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Inclusion of Outdoor High-Voltage Bias Testing in the Quality Assurance Methodology

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Damp Heat Testing Inadequacy

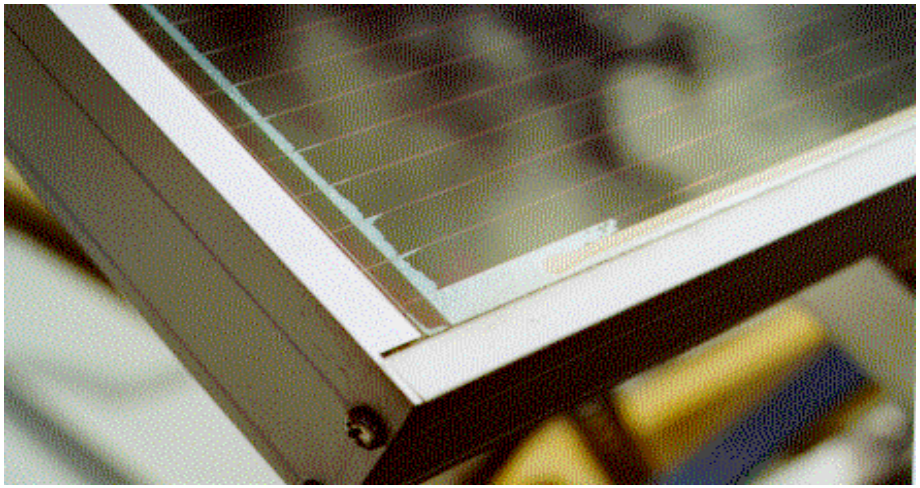
- As shown by Mike Kempe, the outdoor condition at various locations: Riyadh, Bangkok, Miami etc are all significantly different from the damp heat test conditions of 85 ^{0}C at 85% relative humidity (RH).
- Results at different temperatures can be correlated.
- Results under different RH are very difficult to correlate because the activation energies of different modes of degradation vary significantly with RH.
- In this respect outdoor high-voltage bias testing under hot and humid conditions is superior to high-voltage bias testing in the damp heat chamber.

High voltage Bias Testing

- **The relatively slow degradation may be accelerated by two means:**
  - **higher bias voltage compared to the system voltages of 600 V in the USA and 1000 V in Europe and elsewhere and**
  - **continuous application of voltage bias even at night.**
- **It would be possible to determine the Acceleration factors for both by having other modules biased at lower voltages as well as only during the day.**
- **Looking for PV module manufacturers interested in participating in these tests.**

Acceleration Factors

- We should compare the modules taken from arrays reaching high positive and negative voltages with individual modules biased to high voltages in hot and humid conditions.
- We should stress the importance of latitude tilt, periodic cleaning, visual inspection and I-V measurements.
- This comparison would result in direct correlation and acceleration factors with good statistics.



-600 volts
after 8 months

Quality Assurance Methodology

- **Instead of relying exclusively on PV measurements, we should monitor physical changes at various interfaces for gauging the changes that are taking place using both non-destructive and destructive techniques.**
- **We can then apply the principles of Physics of Failure to elucidate failure modes and mechanisms.**