

PVMRW 2016 Program

Tuesday 23 February 2016 (venue: Sheraton West, Lakewood, CO)

PV Module Reliability

●Continental Breakfast (7:30 – 8:00 am)

●The Connection Between Cost and PV Reliability (8:00 – 9:40 am)

8:00 - Welcome to PVMRW 2016 – [David Miller \(NREL\)](#)

8:05 - NREL's Welcome – [Greg Wilson \(NREL\)](#)

8:10 - Introduction - [Geoffrey Bratton \(JP Morgan\)](#) and [Dixon Wright \(Wells Fargo\)](#)

8:15 - SunShot Initiative: Lower Cost via Proven PV Module Reliability – [Geoff Kinsey \(DOE\)](#)

8:35 - Connecting Module Quality Assessments to Field Degradation Rates – [Ian Gregory \(Solar Buyer\)](#)

8:55 - The Importance of Quality & Standards in Emerging Markets – [Guido Agostinelli \(International Finance Corporation\)](#)

9:15 - Discussion – Chairs: [Geoffrey Bratton \(JP Morgan\)](#) and [Dixon Wright \(Wells Fargo\)](#)

●Coffee Break (9:40 – 9:55 am)

●General PV Module Reliability (9:55 – 12:00 pm)

9:55 - Introduction – [Tony Sample \(EC Joint Research Center\)](#) and [Jim Sorensen \(First Solar\)](#)

10:00 - Importance of Quality and Reliability for SolarCity – [Andreas Meisel \(SolarCity\)](#)

10:20 - Lessons Learned From the PVLife Model for PV Module Reliability – [Mukul Agrawal \(Sun Power\)](#)

10:40 - Validating 20 Year Reliability of POWERHOUSE™ 2.0 Solar Modules Using Fault Tree Analysis – [Ankur Khare \(Dow Chemical\)](#)

11:00 - Risk Priority Number for Defect Warranty Claims and Power Warranty Claims – [Mani Govindasamy \(ASU\)](#)

11:20 - Japanese Challenges to Improve Confidence in PV Module Reliability – [Tadanori Tanahashi \(AIST\)](#)

11:40 - Discussion – Chairs: [Tony Sample \(EC Joint Research Center\)](#) and [Jim Sorensen \(First Solar\)](#)

●Lunch (12:00 – 1:00 pm)

●Poster Session (1:00 – 2:00 pm, hosted by authors)

●Modules in Extreme Climates (2:00 – 3:30 pm)

2:00 - Introduction - [Alexander Bradley \(DuPont\)](#) and [Kurt Scott \(Ametek/Atlas\)](#)

2:05 - A Comparison of Degradation Rates Observed at PV Sites in Hot-Dry, Hot-Humid, and Temperate Climates – [Mani Govindasamy \(ASU\)](#)

2:25 - Lessons Learned From the All-India Survey of Photovoltaic Modules – [Anil Kottantharayil \(IIT Mumbai\)](#)

2:50 - Degradation of Veteran Si Modules in Hot Locations in Mexico – [Dalia Martinez Escobar \(UNAM\)](#)

3:10 - Discussion – Chairs: [Alexander Bradley \(DuPont\)](#) and [Kurt Scott \(Ametek/Atlas\)](#)

●Coffee Break (3:30 – 4:00 pm)

●PV Module Standards: General Standards (4:00 – 5:30 pm)

4:00 - Introduction – [Sean Fowler \(Q-Lab\)](#) and [John Wohlgemuth \(NREL\)](#)

4:05 - An Update on IEC 61730 – PV Module Safety Qualification – [Chris Flueckiger \(UL\)](#)

4:25 - PV Module Design Qualification and Type Approval – Edition 3 of IEC 61215 – [Markus Beck \(Siva Power\)](#)

4:45 - Standards for Higher Value of PV: From Desert to BIPV – [Michio Kondo \(AIST\)](#)

5:05 - IEC TS 62941 (QMS for PV Module Manufacturing) and PVQAT TG1 Survey – [Masaaki Yamamichi \(AIST\)](#)

5:10 - Discussion – Chairs: [Sean Fowler \(Q-Lab\)](#) and [John Wohlgemuth \(NREL\)](#)

●Posters (5:30 – 6:30 pm, not hosted – gallery will be open)

Wednesday 24 February 2016 (venue: Sheraton West, Lakewood, CO)
Breakout and Topic-Specific Sessions (PV Modules and Systems)

● **Posters (7:00 – 8:00 am, not hosted – gallery will be open)**

● **Continental Breakfast (7:30 – 8:00 am)**

● **Module Reliability Breakout Session 1: Crystalline-Silicon Modules (8:00 – 10:30 am)**

