equipment that performs the rapid shutdown function, other than initiation devices, must be listed for providing rapid shutdown protection.