



2025

PV Reliability Workshop

Welcome to the 2025 Photovoltaic Reliability Workshop!

NREL hosts this annual workshop so that solar technology experts can discuss current and future issues in PV reliability. Longer-lasting PV systems make lower-cost solar electricity and have less impact on the environment, human health, and natural resources.

PVRW offers a combination of oral presentations, panel discussions with vigorous audience participation, and poster presentations. At our workshop, every attendee is a presenter or the sole guest of a presenter.

Chair:

Chris Deline

Committee:

Teresa Barnes

Ken Boyce

Jennifer Braid

Evelyn Butler

Kristopher Davis

Michael Deceglie

Tristan Erion-Lorico

Robert Flottesmesch

Peter Hacke

Henry Hieslmair

Will Hobbs

Cara Libby

Danielle Merfeld

Christos Monokroussos

Colleen O'Brien

Gernot Oreski

Michael Owen-Bellini

Jon Previtali

Ingrid Repins

Laura Schelhas

Eric Schneller

Adam Shinn

Colin Sillerud

Nick de Vries

Allan Ward

Kent Whitfield

AGENDA – Tuesday, 4 March 2025

Check-In / Breakfast: 7:30 am

8:30 AM **Session 1: Opening session**

AM Session Chairs: Ingrid Repins, George Kelly

- Workshop Opening Remarks —Chris Deline, [NREL \(8:30-8:45\)](#)
- Terabase Mechanized PV System Installation — Matt Campbell, [Terabase \(8:45-9:15\)](#)
- The American Solar Manufacturing Renaissance: Maintaining the Momentum —MJ Shiao, [American Clean Power \(9:15-9:45\)](#)
- PowerMark Prize Announcement —John Wohlgemuth, [PowerMark \(9:45-9:55\)](#)

Break: 9:55 AM

10:25 AM **Session 2: Field results - Extreme Weather**

Session Chairs: Will Hobbs, Brooke Stanislawski

- Assessing the Impacts of Extreme Weather Events on Photovoltaic Installations Using Remote Sensing Imagery —Kirsten Perry, [NREL \(10:25-10:45\)](#)
- Duke Energy's Extreme Weather Perspectives —Matt Pickett, [Duke Energy \(10:45-11:05\)](#)
- Survivability of Island PV Following Hurricane Beryl —Frank Oudheusden, [Azimuth Advisory Services \(11:05-11:25\)](#)
- Panel Discussion [\(11:25-11:45\)](#)

Lunch: 11:45 AM

Poster Session A: 12:45 PM

2:15 PM **Session 3: Issues from the Field**

Session Chairs: Robert Flottemesch, Sanjana Kartik

- Field Testing Methods and Results —Jim Rand, [Core Energy Works](#) (2:15-2:35)
- Typical Rates of Module Anomalies Found in IR Inspections —Nathan Brunner and Charlie Davies, [DNV and Raptor Maps](#) (2:35-2:55)
- Notes from the Trenches —Penny Ladner, [DNV](#) (2:55-3:15)
- Panel Discussion (3:15-3:35)

Break: 3:35 PM

4:00 PM **Session 4: Module Manufacturing**

Session Chairs: Teresa Barnes, Tristan Erion-Lorico

- US Manufacturing Overview —Teresa Barnes, [NREL](#) (4:00-4:05)
- Sensitivity of Material Selection for Glass-Backsheet Modules —Suchi Mitra, [Heliene](#) (4:05-4:20)
- An Update on Qcells' US Manufacturing and Reliability Testing —Max Kontopp, [QCells](#) (4:20-4:35)
- US Module Manufacturing and Hail Resistant Module Development —Hongbin Fang, [LONGi](#) (4:35-4:50)
- Panel Discussion (4:50-5:20)
- Awards from Poster Session A (5:20-5:30)

PVRW Mixer Sponsored by RETC, TÜV Rheinland, and VDE: 5:30 PM

Poster Session A

Tuesday, 4 March 2025

Notes: **DuraMAT** posters are indicated with **red** titles. Presenters are indicated in **bold type**.

