

Fire and Emergency Response

Every electrical system has some risk of starting a fire, including electrical systems in residential, commercial, and industrial buildings. It is this hazard that motivated the creation of the NEC over 100 years ago. Due to the high standard required by the NEC, modern electrical systems rarely start fires. Like electrical systems in buildings, PV systems must also adhere to the NEC. In the rare case that a PV system has a fault that starts a fire, there is very little combustible material present for it to ignite. The only flammable portions of PV panels are the few thin plastic layers, the plastic junction box, and the insulation on its wires. The inverters are also capable of igniting, however, like PV modules, they consist primarily of non-flammable materials. The inverters and transformers are located on concrete pads or raised steel platforms that are isolated from other equipment and vegetation, so a fire in this equipment poses little threat of spreading.

Heat from a small flame is not adequate to ignite a PV panel, but an intense fire or an electrical fault can ignite a PV panel. One real-world example illustrating the low flammability of PV panels occurred during July 2015 in an arid area of California. Three acres of grass under a utility-scale PV facility burned without igniting the panels mounted just above the grass.³ Another example occurred recently in Florida, where there was a 5-acre grass fire under a portion of a 400-acre PV facility that did not ignite any modules.⁴

The most significant fire hazard at a utility-scale solar facility may be the oil in the transformers. There are medium voltage transformers dispersed throughout the site located by each inverter, called inverter step-up (“ISU”) transformers, and there is a large transformer in the interconnection substation, known as the generator step-up (“GSU”) transformer. Traditionally these types of transformers are filled with a non-PCB mineral oil, which is derived from petroleum, and is electrically insulating but flammable. A popular alternative to mineral oil is a transformer fluid made of biodegradable vegetable oil, such as FR3 by Cargill or VG-100 by GE. This type of oil not only has several performance benefits over mineral oil, but it is also dramatically reduces the fire hazard of transformers. These vegetable oils’ flash point of 330°C is dramatically hotter than mineral oil transformer fluid (160°C). Unlike mineral oil, FR3 and VG-100 are classified as a K-class, “high-fire-point”, “fire-resistant”, and “less-flammable” fluid. Also classified as “nonpropagating”, it is self-extinguishing, and will not continuously burn if ignited. Mineral oil, however, will keep burning for hours when ignited, with no feasible way to stop it until all the oil is consumed. Neither mineral oil- or vegetable oil-filled transformers would create a fire hazard for the community or property surrounding the solar facility.

No special equipment is required to respond to a fire incident at a utility-scale PV facility. The most important thing for first responders to know is that as long as the sun is shining on the PV panels they will produce dangerous voltage. However, there is no danger in touching undamaged equipment. There are multiple electrical disconnect switches in PV systems which allows problem areas to be electrically isolated quickly. The International Association of Fire Fighters (“IAFF”) provides online training on responding to fires at PV facilities at www.iaff.org/solar-pv-safety.

Risks of fire associated with ground cover and perimeter vegetation are reduced by landscaping plans that are developed with this specific goal. First responders can safely extinguish grass fires inside of the facility, or monitor and protect the areas surrounding the facility, to ensure the fire does not spread to surrounding areas. The solar facility owner remotely monitors the system around the clock and has personnel available 24/7 for emergencies.

Sources for Further Reading on Fire and Emergency Response:

- Duke Energy: [Fire Safety Guidelines for Rooftop- and Ground-Mounted Solar Photovoltaic \(PV\) Systems](#), September 2015
- North American Electric Reliability Corporation (NERC): [Lessons Learned, Substation Fires: Working with First Responders](#), February 2019

³ Matt Fountain. The Tribune. Fire breaks out at Topaz Solar Farm. July 2015. www.sanluisobispo.com/news/local/article39055539.html

⁴ WBMM News 13, Fire breaks out at Jackson Co. solar farm. August 2022, www.youtube.com/watch?v=byE_BpUX2mc
