APPLICATION NOTE

How to safely open non-load break rated disconnects in PV systems

If you work on photovoltaic (PV) systems, you'll encounter a type of disconnect that's not intended to be opened (turned off) while the system is on. This non-load break rated disconnect is designed to isolate equipment for maintenance, not to interrupt current. Opening it incorrectly could get you hurt.

If you work on PV panels, you should know how to work with a non-load break rated disconnect.

What is a non-load break rated disconnect?

You should be familiar with the lockout-tagout precautions for locking a disconnect (off switch) in the open (off) position. However, in some cases you need to use a tool to open a non-load break disconnect as required by Section 690.15 of the 2020 National Electrical Code (NEC). This kind of disconnect was not made to disconnect something "under load" (when current is running through the circuit). Using a tool is meant to prevent you from turning off the disconnect and causing an arc flash, which could start a fire, damage assets, or injure you.

There are different types of non-load break disconnects, including:

- A connector, such as an MC connector, which comes with the solar module
- A finger-safe fuse holder, such as those seen in a combiner box
- An isolating device, which requires a tool to turn off
- Other methods not specifically defined in the NEC

A non-load break disconnect is not an "off switch"; something else has to turn the circuit off first. It's intended to be opened (turned to the off position) only to isolate equipment from the circuit, so that the equipment can be replaced or maintained. Safely opening a non-load break rated disconnect means making sure that there's absolutely no current going through the circuit you're intending to isolate.

What is a load-break rated disconnect?

By contrast, a load-break rated disconnect is a disconnect that can open a circuit while current is going through it (while it's on). Load-break rated disconnects are used to turn whole systems off, and they can get expensive—which is one reason to use a non-load break rated disconnect that doesn't interrupt current. Additionally, if you're working with direct current, it's much more difficult and expensive to interrupt current (turn off) than with alternating current.

Checking that a non-load break rated disconnect is safe to open

Determining that there's no current and a dc circuit is safe to open with a non-load break rated disconnect is easy with a Fluke 393 FC clamp meter:

1. Turn on your Fluke clamp meter to the Current setting, symbolized as an A with solid and dashed lines over it. The A is for amp (or ampere, the international unit for measuring current); the solid and dashed lines represent dc current.
2. Open the measuring clamp and put it around one conductor (not two in a circuit or cable).
3. Read the current on the display.

Use a solar meter that's rated for the circuit

Be sure you have a meter that's rated for greater than or equal to the voltage and current of the circuit you're reading. Since a solar installation is a Category III environment, and 1500 V dc is increasingly common for ground-mounted solar systems, you should be using a meter that's rated for CAT III 1500 V—and now, Fluke has it.

The Fluke 393 FC CAT III 1500 V True-rms Clamp Meter is the world's only CAT III 1500 V true-rms clamp meter. It's an ac/dc clamp meter that can safely test circuits up to 1500 V dc. It carries an IP 54 rating for use in tough outdoor environments, and its audio polarity indicator makes PV panel installation, commissioning, and troubleshooting easier.

Most clamp meters only measure alternating current (ac), which is fine for a regular electrician wiring a house. But in today's renewable energy world, you measure dc circuits—which can easily be done with the Fluke 393 FC, without even touching a wire.

Measuring current on a PV panel with a Fluke 393 FC clamp meter.

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Tips for safe measurement

If you open (turn off) a non-load break rated disconnect under load, it may get sparky, smoky, or worse. Stay safe when using a clamp meter to measure current in a PV system:

- Read the instructions before using any tool.
- Make sure you have the clamp around only one wire. If there are two or more wires in a cable, the currents in the dc circuit will cancel each other out, giving you a zero reading, even when current is present.
- Check that you're measuring dc and the meter is set to dc, or you'll get a zero reading.
- Test a dc circuit that you know has current first, before you test a circuit that you expect to have no current, to ensure that you're using your meter correctly.

Today's solar installations require a CAT III rated meter that can measure 1500 V dc. Being safe in that environment means having reliable equipment rated to measure sufficient current and voltage—and professional solar technicians know that you can't get more reliable than a Fluke meter. It can save your life.

About the expert

Sean White is a NABCEP Associate Provider and NABCEP Registered Continuing Education provider. He's authored eight technical books on solar PV and energy storage, and he's always working on more. Sean teaches NEC workshops for SPI, Intersolar, and various other entities. He was named the 2014 IREC Trainer of the year and honored as the SNEC Online Trainer of the Decade in 2020.

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