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Sequence Component-Based Adaptive Protection for Microgrids Connected Power Systems

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Abstract : Microgrid protection presents challenges to conventional protection techniques due to the low induced fault current. Protection relays present in microgrid applications require a combination of settings groups to adjust based on the architecture of the microgrid in islanded and grid-connected mode. In a radial system where the microgrid is at the other end of the feeder, directional elements can be used to identify the direction of the fault current and switch settings groups accordingly (grid connected or microgrid connected). However, with multiple microgrid connections, this concept becomes more challenging, and the direction of the current alone is not sufficient to identify the source of the fault current contribution. ORNL has previously developed adaptive relaying schemes through other DOE-funded research projects that will be evaluated and used as a baseline for this research. The four protection techniques in this study are the following: (1) Adaptive Current only Protection System (ACPS), Intentional (2) Unbalanced Control for Protection Control (IUCPC), (3) Adaptive Protection System with Communication Controller (APSCC) (4) Adaptive Model-Driven Protective Relay (AMDPR). The first two methods focus on identifying the islanded mode without communication by monitoring the current sequence component generated by the system (ACPS) or induced with inverter control during islanded mode (IUCPC) to identify the islanding condition without communication at the relay to adjust the settings. These two methods are used as a backup to the APSCC, which relies on a communication network to communicate the islanded configuration to the system components. The fourth method relies on a short circuit model inside the relay that is used in conjunction with communication to adjust the system configuration and computes the fault current and adjusts the settings accordingly.

Keywords : adaptive relaying, microgrid protection, sequence components, islanding detection, communication controlled protection, integrated short circuit model
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