

# Safety Risks & Solutions in PV Systems for Europe & APAC



The purpose of this paper is to discuss the safety issues of PV systems for firefighters and outline how the SolarEdge system can mitigate these safety issues.

## Firefighting

### Risk - Electrocutation:

Firefighters and other first responders called to a blaze commonly cut off power to the burning building as a safety precaution. If the building has a PV installation however, the PV modules continue to generate DC voltage, even if the system is not actually connected to the AC grid. In electrical systems, extra-low voltage (SELV) indicates a safe voltage below 120V. Under these conditions there is a low risk of electrocution. Yet, 3 – 4 connected modules are enough to generate more than 150V. Residential and commercial installations include dozens or hundreds of modules with voltage that can reach up to 1000V.

### Ineffective Solutions:

1. Shutdown functions in traditional inverters merely interrupt current flow, and voltages remain dangerously high.
2. Automatic DC breakers located on the inverter in the cabinet, cannot disconnect the voltage on the modules, adding cost without decreasing the risk.
3. PV module covering:
  - a. Spraying foam – this approach has proven to be ineffective because the foam evaporates or slides off the modules before extinguishing the fire.
  - b. Covering the module with an opaque material – this approach is not practical to implement and even dangerous, as it requires the firefighters to climb onto the burning roof carrying heavy covering material, and risking electrocution.

### Effective Solution - Module-Level Shutdown:

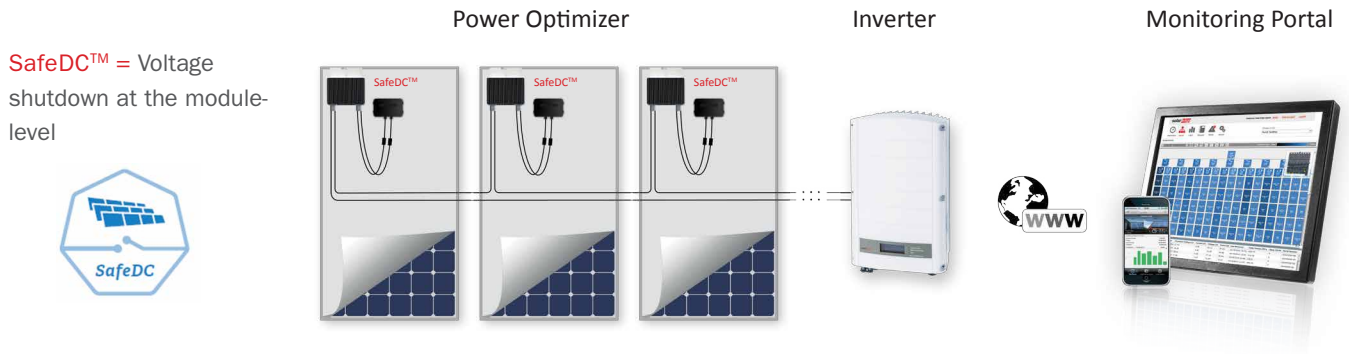
SolarEdge offers a PV power harvesting system that consists of power optimizers connected to each module, a PV inverter and module-level monitoring. Additionally, SolarEdge systems have a built-in safety feature that reduces safety risks.

When power optimizers are connected to the PV modules, the modules continue in “operation mode” only as long as a signal from the inverter is constantly renewed. In the absence of this signal, power optimizers automatically go into safety-mode, shutting down DC current as well as voltage in module and string wires. In safety mode, the output voltage of each module equals 1V. For example, if firefighters disconnect a PV system from the electrical grid during daylight and the PV system consists of 10 modules per string, the string voltage will decrease to 10V<sub>DC</sub>.

Since the maximum string length in a SolarEdge system is 50, the string voltage is limited to 50V<sub>DC</sub>, safely below the risk level. Even under single faults, the solution has been certified to have SELV (<120V) voltages.

### Module-level shutdown occurs automatically in either of these cases:

- A building is disconnected from the electrical grid
- The inverter is turned off
- Power optimizer thermal sensors for each module detect the rising temperature (threshold 85°C)



## Global trends:

Recently, more and more fire authorities, insurance companies and electrical authorities introduce new standards and regulations aimed at increasing PV safety and protecting personnel and property.

In the United States, for example, the National Electric Code, NEC 2014 requires rapid shutdown of PV Systems on Buildings. As part of this requirement, DC voltage from 10 foot from the edge of the array to the inverter has to be lower than 30V<sub>DC</sub> within 10 seconds of rapid shutdown initiation. The SolarEdge solution complies with this requirement. Another example is the German application guide.

### VDE compliance:

The German application guide VDE- AR-E 2100-712 requires, among other things, that after switching off the AC power supply, emergency forces will not expose themselves to the risk of direct contact with DC cables, which still carry a voltage greater than 120 volts DC. SolarEdge P series power optimizers meet this requirement by the patented SafeDC™ function (1V safety voltage). SolarEdge power optimizers allow automatic and fail-safe reduction of DC-voltage to a safe voltage (below 120V<sub>dc</sub>) within the required time. This function is integral to the system and therefore does not require any additional hardware or fire proof constructional measures, leading to a reduction of installation costs. The conformity to the technical requirements in sections 7.1 and 7.4 of the application rule were confirmed to SolarEdge by Primara (see last page).

## Conclusion

The SolarEdge system, with the integral SafeDC™ feature, ensures complete safety for firefighters working with PV modules, eliminates the risk of electrocution, and is the only inverter solution that is certified in Europe as a DC disconnect.

# Declaration of Conformity

**Applicant:** SolarEdge Technologies  
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Israel

**Product type:** Disconnect device for PV generators

**Model:** Safe DC disconnect mechanism

**Use in accordance with regulations:** Disconnection between a PV inverter and a PV generator

**Applied rules and standards:** In dependence on:  
**IEC 60947-3:1999 + Corr:1999 + A1:2001 + Corr1:2001 + A2:2005 in conjunction with IEC 60947-1:2004 (4<sup>th</sup> edition)**  
"Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units"

The safety concept of an aforementioned representative product corresponds at the time of issue of this certificate to the valid safety specifications for the specified use in accordance with regulations.

**Report no:** 13KFS109-01

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