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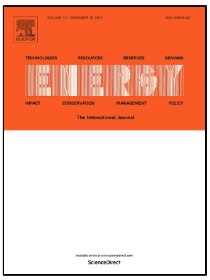

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Enhanced electrical performance in a solar photovoltaic module using V-trough concentrators

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ABSTRACT

The electrical performance of a novel solar photovoltaic collector fabricated by lamination of silicon PV cells onto a copper metal sheet using EVA as the bond material and adding a single water channel underneath was further improved by using V-trough booster reflector mirrors. From the ray-tracing analysis, it was observed that under fixed tilt of 13°, the one-mirror arrangement even though of less concentration provides uniform illumination for seven months, whereas the two-mirror arrangement does not provide uniform illumination in any month except June. The non-uniform illumination on the solar photovoltaic collector due to different incidence angles throughout the day, can be minimized by increasing the length of the reflector mirrors by 2.82 times the length of the modified PV module. Experimental results show that due to the fixed tilt of the V-trough concentrator and the reflection losses on the glazing, the increase in electrical power was realized only for a duration of 90 to 120 minutes around solar noon in one-mirror arrangement and for about 60 minutes around solar noon in the two-mirror arrangement. The higher power output observed for the fixed tilt V-trough concentrator during peak noon conditions is favourable for peak noon demand such as air-conditioning, irrigation, etc.

Keywords: V-trough; PV module; Ray-tracing; PV cooling; Solar concentrator

1. INTRODUCTION

Increased solar intensity with reduced operating temperature are required for an increase in the electrical performance of solar PV modules. A PV module is cooled by attaching a thermal absorber plate and passing a heat transfer fluid underneath it, thereby improving its electrical performance and to collect the thermal energy generated [1]. Even though, this method reduces the PV cell temperature, the improvement in electrical efficiency is still insignificant. The usage of static reflector mirrors called V-trough concentrators will increase the solar flux on the PV cells, thereby producing higher electrical output and reduce the cost of photovoltaic system for the given electrical power demand. Solar concentrators such as Parabolic reflectors and Compound Parabolic Concentrator (CPC) reflectors causes