NREL Highlights RESEARCH & DEVELOPMENT

NREL Determines Better Testing Methods for Photovoltaic Module Durability

NREL discoveries will enable manufacturers to produce more robust photovoltaic modules.

Over the past decade, some photovoltaic (PV) modules have experienced power losses because of the system voltage stress that modules experience in fielded arrays. This is partly because qualification tests and standards do not adequately evaluate the durability of modules that undergo the long-term effects of high voltage.

Scientists at the National Renewable Energy Laboratory (NREL) tried various testing methods and stress levels to demonstrate module durability to system voltage potential-induced degradation (PID) mechanisms. The results of these accelerated tests, along with outdoor testing, were used to estimate the acceleration factors needed to more accurately evaluate the durability of modules to system voltage stress. NREL was able to determine stress factors, levels, and methods for testing based on the stresses experienced by modules in the field.

These results, in combination with those in the literature, suggest that constant stress with humidity and system voltage is more damaging than stress applied intermittently or with periods of recovery comprising hot and dry conditions or alternating bias in between. NREL has determined some module constructions to be extremely durable to PID. These findings will help the manufacturers of PV materials and components produce more durable products that better satisfy their customers.

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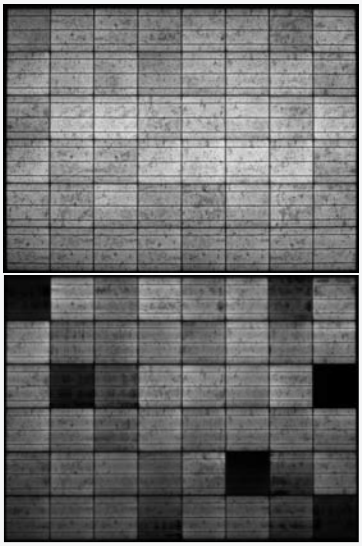
Reference: Hacke, P.; Terwilliger, K.; Smith, R.; Glick, S.; Pankow, J.; Kempe, M.; Kurtz, S.; Bennett, I.; Kloos, M. (2011) "System Voltage Potential-Induced Degradation Mechanisms on PV Modules and Methods For Test." 37th IEEE Photovoltaic Specialists Conference.



Electroluminescence imaging of a multicrystalline module before stress testing (top) and after (bottom) at 50°C, 85% relative humidity, and -600 volts for 89 hours. Some cells in the stressed module are dark because of degraded diode characteristics. Image by Stephen Glick, NREL

Key Research Results

Achievement

NREL determined that there is rapid degradation of some PV modules under system voltage stress and evaluated degradation rates in the field to develop more accurate accelerated testing methods.

Key Result

PV module manufacturers will be better able to choose robust materials and durable designs and guarantee sturdier, longer-lasting products.

Potential Impact

As PV modules become more durable, and thus more efficient over the long term, the risks and the cost of PV power will be reduced.

NREL
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