

**PHOENIX REGIONAL
STANDARD OPERATING PROCEDURES**

PHOTOVOLTAIC INSTALLATIONS

M.P. 205.20B

11/19-N

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PURPOSE

This procedure will establish a standard approach and response to Photovoltaic (PV) installations.

POLICY

It is the policy of the Central Arizona Life Safety System Response Council to respond to reports of emergencies in facilities that have PV systems. Our objective is to provide for life safety and reduce property damage when and where it's safe to do so. It is important to note that because of the significant hazard they present, PV installations will change the way we operate in facilities that have them. Firefighters must recognize the existence of the PV installations early in an incident and know the associated hazards.

PHOTOVOLTAIC SAFETY AWARENESS

PV systems are electrical generators. Photovoltaic arrays generate electricity by converting light energy into electrical energy. These systems are always generating electricity within the modules when they are exposed to light. Grid-tied systems can have electricity back feeding into the inverter until the disconnects are operated.

Photovoltaic Systems are found in residential, commercial and utility installations. All these systems represent a potential electrical shock hazard. Monsoon storms, hail, exposure to fire, or vandalism can create damage to the system which may cause electrical faults. These electrical faults may create a hazardous condition that can override the designed safety systems. Firefighters should use extreme caution when approaching PV systems and the structures they are found on.

DANGERS OF PHOTOVOLTAIC SYSTEMS

PV systems create Direct Current (DC) that must be converted to Alternating Current (AC) for use in the electrical grid; this is done through an inverter. Depending on the type of PV installation and the occupancy, the expected voltages produced are as follows:

- Residential: Up to 600 Volts DC
- Commercial: Up to 1000 Volts DC
- Utility Installations: Up to 1500 Volts DC

Note: Once converted through an inverter 1500 volts of DC current becomes 35,000 volts of AC current.

Emergencies involving PV installations and associated equipment contain hazards unique to electrical systems. This includes an electrocution hazard, toxic products of combustion, and thermal burns from electrical arcing.

PV installations may consist of the PV cell, multiple cells mounted into a module, multiple modules mounted into an array, invertors, disconnects and electrical conduit. Some installations may have a Battery Energy Storage System (BESS).

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Hazardous compounds are used in the manufacturing process to make the cells. If panels are involved in fire, PPE including SCBA shall be worn. Exposure reduction through on scene decontamination shall be utilized.

Disconnects must be utilized to isolate the PV system from the electrical grid and BESS if present. It is important to note that some components of the system may continue to hold energy, this concept is called stranded energy and can represent a potential source of injury. PV panels or modules can be covered with opaque tarps to stop the generation of electricity.

Building integrated PV roofing tiles or shingles are unique in that they serve as the finished roof and generate electrical energy. This type of roof system not only has the electrical hazard associated with it, but they are extremely slippery and represent a fall hazard. Roof operations shall not be conducted on a building integrated PV tile or shingle roof.

When addressing concealed spaces including the attic, consider that electrical wires coming from the PV panels may be energized. It's possible for the aluminum frames of panels and the metal components of mounting racks to become charged if the system has sustained physical damage. Avoid contact with these components.

EMERGENCY RESPONSE PROCEDURES

Firefighters should identify the presence of PV installations early in the incident. Indicators that a PV installation is present are as follows:

- Visible array of PV panels
- Conduit coming from roof
- Invertors mounted on a wall or the ground next to building electrical panel
- Signage found around the electrical system

The presence of a PV installation shall be announced on the tactical radio channel and acknowledged by Command. It is critical that everyone on the fireground is aware of the presence of a PV installation. For example, interior companies must be aware of the potential for live electrical power to be still active in the attic and roof operations may not be possible depending on the layout of the PV array.

When a PV installation is present in a residential or commercial application, and when safe to do so, all disconnects should be operated to electrically isolate the system. In order to fully secure utilities to the structure firefighters should address the following:

- De-energize power coming into the building from utility company.
- De-energize electrical circuits leading from the PV system.
- Operate the rapid shut down switch to isolate the DC power for the PV system and confine the power to the array.
 - Older systems may not have this “rapid shut down switch” function and de-energizing procedures above will leave the circuit from the array to the disconnect fully energized.

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- Evaluate the structure for the presence of a BESS and operate the disconnect if possible.

If a Responsible Party (RP) is available attempt to obtain information about the system and inquire if the PV installation includes a BESS. Direct the RP to contact their installer to respond to assess and mitigate hazards associated with the system.

FIRE IN THE PV ARRAY (RESIDENTIAL AND COMMERCIAL)

In the event that the PV array is involved in fire it's possible to use water to extinguish the fire after the electrical disconnects have been operated. A fog pattern delivered at a minimum of a 10-degree pattern from a minimum distance of 20 feet away will provide for the safe application of water on a PV array. This tactic may only be employed on PV installations up 1000 volts. Most residential and commercial PV systems generate less than 1000 volts. This tactic may not be employed on high voltage utility PV installations.

PV installations are becoming common in parking lots for electrical generation and to provide covered parking. In the event of a car fire in one of these systems it's critical to operate the electrical disconnects that feed the system. These systems are an example of where the decision to apply water to the panels may need to be made. It is mandatory to operate the disconnects prior to the application of water. These installations represent a unique hazard as the modules are overhead.

PHOTOVOLTAIC GENERATING STATIONS (UTILITY SUBSTATIONS)

In large utility substation events we will not engage in any activities related to fire suppression inside the facility. We will simply isolate the area. All fire department personnel will remain outside the fence line and protect exposures as needed. Careful coordination with the proper utility company representatives is required before any action may be considered.