

TG2: Thermal and Mechanical Fatigue

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TG-2 (JP) Leader:

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in NREL PV Module Reliability Workshop 2014

2014/02/26 (Golden, CO)

TG2: Thermal and mechanical fatigue including vibration

Proposed scope:

Failures of cell interconnects and solder bonds have been identified as a key cause of long-term failure of PV modules.

The primary stresses affecting the failure rates have been shown to be thermal and mechanical.

There is evidence that vibration during transportation and/or caused by wind can contribute.

This task group will study how to best induce and quantify these failures.

Current Status

1. Recognition of Current Situation

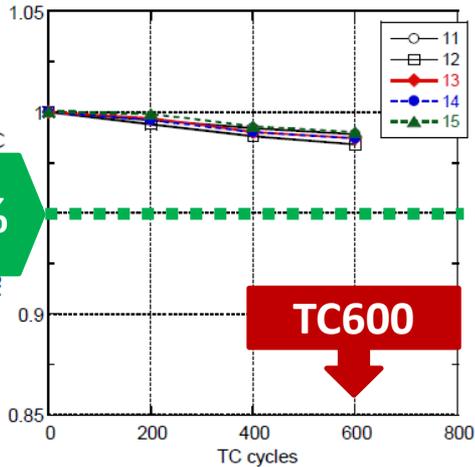
- **TC 200 is not enough**
(NREL: PV Module Reliability Workshop, 2012).
- **Extended TC (ex. TC 600) may effective**, but the long-term period is required.
- In our experience, **the interconnectors- / solder bonds- failures have been observed** even in the moderate climate.
- We need an option for subjecting the module to greater thermal-cycling stress than IEC 61215.

2. Requirements

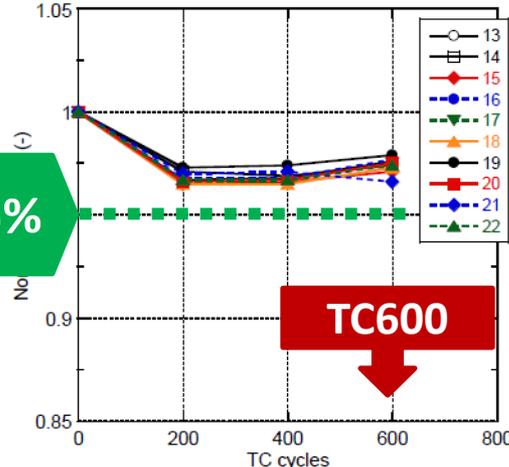
- **Time Saving**
- **Similar Failure Mode with Thermal Cycling**
 - > **Dynamic Mechanical Loading (DML) w/ or w/o TC**

Massive Survey of PV modules Purchased from Market

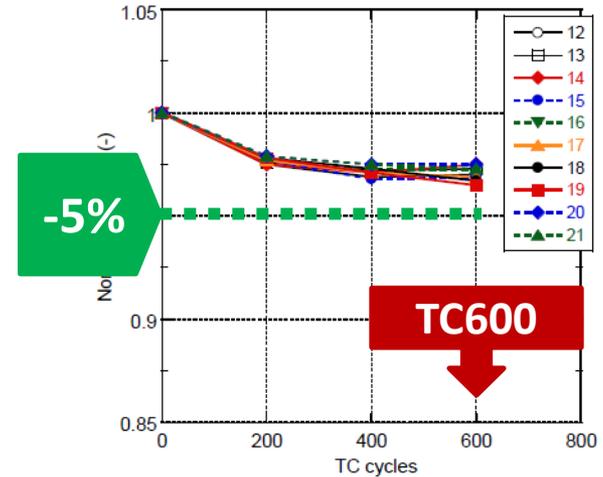
Model A (multi c-Si)



