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Estimating Photovoltaic Modules Operating Temperatures for Renewable Solar Energy Application

A.M. Muzathik[1*], K.B. Samo[1], M.Z. Ibrahim[2] and W.B. Wan Nik[1]

[1] *Maritime Technology Department*
[2] *Engineering Science Department*
Universiti Malaysia Terengganu
21030 Kuala Terengganu, Terengganu, Malaysia

**Author for correspondence e-mail: muzathik64@yahoo.com*

Abstract

The operating cell temperatures of photovoltaic (PV) modules directly affect the performance of the PV system. Commonly two steady state approach prediction models are used to estimate the PV modules cell temperatures, the nominal operating cell temperature model and the Sandia National Laboratory temperature prediction model. In this study the Sandia National Laboratory temperature prediction model was used to predict the PV modules temperatures of Renewable Energy Research Center PV installation at Universiti Malaysia Terengganu. It was found that, in general, the model tends to give better results of temperature prediction. In this analysis more than 4630 PV cell temperature data were used. The *MBE*, *NMBE*, *RMSE*, *NRMSE* and correlation coefficient of predicted and measured PV cell temperatures are -0.3490 ^{o}C,-0.7328%, 1.3571 ^{o}C, 2.8492% and 0.9763, respectively. The statistical results show that the model can be used to predict the PV cell temperatures with an error of less than 3%. It can be seen from the results, that the predicted PV cell temperatures show a good correlation with the measured data. As a conclusion, the PV cell temperatures can be estimated using a new linear model based on the steady state approach prediction model as

$$T_{module}\left(^{o}C\right) = 0.943 \times T_{ambient} + 0.0195 \times Irradiance - 1.528 \times WindSpeed + 0.3529 .$$

Keywords: Operating PV cell temperature, Photovoltaic module, Sandia National Laboratory model, Temperature prediction