Trends in Field and Laboratory Performance of Photovoltaic Modules and Materials

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Motivation for Investigation

- Identify bill of materials (BOM) and/or process control measures for photovoltaic modules with representative failure modes, as informed by accelerated lab & field performance tests to guide next steps in module and material design.

- Apply lessons and observations from accelerated testing to the field, and vice versa.

- Case study: underperformance of manufacturer “Z” modules at a ~5-year-old 15 MW plant in the mid-Atlantic region with 6 arrays.

- Normalized daily performance of each array
  - Red lines show early degradation

LeTID Observed from Site Analytics for Manufacturer “Z” Modules

- Same module type
- In-field I-V curves were obtained for a subset of modules from each array
- Identified light- and elevated temperature-induced degradation (LeTID) in field for 5 of 6 arrays
- Array 1 and some modules in array 2 did not have LeTID
Planned Experiment: Evaluate Impact of Field Regeneration

- With continued injection (illumination and/or current) at elevated temperature, LeTID eventually regenerates – *not yet observed in field*

- LeTID is *accelerated* by increased injection – but how long does it take in the field? Depends on state of modules in the LeTID curve

LeTID Regeneration Procedure
- In lab, current is increased to the module
- In field, increase injection by leaving module at open circuit – *never done before*

Expectation
- Performance recovery is accelerated at open circuit

Question
- Is in-field regeneration an economically feasible proposition?

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Follow on to work previously done on underperformance of manufacturer “Z” modules at a 5 years old plant in the mid-Atlantic region with 6 arrays of 2 MW

Identified light- and elevated temperature-induced degradation (LeTID) in field for 5 of 6 arrays

**Planned experiment:** in-field LeTID regeneration

Expectation of performance recovery, understanding of time to recovery if deploying in-field regeneration strategies is economically viable

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