**DESAIN DAN STRATEGI MANAJEMEN ENERGI UNTUK *MICROGRID* STASIUN PENGISIAN KENDARAAN LISTRIK (SPKL) BERTENAGA SURYA DENGAN INTEGRASI JARINGAN PLN DI KAMPUS LIMO UPN "VETERAN" JAKARTA**

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# ABSTRAK

Pertumbuhan kendaraan listrik (EV) menuntut infrastruktur Stasiun Pengisian Kendaraan Listrik Umum (SPKLU) yang andal agar tidak membebani jaringan PLN. Penelitian ini merancang *AC-Coupled Microgrid* SPKLU bertenaga surya di Kampus Limo UPN "Veteran" Jakarta. Tujuannya adalah menentukan kapasitas fisis komponen dan merancang *Energy Management System* (EMS) berbasis *Rule-Based* yang terintegrasi dengan Indeks Prioritas Pengisian (IPP) untuk koordinasi pembagian daya dinamis, tanpa fitur *Vehicle-to-Grid* (V2G). Metodologi menggunakan pendekatan *Dual-Modeling* pada MATLAB/Simulink (*Complex-Modeling* untuk elektronika daya dan *Fast-Modeling* untuk komputasi makro). Evaluasi kinerja dilakukan melalui simulasi stokastik *Monte Carlo* (3,65 juta hari operasional) menggunakan data cuaca NASA POWER, probabilitas kedatangan komuter VISTA, dan spesifikasi baterai EV GAIKINDO. Hasil perancangan menetapkan kapasitas fotovoltaik sebesar 39,6 kWp dan Sistem Penyimpanan Energi Baterai (BESS) 81,6 kWh. Algoritma IPP terbukti efektif melakukan *peak shaving*, mereduksi lonjakan beban trafo distribusi hingga 55% (dari 44,00 kW menjadi 19,76 kW) sekaligus memastikan EV mencapai target pengisian 90%. Pada simulasi jangka panjang, sistem mencapai keandalan layanan 99,64%, *Self-Consumption Ratio* (SCR) 45,34%, dan *Self-Sufficiency Ratio* (SSR) 49,61%. Algoritma EMS usulan terbukti tangguh merespons fluktuasi cuaca, menjaga umur pakai sel litium, dan mencegah kelebihan beban transformator.

**Kata Kunci:** *Energy Management System* (EMS), Indeks Prioritas Pengisian (IPP), *Microgrid*, *Monte Carlo*, *Peak Shaving*, SPKLU.

***DESIGN AND ENERGY MANAGEMENT STRATEGY FOR A SOLAR-POWERED ELECTRIC VEHICLE CHARGING STATION (EVCS) MICROGRID WITH INTEGRATION INTO THE PLN GRID AT THE LIMO CAMPUS OF UPN "VETERAN" JAKARTA***

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## *ABSTRACT*

*The rapid growth of electric vehicles (EVs) demands reliable public charging stations (SPKLU) to prevent utility Grid overloading. This research designs a solar-powered AC-Coupled Microgrid SPKLU at the Limo Campus of UPN "Veteran" Jakarta. The objective is to determine physical component sizing and design a Rule-Based Energy Management System (EMS) integrated with a Charging Priority Index (IPP) for dynamic power allocation, strictly excluding Vehicle-to-Grid (V2G) functionality. The methodology employs a Dual-Modeling approach in MATLAB/Simulink (Complex-Modeling for power electronics and Fast-Modeling for macro computations). Performance is evaluated using Monte Carlo stochastic simulations (3.65 million operational days) with NASA POWER weather data, VISTA commuter arrival probabilities, and GAIKINDO EV battery specifications. The design results established a 39.6 kWp photovoltaic capacity and an 81.6 kWh Battery Energy Storage System (BESS). The IPP algorithm effectively performs peak shaving, reducing distribution transformer load spikes by 55% (from 44.00 kW to 19.76 kW) while ensuring EVs reach their 90% charging targets. In long-term simulations, the system achieved 99.64% service reliability, a 45.34% Self-Consumption Ratio (SCR), and a 49.61% Self-Sufficiency Ratio (SSR). The proposed EMS algorithm is robust in navigating weather fluctuations, preserving lithium cell lifespan, and preventing transformer overloads.*

***Keywords:*** *Charging Priority Index, Energy Management System (EMS), EV Charging Station, Microgrid, Monte Carlo, Peak Shaving.*