PV QA Task Group #2: Thermal and Mechanical Fatigue including Vibration Thin Film

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Task Group #2: Scope of Work

Task Group 2: Thermal and Mechanical Fatigue including Vibration
(leaders: Chris Flueckiger and Tadanori Tanahashi)

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 stress and quantify PV module quality.

PV QA TG #2: Accelerated Stress Tests for PV

Accelerated Stress Test	Failure Mode	Characterizing Tests
Thermal Cycles **Agreed to be a wear out mechanism**	Broken interconnect Broken cell Solder bond failure Junction box adhesion Module open circuit – potential for arcing Delamination (cell to encapsulant, encapsulant to super/substrate) Outgassing Stress Cracking of jbox/cable glands	Wet leakage current, IV (electrical performance) Strain relief test Ground path continuity Visual Electroluminescence (full current and 10% Isc for shunted cells) Thermal imaging Dark IV Diode functionality Combine with dynamic load and humidity freeze specifically to identify cell cracking propensity. In-situ monitoring of continuity frame and circuit, dark IV Wiring compartment securement (final)

PV QA TG #2: Accelerated Stress Tests for PV

Accelerated Stress Test	Failure Mode	Characterizing Tests
Humidity Freeze **Group discussion – Could be wear out.**	Delamination Junction box adhesion Inadequate edge deletion Adhesion loss of frame to laminate	Static Load Wet leakage current, IV (electrical performance) Strain relief test Ground path continuity Visual Electroluminescence (full current and 10% Isc for shunted cells) Thermal imaging Dark IV Diode functionality In-situ monitoring of continuity frame and circuit, dark IV Wiring compartment securement (final)

PV QA TG #2: Accelerated Stress Tests for PV

Accelerated Stress Test	Failure Mode	Characterizing Tests
Static Mechanical Load (Simulation of wind and snow load) However - ice damming leading to movement of inclined module could lead to wear-out like failure)	Structural failures Broken glass Broken interconnect ribbons Broken Cells Solder bond failures	
Dynamic Mechanical Load (Simulation of wind load and transportation stress)	Broken glass Broken interconnect ribbons Broken Cells Solder bond failures Ground path continuity failure Cracking of frame or loss of mounting system	Visual inspection Ground path continuity EL (low and high current) IV Wet leakage current Junction box securement test

PV QA TG #2: New Work Item Proposal (NWIP)

[Document reference]

NEW WORK ITEM PROPOSAL

Proposer Christopher Flueckiger	Date of proposal 4-23-2012
TC/SC 82	Secretariat Howard Barikmo
Date of circulation	Closing date for voting

A proposal for a new work item within the scope of an existing technical committee or subcommittee shall be submitted to the Central Office. The proposal will be distributed to the P-members of the technical committee or subcommittee for voting on the introduction of it into the work programme, and to the O-members for information. The proposer may be a National Committee of the IEC, the secretariat itself, another technical committee or subcommittee, an organization in liaison, the Standardization Management Board or one of the advisory committees, or the General Secretary. Guidelines for proposing and justifying a new work item are given in ISO/IEC Directives, Part 1, Annex C (see extract overleaf). **This form is not to be used for amendments or revisions to existing publications.**

The proposal (to be completed by the proposer)

Title of proposal	
COMPARATIVE TESTING OF SILICON PV MODULES TO DIFFERENTIATE PERFORMANCE IN MULTIPLE CLIMATES AND APPLICATIONS Part 2: Mechanical and Thermal Cycling Stress Testing	
☐ Standard	☒ Technical Specification

PV QA TG #2: New Work Item Proposal (NWIP)

1 Scope and object

The purpose of this International Standard is to define a test or test sequence that will quickly uncover failures that have been associated with exposure to thermal cycling after many years. IEC 61215 already includes 200 thermal cycles in one leg of the testing and 50 thermal cycles combined in sequence with other stresses. However, field data imply that solder-bond and/or metal-interconnect failures can dominate the failures that are seen in the field, implying that the IEC 61215 test procedure is not adequate to gain confidence in the design in all cases. This test procedure (IEC 62XXX – 2) applies more stress, and, as a part of the rating system described in IEC 62XXX – 1, provides comparative testing to differentiate modules with improved durability to thermal cycling and the associated mechanical stresses.

PV QA TG #2: New Work Item Proposal (NWIP)

1 Scope and object (continued)

Solder-bond and metal-interconnect failures can arise for a number of reasons. Interconnect design that reduces the mechanical stress experienced during thermal cycling can greatly reduce the rate of damage associated with thermal fatigue. Failures have also been associated with cracked silicon cells that then cause increased stress on the metal interconnects that span the cracks. This test method applies thermal-cycling and mechanical stress in a way that will quickly uncover thermal-cycling induced failure after even 10 or 25 years in the field.

PV QA TG #2: Proposed Test Sequence

1. Visual Inspection
2. EL image
3. Power Measurements
4. IR image
5. Insulation Resistance Testing
6. Wet Leakage Current Testing
7. Dynamic Mechanical Load (based on NP 62782 Ed 1.0)
8. Temperature Cycling TC/Humidity Freeze Cycling
   Consideration shall be given to the number of cycles, temperature ranges, rates of temperature change, and dwell times, etc.
9. Visual Inspection
10. EL image
11. Power Measurements
12. IR image
13. Insulation Resistance Testing
14. Wet Leakage Current Testing

PV QA Task Group #2: Current Activities

- **Dynamic Mechanical Load / Temperature Cycling Sequential Testing**

Comparison with long-term Temperature Cycling Tests (TC 600)

Nov. – Dec. 2012	DML Testing IEC 62782 Ed. 1.0 +/- 1,000 Pa, 2-3 cycle/ min, 1,000 cycles
Jan. – Feb. 2013	TC Testing IEC 61215 -40~+85oC, 200 cycles, + Imp
Feb. 2013	Interim Report at NREL PVMRW
Feb. – April 2013	Further development of draft proposal in preparation for WG2 meeting in May

International PV Module Quality Assurance Task Group #2

Want to Volunteer!

To volunteer for **Task Group 2**, individuals may contact the Chris Flueckiger directly or request access to the website at

http://pvqataskforceqarating.pbworks.com/

THANK YOU.

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