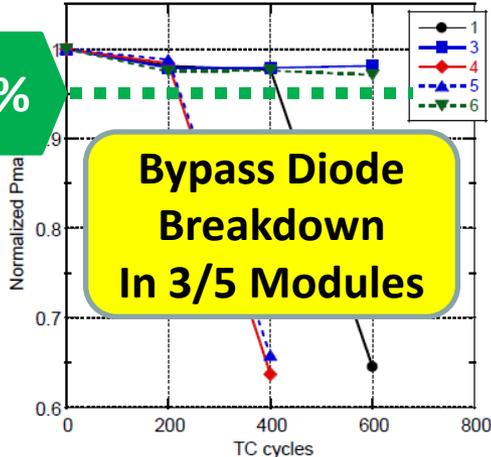
Model B (multi c-Si)



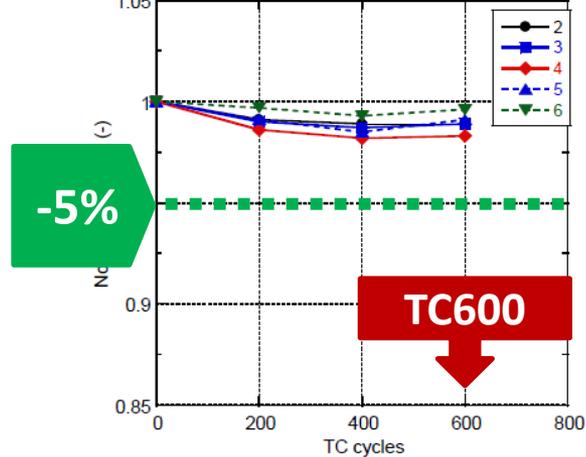
Model C (multi c-Si)



Model E (multi c-Si)



Model F (mono c-Si)



**Sample Size:
5~10 Modules/ Model**

Presented by Kawai et al., in
“The 4th International PV
Module Quality Assurance
Forum”, Oct. 10, 2013 (Kyoto).

In the recently-designed PV modules, obvious power-loss was not induced even by TC600, except “Bypass Diode Breakdown”.

Efforts for the DML Testing w/ or w/o TC

1. NREL

“Evaluation of Dynamic Mechanical Loading as an Accelerated Test Method for Ribbon Fatigue” in IEEE PVSC (June, 2013)

Most of the interconnect ribbons may be strained through module mechanical loading to a level that will result in failure in a few hundred to thousands of cycles..... To evaluate the equivalence of DML to thermal cycling, parallel tests were conducted with thermal cycling.

2. TG-2 (JP)

DML-TC sequential testing may be effective to detect the solder-bond / interconnector failures.

NREL PV Module Reliability Workshop (Feb., 2013)

IEC TC82/WG2 Meeting (May, 2013)

Global TG-2: Discussion (Nov, 2013)

Discussion to follow separated the purpose of the DML/TC sequence and DML alone.

DML/TC: Break susceptible cells and realize that effect on module performance.

DML: Quick evaluation of ribbon interconnects fatigue resistance, will not assess cracked cells nor solder bonds.

Philosophy for DML loading level:

Should be equivalent to manufacturing/ use/ environmental loading. Therefore it may be reasonable to define a single loading level regardless of module size or shape.

Not attempting to produce equivalent deflection or strains:

Since smaller modules are naturally stiffer, they have a higher resistance to these types of failures.

Global TG-2: Timeline (tentative)

	Qualification	QMS	Comparative Rating (TG-2)	Service Life Prediction
Current status	Issued as standards	Revised NWIP submitted	Proposed as concepts	Concepts
2014 goal	Submit Ed 3 61215 Ed 2 61730	Publish new TS	Enumerate tests Establish framework	Develop criteria to evaluate QMS related to service life; NWIP
2015 goal	Publish new editions	Start use of the TS in factory inspection	Complete drafts of set of tests	Complete CD
2016 goal		Revise QMS document to reflect feedback	Revise rating system to reflect tests	Publish
Chamber test times	Modules: ~ 6 weeks	TBD	TBD	3 years ?

Want to Volunteer!

To volunteer for TG-2, individuals may contact to TG-2 Leaders (Nick-san or Tanahashi) directly,

or request access to the website at

<http://pvqataskforceqarating.pbworks.com/>