- 001. *Dynamic mechanical compatibility of trackers and PV modules (DuraMAT)*, **C. O'Brien**
- 004. *Steady-state and Sequenced Accelerated Aging to Reveal Degradation Pathways and Inform IEC Testing Standards*, **K. Liu**, D.C. Miller, N. Bosco, J.M. Newkirk, R.H. Dauskardt
- 007. *Leveling up for big format bifacials*, **S. Ovaitt**, C. Deline, B. McDanold, J. Park, B. Sekulic, T. Silverman, E. Palmiotti
- 010. *Progress Towards a Universal PV Plug and Socket*, **M. Kempe**
- 013. *Recommendations and Limitations for Winter PV Capacity Tests*, **A. Dionigi**
- 016. *Forecasting glass resilience of large format modules*, **M. Springer**, T. Silverman, J. Newkirk, N. Bosco
- 019. *Critical Role of Incoming Quality in Domestic Module Manufacturing*, **P. Bhatt**
- 022. *Simulating Wind-Driven Physics and Instabilities in Single-Axis Trackers*, **E. Young**
- 025. *Field connectors – observations from current construction projects*, **R. Chatelain**, T. Deer

028. *Mapping PV degradation mechanisms and field performance by leveraging large language models*, **B. Li**, M. Springer, D. Jordan, A. Jain
031. *IEC 61724 Standard Overview*, **M. Gostein**
034. *Predicting Degradation Kinetics Occurring During Encapsulant Lifetime*, H. Dedmon, S. Kruse, J. Kustas, J. Braid, M. Chandross, **M. Wilson**
037. *De-Risking EPE Encapsulants: Modeling Polymer-Polymer Interfaces*, **H. Dedmon**, M. Wilson, E. Palmiotti
040. *Applying Geospatial Workflows with “PVDeg”*, **T. Ford**, S. Ovatt, M. Springer, M. Kempe
043. *New Cells, New Issues: Stress Tests for N-Type PV Module Designs*, **A. Sinha**, J.N. Jaubert, D.B. Kern, T. Karin
046. *Module breakage impacts on system availability*, **C. Helms**, N. de Vries
049. *Effect of Cell Cracks on Module Power Loss and Degradation: Modern Module Architectures*, **V. Parikh**
052. *Accelerated stress testing to deconvolute simultaneous-but-distinct degradation pathways under UV illumination*, **R. Wai**, X. Hanna, J. Newkirk, K. Terwilliger, S. Johnston, D. Miller, P. Hacke, D. Kern
055. *Root cause investigation of glass cracking in field-mounted solar modules*, **J. Karas**, R. Flottesmesch, V. Parikh
058. *Investigation of inner layer cracking in PPE backsheets*, **S. Mitterhofer**, Z. Li, A. Aiello, K. Jensen, X. Gu, M.D. Kempe, W. Hobbs
061. *Reliability Evaluation of High-Efficiency Double-Glass PV Modules*, **J.M. Kuitche**

064. *Failure modes in modern cell interconnects for PV modules*, **P. Hacke**, N. Bosco, J. Hartley, S. Uličná
067. *Updates to the Variational Auto-encoder for crack parametrization*, **N. Jost**, O. Sanghi, B. Byford, E. Cooper, B. Pierce, I. Deane, J. Braid
070. *Let's Not R-EPE-at Our Mistakes*, **M. Mirzokarimov**, D. Roberts, L. Schelhas, H. Dedmon, M. Wilson, J. Munro, L. Madenjian, M. Issa, **E. Palmiotti**
073. *Emerging Technique for Detecting Damage On Various Module Layouts*, **R.M. Smith**, D.J. Colvin, B.A. Thompson, C.J. West, E.M. Langlois
076. *Gridline wear-out depends on the regime of crack opening*, **S. Rabade**, N. Bosco
079. *Measuring the stress factors for PV back sheet degradation*, **A. Wesley**, S. Oviatt, M. Prilliman, J. Newkirk, R. Arnold, M. Springer, M. Kempe
082. *DuraMAT Data Hub Chat*, **R. White**, S. Zisman, A. Nag, D. Rager
085. *Strengthening PV Thin Glasses Using Salt Pastes*, **J. Rimsza**, J. Nance, K. Strong
088. *Encapsulants for screen-printed copper contacts*, T. Druffel, **D. Williams**, K. Elmer, E. Yenney, A. Nambo, R. Dharmadasa, P. Stradins, P. Hacke, W. Nemeth, S. Theingi, K. Kenney, J. Munro
091. *Steel module frames plus trackers equals cost savings*, **L.B. Ahsler**
094. *Development of version 1 of the National Climate Database (NCDB)*, **J. Yang**, M. Sengupta, A. Habte, Y. Xie, M. Bailey, D. Nychka, S. Bandyopadhyay

