INTRODUCING EMCP 4 ARC FLASH ENERGY REDUCING MAINTENANCE MODE

Ryan Byrd
Engineering Project Team Leader
Investor Controls Team

October 2017

CATERPILLAR®

BACKGROUND

Since 2014, NFPA 70, Section 240.87 (Arc Energy Reduction), has required a method to reduce clearing time of arc flash energy. This applies when the highest continuous-current trip setting for which the actual overcurrent device installed in a circuit breaker is rated, or can be adjusted, to 1200 A or higher.

The basic intent is to protect personnel working near energized equipment through a reduction of the arc flash hazard by limiting the duration of fault current. This can be accomplished with a lowered instantaneous trip setting in the overcurrent device.

As per NFPA 70, Section 240.87, "An instantaneous trip is a function that causes a circuit breaker to trip with no intentional delay when currents exceed the instantaneous trip setting or current level. If arcing currents are above the instantaneous trip level, the circuit breaker will trip in the minimum possible time."

The Arc Flash Energy Reducing Maintenance Mode feature within the EMCP 4 is intended to help a generator set's installation meet the 2017 edition of NFPA 70, Section 240.87 (Arc Energy Reduction). This feature applies to EMCP 4.2B, 4.3 and 4.4 with software version 4.8 or higher. Programming can be done via the EMCP screen or with Cat® Electronic Technician (ET), and above. This feature is designed for use with the Internal Voltage Regulator within the EMCP 4, but is also compatible with the CDVR.

In order to minimize the arc flash energy, the instantaneous trip setting of the overcurrent device should be set below the expected arc fault value. Keep in mind that the arc fault value is just a portion of the available fault current and will depend on voltage. In addition, the sensing equipment must be able to measure up to the expected arc fault current. This may require a change to the existing sensing equipment.

To fulfill the requirements of NFPA 70, an alternate instantaneous overcurrent set point can be applied. This alternate set point comes with a couple of considerations. Firstly, the expected value of the arcing current must be determined. NFPA 70, Section 240.87 references IEEE 1584™, 2002 - IEEE Guide for Performing Arc Flash Hazard Calculations, as an available method to provide guidance in determining arcing current. More complex systems may require a more detailed study to determine the anticipated arc fault current. Secondly, the lower instantaneous overcurrent setting must always be below the anticipated arc fault level. This may be an acceptable solution unless a coordination study requires the instantaneous setting to be higher than the expected arc fault value.

A few notes on coordination studies:

- In order to properly determine the instantaneous trip setting for Maintenance Mode, both a coordination study and an arc flash hazard study must be performed. The arc flash study will provide the information needed to determine the new instantaneous trip setting while the coordination study will determine the effect on other downstream devices with the new setting. An evaluation must be done to both maximize the system safety and minimize the impact on the system coordination.
- Where the NEC requires Selective Coordination, be aware that the coordination study and the new set point as determined by the arc flash study may conflict. This is because it is common for the Selective Coordination to set up devices where the instantaneous settings are greater than the available fault current, which is also above the potential arc fault current. In those cases, other methods cited in 240.87 may be needed to satisfy the code. In other words, a coordination study may recommend trip settings be raised on a breaker, but the higher setting may allow larger fault current if there is a fault on the system, thus being in direct conflict with the intent of lowering arc fault current.
- A full coordination and arc flash study should consider both the prospective arc fault current as well as the inrush and transient load surges to ensure that nuisance tripping will not occur. This could be due to large motor starting or energizing transformers, for example.

EMCP 4 DETAILS

The EMCP 4 Arc Flash Energy Reducing Maintenance Mode feature provides a method to reduce clearing time via two functions that work together.

