ABSTRAK

TASYA NAFTALY. Analisis Eksperimental Pengaruh Sistem Pendingin Berbasis *Water cooling* Terhadap Efisiensi Dan Keluaran Daya Panel Surya Monokristalin Dan Bifacial Pada Kondisi Iklim Tropis. Dibimbing oleh HERI SUYANTO, S.T., M.T.

Indonesia yang beriklim tropis memiliki potensi radiasi matahari tinggi, namun kenaikan suhu operasi panel surya akibat radiasi tersebut dapat menurunkan efisiensi dan daya keluarannya. Salah satu solusi yang dapat diterapkan adalah sistem pendingin berbasis *water cooling*. Penelitian ini bertujuan menganalisis perbedaan efektivitas sistem *water cooling* dalam meningkatkan efisiensi dan daya keluaran pada panel surya monokristalin dan bifacial, serta menguraikan penyebab perbedaan respons termal dan kelistrikan antar kedua jenis panel. Metode yang digunakan adalah eksperimen langsung terhadap kedua jenis panel pada kondisi tanpa pendingin dan dengan *water cooling* di Laboratorium Renewable Energy and Hybrid System, Institut Teknologi PLN, dengan parameter suhu permukaan, tegangan, arus, daya keluaran, dan efisiensi. Hasil menunjukkan penerapan *water cooling* meningkatkan daya keluaran panel monokristalin dari 900 W menjadi 998 W (10,84%) dan efisiensi dari 14,04% menjadi 15,70% (11,88%), sedangkan panel bifacial meningkat dari 705 W menjadi 773 W (9,75%) dengan efisiensi dari 10,79% menjadi 11,92% (10,44%). Suhu permukaan turun 3,60°C (bifacial) dan 3,86°C (monokristalin), diikuti kenaikan tegangan rata-rata 3 V dan 4 V, sementara arus keluaran menurun pada kedua panel. Panel monokristalin menunjukkan peningkatan performa sedikit lebih tinggi dibanding bifacial terhadap penerapan *water cooling* pada iklim tropis.

Kata kunci : Bifacial, Efisiensi Panel Surya, Iklim Tropis, Monokristalin, *Water cooling*

ABSTRACT

TASYA NAFTALY. *Experimental Analysis of the Effect of a Water cooling-Based Cooling System on the Efficiency and Power Output of Monocrystalline and Bifacial Solar Panels under Tropical Climate Conditions*. *Supervised by* HERI SUYANTO, S.T., M.T.

Indonesia, with its tropical climate, has high solar radiation potential; however, the resulting increase in solar panel operating temperature can reduce efficiency and power output. One solution that can be applied is a water cooling-based cooling system. This study aims to analyze the difference in effectiveness of the water cooling system in improving efficiency and power output in monocrystalline and bifacial solar panels, as well as to explain the causes of differences in thermal and electrical response between the two panel types. The method used was direct experimentation on both panel types under conditions without cooling and with water cooling at the Renewable Energy and Hybrid System Laboratory, Institut Teknologi PLN, with parameters including surface temperature, voltage, current, power output, and efficiency. The results showed that the application of water cooling increased the power output of the monocrystalline panel from 900 W to 998 W (10.84%) and efficiency from 14.04% to 15.70% (11.88%), while the bifacial panel increased from 705 W to 773 W (9.75%) with efficiency rising from 10.79% to 11.92% (10.44%). Surface temperature decreased by 3.60°C (bifacial) and 3.86°C (monocrystalline), followed by an average voltage increase of 3 V and 4 V, while output current decreased in both panels. The monocrystalline panel showed a slightly higher performance improvement compared to the bifacial panel in response to the application of water cooling under tropical climate conditions.

Keyword : Bifacial, Monocrystalline, Solar Panel Efficiency, Tropical Climate, Water cooling