

ANALYSIS OF THE EFFECT OF FLOATING SOLAR PANEL DISTANCE ON WATER AS A PASSIVE COOLING SYSTEM

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Abstract

Solar panels are devices that convert solar energy into electrical energy, with performance being highly sensitive to operational temperature. An increase in panel surface temperature can significantly reduce energy conversion efficiency. One promising method to mitigate this thermal degradation is the utilization of passive cooling through the water body in a floating solar panel (FPV) system. This study aims to empirically analyze the effect of varying the vertical distance between a floating solar panel and the water surface (10 cm, 20 cm, and 30 cm) on the system's output power and overall efficiency. Furthermore, it compares the performance of series and parallel circuit configurations under these conditions. The research was conducted through direct field testing using a 200Wp monocrystalline solar panel mounted on an adjustable floating platform. Key parameters, including solar intensity, panel temperature, ambient temperature, voltage, and current, were measured every 10 minutes from 09:00 to 15:00 WIB under clear weather conditions. The collected data were used to calculate input power (P_{in}), output power (P_{out}), and system efficiency (η). The results revealed that the 10 cm distance, despite yielding a lower average output power of 4.04 W, achieved the highest average efficiency of 2.68% in the parallel configuration. This indicates that the passive cooling effect is most pronounced at closer proximity, enhancing the energy conversion rate even if total solar irradiance is slightly reduced. In contrast, the 20 cm and 30 cm distances produced higher average power (4.65 W and 4.76 W, respectively) but with lower efficiencies (2.60% and 2.38%). The parallel configuration generally provided more stable performance, which is advantageous in the dynamic FPV environment.

Keywords: Floating Photovoltaic, Passive Cooling, Energy Efficiency, Panel Air Gap, Series-Parallel Configuration

INTRODUCTION

The escalating global energy demand, coupled with the pressing challenges of climate change and the finite nature of fossil fuels, has catalyzed a worldwide transition towards sustainable and renewable energy systems. Among the various renewable technologies, solar photovoltaic (PV) power generation stands out as a particularly promising solution due to the sun's abundant and widely distributed energy. For nations situated in the equatorial belt, such as Indonesia, the consistent and high solar irradiance throughout the year presents a significant opportunity to harness solar energy for both localized and grid-scale applications. However, the practical efficiency of PV technology is fundamentally constrained by environmental and operational factors, chief among them being the thermal degradation of the solar cells.