Energy Maximization of Old PV Array under Discoloration Conditions Using Different Interconnection Schemes

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***Abstract*— Discoloration of solar panels is a phenomenon where the color of the panels changes over time due to numerous environmental variables such as temperature, irradiance, and humidity. Discoloration causes a significant impact on the PV performance reduction considering output power. The power degradation increases gradually due to the increment of discoloration of aged PV array modules. In this work, the effect of discoloration has been investigated practically by considering a five-year aged 200 W PV array. The array modules are connected in 4×5 array configurations and the power rating of each module is 10W. The PV modules are tested individually using a professional PV tester and visual imaged-based investigations have been made to identify the discoloration effects on each module output power. Based on these results the array modules are rearranged to increase the output power using a module rearranged technique. Moreover, five different interconnection schemes are applied to make a comparative investigation considering the PV array output power and percentage of recoverable energy. The experimental results show that the BL interconnection scheme can generate 4.93% more energy than the typical SP interconnection.**

Keywords*— *Photovoltaic modules, PV array configurations, module interconnection, degradation, discoloration.

I. INTRODUCTION

The socioeconomic progress of a society continues to depend heavily on energy. With rising oil prices and the negative effects of burning fossil fuels on the environment, it becomes more challenging [1]. There is currently enough flexibility and reliability provided by diverse renewable energy sources and technological advancements to lessen the energy deficit brought on by the rise in demand [2]. In the market for renewable energy, photovoltaic energy is currently a major player [3]. A PV system can be effective for a modest energy need only if the installation is adjusted and maintained. Understanding the longevity and dependability of such a system depends on aging factors, such as hotspots, discoloration, micro-cracks, delamination, etc [4]. Among them, discoloration is an important factor that starts the aging process. Discoloration increases the power reduction, mainly the current decreases, which increases the mismatch power losses in the array modules. Consequently, mismatch power loss increases the discoloration and hotspots. In the outdoor exposure of PV array modules, different types of discoloration can occur. Fig. 1 shows the different discolorations due to environmental effects [5].

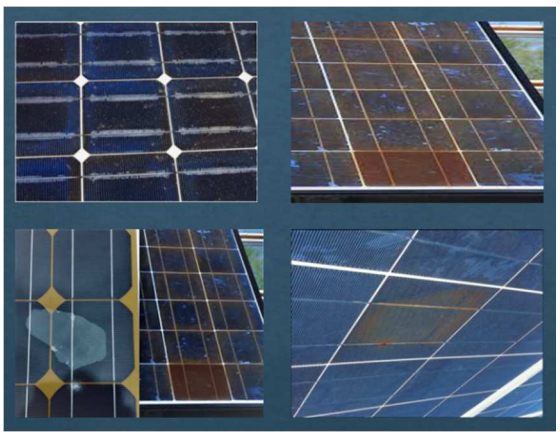

Fig. 1. Discoloration effects on photovoltaic modules