Introduction
To assure electrical distribution system reliability, the overcurrent protective devices must perform under overcurrent conditions as expected throughout the life of the system. Some mechanical devices, such as circuit breakers, require periodic manual operation, maintenance, testing, and possibly replacement to achieve this goal. If circuit breakers are not properly maintained and tested, the operating and interrupting capability, ability to protect system components, and electrical safety of the system may be compromised.

Although fuse terminations, clips, and disconnects require periodic maintenance, the fuse itself does not require any maintenance or testing to assure proper operation and protection under overcurrent conditions. This is because the fuse does not contain any mechanical linkages that could adversely affect overcurrent protection performance over time. In addition, when a fuse opens due to an overcurrent condition, installing a new fuse of the same type and rating maintains the original design integrity.

Mechanical Device Testing and Maintenance
An unfortunate but common practice in the industry is to install an electrical distribution system with circuit breakers and ignore the required testing and maintenance. This is often true for commercial, institutional, and industrial facilities. The belief seems to imply that all one needs to do is put in a circuit breaker and it will provide a lifetime of operations and resettability without maintenance or testing. However, several standards and manufacturers’ literature detail the need for maintenance and testing of circuit breakers.

These include standards such as NFPA 70B Recommended Practice for Electrical Equipment Maintenance and NEMA AB4 Guidelines for Inspection and Preventative Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications. Both of these standards recommend periodic maintenance and testing of circuit breakers ranging from mechanical operation to overload and instantaneous (short-circuit) performance testing.

In many cases, testing requires the circuit breaker to be removed from the enclosure and special test equipment to be used. Thus, testing and maintenance of circuit breakers can be a very time consuming and costly practice. However, if maintenance and testing of circuit breakers is ignored due to time or cost restrictions, proper protection and safety of the electrical system is at question.

Mechanical Device Replacement
If maintenance and testing verifies that a molded case circuit breaker (MCCB) is inoperative or improperly calibrated, replacement is necessary. Care must be taken to assure that the molded case circuit breaker is replaced by a device with suitable ratings. For instance, since there is no rejection feature, the replacement device must be verified to have an interrupting rating suitable for the application.

Another situation that may require replacement of molded case circuit breakers is after a fault operation. IEEE Standard 1015 Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems indicates “It is prudent to replace any MCCB that has interrupted, at most, two faults at rated maximum current.” Following this recommendation can be difficult since the fault current level and history of operation are typically not known or documented.

Component Protection
The protection of system components is the primary purpose of overcurrent protection. The inability of overcurrent protection devices to operate as expected can cause destruction of system components and lead to unnecessary downtime. For instance, if a circuit breaker has become inoperable due to a lack of maintenance and cannot open under overcurrent conditions, components such as conductors and equipment can be damaged and present hazardous conditions. Because fuses do not rely on mechanical linkages and thus do not need maintenance to assure proper overcurrent operation, protection of components is not compromised over time.

Electrical Safety Considerations
Arc flash hazards are an increasing concern in the maintenance of electrical systems. Protecting against arc flash hazards relies on the overcurrent protective device to operate as expected. Any delay in operation can greatly increase the arc flash hazard and create an unsafe condition for maintenance personnel. For example, if a low voltage power circuit breaker is expected to clear within 5 cycles, but instead takes 30 cycles to open due to an incorrect setting or lack of maintenance, the arc flash hazard may be six times the expected hazard. In such a situation, the worker could suffer serious burns and possibly even death. With the inherent reliability of fuses, overcurrent operation is as expected and in many cases, the current-limiting ability actually helps to greatly reduce the arc flash hazards.

Conclusions
When selecting overcurrent protection devices, a primary consideration should be the reliability over the life of the electrical system. If mechanical devices, such as circuit breakers, are selected, periodic maintenance and testing is essential to the proper operation and protection of the electrical system components and workers. The owner of the facility must realize this and should perform required maintenance and testing to assure proper operation and protection, despite possible time or monetary issues. If fuses are selected, the maintenance and testing concerns are greatly limited and the system reliability, protection and safety can be improved.

For more information see the Reliability and Maintenance Webpage at: [http://www.bussmann.com/apen/topics/reliability/](http://www.bussmann.com/apen/topics/reliability/)

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