097. *Polysilicon issue of TOPCon bottom cells for perovskite/silicon tandem solar cell performance.*, **C. Lee**, J. Hyun, **H. Lee**, D. Kim
100. *Technoeconomic analysis (TEA) support*, **J. Zuboy**, B. Smith, M. Woodhouse
103. *Modeling Crystallization and Melting in EVA and Polyolefin Encapsulation to Augment Stress Predictions in Cracked PV Modules Over a 24-hour Period*, **K. Long**, K. Cundiff, J. Hartley
106. *Unscrambling combiner box SCADA tags using high frequency time series data*, **R. van Haaren**, M. Marosvari, H. Coleman, K. Rhee
109. *Comparative Dust Soiling Assessment for PV systems: Evaluating Multiple Methodologies*, **B. Pendleton**
112. *Distributed Strain Sensing of Solar PV Single-Axis Tracking System Under Dynamic Wind Loads*, **Y.J. Li**, H. Zhang, A. Chutani, P. Dice, G. Robinson, A.R. Dyreson, M.J. DeJong
115. *A Framework for the Multimodal Analysis of Photovoltaic (PV) Data*, **S.N. Venkat**, J. Raby, B. Thompson, D.J. Colvin, M. Liggett, K. Lu, M. Bolen, S. Johnston, D. Kern, G. Horner, K.O. Davis
118. *Outdoor Performance of n-type Modules With and Without Cell Cracks Over One Year*, **T. Karin**
121. *Silicon Module Recycling by High-Power Lasers*, P.K. Kanaujia, M. Owen-Bellini, H. Mirlletz, D.L. Young, **M.C. Gupta**
124. *A computationally derived framework for predicting probability of PV module glass breakage by hail impact*, J. Hartley, **S.J. DiGregorio**
127. *Walkable Solar Panels*, **D. Meakin**

AGENDA – Wednesday, 5 March 2025

Check-In / Breakfast: 7:30 am

8:30 AM **Session 5: Module Reliability Science**

Session Chairs: Ashley Gauling, Colin Sillerud

- Breaking the Trend: Are Retro PV Module Designs a Cost-Effective Solution to Glass Reliability? — Jennifer Braid, [SNL](#) (8:30-8:50)
- Spontaneous Glass Breakage in Glass-Glass Modules —Ellie Palmiotti, [NREL](#) (8:50-9:10)
- Novel temperable glass for improved performance in solar applications —Alex Mitchell, [Corning Incorporated](#) (9:10-9:30)
- Panel Discussion (9:30-9:50)

Break: 9:50 AM

10:20 AM **Session 6: Module reliability - UVID**

Session Chairs: Kaushik Roy Choudhury, Peter Hacke

- Accelerated UVID Testing and Comparison to Outdoor Testing —Archana Sinha, [PVEL](#) (10:20-10:40)
- UV + Damp Heat Induced Power Losses in Fielded Utility N-Type Si PV Modules —Ashley Gauling, [NREL](#) (10:40-11:00)
- Performance and Degradation of PV Encapsulants for UV Induced Degradation Study —Dennice Roberts, [NREL](#) (11:00-11:20)
- Panel Discussion (11:20-11:40)

Lunch: 11:40 AM

Poster Session B: 12:40 PM

2:10 PM **Session 7: PV System Insurance**

Session Chairs: Nick de Vries, Leah Holton

- PV Risks and the Insurance Landscape —Mike Perron and Sandy Calvert, [FM Global and Moore-McNeil](#) (2:10-2:30)
- NatCat Modeling and Resiliency Considerations for Solar Property Insurance —Nicole Thompson, [kWhAnalytics](#) (2:30-2:50)
- Models, PMLs, and Insurance Sublimits —Lauren Carroll-Allan, [CAC Specialty](#) (2:50-3:10)
- Panel Discussion (3:10-3:30)

