PHOTOVOLTAIC INSTALLATIONS

Effective:	April 4, 2025
Scheduled Review:	April 4, 2028
Approved:	Fire Chief Mike Kennedy

I. PURPOSE

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

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.

II. PHOTOVOLTAIC SYSTEMS

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 invertor until the disconnects are operated.

PV systems are found in residential, commercial and utility installations. All these systems represent a potential electrical shock hazard. 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.

III. HAZARDS 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).

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.

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.

IV. INCIDENTS INVOLVING PHOTOVOLTAIC SYSTEMS

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

If the building owner or maintenance staff is available, attempt to obtain information about the system and inquire if the PV installation includes a BESS.

When possible, the PV system installer should be called to assess and mitigate hazards associated with the system.

V. FIRE IN THE PV ARRAY - RESIDENTIAL AND COMMERCIAL

If the PV array is involved in fire, it is 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 twenty (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.

As the PV Panel burns the material can liquify and can follow the path of least resistance. This may extend the fire non-typically and cause extension below the panels and in the structure. Overhaul efforts must address this risk.

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 is 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.

VI. PHOTOVOLTAIC GENERATING STATIONS - UTILITY SUBSTATIONS

In large utility substation events, crews will not engage in any activities related to fire suppression inside the facility. Crews 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.

VII. PVSTOP

On the bay floor of Station 1, there are two applicators (similar to 2.5 gallon water extinguishers) of a product called PVSTOP. PVSTOP is a water-based polymer coating that is sprayed onto solar panels like a “liquid tarp”, blocking the light and “switching off” the solar panel system in seconds. Once applied, the PVSTOP coating dries into a protective, non-flammable film, which can be peeled off the solar panels without damaging the system when it is time to re-activate the PV system.

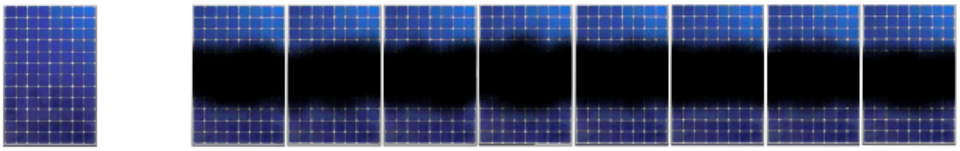
- This PVSTOP device is NOT a fire extinguisher and must not be used as such.
- 40% coverage of PVSTOP across the center of the solar panel array will render the solar panels electrically safe.
- There will still be volts (V) present in the PV system as light is still being received by the uncoated solar cells, however the 40% coverage breaks the circuit, reducing the amps (I) to zero. As an example, a residential solar system with 40% PVSTOP coverage may still be producing significant voltage, but with 0 amps, the system is producing 0 power (100 volts x 0 amps = 0 watts)

- Although 40% coverage of PVSTOP will render the solar panel array electrically safe, the objective should always be 100% coverage as a "best practice" procedural measure.

PANELS IN PORTRAIT ORIENTATION

STEP 1

Apply a strip of PVSTOP across the centre (40%) of the solar panel array.



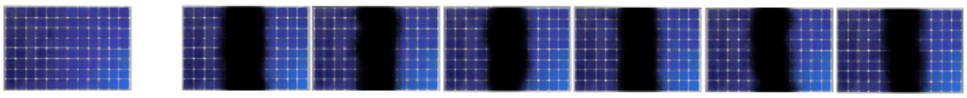
STEP 2

Continue to apply PVSTOP until the solar panel array is completely coated or until the PVSTOP canister is empty (for additional safety, panel protection and allows the coating to be more easily peeled off post application)**.**

PANELS IN LANDSCAPE ORIENTATION

STEP 1

Apply a strip of PVSTOP across the centre (40%) of the solar panel array.



STEP 2

Continue to apply PVSTOP until the solar panel array is completely coated or until the PVSTOP canister is empty (for additional safety, panel protection and allows the coating to be more easily peeled off post application).