Characterization of Potential Induced Degradation Sensitivity of Crystalline Silicon Modules

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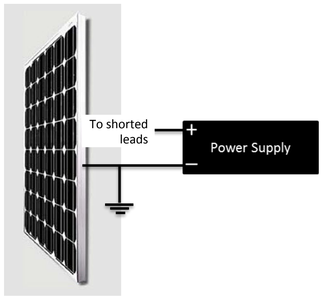
ABSTRACT

With the cost of PV modules plummeting and production volumes expanding to record levels, module manufacturers are experiencing increasingly aggressive cost pressures. An estimated 26 GW of nameplate PV capacity was installed globally in 2011. A one-percent performance degradation translates to a loss of 260 MW of nameplate power - roughly the total installed PV in 2000. This staggering number underscores the importance of maintaining a focus on PV module quality and durability. PV modules are subjected to a wide range of harsh environmental stress conditions: temperature swings, humidity, hot and freezing temperatures, high voltages, and UV radiation are a few examples. This work focuses on the impact that elevated voltage levels can have on PV module performance. This degradation mechanism is commonly referred to as potential-induced degradation (PID). We present experimental results of over sixteen commercially available modules subjected to positive and negative biases of 1,000 volts in damp-heat conditions (85C / 85% RH). PV module degradations induced by the experimental conditions range from negligible to catastrophic and depend strongly upon bias polarity. Observed degradation in power ranges from less than 1% to almost 50%.

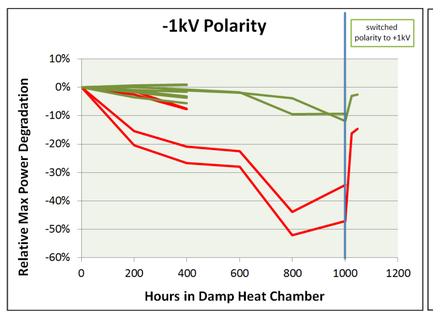
TEST DESCRIPTION

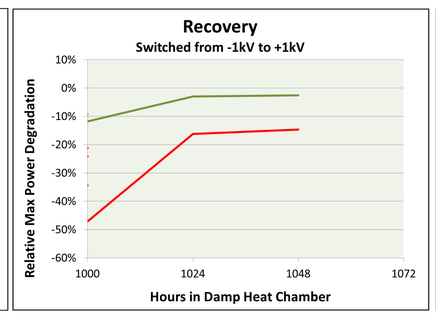
- »Damp heat conditions (85° C / 85% RH)
- »Four module types evaluated
- »Two modules per type at +1kV
- »Two modules per type at -1kV
- »Modules characterized every 200 hours

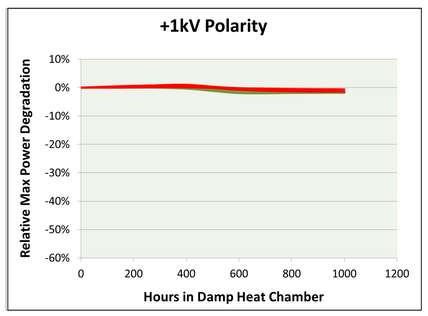


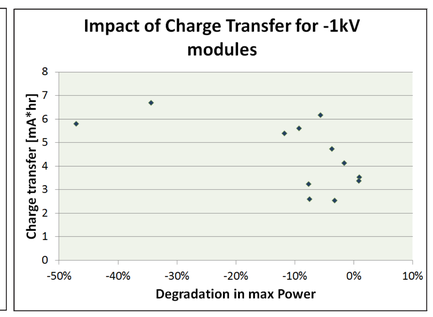
TEST RESULTS

Canadian Solar Modules; competitor modules









CONCLUSIONS

- »PV modules built with Canadian Solar cells showed greater PID stability
- »70% - 80% of the degradation was recovered by reversing the polarity for 48 hrs
- »Leakage current has no correlation to PID sensitivity
- »All modules exhibited minimal degradation with positive bias
- »Charge transfer had no correlation to degradation magnitude

ELECTROLUMINESCENCE IMAGES

« -1kV +1kV »

0 hours | 200 hours | 400 hours | 600 hours | 800 hours | 1000 hours | 1024 hours | 1048 hours

CANADIAN SOLAR MODULES

COMPETITOR MODULES