

PERENCANAAN SISTEM PLTS OFF-GRID UNTUK PEMENUHAN KEBUTUHAN ENERGI PENERANGAN PADA FASILITAS PENCUCIAN DAN PENGINAPAN MOBIL DI KOTA TANJUNGBALAI DI KOTA TANJUNGBALAI

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ABSTRAK

Pemadaman listrik yang sering terjadi pada malam hari di fasilitas pencucian dan penginapan mobil di Kota Tanjungbalai menyebabkan terganggunya operasional, menurunnya tingkat keamanan, serta berkurangnya kenyamanan pelanggan akibat tidak tersedianya penerangan cadangan. Kondisi ini menunjukkan perlunya sistem penyedia energi mandiri yang andal untuk menjamin kontinuitas penerangan. Penelitian ini bertujuan merencanakan sistem Pembangkit Listrik Tenaga Surya (PLTS) off-grid sebagai solusi backup penerangan pada fasilitas tersebut. Metode penelitian menggunakan pendekatan kuantitatif dengan analisis teknis melalui identifikasi beban penerangan kritis, perhitungan kebutuhan energi harian, serta penentuan kapasitas komponen utama sistem meliputi panel surya, baterai, solar charge controller (SCC), inverter, dan konfigurasi sistem kelistrikan beserta proteksinya. Data radiasi matahari dan efisiensi sistem digunakan sebagai dasar perancangan kapasitas pembangkit dan penyimpanan energi. Hasil perancangan menunjukkan bahwa total beban penerangan kritis sebesar 635 W dengan durasi operasi 10 jam per malam menghasilkan kebutuhan energi harian sebesar 6.350 Wh. Setelah memperhitungkan rugi-rugi sistem, energi efektif yang harus disediakan sebesar 8.915 Wh/hari. Sistem PLTS yang dirancang terdiri dari 6 modul panel surya monokristalin 450 Wp (total 2,7 kWp), bank baterai 24 V 400 Ah, SCC tipe MPPT 150 A, dan inverter pure sine wave 1.000 W.

Kata Kunci : PLTS off-grid, penerangan cadangan, energi surya, perencanaan sistem, energi terbarukan.

***DESIGN OF AN OFF-GRID SOLAR POWER SYSTEM TO MEET
LIGHTING ENERGY NEEDS AT A CAR WASH AND AUTO CAMP
FACILITY IN TANJUNGBALAI CITY***

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ABSTRACT

Frequent nighttime power outages at a car wash and auto camp facility in Tanjungbalai City disrupt operations, reduce safety levels, and decrease customer comfort due to the absence of backup lighting. This condition highlights the need for a reliable independent energy supply system to ensure lighting continuity. This study aims to design an off-grid Solar Power System (PLTS) as a backup lighting solution for the facility. A quantitative approach with technical analysis was applied, including identification of critical lighting loads, calculation of daily energy demand, and determination of the required capacity of the main system components such as solar panels, batteries, solar charge controller (SCC), inverter, as well as electrical configuration and protection systems. Solar irradiation data and system efficiency were considered as the basis for sizing the generation and storage capacity. The results indicate that the total critical lighting load is 635 W operating for 10 hours per night, resulting in a daily energy demand of 6,350 Wh. After accounting for system losses, the effective energy requirement becomes 8,915 Wh/day. The designed system consists of six 450 Wp monocrystalline solar panels (2.7 kWp total), a 24 V 400 Ah battery bank, a 150 A MPPT solar charge controller, and a 1,000 W pure sine wave inverter.

Keywords: Off-grid PV system, backup lighting, solar energy, system planning, renewable energy.