ABSTRAK

Gardu Induk memegang peran penting dalam keandalan sistem tenaga listrik, salah satunya melalui ketersediaan suplai daya DC 110V untuk perangkat proteksi dan kontrol. Pemantauan kondisi baterai cadangan pada umumnya masih dilakukan secara manual menggunakan *AVOmeter*, yang kurang efisien dan berisiko keterlambatan dalam deteksi gangguan. Penelitian ini dilakukan di Gardu Induk Ujung Berung dengan tujuan untuk merancang dan mengimplementasikan sistem *monitoring* per sel baterai 110V DC berbasis *Internet of Things (IoT)*, serta menganalisis kinerja sistem tersebut. Perangkat utama yang digunakan meliputi *NodeMCU ESP32*, *multiplexer CD74HC4067*, dan resistor pembagi tegangan. Sistem mampu membaca tegangan tiap sel baterai secara bergantian dan mengirimkan data secara langsung ke aplikasi Telegram serta menampilkannya pada *LCD* 16x2. Jika terdeteksi sel baterai dengan tegangan di bawah 1.0V, sistem secara otomatis mengirimkan notifikasi peringatan tanpa intervensi manual. Hasil pengujian menunjukkan sistem memiliki akurasi tinggi yaitu 99.01% dengan nilai *error* 0.99% dan waktu respon notifikasi rata-rata 2,3 detik. Dari lima sel yang diuji, sistem berhasil mengklasifikasikan Baterai 1, 2, dan 4 dalam kondisi baik, Baterai 3 dalam kondisi rendah (1.145V), dan Baterai 5 dalam kondisi buruk (0.821V). Sistem ini terbukti efektif dalam memberikan informasi cepat dan akurat, serta mendukung pemeliharaan baterai secara efisien.

Kata Kunci: *IoT*, Gardu Induk, ESP32, Baterai 110V DC, Monitoring, Telegram.

ABSTRACT

Substations plan a vital role in ensuring the reliability of electrical power systems, one of which is by maintaining a stable 110V DC power supply for protection and control equipment. Typically, battery condition monitoring is still performed manually using an AVOmeter, which is inefficient and prone to delayed fault detection. This research was conducted at the Ujung Berung Substation with the aim of designing and implementing a cell-by-cell 110V DC battery monitoring system based on the Internet of Things (IoT), as well as analyzing its performance. The system uses NodeMCU ESP32 as the main controller, along with a CD74HC4067 multiplexer and voltage divider resistors. It reads the voltage of each battery cell sequentially and sends direct data to the Telegram application while also displaying it on an LCD 16x2 screen. If a battery cell's voltage drops below 1.0V, the system automatically sends an early warning notification without manual intervention. Test results show that the system has high accuracy and an average notification response time of 2.3 seconds. For example, out of five tested cells, the system successfully classified Batteries 1, 2, and 4 as in good condition, Battery 3 as low (1.145V), and Battery 5 as poor (0.821V). This IoT-based system is proven effective in providing fast and accurate information, thereby supporting efficient battery maintenance.

Keywords: IoT, Substation, ESP32, 110V DC Battery, Monitoring, Telegram.