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TESTING OF ADVANCED DISTANCE PROTECTION RELAYS

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Testing of modern distance protection relays requires excellent understanding of the operating principles and the individual protection elements, as well as the logic of the particular scheme being tested and the purpose of the test.

The testing of these complex devices can not be successfully performed using the methods applicable for electromechanical distance relays. The order of testing of basic and complex protection functions needs to start with the individual protection elements – distance, directional, overcurrent and then move into testing of more complex functional elements such as distance characteristics with load encroachment or with directional supervision. These elements need to be tested not only under basic fault conditions, but also under evolving faults and power swing conditions. Steady-state, dynamic and transient simulations are analyzed.

Distance relays, with communication accelerated schemes, operate based on the state of multiple monitored signals such as permissive signals, breaker status signals, and communication channel status signals. Time coordination of these signals and synchronization with the pre-fault and fault analog signals is required in order to perform adequate testing of these types of schemes.

The paper later discusses the challenges in the testing of communication based schemes in transmission line protection relays. A detailed example is used to describe this approach from the perspective of testing requirements – i.e., requirements for simulation of breaker status, communication and state of channel signals and how they should be synchronized with the analog signals simulating pre-fault, fault and post-fault conditions.

Testing of distance relays used on double circuit transmission lines expands the challenges for testing due to the impact of mutual coupling – with both lines in service and with one out of service and grounded – needs to be properly simulated for the successful testing. If the distance relay being tested has a mutual current compensation function, the zero sequence current from the parallel circuit will need to be simulated.

Cross-country faults can have significant impact on the operation of distance relays used on double circuit lines. This is especially important in the case of single pole trip and reclosing. The testing of the relays under such conditions requires proper simulation and monitoring of the response of single phase tripping and closing contacts.

The testing of distance relays under out-of-step conditions is also challenging due to the requirements for realistic simulation of such system conditions. The test also need to cover the cases when there is a fault during the power swing.

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