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Tech Spec

A Newsletter for the Design Professional



Introduction:

As an industry practice, short-circuit calculations lead to the selection of overcurrent protective devices based on available three-phase fault currents. If the overcurrent devices have an adequate three-phase interrupting rating, engineers are generally satisfied that the system complies with **NEC 110.9**.

Though three-phase bolted faults (shorts which require all three legs to be electrically connected) do occur, far more common is the mishap of a slipped screwdriver, dropped wrench, or worn insulation that shorts one phase to ground, creating a single-pole short-circuit. These phase-to-ground faults affect the performance of circuit breakers in different ways, depending upon the grounding scheme. Two of these performance areas were addressed by changes to **240.85** of the 2002 NEC. They are the proper application of slash ratings and individual pole interrupting capabilities. This Tech Spec, the second issue covering changes to the 2002 NEC, will focus on these changes and the reasons for the changes.

Slash Ratings

A slash-rated circuit breaker is one with two voltage ratings separated by a slash, such as 208Y/120 volt. The smaller of the two ratings is for overcurrents at line-to-ground voltages, meant to be cleared by one pole of the device. The larger of the two ratings is for overcurrents at line-to-line voltages, meant to be cleared by two or three poles of the circuit breaker.

Slash-rated circuit breakers are not intended to open phase-to-phase voltages across only one pole. Where it is possible for full phase-to-phase voltage to appear across only one pole, a fully rated circuit breaker must be utilized. A fully rated circuit breaker is one that has only one voltage rating, such as a 480 volt circuit breaker. For example, a 480 volt circuit breaker can open an overcurrent at 480 volts with only one pole, such as might occur when Phase A goes to ground on a 480 volt corner grounded delta system.

240.85 of the 2002 NEC was changed to read:

240.85 Applications. A circuit breaker with a slash rating, such as 120/240V or 480Y/277, shall be permitted to be applied in a solidly grounded circuit where the nominal voltage of any conductor to ground does not exceed the lower of the two values of the circuit breaker's voltage rating and the nominal voltage between any two conductors does not exceed the higher value of the circuit breaker's voltage rating.

The change was the addition of the words "solidly grounded"*. This was needed to emphasize that slash-rated devices were not appropriate on resistance-grounded and ungrounded systems.

*Solidly grounded is defined in 230.95 of the NEC ® as:

Connection of the grounded conductor to ground without inserting any resistance or impedance devices.

Single Pole Interrupting Capabilities

The single-pole interrupting capability of a circuit breaker is its ability to open an overcurrent at a specified voltage utilizing only one pole of the circuit breaker. What are the single-pole interrupting capabilities for overcurrent devices? Per ANSI C37.13 and C37.16, an airframe/power circuit breaker has a single-pole interrupting rating of 87% of its three-pole rating. Listed three-pole molded case circuit breakers have minimum single-pole interrupting capabilities according to Table 7.1.7.2 of UL 489.

Molded-case circuit breakers may or may not be able to safely interrupt single-pole faults above these values since they are typically not tested beyond these values. For current-limiting fuses, the marked interrupting rating is the tested single-pole interrupting rating.

A Fine Print Note was added to 240.85 of the 2002 NEC to alert users that circuit breakers have single-pole interrupting capabilities that must be considered for proper application.

240.85 FPN: Proper application of molded case circuit breakers on 3-phase systems, other than solidly grounded wye, particularly on corner grounded delta systems, considers the circuit breakers' individual pole interrupting capability.

As an example of single-pole interrupting capability in a typical installation, consider a common three-pole, 20 amp, 480 volt circuit breaker with a three-pole interrupting rating of 65,000 amperes. Referring to Table 7.1.7.2 of UL 489, this breaker has an 8,660 ampere single-pole interrupting capability for 480 volt faults across one pole. If the available line-to-ground fault current exceeds 8,660 amps at 480 volts, such as might occur on the secondary of a 1000 KVA, 480 volt, corner-grounded delta transformer, the circuit breaker may be misapplied. In this case, the breaker manufacturer must be consulted to verify interrupting capabilities and proper application.

Conclusion:

Changes to the 2002 NEC emphasize the need to apply circuit breakers based upon the grounding scheme. Slash rated devices can only be applied on solidly grounded systems, and single pole interrupting capabilities must be observed for corner grounded, resistance grounded, and ungrounded systems. For additional detailed application information on these two subjects go to:

<http://www.bussmann.com/library/docs/240.85%20Circuit%20Breaker%20Applications.pdf>

If you do not have internet capability or have additional questions, contact Bussmann Application Engineering at (636) 527-1270, (636) 527-1607 (fax), or e-mail (fusetech@buss.com).