

Introduction of Break-out Session 2



International PV Module Quality Assurance Forum

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Outline of this presentation

- Review of Results from Survey
- Goal of Break Out Session 2
- Review of Accelerated Stress Tests used for PV
- Specific Tasks for Break Out Session 2

Survey Results

Stress	Pass/Fail	Multi-level	No Opinion	No Rating
System Voltage	36%	42%	19%	3%
Temperature	17%	70%	11%	2%
Temperature Cycling	24%	62%	12%	2%
Humidity	23%	63%	11%	2%
UV	25%	61%	11%	2%

Survey Results

Stress	Pass/Fail	Multi-level	No Opinion	No Rating
Snow Load	49%	33%	15%	4%
Salt Spray	49%	32%	15%	4%
Hail	58%	24%	13%	4%
Wind	45%	37%	15%	2%
Transportation	52%	26%	16%	7%
Farmland	46%	21%	24%	9%

Survey Observations

- **Highest % votes for multi-level tests for:**
 - Temperature
 - Temperature Cycling
 - Humidity
 - UV
- **Majority favored qualitative tests (pass/fail) for those tests that already have quantitative levels available:**
 - Hail
 - Mechanical Load
 - Salt Spray

I will interpret this to mean that most are happy with the choice of levels now available for these 3 tests.

Survey Observations

- **For voltage, where you can now qualify for any voltage level, the survey results are confusing:**
 - 42% for quantitative (multi-level) which it now offers
 - 36% for qualitative (pass/fail)

Which leaves me wondering who the 36% think should set the voltage level that you run the pass/fail test on?

Goal of Breakout Session #2

- **Select a limited set of the accelerated stress tests that:**
 - Stress important failure and degradation mechanisms.
 - Can be evaluated to determine an acceleration factor versus field deployment in various climate categories.
 - Is likely to provide a useful service life prediction once the relevant acceleration factors are known.
- **Wear-out mechanisms versus infant mortality/design issues**
- **Limitations**
 - It is not possible to test for every possible failure mechanism.
 - The first round will be limited to crystalline silicon modules. Other technologies will follow later.
- **Lets start with my list from yesterday.**
 - **Red = Wear out issues**
 - **Green = Design/Process Issues or infant mortality**

Accelerated Stress Tests for PV

Accelerated Stress Test	Failure Mode
Thermal Cycles	Broken interconnect Broken cell Solder bond failure Junction box adhesion Module open circuit – potential for arcing
Damp Heat (Humidity & Temperature)	Corrosion Delamination Encapsulant loss of adhesion & elasticity Junction box adhesion Electrochemical corrosion of TCO Inadequate edge deletion
Humidity Freeze	Delamination Junction box adhesion Inadequate edge deletion

Accelerated Stress Tests for PV (cont)

Accelerated Stress Test	Failure Mode
UV & Temperature	Delamination Encapsulant loss of adhesion & elasticity Encapsulant & backsheet discoloration Ground fault due to backsheet degradation
Static Mechanical Load (Simulation of wind and snow load)	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

Accelerated Stress Tests for PV (cont)

Accelerated Stress Test	Failure Mode
Hot spot test	Hot spots Shunts in cells or at scribe lines Inadequate by-pass diode protection
Hail Test	Broken glass Broken cells
By-pass Diode Thermal Test	By-pass diode failures Overheating of diode causing degradation of encapsulant, backsheet or junction box
Salt Spray	Corrosion due to salt water & salt mist Corrosion due to salt used for snow and ice removal
Ammonia Test	Exposure to farm waste

Break-out sessions

Six rooms: All will have same topic – each person has opportunity to express opinion

Given set of questions to discuss (next slides)

Polls will be taken to judge the consensus of the group

Leaders will summarize and present results

Instructions to all

1. Discuss List of Stress Tests

- Is the list complete?
- What about just Temperature?
- Are there other combinations of stresses that we should be testing for (ie. Voltage, humidity and temperature)

2. Are the criteria for selection correct?

Accelerated tests that:

- Stress important failure and degradation mechanisms.
- Can be evaluated to determine an acceleration factor versus field deployment in various climate categories.
- Are likely to provide a useful service life prediction once the relevant acceleration factors are know.

3. Prioritize the list of accelerated stress tests.

- Discussion
- Select top 4 or 5 via vote

4. Prepare summary presentation back to main group

Results

- **Results of this process will be used to establish committees chartered with the development of the next generation of quantitative test standards that stress wear out mechanisms and can predict the service life for crystalline Si PV modules.**
- **Probably one committee will be set up for each of the selected accelerated stress tests.**