Break: 3:30 PM

4:00 PM **Session 8: Inverters and BOS**

Session Chairs: Colleen O'Brien, Michael Bolen

- More than One Side to the Story: a Forensics Dive into PV Connector Failures —Laurie Burnham, [SNL](#) (4:00-4:20)
- Uncapped Photovoltaic Connectors - A Combined Field and Chamber Study Verifies and Elucidates the Degradation —Dave Miller, [NREL](#) (4:20-4:40)
- Nominal Operating IGBT Temperature (NOIT), A Metric for Establishing Reliable Inverter Operations —Nick deVries, [Silicon Ranch](#) (4:40-5:00)
- Panel discussion (5:00-5:20)
- Awards from Poster Session B (5:20-5:30)

End of Wednesday Sessions

Poster Session B

Wednesday, 5 March 2025

Notes: Presenter names are in **bold type**.

- 002. *Lessons learned from solar PV energy yield assessment validation*, **E. Giacchino**, E. Soderlund, E. DeCristofaro, J. Silhavy, M. Sleiman
- 005. *Comparison of degradation due to outdoor exposure and accelerated stress testing in perovskite solar cells*, **T. Tayagaki**, S. Hirooka, H. Kobayashi, K. Yamamoto, T.N. Murakami, M. Yoshita
- 008. *IEC TC 82 Status*, **G. Kelly**
- 011. *A New Framework for Standardized Assessments of Risk Severity for Issues in Operating Assets*, **D. Penalva**
- 014. *2000V PV System LCOE Benefit Analysis*, **B. Frazier**
- 017. *Selecting bankable resource data for solar energy assessments*, **C. Bordonaro**, P. Metaut, A. Berlinsky, T. Romshek
- 020. *IEC Standard Aging Sequences for Adhesion in PV Modules*, **R. Arnold**, D. Miller, A. Jackson
- 023. *Going beyond stuck trackers: how well do your trackers work?*, **W. Hobbs**, K. Anderson
- 026. *Evaluation of front eave loads caused by snow accumulation on PV modules*, **T. Tanahashi**, T. Chiba, S. Adachi, H. Arakawa, Y. Tsuno, K. Ikeda, T. Oozeki

- 029.** *Hail Damage - A Direct Comparison of Glass-Polymer and Glass-Glass Modules, A. Hendricks*
- 032.** *Analyzing the Mechanical Resilience of PV Modules with Different Frame Designs, T. Billie*
- 035.** *Field Testing of PID-p Susceptible Bifacial PERC Modules: Impact of Light, Voltage and Module History, C. Molto, D.J. Colvin, R. Smith, P. Hacke, F. Li, G. TamizhMani, J. Oh, H. Seigneur*
- 038.** *Effect of Salt Mist and DH Preconditioning on PID for Mono and Bi-facial half cell PERC modules, C. Bainier, J. Cano-Garcia, G. Kaur, E. Kam-Lum*
- 041.** *Encapsulation selection for TOPCon cells with LECO, J. Munro, Y. Li, L. Madenjian, M. Issa, P. Brigandi*
- 044.** *Investigating Temperature Uniformity and Accuracy in PV Module Lamination: A Verification Study, A. Jackson, R.L. Arnold*
- 047.** *Wind-Induced Dynamic Loading and PV Module Frame Fatigue Crack Initiation and Propagation, F. Oudheusden, C. Needham, J. Ness*
- 050.** *Comparing Outdoor and Indoor I-V Curves on Bifacial PERC PV Modules Experiencing Polarization-Type Potential-Induced Degradation (PID-p), D. Colvin, C. Molto, R. Smith, M. Matam, P. Hacke, F. Li, G. TamizhMani, H. Seigneur*
- 053.** *Hail Kinetic Energy damage thresholds on large scale PV panels, J. Carl*

