PV MODULE DIAGNOSIS BY MEASURING MAGNETIC FLUX DENSITY ON THE MODULE SURFACE

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INTRODUCTION

PV systems are the most rapidly growing renewable energy systems. The current bottlenecks for PV systems are low efficiency and maintenance cost. Even though, it is believed that PV systems require less maintenance due to its stationary structure, still they are subjected to various faults. Hence, most of faults in PV arrays are not visible and they remain undetected for a long time, propagate to the other parts in array and finally result in a complete failure. Therefore, to keep the efficiency, safety and reliability of PV systems, fault detection and condition monitoring are important. In this study to address this problem, taking advantage of the correlation between current and magnetic flux density, a new fault detection method is applied to several PV modules. The proposed method is the magnetic flux density measurement at the surface of modules using a small integrated magnetic sensor.

EXPERIMENT

In this study the magnetic flux density profiles at the surface of various types of PV modules are measured and analyzed, then the results are compared to their EL and thermographic images. Measurements have been done under the short circuit or forward bias condition on each PV module under illuminated and unilluminated conditions. The experiments are carried out on mono, multi c-Si and thin film (CIS) PV modules, which are normal modules and degraded ones by damp and heat (DH) tests.

Figure 1 shows the EL image of the test PV module degraded by a DH test of 85% humidity and 85°C temperature for 3000 hours and its output has dropped by 20%. The module is forward biased by 8 A current and then the magnetic flux density is measured under unilluminated condition. Figure 2 shows the temperature and magnetic flux density (Bx, Bz) profiles along the column arrowed in Fig.1. A pair of peaks and valleys of Bx in each cell result from busbars currents and unequal intensity shows nonuniform current distributions in a cell. The module surface temperature profile also reflects the same situation.

Consequently, the magnetic flux density measurements on the surface of the PV module can lead us to detect different types of PV module faults. This method is able to detect faults which modify current density profiles in various modules. Additionally, this method can diagnose working PV modules without any electrical contacts.