

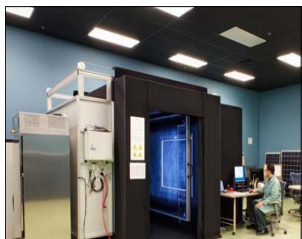
Failure Rates from Certification Testing to UL and IEC Standards for Flat Plate PV Modules

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Purpose

The purpose of this analysis is to report the most common failure modes identified during certification projects for flat plate PV modules tested at the CFV Solar Test Laboratory from April 2011 to December 2012. Our statistics are compared to similar findings reported by Fraunhofer ISE and TÜV Rheinland Photovoltaic Testing Laboratory so as to identify the most common failure modes occurring in PV module certification testing.

The CFV Facility



AAA+ Flash Simulator



Mechanical Load Tester



CFV's Outdoor Test Site



Large Climate Chamber



Large UV Chamber (5x sun)

CFV Solar Test Laboratory is a state-of-the-art PV test center accredited to ISO17025. Since April 2011, CFV has been conducting module certification testing for its partners CSA and VDE. 54 certification projects have been completed (24 Mono-Si, 25 Poly-Si, 2 A-Si/C-Si Tandem, 1 CIGS, 1 CPV, and 1 Spherical C-Si) using CFV's indoor and outdoor testing equipment. CFV's projects have included all environmental tests per UL1703, IEC61215, and IEC61646 and their respective pre- and post-characterization steps.

Results

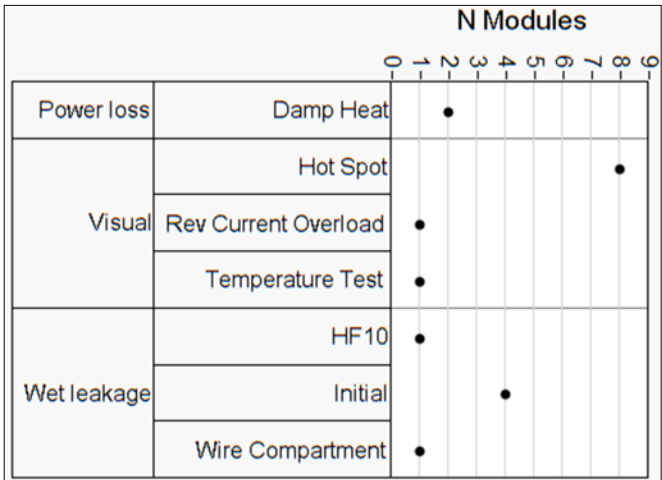


Figure 1: Number of certification modules failing at CFV for different failure modes and effects.

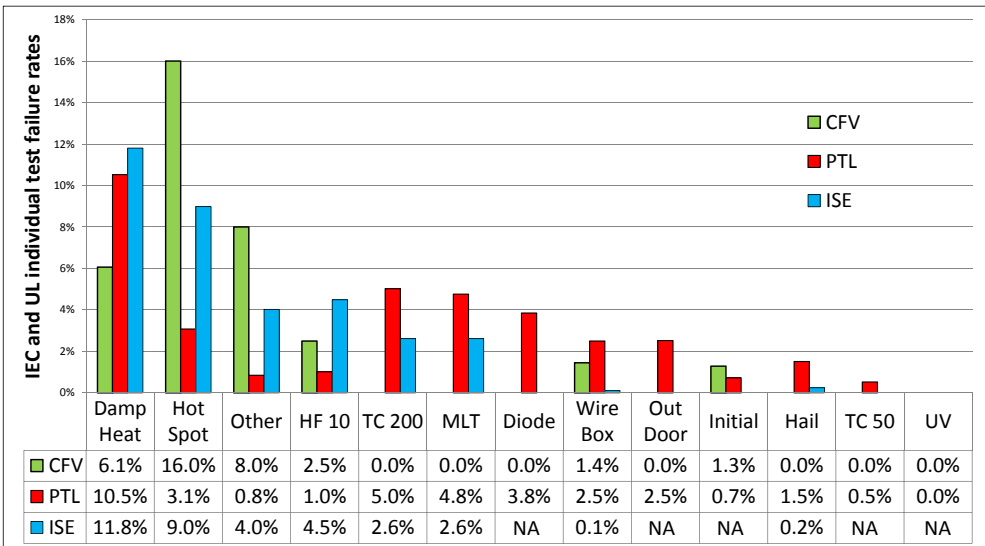


Figure 2: CFV, PTL, and ISE failure rates for characterization tests by environmental stress

Notes:

- CFV data is for projects performed between April 2011 and December 2012.
- PTL data reported is from 1997 to 2005.
- ISE data reported is from 2006 to 2009.

Conclusions

1. Three labs show similar failure rates for common failure modes: Damp Heat, Humidity Freeze, TC 200, and the Mechanical Load Test.
2. The failure rates for the hot-spot test differ considerably among the three labs. This is possibly due to differences in procedures or standard followed. CFV and ISE follow the procedure outlined in Rev 3 of IEC for identifying the lowest shunt resistance cell.
3. In the interest of standardized testing, some normalization around the hot-spot test should be considered.
4. No UV failures specifically reported by any lab, which is not surprising due to the low dosage of UV exposure received by modules during this test (the equivalent of roughly 30-90 days of outdoor exposure).

References

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- Li, B., Arrends, T., Kuitche, J., Shisler, W., Yi, K., & Tamizhmani, G. (2008, September). *IEC and IEEE design qualifications: An analysis of test results acquired over nine years*. 21st European Photovoltaic Solar Energy Conference, Dresden, Germany.
- UL 1703. Standard for Safety for Flat-Plate Photovoltaic Modules and Panels, Third Edition.