

ABSTRAK
RANCANG BANGUN SIMULATOR SISTEM MANAJEMEN
PEMBAGIAN BEBAN PENYULANG GARDU
DISTRIBUSI 20KV BERBASIS ESP32

(2026 : xvi + 51 Hal + 32 Gambar + 13 Tabel + Lampiran)

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Penelitian ini bertujuan merancang dan membangun simulator sistem manajemen pembagian beban penyulang gardu distribusi 20 kV berbasis ESP32 sebagai media pembelajaran skala laboratorium. Simulator mengintegrasikan sensor arus ZMCT103C, sensor tegangan ZMPT101B, relay, LCD 20×4, dan potensiometer untuk memantau serta mengendalikan kondisi pembebanan secara *real-time*. Hasil pengujian menunjukkan bahwa sistem mampu membaca parameter kelistrikan dengan tingkat akurasi tinggi, ditunjukkan oleh selisih daya aktif sebesar 0,002 W, rugi daya 0,0001 W, dan *drop* tegangan 0,001 V dibandingkan hasil perhitungan teoritis. Algoritma *load balancing* dan *load shedding* bekerja sesuai rancangan dengan mengaktifkan penyulang cadangan saat terjadi *overload* serta mempertahankan kontinuitas penyaluran daya berdasarkan prioritas. Berdasarkan hasil tersebut, dapat disimpulkan bahwa simulator beroperasi secara otomatis, responsif, dan andal dengan efisiensi 92,40%–97,29%, sehingga layak digunakan sebagai media pembelajaran dan simulasi operasi sistem distribusi tenaga listrik serta mendukung pemahaman konsep manajemen pembagian beban secara komprehensif.

Kata kunci: Beban, Penyulang, Simulator, Gardu Distribusi, ESP32.

ABSTRACT
DESIGN AND CONSTRUCTION OF A MANAGEMENT SYSTEM
SIMULATOR LOAD SHARING OF SUBSTATION FEEDERS 20KV
DISTRIBUTION BASED ON ESP32

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This study aims to design and build a load sharing management system simulator for a 20 kV distribution substation feeder based on ESP32 as a laboratory-scale learning medium. The simulator integrates a ZMCT103C current sensor, a ZMPT101B voltage sensor, a relay, a 20x4 LCD, and a potentiometer to monitor and control loading conditions in real-time. The test results show that the system is able to read electrical parameters with a high level of accuracy, indicated by a difference in active power of 0.002 W, a power loss of 0.0001 W, and a voltage drop of 0.001 V compared to theoretical calculations. The load balancing and load shedding algorithms work as designed by activating backup feeders when an overload occurs and maintaining continuity of power distribution based on priority. Based on these results, it can be concluded that the simulator operates automatically, responsively, and reliably with an efficiency of 92.40%–97.29%, making it suitable for use as a learning medium and simulation of electric power distribution system operations and supporting a comprehensive understanding of load sharing management concepts.

Keywords: Load, Feeder, Simulator, Distribution Substation, ESP32.