UNIVERSITI TEKNOLOGI MARA

DETERMINATION OF NOMINAL MODULE OPERATING TEMPERATURE FOR POLYCRYSTALLINE PHOTOVOLTAIC MODULE

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Under the certification of design qualification and type approval for PV modules; IEC61215 and IEC61424, Nominal Module Operating Temperature (NMOT) has been introduced in the year 2016 replacing Nominal Operating Cell Temperature (NOCT) due to the uncertainty of NOCT value and challenges during the execution of NOCT quantification. In addition, numerous studies still emphasized on NOCT determination which does not adhere to the IEC61215-2 standards. Moreover, NMOT in the IEC61215-2 standards was very limitedly deliberated particularly in the context of tropical climate conditions. Thus, the aim of this study is to determine the NMOT for polycrystalline PV module that suits Malaysia climate. This aim has been achieved through three sequential objectives of designing and developing a stand-alone photovoltaic (SAPV) system for NMOT testing, determining the coefficient of solar irradiance (μ_0) and coefficient of wind speed (μ_1) in NMOT model and establishing a revised NMOT model that suits Malaysia climate conditions. The design of the 0.345 kWp SAPV system for NMOT testing was first performed using mathematical model with solar irradiation profile of the chosen site and loads requirement as the two main constraints. The SAPV system obtained from the design was then installed according to IEC61215-2 and IEC61853-2 recommendations at the chosen site in Shah Alam, Malaysia. All climatic data were obtained `5 months' to satisfy the amount of data and the data filtration requirement by IEC61853-2. The data were then analysed using regression. Subsequently, the μ_0 of 35.927 and μ_1 of -2.724 were obtained from the regression analysis. These values were then used to modify the NMOT in mathematical model described in the IEC61215-2 standard. Consequently, a revised NMOT model was established for polycrystalline PV module under the Malaysia climate. The revised NMOT model showed a calculated NMOT value of 55.6℃ for polycrystalline PV module based on the corresponding Standard Reference Environment (SRE) conditions of Malaysia, i.e. ambient temperature (AT) of 31℃, solar irradiance (SI) of $800\mathrm{W/m^2}$ and wind speed (WS) of $1\mathrm{ms^{-2}}$. The accuracy of the revised NMOT model was found to be acceptable with PE, RMSE, and MAPE found to be 4.34%, 1.84℃ and 4.50% respectively.

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