Solar Durability Workshop

How PV Standards Developed

Case Study: Hot Spot Endurance Test

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Standard Development Cycle

UL have all 5 pillars in this cycle.
PV Test Standard

PV test standards have several challenges. For example:

- Fast moving technology vs. lengthy standard development process;
- R&R: Repeatability and Reproducibility, especially for outdoor testing;
- Long system operation lifetime vs. demand for quick certification to market;
- Highly accelerated stress test vs. keeping in the similar failure mode.

Hot Spot and Bypass Diode

Without bypass diode, the heat dissipation $Q$ from shaded cell is: $P_{3N-1}$

$P \sim \eta$

$Q \sim \Delta T, A$

With 3 bypass diodes, the heat dissipation $Q$ from shaded cell is reduced to: $P_{N-1}$

short circuit module
Field Failures
Before JPL Block V, 1981
• No requirement for hot spot

UL1703: Test Equipment
UL 1703 Ed.1-1986, Ed.2-1993, Ed.3-2002
• Three cells, 1hr on - 0.5hr off
• Total 100hrs on time
• Indoor test with temperature control
• Use external power supply to provide maximum heat dissipation energy.
UL1703: Test Failures

IEC 61215 History and Current

Very few test failures. Not reflect field failure problem.

IEC 61215 Ed.1-1993
- One cell, 1hr on - 0.5hr off, total 5hrs

IEC 61215 Ed.2-2005
- One cell, 5hrs on - no off (may in two days)
Test 4 cells:
3 with lowest $R_{shunt}$,
1 with highest $R_{shunt}$.

Adjust shaded area to get maximum power dissipation.

On time: 1-5 hours.

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