Chapter 6
Instantaneous Overcurrent (50) Element Testing

1. Application

Although the official title of the 50 element is “instantaneous overcurrent”, a time delay is often added to transform it into a definite-time overcurrent element. A 50-element will operate if the current is greater than the pick-up setpoint for longer than the time delay setting. When the 50-element is used for phase overcurrent protection, it is labeled “50”. The element designation for ground instantaneous overcurrent protection is “50G”. “50N” is the designation for neutral instantaneous overcurrent protection.

The 50-element can be used independently or in conjunction with time overcurrent (51) functions. When used in a grounding scheme, typically all feeders have identical pick-up and time delay settings. The main breaker would have a slightly higher setting and/or longer time delay to ensure that a ground fault on a feeder will be isolated by the feeder breaker before the main breaker operates. An example 50-element ground protection scheme is shown in the following figures.

The 50-element protective curve looks like an “L” on a Time Coordination Curve (TCC…see Chapter 1 for details). The element will operate if the current is on the right side of the vertical line for longer than shown by the horizontal line of the protective curve. In our example, a feeder ground fault greater than 10 amps must last longer than one second before the 50-element will operate. The main breaker protection will operate if any ground fault is greater than 15 Amps for longer than 2 seconds

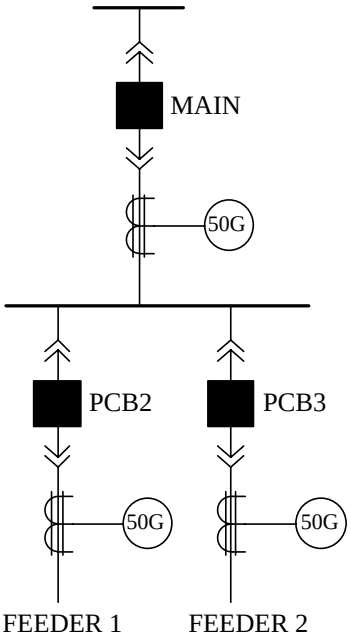

Figure 5- 1: Ground Fault Protection Single Line Drawing

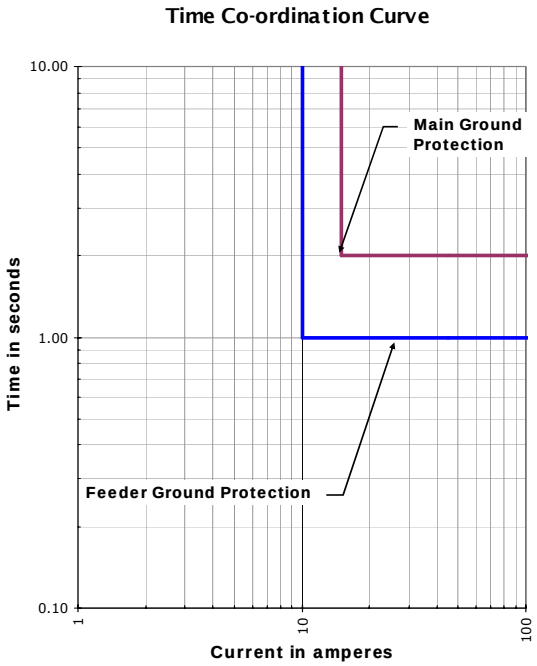

Figure 5- 2: Ground Protection TCC

The 50-element can also be applied in conjunction with inverse-time overcurrent elements to better protect equipment during high-current faults. The amount of damage created during a fault can be directly related to the size and duration of fault current. The relay should operate faster during high fault currents to limit the amount of damage.

The following figures display how the 50-element can enhance equipment protection as well as coordination with other devices. In “50/51 TCC#1”, the time overcurrent relay curve intersects the cable damage curve and, therefore, does not provide 100% protection for the cable. The cable is only 100% protected if its damage curve is completely above the protection curve. Adding a 50-element to the time overcurrent element will provide 100% cable protection as shown in “50/51 TCC #2”. The addition of the 50-element, however, has created a mis-coordination between the R2 relay and downstream Fuse 1 as the two curves now cross. This problem can be solved by adding a slight time delay of 0.03 seconds which will coordinate with the downstream fuse as shown in “50/51 TCC#3”.

If we wanted to provide the best protection for the cable and fully utilize the available options of most relays, we could add a second 50-element with no intentional time delay with a pickup setting higher than the maximum fuse curve current. “50/51 TCC#4” displays this additional protection. Adding another 50-element will cause the relay to trip sooner at higher currents and will hopefully reduce the amount of damage caused by faults.