- 056.** *Wind-Induced Dynamic Loading and PV Module Frame Fatigue Crack Initiation and Propagation*, F. Oudheusden, **C. Needham**, J. Ness
- 059.** *Module Mounting Design Qualification Challenges*, **J. Sorensen**, S. Lokanath
- 062.** *Incentivizing reliable PV through Revenue Put insurance premium reduction*, **H. Rasmussen**, A. Shinn
- 065.** *Main factors contributing to the underperformance of solar modules in Colombia: high power tolerances and degradation due to inadequate cleaning procedures and improper handling of solar modules*, **R. Naranjo**, L.F.R. Chavez, J. Barrera, K. Visbal, J.S. Conejo
- 068.** *Spectroscopic analysis of water in PV modules: from water detection to water mapping in polymers*, **C. Buerhop-Lutz**, O. Stroyuk, O. Mashkov, S. Vorstoffel, O. Ghaffari, I. Peters
- 071.** *Filtering of Operational Data for Performance Issue Breakdowns*, **B. Pereyra**
- 074.** *A New Vulnerability in Bypass Diodes Under High Temperature, Long Term Operation in Reverse Bias (HTRB)*, K. Rane, **N. Shiradkar**
- 077.** *Pre-failure signatures of solar pv inverters: a pathway for improving inverter reliability*, **K. Buch**, R. Dhakal, W. Li
- 080.** *Unraveling the Degradation of SHJ Solar Cells with 82% Less Silver*, **M.W. Martinez-Szewczyk**, O.J. Hildreth, M.I. Bertoni
- 083.** *Classification of Defects in Thin film Silicon Modules for Hotspot Formation Using EL Imaging*, **S.K. Pullayikody**, P.

Sluijs, N. Zeiher, V. Venkatesh, G. Mathiazhagan, R. Vasudevan, A. Smets

- 086.** *Rapid Screening of SHJ and TOPCon Solar Cells for UV Degradation*, **J.D. Zubieta Sempertegui**, N. Moser-Mancewicz, J.G. Gezelter, S.R. Buffone, S. Cheng, M. Kamperai, N.G. Tshuma, G. Thomas, C. Biauou, J.L. Bryan, K.O. Davis, M.I. Bertoni, L.S. Bruckman, I.T. Martin
- 089.** *PV Equipment Failures: Patterns and Predictions from O&M log data*, **C. Sotero**
- 092.** *Best practices for pv project hail recovery*, **S. Ressler**
- 095.** *An evaluation of operational PV project availability performance*, **K. Mullaney**, A. Chang, B. Grenko
- 098.** *Evaluating the Degradation of Silicon Heterojunction Devices Through Chemical Analysis and Computational Simulation*, **N. Moser-Mancewicz**, J. Ochoa, M. Martinez-Szewczyk, T. Bantle, D. Kern, D. Jordan, S. Johnston, J. Medvedeva, M. Bertoni
- 101.** *Reliable design: establishing a feedback loop between real world and design conditions*, **D. Herron**, A. Lindsay, M. Toro
- 104.** *Module Due Diligence for Procurement by a Developer*, **S.K.L. Xu**
- 107.** *Field Demo Sneak Peak: Side-by-Side Comparison of Hail Damage Mitigation*, **K. Reiter**, M. Bolen, D. Doerner
- 110.** *Fluctuating PV module wind loads*, **Y. Fewless**
- 113.** *Anomaly detection in PV fleet data via interpretable machine learning*, **B. Meyers**, A. Dufour, G. Ogut

116. *Comparative Dust Soiling Assessment for PV systems: Evaluating Multiple Methodologies*, **S. Li**, B. Pendleton, T. Müller
119. *MANTIS: from multiscale analysis to next generation thin film module inspection systems*, **G. Horner**
122. *Inline, Non-contact EL Scanner for Module Inspection and Quality Control*, **K. Lu**, E. Ignatovich, P. Miller, L. Vasilyev, A. Dirriwachter, J. Williams, T. Frank, E. Schneller
125. *Development of meaningful, low-cost Solar PV module and mounting fastener stack testing equipment and procedures*, **G. Robinson**

AGENDA – Thursday, 6 March 2025

Check-In / Breakfast: 7:30 am

8:30 AM

Session 9: Next-Gen PV Reliability

Session Chairs: David Young, Silvana Ovaitt

- An Update on Perovskites Performance and Reliability Based on PACT's Testing — Michael Deceglie and Tim Silverman, [NREL](#) (8:30-8:50)
- Qualification Test Standards for Floating PV — Mauro Pravettoni, [TII - Abu Dhabi](#) (8:50-9:10)
- Reliability of TOPCon Solar Cells: Understanding Degradation and Recovery of Poly-Si/SiOx Passivating Contacts — Aditya Ratnapagol, [NREL](#) (9:10-9:30)
- UVID Initiates Metastability in the Dark: How to Properly Measure n-Type Modules — Todd Karin, [PVEL](#) (9:30-9:50)

