ABSTRAK

Sistem tenaga listrik memerlukan proteksi yang cepat dan andal untuk mengamankan peralatan dan menjaga stabilitas jaringan dari berbagai jenis gangguan. Penelitian ini menganalisis kinerja relai jarak dalam mendeteksi dan mengisolasi gangguan satu fasa, fasa-fasa, dan tiga fasa, membandingkan efektivitas teleproteksi konvensional dengan teleproteksi berbasis GOOSE Message IEC 61850 dalam skema *Permissive Underreach Transfer Trip*. Metodologi pengujian melibatkan simulasi gangguan langsung menggunakan alat uji Omicron CMC 356 dan analisis data melalui aplikasi MiCOM S1 Agile. Hasil pengujian menunjukkan bahwa untuk gangguan satu fasa, meskipun TP konvensional mencatat relai *time trip* instan di zona 1 selama 8 ms dan *fault clearing time* total selama 71 ms. Sementara itu, GOOSE Message, yang beroperasi di zona 2 *receive*, mencapai *fault clearing time* yang lebih cepat selama 31-44 ms. Pada gangguan fasa-fasa di zona 2 *receive*, GOOSE Message (8-20 ms untuk relai *time trip* dan 35-43 ms untuk *fault clearing time*) secara signifikan mengungguli teleproteksi konvensional (33 ms untuk relai *time trip* dan 81 ms untuk *fault clearing time*). Meskipun gangguan tiga fasa tidak ada data untuk teleproteksi konvensional, GOOSE Message mampu memutuskannya (13 ms untuk relai *time trip* dan 36 ms untuk *fault clearing time*). Implementasi GOOSE Message secara nyata meningkatkan kecepatan pemutusan gangguan dan keandalan sistem proteksi relai jarak, meminimalkan risiko kerusakan peralatan di sistem tenaga listrik dan mencegah meluasnya dampak gangguan.

Kata kunci: Relai Jarak, GOOSE Message, Teleproteksi, Gangguan.

ABSTRACT

Electrical power systems require fast and reliable protection to secure equipment and maintain grid stability against various types of faults. This research analyzes the performance of distance relays in detecting and isolating single-phase, phase-to-phase, and three-phase faults, comparing the effectiveness of conventional teleprotection with IEC 61850 GOOSE Message based teleprotection within a Permissive Underreach TransferTrip (PUTT) scheme. The testing methodology involved direct fault simulations using an Omicron CMC 356 test set and data analysis through the MiCOM S1 Agile application. Test results indicate that for single-phase faults, while conventional teleprotection recorded an instant relay trip time in zone 1 of 8 ms and a total fault clearing time of 71 ms, GOOSE Message, operating in zone 2 receive, achieved a faster fault clearing time of 31-44 ms. For phase-to-phase faults in zone 2 receive, GOOSE Message (8-20 ms for relay trip time and 35-43 ms for fault clearing time) significantly outperformed conventional teleprotection (33 ms for relay trip time and 81 ms for fault clearing time). Although data for three-phase faults with conventional teleprotection was unavailable, GOOSE Message was able to clear them (13 ms for relay trip time and 36 ms for fault clearing time). The implementation of GOOSE Message substantially enhances fault clearing speed and the reliability of distance relay protection systems, minimizing the risk of equipment damage in the electrical power system and preventing the widespread impact of faults.

Keywords: Distance Relay, GOOSE Message, Teleprotection, Fault.