Frequently asked questions

Primary vs secondary injection testing of molded case circuit breakers

What standards are applicable to testing molded case circuit breakers?

ANSI/NEMA AB 4 Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications provides guidance for inspections, testing, and maintenance of molded case circuit breakers (MCCBs), which are the heart of the electrical power system. The standard specifies the guidelines for inspection and preventative maintenance of MCCBs that are used in commercial and industrial applications. It recommends many non-destructive tests to verify operational circuit breaker characteristics including mechanical operation tests, insulation resistance tests, individual pole resistance tests (millivolt drop test), inverse time overcurrent trip test, instantaneous overcurrent trip test, and rated hold-in test. Most of these tests also provide excellent baseline information for future maintenance evaluation tests.

What is primary injection testing?

Injection of overload and fault level magnitude currents through a circuit breaker or protective device current transformers to determine if the device is performing within specifications. The field test procedure detailed in ANSI/NEMA AB 4 is a modified version of the overload calibration and magnetic trip calibration detailed in UL489.

What problems are there with primary injection testing?

The data obtained from field primary injection tests can differ from published data, as manufacturers conduct all tests using fixtures specifically designed for the circuit breaker in controlled ambient conditions with long cool-down periods between tests. Any "failed" test should be sent to the manufacturer for evaluation under standard test conditions. This test is accomplished utilizing a large and heavy (some over 1200lbs) test set capable of delivering the required test current utilizing substantial test power that may not be readily available. Difficulties with field testing of circuit breakers is one reason behind the development of electronic trip units.

Can molded case circuit breakers be damaged by primary injection testing?

When using the instantaneous overcurrent trip test described in Section 6.6 of ANSI/NEMA AB 4, there is the risk of damaging instantaneous (magnetic) only MCCBs, such as motor circuit protectors (MCP). MCPs lack thermal elements, which makes the devices susceptible to thermal damage during these tests. Primary injection testing—ramped or pulsed—may be of a sufficient duration or repeated often enough to overheat and destroy current-sensitive coils as well as damage the contacts. If current-sensing coils are not destroyed during these tests, their current sensing characteristic may be altered because of heating. Damaging the current sensing coils will render the MCP useless.

Are molded case circuit breakers tested in the factory by primary injection?

Thermal-magnetic MCCBs are tested by primary injection in the factory as part of calibration adjustment. The magnetic and thermal adjustments are different for each breaker. However, there is an adjustment means that changes the gap between the bimetal and magnetic armature. MCCBs with electronic trip units are also tested by primary injection as part of a final quality control process. A certified test report of factory tests can be obtained from the manufacturer.

What is secondary injection testing?

Secondary injection testing involves simulating overload and fault level magnitude currents on the current transformer's secondary side to verify the trip characteristics, trip actuator, and latch mechanism. Secondary test sets are lightweight, easier to operate, do not require the circuit breaker to be removed from the assembly, involve substantially less test power, and allow testing to be performed faster with reduced downtime.

Which type of test should be specified?

ANSI/NEMA AB 4 lists the use of a secondary injection test as an alternate means for verification of the inverse-time overcurrent trip test. It should be noted that the secondary injection test does not validate the integral current transformers within the circuit breakers, although there is new technology available in trip units that does. Based on the criticality of the load, a decision should be made if the costs and downtime required for field primary injection are necessary or certified test reports should be ordered with the equipment.

Powering Business Worldwide

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Printed in USA
Publication No. MZ027042EN / GG
March 2021