

FIRE DEPARTMENT EMERGENCY OPERATIONS

- The PV array will always generate electricity during daylight, even when cloudy, raining, snowing, etc., and the generation of electricity cannot be turned off.
- Consider all PV equipment and wires to be energized, and do not touch or cut into or through PV modules, conduit or equipment.
- Do not open combiner box (square box, usually only on large commercial units). All energized wires from the solar panels are fed into the combiner box, then combined into two large high-current wires. Opening this box is dangerous. Boxes are normally locked.
- Wear SCBA and full protective clothing.

If solar panels or batteries are on fire:

- Locate battery storage area (if applicable).
- Ensure that people downwind of the fire are protected and have a location to shelter in place.
- Use Class C extinguishing agents – CO₂ or dry chemicals, if a PV system shorts and starts a fire.
- Extinguish lead-acid battery fires with CO₂ foam or dry chemical fire extinguishers.
- Should the PV array become engulfed in a fire, use water in a fog pattern, maintaining a minimum distance of 33 feet from the energized source.

*Never assume that
equipment is de-energized.*



IN EMERGENCIES, CALL DUKE ENERGY FOR ASSISTANCE:

- Indiana: 800.339.8517
- Ohio/Kentucky: 800.310.6346
- Duke Energy Carolinas: 800.726.5150
- Duke Energy Progress Carolinas: 866.570.5949
- Duke Energy Progress Florida: 800.365.9947



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FIRE SAFETY GUIDELINES FOR ROOFTOP- AND GROUND-MOUNTED SOLAR PHOTOVOLTAIC (PV) SYSTEMS



This brochure is intended for fire personnel responding to a fire where rooftop- and ground-mounted solar PV systems have been installed.



HAZARDS OF A SOLAR PHOTOVOLTAIC SYSTEM

Under normal operating conditions, PV systems are safe to operate. The PV industry has a good safety record, with only one solar PV electrical injury to a firefighter reported worldwide.



FOAM OR SALVAGE COVER – You cannot block the sunlight on the PV array with foam or a salvage cover. Foam will slide off the PV array, and although a salvage cover significantly reduces sunlight to the array, electricity can still be generated through it.

Inhalation exposure – During a fire or explosion, the PV frame can quickly degrade, exposing hazardous chemicals to direct flame which can then spread in the smoke plume:

- **Boron** – No health effects to humans or the environment.
- **Cadmium Telluride** – A known carcinogen. The primary route of exposure is inhalation.
- **Gallium Arsenide** – The health effects have not been studied. Considered highly toxic and carcinogenic.
- **Phosphorus** – Fumes from compounds are considered highly toxic. The NIOSH (National Institute for Occupational Safety and Health) recommended exposure limit to phosphorus is 5 mg/m³. A lethal dose of phosphorus is 50 milligrams.

Removal and cleanup of damaged PV systems are performed under the direction of the owner, by qualified and trained individuals. Owners of PV systems are prepared to have damaged panels removed and recycled. In the event damaged PV panels must be moved, firefighters should use full turnout gear, due to the potential presence of hazardous chemicals and decomposition products. Some of these chemicals/products can be corrosive to the skin and dangerous if inhaled.



Please do not pull the electric meter to shut off power to a building.

Electrical shock and burns – Contact with electricity can cause a range of effects, from a slight tingling sensation because of involuntary muscle reaction to severe burns, and even death. Burns that may occur in electrical incidents include electrical, arc and thermal. Arc temperatures can reach 15,000 to 35,000 degrees.

Roof hazards – Consider the weight of the PV array on a weakening roof structure and the fact that you may not be able to access the roof over the fire:

- Do not cut into PV modules
- Do not cut any electrical conduits
- Consider cross-ventilation
- Be aware of tripping hazards to prevent falls

Ground hazards – There may be uneven terrain where ground-mounted arrays are located. Use caution when approaching. Also, be alert to local wildlife habitat in the area and do not cut any electrical conduits.

Battery hazards – Some older installations may have batteries installed.

- As a rule, batteries burn with great difficulty.
- If batteries are exposed to fire, however, the fumes and gases generated are extremely corrosive.
- Electrolyte is corrosive and should be handled appropriately.
- Spilled electrolyte can react and produce toxic fumes and release flammable and explosive gases when it comes into contact with other metals and liquids.
- Due to the potential of explosive gases, prevent all open flames and avoid creating sparks.

Battery emergencies

- Wear full protective clothing and self-contained breathing apparatus (SCBA).
- Extinguish lead-acid battery fires with CO₂, foam or dry chemical fire extinguishers.
- Do not use water to put out a battery fire.
- Never cut into the batteries under any circumstances.
- If the battery is punctured by a conductive object, assume that the object has electrical potential.

Note:

When working near electrical circuits, keep in mind that, typically, hot sticks on many engines can detect only alternating current, and would not detect direct current in PV wiring or battery conductors.

Personal protective equipment – Firefighters should follow the minimum standard in NFPA (National Fire Protection Association) 1971, Protective Ensemble for Structural Firefighting, and NFPA 1500, Chapter 7, Personal Protective Equipment.

Things to consider

Size up the rooftop- or ground-mounted system and look for warning labels on electrical disconnects.

Lock-out and tag-out all electrical disconnects, isolating the PV system at the inverter.

Ventilation – Consider where to cut or whether to use cross-ventilation.

Evacuation – If a rooftop-mounted system is involved in a fire, evacuate the building where the rooftop array is located.

Shelter in place – Does the size of the emergency and the involvement of the array constitute the need to protect populations downwind?

- Walking on or breaking PV modules could release all the energy in the system simultaneously.
- Cut or damaged wires from a nighttime operation could become energized in the daytime.
- Spotlights used during an evening operation are not bright enough for the PV system to generate electricity, but scene lighting may.
- Lightning is bright enough to create an electrical surge.