8:00 - Introduction – [David Meakin \(Sun Power\)](#) and [Ajay Saproo \(Sun Edison\)](#)

8:05 - The Reliability of Dual Glass Modules Designed for Harsh Climates – [Xu Jianmei \(Trina Solar\)](#)

8:25 - Climate-Specific Thermal Cycling—Is It Required for Reliability Testing? – [Nick Bosco \(NREL\)](#)

8:45 - Properties of Cracks in Solar Cells and Their Impact on Long Term Module Power – [Felix Haase \(ISFH\)](#)

9:05 - Snail Tracks: Identification of Critical Environmental Stresses, Corrosion Products and Influences of Module Components – [Ines Duerr \(Fraunhofer ISE\)](#)

9:25 - A Physics-Based Model for Potential Induced Degradation and Its Implications for PV Systems – [Max Koentopp \(HanWha Q-Cells\)](#)

9:45 - Revising the Bypass Diode Thermal Test in the IEC 61215 Standard to Accommodate Effects of Climatic Conditions and Module Mounting Configurations – [Narendra Shiradkar \(Jabil\)](#)

10:05 - Discussion – Chairs: [David Meakin \(Sun Power\)](#) and [Ajay Saproo \(Sun Edison\)](#)

● **Module Reliability Breakout Session 1: Thin Film Modules (8:00 – 10:30 am)**

8:00 - Introduction – [Markus Beck \(Siva\)](#) and [Leonardo Lopez \(Dow Chemical\)](#)

8:05 - Alternate DH Test Methods To Mitigate Test-Specific Degradation in CIGS Modules – [Hiroshi Tomita and Darshan Schmitz \(Solar Frontier\)](#)

8:25 - Partial-Shade Endurance Testing for Monolithic Thin-Film Photovoltaic Modules – [Tim Silverman \(NREL\)](#)

8:45 - Achieving Relevant and Reproducible Power Measurements for Thin-Film Modules – [Mike Deceglie \(NREL\)](#)

9:05 - Seven Useful Things We Can Learn From the Physics of Metastability in Thin-Film Modules – [Ingrid Repins \(NREL\)](#)

9:25 - On Prediction of Moisture-Induced Degradation in the Field for Flexible PV Modules – [Kedar Hardikar \(MiaSolé Hi-Tech\)](#)

9:45 - Factors in the Development of a PID Standard for Thin Film Modules: IEC 62804-2 – [Peter Hacke \(NREL\)](#)

10:05 - Discussion – Chairs: [Markus Beck \(Siva\)](#) and [Leonardo Lopez \(Dow Chemical\)](#)

● **Coffee Break (10:30 – 10:45 am)**

● **Module Reliability Breakout Session 2: Soiling (10:45 am – 12:15 pm)**

10:45 - Introduction – [Matt Muller \(NREL\)](#) and [James Webb \(Corning Incorporated\)](#)

10:50 - Soiling and Abrasion Testing of Surfaces for Solar Energy Systems Adapted to Extreme Climatic Conditions – [Karl-Anders Weiß \(Fraunhofer ISE\)](#)

11:10 - Field Performance and Persistence of Anti-Soiling Coatings on Photovoltaic Glass – [Brenor Brophy \(Enki Technology\)](#)

11:30 - The Modeling of the Effects of Soiling, Its Mechanisms, and the Corresponding Abrasion – [Lin Simpson \(NREL\)](#)

11:50 - Discussion – Chairs: [Matt Muller \(NREL\)](#) and [James Webb \(Corning Incorporated\)](#)

● **Module Reliability Breakout Session 2: Integrated Module (Power) Electronics, Including Microinverters (10:45 am – 12:15 pm)**

10:45 - Introduction – [Chetan Chaudhari \(Maxim Integrated\)](#) and [Joseph Walters \(USPVMC\)](#)

10:50 - Accelerated Reliability Evaluation of Module Power Electronics – [Jack Flicker \(SNL\)](#)

11:10 - Challenges and Opportunities in Implementing a Distributed Parallel MLPE Power Regulation Topology – [Tim Johnson \(TenK Solar\)](#)

11:30 - Other MLPE Solutions – [Gal Bauer \(Tigo Energy\)](#)

11:50 - Discussion – Chairs: [Chetan Chaudhari \(Maxim Integrated\)](#) and [Joseph Walters \(USPVMC\)](#)

●Lunch (12:15 – 1:00 pm)

●Poster Session (1:00 – 2:00 pm, hosted by authors)

●System and Resource Assessment (2:00 – 3:30 pm)

2:00 - Introduction – James Alfi (EDF Renewable Energy) and Frederic Dross (DNV GL PVEL)

2:05 - A Physics-Based Model to Analyze Satellite Data and the Availability of Solar Resources –
Manajit Sengupta (NREL)

