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Coordination Tool for Overcurrent and Earth-Fault Relays at A 33/11 KV Power Distribution Substation in Basrah City

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Abstract
The coordination of overcurrent relay protection in the power framework is crucial for preserving electrical distribution systems. It ensures that both primary and backup protection are provided to the system. It is essential to maintain a minimal level of coordination between these relays in order to reduce the overall running time and guarantee that power outages and damage are kept to a minimum under fault conditions. Proper coordination between the primary and back-up relays can minimize the operation duration of overcurrent with instantaneous and earth fault relays by selecting the optimum TMS (Time Multiplier Setting) and PS (Plug Setting). The present study investigates the difficulty associated with determining the TMS and PS values of earth-fault and overcurrent relays at the 33/11 kV power distribution substation in Basra using the instantaneous setting element. Overcurrent and earth fault relays were simulated in two scenarios: one with a time delay setting and one with an immediate setting. This procedure was carried out to generate Time Current Characteristics (TCC) curves for each Circuit Breaker (CB) relay took place in the Nathran substation, which has a capacity of 2×31.5 MVA and operates at a voltage level of 33/11 kV. The substation is a part of the Basrah distribution network. The short circuit current is estimated at each circuit breaker (CB), followed by the simulation of protection coordination for the Nathran substation using the DIgSILENT Power Factory software. This research is based on real data collection, and the setting considers the short-circuit current at the farthest point of the longest feeders. The results show the effectiveness of the proposed coordination scheme, which reduced trip operation time by 20% compared to the presented case study while maintaining coordination between primary and backup protection.

Keywords
Relay coordination, instantaneous relay, earth relay, Inverse Definite Minimum Time relays

I. Introduction

Under the normal operational conditions of grid-connected power systems, load flow is in safe mode if it is within the limits of the connected loads. If the current flow is constant and there is no high heat, then the operation status is stable and normal. However, electrical hazards are possible due to sudden, unavoidable overloads or short circuits [1].

Protection devices in transmission or distribution systems handle this challenge by continuously monitoring the power system to detect faulty lines. These lines are subsequently isolated to guarantee continued supply to the remaining area. Protective relays are the main devices utilized for this purpose. Distance protection relays are very common in transmission networks due to their sufficient speed and sensitivity [2]. However, overcurrent (OC) and earth fault (EF) devices primarily perform protective functions in distribution systems as a pri-