LETID AND THE FUTURE OF MODULE DEGRADATION TESTING

A Comparison of Test Methods on Module Level

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Webinar pv magazine
Freiburg, 18.10.2019

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TestLab PV Modules
Failure Research and Testing Service

Failure analysis
- Identification of root causes and relevant stress factors
- Failure prevention

Testing beyond standards
- Combined stress tests, e.g. UV + humidity
- Test development

PV Module Certification in close Cooperation with VDE since 2005.

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LeTID Module Testing
Challenges for EPCs, investors and testing laboratories

- “Black box” PV module
  - LeTID behavior is influenced by various factors, such as firing profiles [1,2], wafer thickness [3], BO-stabilization procedures [4]
  - This information is usually not available
- Long timescales
  - ~years until max. degradation is reached in the field [5]
  - Not detected by IEC 61215-2:2016 MQT 19
- Superposition of more than one process at the same time

- Demands for LeTID module tests
  - Risk estimation
  - Acceptance criterion?
  - Comparability of results
  - Acceptable testing time
- Standardization
  - Discussed for IEC test specification: 75 °C, MPP mode, CID

Commercial Modules

Further Testing

Still degrading

Testing until maximum degradation is too time consuming for module quality testing

→ Stop Criterion?
→ Further acceleration?
What if we accelerate further?

- Start of the regeneration phase within 300h
- Wide range of sensitivity ($\Delta P \approx -1.5\% ... -9\%$)
- Is the maximum detected degradation comparable to slow LeTID test results?

Impp $= (85 \pm 7) ^\circ C$
Commercial Modules
Multi-PERC Comparison

Are the results comparable?

- Direct comparison for two module types (Multi-PERC)
- Comparable performance losses for Multi-PERC K (within the testing time)
- Higher losses in fast test for Multi-PERC G, reason: degradation still ongoing in slow test

$\Delta P / \%$

$R = \pm 0.5 \%$

$t / h$

Isc-Impc
$(75 \pm 5) \, ^{\circ}C$

Impc
$(85 \pm 7) \, ^{\circ}C$
Are the results comparable?

- Direct comparison for two module types (Mono-PERC)
- Almost no degradation in fast test
- Possible reason: high acceleration of regeneration process → field relevant degradation not detected

Commercial Modules
Mono-PERC

![Graph showing the performance of Mono-PERC modules over time]

- $\Delta P / \%$ vs. time / h
- $R = \pm 0.5 \%$

- Isc-Impm $(75 \pm 3) \, ^\circ C$
- Impm $(85 \pm 7) \, ^\circ C$
6-Cell-Laminates
LID 85°C vs. CID 75°C

Test Equipment LID
- Climatic Chamber
- Integrated AAA Solar Simulator (IEC 60904-9)

*To be verified*
Conclusions

- LeTID test experience at TestLab PV Modules

- LeTID can be suppressed by some manufacturers
- Discussed for IEC test specification: CID, 75 °C, Isc-Impp,
  - Reliable method for LeTID detection, but long testing times
- Accelerated test: CID, 85 °C, Impp
  - Acceptable testing times
  - Risk of underestimation in case of mono-Si
- Promising solution: only increasing temperature, e.g. 85 °C, MPP mode
  → will be further investigated
Thank you for your Attention!

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