2:25 - Field experience: Degradation Rates, Lifetimes & Failures – Dirk Jordan (NREL)

2:45 - Beyond LCOE: System Reliability Observations from the Field – Eric Daniels (Sun Cycle)

3:05 - Discussion – Chairs: James Alfi (EDF Renewable Energy) and Frederic Dross (DNV GL PVEL)

●Coffee Break (3:30 – 4:00 pm)

●Review of Breakout Sessions; PV Module Standards: Overview of Specific Standards (4:00 – 5:30 pm)

4:00 - Introduction – George Kelly (Sunset Technology) and Mike Kempe (NREL)

4:05 - Review from breakout sessions – Session Chairs (various)

4:35 - Development of IEC Module Standards by WG2 – John Wohlgemuth (NREL)

5:00 - Poster Awards: Xiaohong Gu (NIST)

5:05 - Discussion – Chairs: George Kelly (Sunset Technology) and Mike Kempe (NREL)

●Posters (5:30 – 6:30 pm not hosted – gallery will be open)

Thursday 25 February 2016 (venue: Sheraton West, Lakewood, CO)
PV System Reliability

● **Posters (7:00 – 8:00 am, not hosted-gallery will be open)**

● **Continental Breakfast (7:30 – 8:00 am)**

● **General System Reliability (8:00 – 10:15 am)**

8:00 - Introduction – [Rounak Kharait \(Leidos Engineering\)](#) and [Andreas Meisel \(SolarCity\)](#)

8:05 - Overview of System Reliability – [Olga Lavrova \(SNL\)](#)

8:25 - PV System Reliability: An O&M Perspective – [Geoff Klise \(SNL\)](#)

8:45 - Test Procedures for Determining Long Term Degradation From Early Degradation Indicators – [Matthias Heinze \(TÜV\)](#)

9:05 - The Big Picture: How Updated Codes and Standards Address PV System Safety – [Jason Fisher \(Solar City\)](#)

9:25 - PV System Performance Assessment with IEC 61724-1,2,3 and Its Use in IECRE Certification –
[Sarah Kurtz \(NREL\)](#) and [Michael Gostein \(Atonometrics\)](#)

9:55 - Discussion – Chairs: [Rounak Kharait \(Leidos Engineering\)](#) and [Andreas Meisel \(SolarCity\)](#)

● **Coffee Break (10:15 – 10:30 am)**

● **Inverters (10:30 – 12:00 pm)**

10:30 - Introduction – [Chris Deline \(NREL\)](#) and [Timothy Stocker \(SMA America\)](#)

10:35 - Accelerated Reliability Evaluation of Microinverters and Optimizers (PREDICTS) –
[Mani Govindasamy \(ASU\)](#)

10:55 - Defining Accelerated Test Requirements for Microinverters using a Physics-of-Failure-based Approach –
[Arvind Vasan \(Empower Microsystems\)](#)

11:15 - Assessment of a Redundant Low Voltage Parallel PV System – [Tim Johnson \(TenK Solar\)](#)

11:35 - Discussion – Chairs: [Chris Deline \(NREL\)](#) and [Timothy Stocker \(SMA America\)](#)

● **Lunch (12:00 – 1:00 pm)**

● **Poster Session (1:00 – 2:00 pm, hosted by authors)**

● **Rapid Shutdown (2:00 – 3:30 pm)**

2:00 - Introduction – [Nate Coleman \(Solar City\)](#) and [Geoff Kinsey \(DOE\)](#)

2:05 - Applications and Test Methods of PV Module Disconnect Switches – [Matthias Heinze \(TÜV\)](#)

2:25 - Firefighters' Perspective – [Matt Paiss \(IAFF Representative to NEC\)](#)

2:45 - NEC 2017 Rapid Shutdown: Product Compliance and Implementation Options – [Tim Zgonena \(UL\)](#)

3:05 - Discussion – Chairs: [Nate Coleman \(Solar City\)](#) and [Geoff Kinsey \(DOE\)](#)

● **Coffee Break (3:30 – 4:00 pm)**

● **Utility-Scale Systems and Standards (4:00 – 5:30 pm)**

4:00 - Introduction – [John Granger \(NextEra\)](#) and [Gregory Nielson \(Vivint\)](#)

4:05 - Arc-Fault Detection & Mitigation – [Jay Johnson \(SNL\)](#)

4:25 - Ground Faults (Detection & Mitigation) – [Jack Flicker \(SNL\)](#)

4:45 - Considerations and Structured Approach for Selecting and Deploying Climate-Specific Polymeric for
Wire Management Means – [Sumanth Lokanath \(First Solar\)](#)

5:05 - Discussion – Chairs: [John Granger \(NextEra\)](#) and [Gregory Nielson \(Vivint\)](#)