Arc detection in Delta PV inverters

How to minimize the risk of arcing in solar installations on buildings.
An information brochure for solar installers.

What is electrical arcing and how does it occur?

Arcing occurs when an electric current jumps between two electrodes and is accompanied by a bright light. If the potential difference and current density are high enough, the energy released during the flashover is sufficient to cause impact ionization and the formation of plasma, which can reach a temperature of over 5000 °C.

Certain technical applications, such as arc welding, deliberately exploit this phenomenon. However, in most cases arcing is an unwanted by-product that must be avoided. Unwelcome arcing can be broadly categorized as either switching arcs or arc faults. Switching arcs occur when an electric switch is turned on or off. The most impressive example is undoubtedly the bright electric arc that can be seen from a distance during switching operations in power substations.

This document looks at arc faults in solar installations. Ideally, these should never occur but if they do, they must be quickly identified and eliminated.

Arc faults can originate from: solar modules, wiring, switches, junction boxes, inverters, etc.

The direct current (DC) and alternating current (AC) sides are examined separately in the process. Arcing on the AC side is automatically extinguished when the current flow reverses direction at the zero crossing point, as the energy required to maintain the arc is no longer available. Since a much greater quantity of energy is required to re-ignite the arc than to maintain an existing arc, this usually takes care of the problem.

Arcing on the DC side, however, requires more attention.

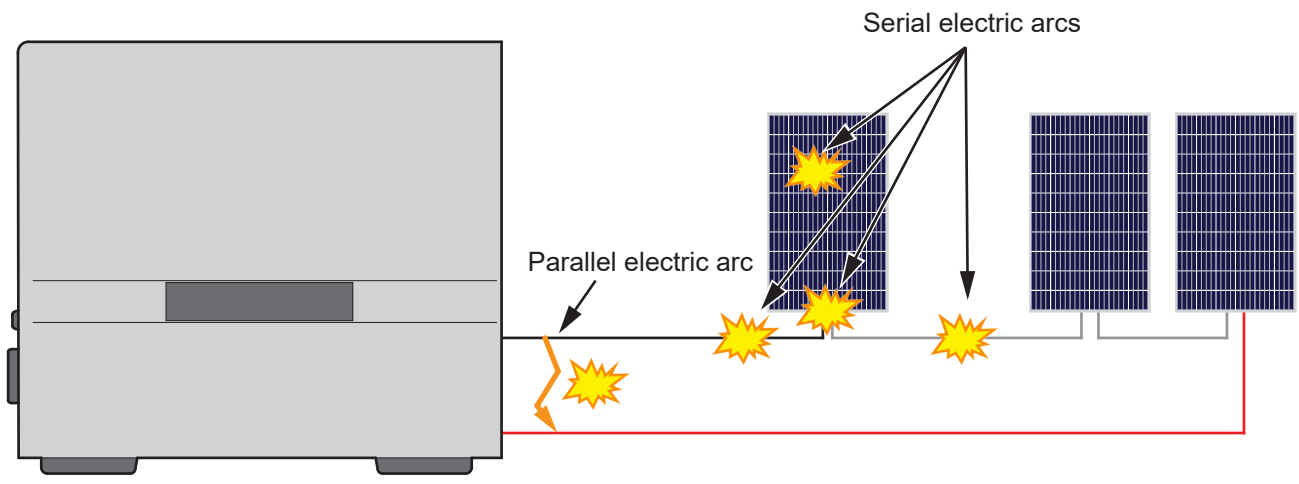
DC arcing is a source of danger

Arcing on the DC side has a particular characteristic: the arc will persist for as long as there is sufficient direct current and direct voltage available. In extreme cases, arcing on the DC side can last for up to several minutes, and the risk of consequential damage increases with every second.

Parallel arcs – arcs that jump from a positive cable to a negative cable – are a rare occurrence as module cables are double insulated. Series arcs, on the other hand are more common.

DC arcs can originate from:

- damaged, pinched or worn conductors
- loose or bad connections
- cracked or corroded solder points in modules or other components



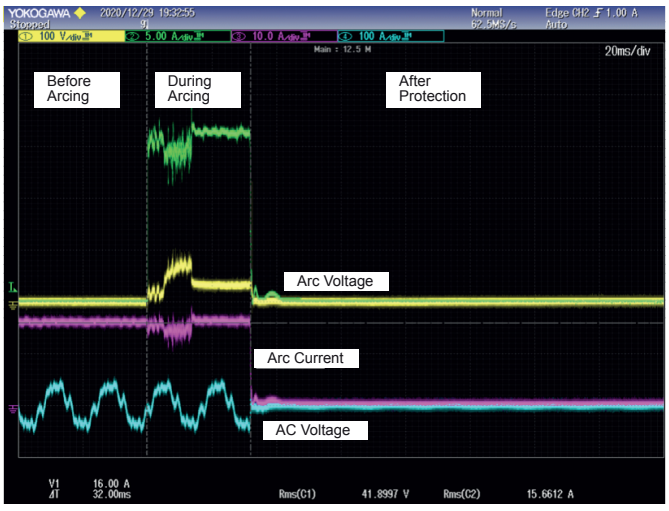
The risk of fire should never be underestimated

Arcing is not a problem inherent solely to solar installations and can occur in any electrical system. However, certain characteristics of solar installations must be taken into account to prevent arcing and serious damage by fire:

- Solar systems are often installed on or next to buildings, and fires can quickly spread to the building itself.
- Solar systems operate with high voltages and magnitudes of current.
- Solar systems are getting larger and more complex. The more components and cables installed, the higher the risk of arcing.

Fortunately, arcing in solar installations rarely leads to serious fires. However, when it does, they pose a serious threat to both people and property, and can cause enormous damage.

Delta inverters have a built-in safety function



Delta inverters have a built-in safety function that detects arcing on the direct current side, particularly at the connectors and in DC cables.

A special procedure is used to examine the waveform of direct currents and check for anomalies, such as superimposed noise.

However, identifying the exact location of arcing is difficult, preventing targeted elimination. Delta inverters therefore switch off the power from which the arc draws its energy.

The inverter does this by automatically disconnecting itself from the grid for a very short period. This cuts off the supply of energy to the arc and reduces the risk of consequential damage to a minimum.

As a solar installer, how can you minimize the risk?

Carry out all installation work carefully and in accordance with the applicable regulations.

Always lift solar panels by their frame and take care not to damage the contacts when stacking them.

Ensure that all connections are correct and secure wherever they are located within the installation. Serial arcing primarily occurs at contact and connection points. Pay particular attention to the plug-in connections between the module cables and the inverter.

Check regularly for visible damage. Cable materials age when exposed to sun, wind and rain.

Always close covers tightly so that no moisture can penetrate and lead to corrosion.

Take account of the special physical properties of aluminum when using aluminum cables. For detailed information, refer to the installation and operating instructions of the respective inverter.

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