

Simulated Energy Production and Performance Ratio of 5 MW Grid-Connected Photovoltaic under Tropical Savannah Climate in Kupang Timor Island of Indonesia

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Abstract

The objective of this paper is to obtain energy output and performance ratio of 5 MW grid-connected PV plant. The plant is located near the city of Kupang in the southeast of Indonesia. The location belongs to dry tropical climate with 28°C average daily temperature and 67% and 87% average sunshine index during the rainy and hot season respectively. Daily solar irradiation varies from 5.52 to 6.38 kWh/m². The plant uses 21,840 poly-crystalline 230 W modules configured as 1,040 array strings, and each array consists of 21 series-connected modules. The array is ground-mounted, fixed-tilted at 15° and facing north. Maximum output is 5,023.2 kW. Conversion to AC is done by 250-unit inverter of 20 kW. Grid connection is via 10-unit of 630 KVA transformers. PVSyst simulation is fed with synthetic meteorological data which yielded annual energy of 7,476 MWh that varies monthly from 526 to 770 MWh, with an average of 623 MWh. Average annual yields are 4.08 kWh/kWp/day. Variation of tilt angles from 10° to 20° has small effects on energy output. Monthly performance ratio varies from 80% to 86% and average at 82%. Low-performance ratio is shown during May to August period which is likely caused by the high ambient temperature that affects the output of the solar module. PV loss due to temperature is the highest losses component at 11.2%.

Keywords: grid-connected photovoltaic, tropical climate, energy production, performance ratio, IEC 61724

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