ARTICLE
# 691

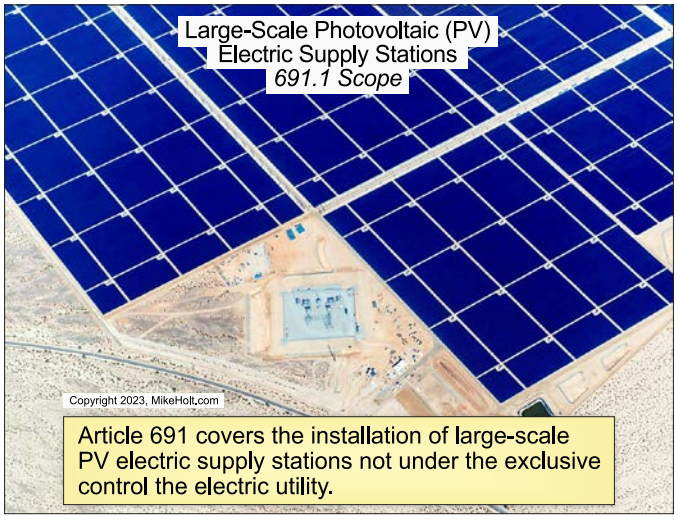
# LARGE-SCALE PHOTOVOLTAIC (PV) ELECTRIC SUPPLY STATIONS

## Introduction to Article 691—Large-Scale Photovoltaic (PV) Electric Supply Stations

The general requirements for solar photovoltaic (PV) systems are covered by Article 690. This article defines what a large-scale photovoltaic system is and the additional requirements that must be met to take advantage of the alternative design and safety features unique to large systems. Large-scale PV systems are privately owned PV systems operated solely to provide electricity to a regulated electric utility as compared to the Article 690 systems that may be operated to provide power to the end user, electric utility, or a combination of both. Large-scale photovoltaic (PV) electric supply stations require a careful documented review of the design by an engineer to ensure safe operation and compliance with the applicable electrical standards and industry practices.

## 691.1 Scope

Article 691 covers the installation of large-scale PV electric supply stations not under control of an electric utility. ▸Figure 691–1




▸Figure 691–1

**Note 1:** Facilities covered by this article have specific design and safety features unique to large-scale PV facilities outlined 691.4 and are operated for the sole purpose of providing electric supply to a system operated by a regulated electric utility for the transfer of electric energy.

## 691.4 Special Requirements for Large-Scale PV Electric Supply Stations

Large-scale PV electric supply stations are only permitted to be accessible to authorized personnel and must comply with the following requirements:

(1) Electrical circuits and equipment must be maintained and operated by qualified person.

(2) PV electric supply stations must be restricted in accordance with 110.31 and have field-applied hazard markings that are permanently affixed and have sufficient durability to withstand the environment involved [110.21(B)].

(3) The connection between the PV electric supply and the electric utility system must be through medium- or high-voltage switch gear, substations, switchyards, or similar methods whose sole purpose is to interconnect the two systems.

(4) Loads within the PV electric supply station must only be used to power auxiliary equipment for the generation of the PV power.

(5) Large-scale PV electric supply stations are not permitted to be installed on buildings.

(6) The station is monitored from a central command center.

(7) The station has an inverter generating capacity of not less than 5000 kW.

Some individual sites with capacities less than 5000 kW are operated as part of a group of facilities with a total generating capacity of much greater than 5000 kW.

## 691.5 Equipment

All electrical equipment must be approved for installation by one of the following:

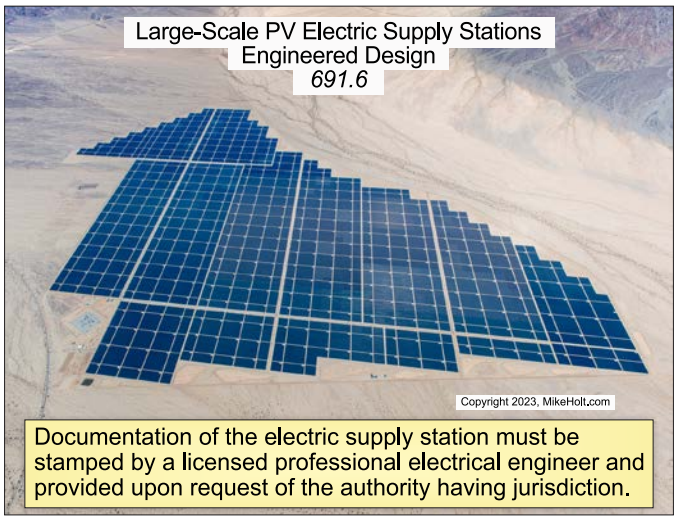
(1) Listing and labeling

(2) Be evaluated for the application and have a field label applied

(3) Where products complying with 691.5(1) or (2) are not available, by engineering review validating that the electrical equipment is evaluated and tested to relevant standards or industry practice

## 691.6 Engineered Design

Documentation of the electric supply station must be stamped by a licensed professional electrical engineer and provided upon request of the authority having jurisdiction. Additional stamped independent engineering reports by a licensed professional electrical engineer detailing compliance of the design with applicable electrical standards and industry practice must be provided upon request of the authority having jurisdiction. ▸Figure 691–2




▸Figure 691–2

This documentation must include details of the conformance of the design with Article 690 and any alternative methods to Article 690, or other articles of the *NEC*.

## 691.7 Conformance of Construction to Engineered Design

Documentation by a licensed professional electrical engineer that the construction of the electric supply station conforms to the electrical engineered design must be provided upon request of the authority having jurisdiction. Additional stamped independent engineering reports by a licensed professional electrical engineer detailing that the construction conforms with this *Code*, applicable standards, and industry practice must be provided upon request of the authority having jurisdiction. This independent engineer must be retained by the system owner or installer.

## 691.8 Direct-Current Operating Voltage

Large-scale PV electric supply station calculations must be included in the documentation required in 691.6.

## 691.9 Disconnect for Isolating Photovoltaic Equipment

Equipment disconnects are not required to be within sight of equipment and may be remote from the equipment.

The engineered design required by 691.6 must document disconnection procedures and means of isolating equipment.

For information on electrical system maintenance, see NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance.* For information on written procedures and conditions of maintenance, including lockout/tagout procedures, see NFPA 70E, *Standard for Electrical Safety in the Workplace.*

Buildings whose sole purpose is to house and protect supply station equipment are not required to include a rapid shutdown function to reduce shock hazard for firefighters [690.12]. Written standard operating procedures must be available at the site detailing necessary shutdown procedures in the event of an emergency.

## 691.10 Fire Mitigation

PV systems that do not provide arc-fault protection as required by 690.11 must include details of fire mitigation plans to address dc arc faults in the documentation required in 691.6.

Fire mitigation plans are typically reviewed by the local fire agency and include topics such as access roads within the facility.

## 691.11 Fence Bonding and Grounding

Fence grounding requirements and details must be included in the documentation required in 691.6.

**Note:** See 250.194 for fence bonding and grounding requirements for PV systems that operate at more than 1000V between conductors. Grounding requirements for other portions of electric supply station fencing are assessed based on the presence of overhead conductors, proximity to generation and distribution equipment, and associated step and touch potential.