

PV Module Reliability Workshop

February 18–19, 2010

Denver West Marriott, Golden, Colorado

Agenda

Feb. 18 Morning – Overview of PV Reliability Issues

Chairs: Kevin Lynn & Peter Hacke

7:00 – Continental Breakfast

8:00 – Kevin Lynn (DOE), and Sarah Kurtz (NREL) – Welcome and Purpose

8:30 – Kurt Scott (Atlas) – Weather Durability of PV Modules; Developing a Common Language for Talking about PV Reliability

9:00 – John Wohlgemuth (BP Solar) – Overview of Failure Mechanisms and PV Qualification Test Standards

9:30 – Patrick McCluskey (CALCE/Univ. of Maryland) – Reliability Modeling for Photovoltaic Modules

10:00 – Break

10:30 – Glenn Alers (UC Santa Cruz) – Failure Analysis Techniques from the Electronics Industry

11:00 – Reinhold Dauskardt (Stanford) – Application of Microelectronics Thin-Film Adhesion and Thermomechanical Reliability Metrologies to PV Devices and Modules

11:30 – Max Davis (Steel and Silicon Engineering) – Electrical, Mechanical, and Thermal Modeling

12:00 – Lunch

Feb. 18 Afternoon – Predicting Long-Term Performance for PV Products

Chairs/Discussion Leaders: Jennifer Granata & John Wohlgemuth

1:30 – Joseph Kuitche (ASU) – Statistical Lifetime Predictions for PV Modules

1:50 – Al Zielnik (Atlas) – Beyond Qualification – Testing for Long-Term PV Module Durability

2:10 – Peter Hacke (NREL) – Test-to-Failure for Long-Term Performance Assessment

2:30 – Ryan Gaston (Dow) – Designing for Reliability: Thin-Film Building Integrated Photovoltaic Modules

2:50 – Nick Bosco (NREL) – Quantifying the Weather: an Analysis for Thermal Fatigue

3:10 – Panel Discussion: Can We Use These Results to Predict 20–30 Years into the Future for Products that Have Been Created in the Last Year?

3:30 – Break

Feb. 18 Afternoon – Ensuring Quality to Satisfy the Investors

Chairs/Discussion Leaders: Sarah Kurtz & Govindasamy Tamizhmani

3:50 – Steve Voss (SunEdison) – What Demonstration of Reliability Is Needed Before Investment?

4:10 – Alex Mikonowicz – Consensus Guidelines for Quality Assurance and Their Role As a Foundation for Lifetime Predictions

4:30 – David DeGraaff (SunPower) – Case study: SunPower Manufacturing Quality Methods

4:50 – Panel Discussion: Are quality assurance guidelines adequately defined? What do we need to do as a community to ensure that the billions of dollars of product going into the field are of adequate quality?

5:10 – Break

5:30 – Poster Session

5:30–7:30 pm – Posters and Discussion. Cash bar and snacks. See separate listing for poster titles

Feb. 19 Morning – Technology-Specific Issues (three parallel sessions)

7:00 Continental Breakfast

Silicon—Chair/Discussion Leader: Peter Hacke

8:00 – John Wohlgemuth (BP Solar) – Failure Modes of Crystalline Si Modules and How to Eliminate Them

8:30 – Govindasamy Tamizhmani (Mani) (TUV Rheinland PTL) – Experience with Qualification and Safety Testing of Silicon Modules

9:00 – Discussion: Are there field failures that are not caught by the current qual test? Are there new failure modes that need to be studied? Do high system voltages cause new module failures? New materials for modules?

9:30 – Break

10:00 – Dirk Jordan (NREL) – Degradation Rates—What Do We See?

10:30 – James Bing (New Energy Options) – Decades in the Installed Environment—Do Silicon Modules Really Last More than 20 Years?

11:00 – Discussion: Is the performance in the field adequate? If not, what is needed—better QA, qual test, or?

