

ABSTRACT

THE EFFECT OF SOLAR IRRADIANCE AND ELECTRICAL LOAD ON THE EFFICIENCY OF AN OFF-GRID SOLAR POWER SYSTEM USING DUAL 12V BATTERIES WITH A CAPACITY OF 400WP

(M.Daffa Alfarizi, 2025 : 56 Pages, 9 Tables, 18 Figures)

The increasing demand for electrical energy in various regions, especially in areas not yet reached by the national electricity grid (PLN), has encouraged the utilization of renewable energy sources such as Solar Power Plants (PLTS). However, the efficiency of PLTS systems is still influenced by various factors, primarily solar irradiance and electrical load. This study aims to analyze the effect of solar irradiance and load variation on the efficiency of an off-grid PLTS system that uses two 12V VRLA batteries and 400 WP solar panels. The observed parameters involve direct experimentation using a design-and-build approach and performance measurements based on voltage (V), current (A), power (W), and efficiency (%). The independent variables in this research are solar irradiance and load (ranging from 400 to 800 watts), while the dependent variables include the efficiency of the solar panel, MPPT solar charge controller, inverter, and the overall PLTS system. Testing was conducted by measuring the output of each system component under varying irradiance and load conditions. The results show that PLTS efficiency increases along with higher solar irradiance and appropriately matched loads. The highest recorded efficiency was 17.2% for the solar panel, 98.7% for the MPPT controller, and 98.8% for the inverter at an 800-watt load and peak solar irradiance. The combination of optimal solar intensity and appropriate load selection significantly enhances the overall efficiency of the PLTS system.

Keywords: *Solar Power System (PLTS), solar irradiance, electrical load, power efficiency, off-grid system.*