1. A means to accept an energy-reducing maintenance switch, and provide means to connect a local status indicator.

2. An instantaneous overcurrent setting that can be set below the available arcing current

Function 1 is accomplished with new set points within the EMCP 4 Digital Inputs and Digital/Relay Outputs. Digital Inputs can be programmed for "Maintenance Mode Command" as a Command/Status parameter. This can be set to "Active High" or "Active Low." When active, this feature removes intentional delay in the trip time for the circuit breaker trip. This reduces the clearing time when a worker is within the arc flash boundary defined in NFPA 70E. When deactivated, the breaker trip setting reverts to the previous values.

Digital/Relay Outputs can be programmed as "Maintenance Mode Active" to allow for wiring of an external status indicator (e.g., light). When the Arc Flash Energy Reducing Maintenance Mode is activated from a programmed input, this output will become active. The local Authority Having Jurisdiction (AHJ) will have final word on the details of the external indicator installation.

Note: Event Response Configuration is NOT supported for this event.

Function 2 is accomplished with a new set point within the EMCP 4. In the EMCP screens (Main Menu => Configure => All Setpoints => Gen Monitor/Protect => Generator Overcurrent) is the Maintenance Mode Definite Time Overcurrent Shutdown Percentage Threshold parameter. This parameter is also found in Cat ET under the Generator Current Monitoring group of parameters. This parameter has a default value of 150% and can be set between 1% and 3200% (of rated current). The final programmed value will depend on the system study. There is no adjustable time delay associated with this set point and it does not interfere with the existing overcurrent set point. It will activate as soon as the output current reaches the programmed percentage. The EMCP 4 will trigger a Hard Shutdown and disable excitation with no intentional delay. This shutdown will trigger the same SPN-FMI combination as the normal overcurrent (2448-0).

Note: When the EMCP 4 Arc Flash Energy Reducing Maintenance Mode feature is active, this set point works in parallel with all other Definite and Inverse time overcurrent set points in the EMCP. This means that the most conservative set points will take precedence.

Note: Event Response Configuration is NOT supported for this event.

COMPATIBILITY WITH CDVR

The EMCP 4 Arc Flash Energy Reducing Maintenance Mode feature also works with the CDVR, but with some differences. The following steps need to be taken to take advantage of this feature with the CDVR:

1. Additional wiring is required between an EMCP Digital/Relay Output and the Disable Excitation input on the CDVR (bringing the CDVR Contact Sense – Excitation Disable pin to the same voltage as the CDVR Contact Sense – Common pin). This also means that no time delay is available within the CDVR to disable excitation when triggered from the EMCP output.

2. The Maintenance Mode Definite Time Overcurrent Shutdown Percentage Threshold in the EMCP should be programmed according to the site needs with the Maintenance Mode enabled via a Digital Input. The Digital or Relay Output in Step 1 should be programmed for Common Shutdown.

CONCLUSION

The Arc Flash Energy Reducing Maintenance Mode feature within the EMCP 4 provides a method to reduce clearing time of arc flash energy. This feature is flexible enough to take into account complex coordination studies, but can easily accommodate simple systems.

ABOUT CATERPILLAR

About Caterpillar

For more than 90 years, Caterpillar Inc. has been making sustainable progress possible and driving positive change on every continent. Customers turn to Caterpillar to help them develop infrastructure, energy and natural resource assets. With 2016 sales and revenues of $38.537 billion, Caterpillar is the world's leading manufacturer of construction and mining equipment, diesel and natural gas engines, industrial gas turbines and diesel-electric locomotives. The company principally operates through its three product segments – Construction Industries, Resource Industries and Energy & Transportation – and also provides financing and related services through its Financial Products segment. For more information, visit caterpillar.com. To connect with us on social media, visit caterpillar.com/social-media.

For more information, visit cat.com/powergeneration.
To connect, visit forums.cat.com/powerperspectives.

Diesel Solutions Center: ***cat.com/powergeneration***

Online Community: ***forums.cat.com/powerperspectives***

Facebook: ***facebook.com/Caterpillar.Electric.Power***

YouTube: ***youtube.com/CatPowerGeneration***

BUILT FOR IT.™

LEXE1295-00 October 2017