



Contribution ID: 273

Type: Poster Presentation

Effects of changing operational voltage on Thermal and Current-Voltage measurements of poly-crystalline Photovoltaic module and individual cells

Photovoltaic (PV) cells operating in the field generally have a degree of cell mismatch caused by; a) inherent mismatch from manufacturing shortcomings and b) different operational conditions, cell mismatch caused by external environmental factors such as partial shading or soiling and potential induced degradation (PID). This study focuses on the analysis of current-voltage (I-V) characteristics based on voltage measurements of individual cells and module current of a poly-crystalline PV module recorded concurrently with thermal images. This facilitates the understanding of the behaviour of abnormal thermal signatures at different operational I-V points, which were achieved by varying a resistive load. The change in load conditions influenced the module's current, voltage operational points and temperature distribution such that the mismatched cells behave differently. Mismatched cells are likely to operate in reverse bias and cause abnormal thermal signatures when the module's operational voltage is less than its maximum power voltage (VMP) of 28 V. Cell mismatch is unlikely to occur, hence no abnormal hot cells on TIR images, when the operational voltage of the module is greater than VMP. The dynamics of the abnormal thermal signatures can mislead decisions during TIR imaging inspections when bad cells do not show their abnormal thermal signature on TIR images. It is beneficial to optimise power output with the operational voltage higher and not less than VMP, since the bad cells will not become abnormally hot to cause detrimental effects. This study shows additional insights which can improve the operation, TIR imaging inspections, reliability and performance of poly-crystalline PV modules.

Keywords: poly-crystalline cells, hot cells, different load conditions

Apply to be considered for a student ; award (Yes / No)?

Yes

Level for award;(Hons, MSc, PhD, N/A)?

PhD

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Session Classification: Poster Session

Track Classification: Track F - Applied Physics