Reliability and degradation analysis of field-aged photovoltaic modules under harsh environmental conditions

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Reliability and performance characterization of solar photovoltaic systems will become increasingly important in the coming years. Solar photovoltaic modules, as the system's main components, are exposed to various environmental and climatic conditions during their lifetime. System reliability depends on performance and failure modes, which can occur during production, shipping and plant installation. In addition, environmental factors can also affect the performance of photovoltaic systems, leading to multiple failures during their power generation. Ambient temperature, solar irradiation, wind, dust, humidity, and precipitation are the main stress factors that degrade PV modules in different ways over time.

Long-term performance monitoring and characterization of field-exposed solar photovoltaic (PV) modules are critical for efficient power production. This work attempts to evaluate the performance degradation of crystalline silicon technology after several years of field exposure in Djibouti's harsh desert maritime climate. Characterization techniques such as visual inspection (VI), infrared thermography (IR), ultraviolet fluorescence (UVFL), electroluminescence (EL) imaging, and electrical characterization are performed to detect predominant degradations mechanisms [1-2]. The electrical characteristics have been determined and normalized at Standard Test Conditions (STC) with translation equations. Finally, the degradation rates are evaluated.

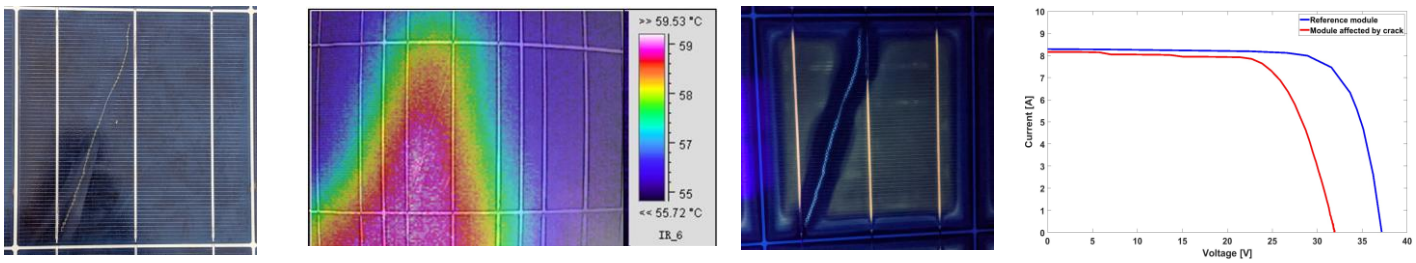

Figure 1: RGB, IR, UVFL and I-V characteristics of a PV module affected by cracks.

References:

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