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Analysis on Solar Panel Performance and PV-Inverter Configuration for Tropical Region

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Abstract : Solar energy is abundant in nature, particularly in the tropics which have peak sun hour that can reach 8 hours per day. In the fabrication process, Photovoltaic's (PV) performance are tested in standard test conditions (STC). It specifies a module temperature of 25°C, an irradiance of 1000 W/ m^2 with an air mass 1.5 (AM1.5) spectrum and zero wind speed. Thus, the results of the performance testing of PV at STC conditions cannot fully represent the performance of PV in the tropics. For example Indonesia, which has a temperature of 20-40°C. In this paper, the effect of temperature on the choice of the 5 kW AC inverter topology on the PV system such as the Central Inverter, String Inverter and AC-Module specifically for the tropics will be discussed. The proper inverter topology can be determined by analysis of the effect of temperature and irradiation on the PV panel. The effect of temperature and irradiation will be represented in the characteristics of I-V and P-V curves. PV's characteristics on high temperature would be analyzed using Solar panel modeling through MATLAB Simulink based on mathematical equations that form Solar panel's characteristic curve. Based on PV simulation, it is known then that temperature coefficients of short circuit current (ISC), open circuit voltage (VOC), and maximum output power (PMAX) consecutively as high as 0.56%/oC, -0.31%/oC and -0.4%/oC. Those coefficients can be used to calculate PV's electrical parameters such as ISC, VOC, and PMAX in certain earth's surface's certain point. Then, from the parameters, the utility of the 5 kW AC inverter system can be determined. As the result, for tropical area, string inverter topology has the highest utility rates with 98, 80 %. On the other hand, central inverter and AC-Module Topology has utility rates of 92.69 % and 87.7 % eventually.

Keywords : Photovoltaic, PV-Inverter Configuration, PV Modeling, Solar Panel Characteristics.
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