Break: 9:50 AM

10:20 AM

Session 10: Trackers + hail

Session Chairs: Michael Deceglie, Sumanth Lokanath

- Effectiveness of Hail Stow in Photovoltaic Systems — Jon Previtali, [VDE](#) (10:20-10:40)
- Full-scale High Speed Wind Testing of Trackers — David Kresse, [NexTracker](#) (10:40-11:00)
- Fatigue Loading of Purlins for Single Axis Solar Trackers — Nat Healy and Scott Van Pelt, [GameChange Solar](#) (11:00-11:20)
- Panel Discussion (11:20-11:40)

Lunch: 11:40 AM

Poster Session C: 12:40 PM

2:10 PM

Session 11: System Analysis & Modeling

Session Chairs: Elsa Kam-Lum, Steven DiGregorio

- Repowering and Decommissioning Cost Model — Cara Libby, [EPRI](#) (2:10-2:30)
- Is Your Project Underperformance Caused by Unreliable Trackers? — Dan Chawla, [Natural power](#) (2:30-2:50)
- Energy at the End of the World: Renewable System Design for the South Pole — Amy Bender, [ANL](#) (2:50-3:10)

Break: 3:10 PM

3:40 PM

Session 12: Manufacturing and circularity

Session Chairs: Michael Kempe, Gernot Oreski

- Glass and Silicon Recovery from Solar Modules Using Laser Processing — Mool Gupta, [UVA](#) (3:40-4:00)
- Uncovering Reliability Risks in Advanced PV Modules: A Data-Driven Approach for Industry Guidelines — Mahyar Nezhad, [Kiwa](#) (4:00-4:20)
- Module Warranty Backstop by Munich Re — Ron Sastrawan, [Munich RE](#) (4:20-4:40)
- Panel Discussion (4:40-5:00)
- Awards from Poster Session C (5:00-5:10)
- Workshop Closing Remarks — Chris Deline, [NREL](#) (5:10-5:20)

Workshop Closes

Poster Session C

Thursday, 6 March 2025

Notes: Presenter names are in **bold type**.

- 003.** *Developing a UV Spot Test for Years of Equivalent Exposure, I. Repins, T. Silverman, E. Palmiotti, M. Deceglie, A. Gauling*
- 006.** *Residual Effects of Long-Term Vegetation Shading on a Ground Mount PV Array, R. Stromberg*
- 009.** *GroundWork® Eyewitness™ Hail Monitoring and Event Reporting Service: A summary of hail data collected from a dense network of hail monitoring devices, T. Morrison, J. Chard, A. Bryan, A. Will*
- 012.** *What is a polyolefin? A critical overview of ethylene copolymers as PV module encapsulants, G. Oreski, C. Barretta, P. Christöfl, P. Gebhardt, K.A. Weiss, D. Miller, M. Kempe, S. Ulicna, A. Virtuani, H. Li, B. Habersberger, J. Munro, K. Proost, M. Kühne*
- 015.** *Analysis the Performance of PV Modules with Different Failures under Longtime Outdoor Condition, B. Wang*
- 018.** *Low-cost daytime electroluminescence imaging, A.M. Gabor, R. Landy, J.D. Friedl*
- 021.** *Screening early field failure in metal halide perovskite modules through stress testing, N.P. Irvin, S. Uličná, J. Schall, D.B. Kern, T.J. Silverman, M. Deceglie, C. Fei, X.*

Shi, R.L. Arnold, B. McDanold, J. Parker, J. Huang, J.J. Berry, J.S. Stein, L.T. Schelhas