11:30 – Break

CPV—Chairs/Discussion Leaders: Peter Hebert & Greg Flynn

8:00 – Daryl Myers (NREL) – Solar Resource Data for CPV

8:30 – Matthew Muller (NREL) – Spectral Effects in CPV Performance

9:00 – Discussion of Solar Resource Issues for CPV

9:30 – Break

10:00 – Ian Aeby (Emcore) – Failure Modes of CPV Modules and How to Test for Them

10:30 – Nick Bosco (NREL) – Thermal and Current Cycling for CPV Qualification

11:00 – Discussion of Failure Modes in CPV

11:30 – Break

Moisture Sensitivity of Thin Films—Chairs/Discussion Leaders: Ryan Gaston and Michael Kempe

8:00 – Kent Whitfield (Miasole) – Common Failure Modes for Thin-Film Modules and Considerations Toward Hardening CIGS Cells to Moisture

8:30 – D.J. Coyle, H.A. Blaydes, J.E. Pickett, T.R. Tolliver, and R.A. Zhao (GE Global Research) – Packaging Requirements for ITO-Hardened CIGS

9:00 – Discussion: After Hardening, What Protection Do We Need?

9:30 – Break

10:00 – Arrelaine Dameron (NREL) – Methods for Measuring Moisture Ingress and Requirements for Protecting Moisture Sensitive Cells

10:30 – Samuel Graham (Georgia Tech) – Approaches to Barrier Coatings for the Prevention of Water Vapor Ingress

11:00 – Discussion: Which aspects of the problem are solved? Where is more work needed?

11:30 – Break

11:45 – Lunch

Feb. 19 Afternoon – Technology-Specific Issues Continued (three parallel sessions)

Packaging—Chair/Discussion Leader: Zhiyong Xia

- 1:00 – Mike Kempe (NREL) – Types of Encapsulant Materials and Physical Differences Between Them
- 1:20 – Tim Zgonena (UL) – Safety Concerns with New Polymeric Materials
- 1:40 – Discussion of New Polymeric Materials and Testing Needs
- 2:10 – Christopher Barry (Pilkington) – Why Glass Sometimes Breaks
- 2:40 – Discussion of Glass and Expected Changes in the Future
- 3:00 – Break

CPV—Chairs/Discussion Leaders: Robert McConnell & Ian Aeby

- 1:00 – Andy Hartzell (3M) – Durability of Optical Materials
- 1:20 – David Miller (NREL) – Durability of Poly(Methyl Methacrylate) Lenses Used in Concentrated Photovoltaics
- 1:40 – Discussion of Test Needs for Optics for CPV
- 2:00 – Mike Ludowise (SolFocus) – Questions about IEC 62108 Implementation
- 2:20 – Discussion of IEC 62108: Intentions, Interpretation, and Implementation
- 3:00 – Break

Metastabilities of Thin Films—Chair/Discussion Leader: Jim Sites

- 1:00 – Jeff Yang (Uni-Solar) – Metastability of Amorphous Silicon – Historical Perspective and Real-Life Performance
- 1:30 – Dave Albin (NREL) – Metastable Effects in Polycrystalline Thin Film Cells and Correlations with Performance and Reliability
- 1:50 – Joe delCueto (NREL) – Comparison of Injection of Carriers Through Light Soaking and Forward Bias in Dark
- 2:10 – Discussion (and sharing of other data): How do we differentiate reversible from irreversible changes? How does a-Si experience with the Staebler-Wronski effect help with CIGS/CdTe issues? Can we use the same pre-conditioning test for all thin-film modules?
- 3:00 Break

Feb. 19 Afternoon – Wrap-up

Summaries from Breakout Sessions—Chair: Sarah Kurtz

- 3:30 – Summaries from Six Breakout Sessions (10 min each)
- 4:30 – Closing: Feedback Forms, etc.

4:45 Adjourn

5:00 NREL tour