PRESS RELEASE

Safe PV Systems: Fraunhofer ISE Tests Arc Fault Detectors

The Fraunhofer Institute for Solar Energy Systems ISE has developed a unique modular test stand for photovoltaic inverters with integrated arc fault detection. These integrated warning systems in inverters increase the safety of solar installations by initiating an automatic shut down in the event of arcing. With the newly published international standard IEC 63027, more reliable and realistic tests can be carried out on detectors. Fraunhofer ISE was involved in the development of the new test standard, which was published on May 3 2023.

Serial arcing in PV systems occurs due to contact problems, e.g., faulty solder joints in the module or in the DC wiring of the inverter. In a worst case scenario the high temperatures at faulty contact points can cause the system to catch fire.
Arc fault detectors (AFD) in inverters take advantage of the fact that the arc leads to a current jump in the inverter or a characteristic broadband noise: They detect the arc and switch off before a critical energy is reached. These detectors have been mandatory for newly installed PV systems in the U.S. since 2011. "National and international studies have shown that arcing occurs very rarely in PV systems with a high-quality installation. Nonetheless, manufacturers in the European market offer arc detectors on a voluntary basis. Some building insurers have insisted on these detectors for fire protection reasons," explains Felix Kulenkampff from Fraunhofer ISE, who developed the new IEC standard in a standardization committee together with representatives from industry, testing companies and research. The new IEC standard eliminates some of the weaknesses of the old US standard, which did not simulate real operation sufficiently. As a result, many arcs went undetected, because they did not reach the alarm threshold values or because false alarms were triggered.

Test bench realistically reproduces electric arc

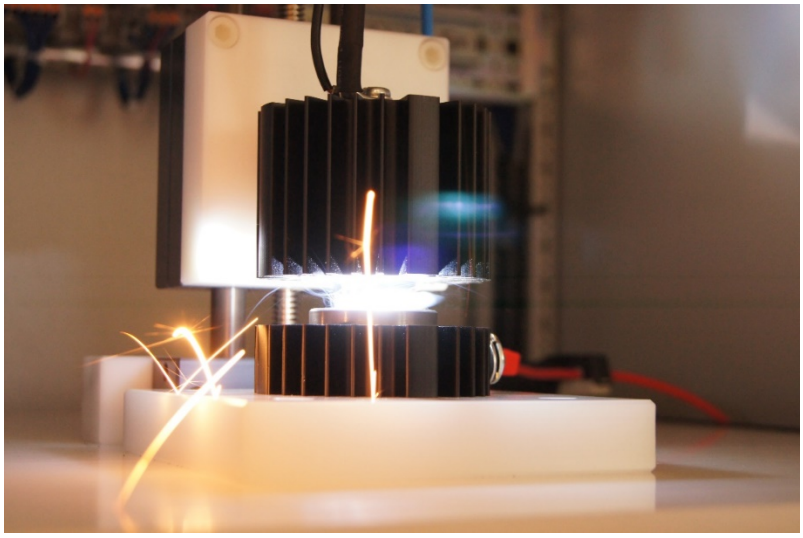
"A realistic test setup can significantly reduce the risk of undetected arcs and false tripping. In the test, it should be possible to ignite the arc as realistically as possible and under repeatable conditions," explains Felix Kulenkampff. For the test according to IEC standard 63027 (whose basic parameters match the revised US standard UL 1699B), an electronic DC source is used as a PV simulator instead of real PV modules. Current flows from the PV simulator into the inverter through a connection point that can be precisely disconnected. The connection point is a ball-and-socket joint made up of two tungsten electrodes, which are pulled apart at a defined speed, thus igniting a charac-

Contact
Claudia Hanisch M. A. | Communications | Phone +49 761 4588-5448 | claudia.hanisch@ise.fraunhofer.de
Felix Kulenkampff | High Power Electronics and Systems | Phone +49 761 4588-2124 | felix.kulenkampff@ise.fraunhofer.de
Fraunhofer Institute for Solar Energy Systems ISE | Heidenhofstraße 2 | 79110 Freiburg | www.ise.fraunhofer.de

teristic arc. Fixed test parameters (electrode distance and speed) can be stored and selected for the test sequence. To ensure that the measurement result is not influenced by the PV simulator, a filter network is connected between the inverter and the simulated PV system.
The time until the inverter is switched off is decisive for the proper functioning of the arc detector: The less time an arc burns, the lower the energy input is into the faulty contact point, i.e., short switch-off times reliably prevent a fire from starting. If the energy is between 200 and 750 joules and the switch-off time is less than 2.5 seconds, the detector passes the test. Automatic reconnection after detector tripping is allowed four times within 24 hours. After the fifth time it must be reconnected manually.
The test bench set up in the TestLab Power Electronics not only implements the above-mentioned test requirements in accordance with the standards. Thanks to its modular design the set up also allows for different test scenarios of string inverters with different connections of PV module strings. It is possible insert additional modules for testing PV module inverters and string collectors. The test bench is suitable for DC voltages up to 1,500 V. It has three DC inputs for up to 16 A and one DC input for up to 32 A.
"With the new test bench, we are expanding the range of services offered by our TestLab Power Electronics, where we perform accredited tests in accordance with grid codes, efficiency measurements and impedance spectroscopy investigations of inverters," says Steffen Eyhorn, head of TestLab Power Electronics.

Research and development on electric arcs also in other applications

DC arc protection is relevant not only for the field of photovoltaics, but also for other technologies like battery technology, aviation or electromobility. In all applications, a tendency towards higher voltages can be seen, which increases the probability of electrical flashovers and resulting parallel or series arcs. In both completed and ongoing research projects, Fraunhofer ISE uses its experience gained in the PV sector for other applications in order to provide consulting services for various industries. "For problem solving, our team can draw on a database of arc signals in various real plant configurations. This allows us to get to the bottom of error sources," says Felix Kulenkampff.



Triggering an arc in the TestLab Power Electronics on the test stand for arc detector tests. © Fraunhofer ISE

Link to the standard: https://webstore.iec.ch/publication/27362

During The smarter E Munich (June 14-16, Messe München, Hall A1, Booth 440), Fraunhofer ISE researchers will present their services on arc detection and other photovoltaic and power electronics topics.