

ABSTRAK

PENGARUH BEBAN KERJA DAN KAPASITAS WATT PEAK TERHADAP EFISIENSI PLTS SISTEM OFF GRID MENGUNAKAN DOUBLE BATTERY 12 V

(Rangga Yuliansya, 2025 , 42 Halaman, 10 Tabel, 20 Gambar, 16 Lampiran, Email : (ranggayuliansya03@gmail.com))

Penelitian ini bertujuan untuk menganalisis pengaruh variasi beban kerja (400–800 Watt) dan kapasitas watt peak (100–400 Wp) terhadap efisiensi sistem Pembangkit Listrik Tenaga Surya (PLTS) off-grid yang menggunakan konfigurasi double battery VRLA 12 V. Pengukuran dilakukan pada berbagai titik komponen, seperti panel surya, MPPT, baterai, dan inverter, guna mengevaluasi kinerja sistem secara menyeluruh. Hasil pengamatan menunjukkan bahwa peningkatan kapasitas watt peak berbanding lurus dengan peningkatan efisiensi panel surya, efisiensi MPPT, serta kestabilan arus dan tegangan keluaran. Panel 100 Wp memiliki efisiensi sekitar 15%, sedangkan panel 400 Wp meningkat hingga lebih dari 18%. Efisiensi MPPT juga mengalami kenaikan dari sekitar 94% menjadi mendekati 97%, menunjukkan performa pelacakan titik daya maksimum yang semakin optimal pada kapasitas panel yang lebih besar. Selain itu, efisiensi inverter meningkat seiring dengan penambahan beban kerja dan kapasitas panel, mencapai efisiensi maksimal pada beban 800 Watt. Sistem menunjukkan efisiensi PLTS secara keseluruhan berkisar antara 12,47% hingga 16,70%, dengan efisiensi tertinggi terjadi pada konfigurasi 400 Wp dan beban 800 Watt. Durasi suplai listrik pun meningkat pada beban rendah, menunjukkan hubungan langsung antara besar beban, efisiensi sistem, dan ketahanan daya simpan baterai. Secara keseluruhan, sistem PLTS off-grid yang diuji menunjukkan performa efisien dan stabil dalam berbagai kondisi beban dan kapasitas panel, serta mampu menjadi alternatif energi terbarukan yang andal untuk kebutuhan listrik skala kecil hingga menengah.

Kata Kunci : Watt Peak, Beban Kerja, Laju Alir Listrik, Double Battery, Pembangkit Listrik Tenaga Surya, Efisiensi Energi Terbarukan

ABSTRACT

THE INFLUENCE OF WORKLOAD AND WATT PEAK CAPACITY ON THE EFFICIENCY OF AN OFF-GRID SOLAR POWER PLANT SYSTEM USING A 12 V DOUBLE BATTERY

(Rangga Yuliansya, 2025, 42 Pages, 10 Tables, 20 Pictures, 16 Appendixs, Email : ranggayuliansya03@gmail.com)

This research aims to analyze the effect of varying load demands (400–800 Watts) and different solar panel watt peak capacities (100–400 Wp) on the efficiency of an off-grid Solar Power Generation System (PLTS) using double VRLA 12 V batteries. Measurements were taken at several system components, including solar panels, MPPT controllers, batteries, and inverters, to comprehensively assess overall system performance. The results indicate a direct correlation between increased watt peak capacity and improved efficiency across the system. Solar panel efficiency increased from around 15% for 100 Wp panels to over 18% for 400 Wp panels. Similarly, MPPT efficiency improved from approximately 94% to nearly 97%, demonstrating enhanced power point tracking performance at higher capacities. Inverter efficiency also increased with higher load and panel capacity, achieving optimal conversion efficiency at an 800 Watt load. The overall PLTS system efficiency ranged from 12.47% to 16.70%, with the highest value achieved under a 400 Wp panel and 800 Watt load configuration. Additionally, energy supply duration extended significantly under lower loads, showing the inverse relationship between energy consumption and system endurance. Overall, the off-grid PLTS system tested in this study proved to be efficient and stable under varying operational conditions, positioning it as a viable renewable energy solution for small- to medium-scale electricity needs.

Keywords: *Watt Peak, Workload, Electrical Flow Rate, Double Battery, Solar Power Plant, Renewable Energy Efficiency*

