Application Note

Substation Automation and Protection Division

Testing Considerations for the Circuit-Shield Type 51 with Long-time Curves

Introduction

The Circuit-Shield™ Type 51 series time-overcurrent relays are of analog solid-state design and use resistor-capacitor networks to create the timing curve characteristic. Units with one of the long-time curves need special consideration when repetitive timing tests are run as part of commissioning or routine maintenance checking. Specifically these are the Type 51L (long-time), Type 51YM (long-time very-inverse), and Type 51IM (long-time inverse).

If repetitive timing trials are conducted by the test technician (without special consideration), there will be a tendency for the first trial to give a correct result, with the following trials giving a shorter operating time, possibly outside the acceptable tolerance.

This is caused by the incomplete resetting of the charge on the timing capacitors. This characteristic is exhibited only on the units with long-time curves because of the relatively large values of capacitance used in the circuitry to create these particular curve shapes. Upon a trip, the internal circuitry of the relay acts to discharge these capacitors, but there is limited energy available to do so after a tripping operation because the timing circuits of this relay are self-powered by the input current being measured.

Solution

The solution to obtain consistent timing is to emulate in the testing procedure the same conditions that occur in service. When the current is below the pickup setting, but is above some minimum value, transistors act in the measuring circuit to clamp the timing capacitors' voltages to zero. When pickup is exceeded, the clamp is instantaneously removed, and the capacitors will charge at a rate proportional to the current level. So prior to running a timing test, a "prefault current" in the range of 50% to 70% of the pickup tap setting should be applied for approximately 1 second. This will insure that the timing capacitors are fully reset prior to applying the test fault current. It is acceptable to switch from pre-fault current to zero current, and then to apply the test fault.

This procedure will give very good repeatability in the relay timing. Use of this procedure is totally appropriate since the long-time curves are most commonly applied in motor protection applications, and not in an application where fast circuit breaker reclosing is used.

Contributed by:
Cliff Downs
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ABB Inc.
7036 Snowdrift Road
Allentown, PA 18106
800-634-6005 Fax 610-395-1055
Email: powerful.ideas@us.abb.com
Web: www.abb.com/substationautomation