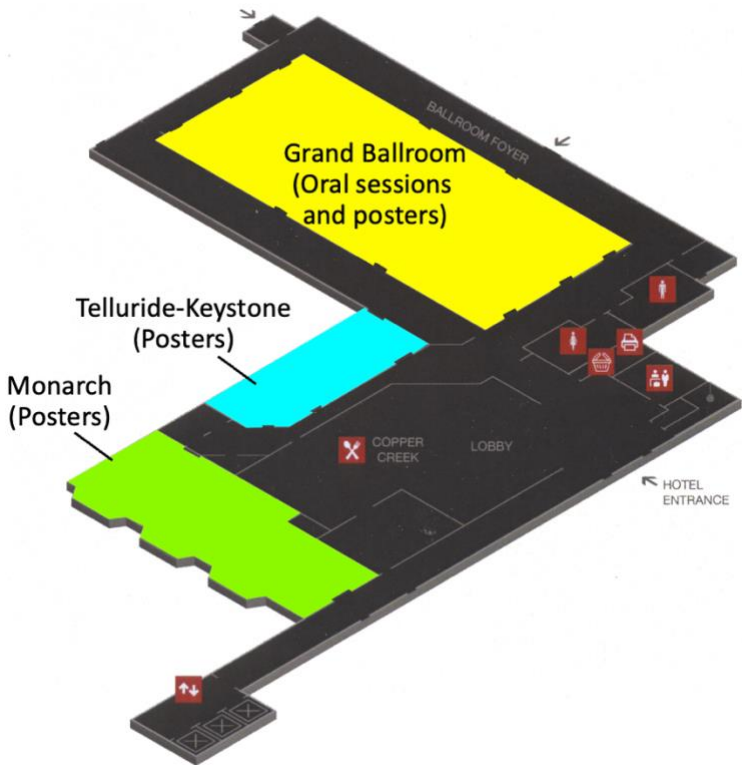
- 024.** *A Tool to Create High-Fidelity and Adaptive Finite Element Model for PV Systems*, **X. He**, W. Arsalane, M.P. Shah
- 027.** *From Hail to Hardware: A Comprehensive Risk Assessment for Solar Asset Resilience*, **R. Fagan**
- 030.** *PV Standards Activities of IEC*, **J. Wohlgemuth**
- 033.** *Soiling loss modeling in regions across the US*, **A. Berlinsky**, P. Metaut, C. Bordonaro, T. Romshek
- 036.** *Adaptable Silicon Solar Cell Metrology in the Age of the Inflation Reduction Act*, **H. Wilterdink**, A.B. Karpen, N. Degenhart, L. Bruno, W. Dobson, R. Sinton
- 039.** *X-Ray Imaging as a Tool for Understanding Photovoltaic Connector Failures*, **S. DiGregorio**, L. Burnham, B. King
- 042.** *Performance evaluation of a Brazil research floating PV power plant*, D.A. Cassini, A.S.A. Diniz, V.C. Santana, D.S. Braga, **L.L. Kazmerski**
- 045.** *Module Mounting Design Qualification Challenges*, **S. Lokanath**, J. Sorensen
- 048.** *17 Years of Investigating Fires in PV Systems: A Synopsis of Experience*, **B. Brooks**
- 051.** *Module and tracker deformation*, **G. Jago**

- 054.** *Low-Cost Vibrational Sensors for in-situ High-wind Detection and Analysis*, **D.C. Jordan**, R. Smith, B. Sekulic, H. Seigneur
- 057.** *Characterizing PV Modules using Paralleled MOSFET Loads with Active Feedback*, A. Mapes, **W. Sekulic**
- 060.** *Updates on PV Bio-Soiling in the Southeast U.S.*, **M. Muller**, A. Rivera, M. Valerino
- 063.** *A Comprehensive Test-to-Failure Protocol for PV Module Hail Damage: Integrating Weibull Analysis and Impact Mechanics*, **T. DeWolf-Moura**, S.A. Far, P. Bostock, R. Fritz, A. Hernandez, M. Kaur, C. Kedir, M. Pilliod, J. Previtali, J.R. Reynolds
- 066.** *Evaluation of Durability and Cracking Propensity of Emerging PV Backsheets after Accelerated Laboratory Weathering*, **X. Gu**, S. Mitterhofer, Z. Li, A. Aiello, A. Aiello, K. Jensen, H.H. Hsien, A. Kadri, L. Ji
- 069.** *The road to perovskite bankability*, **F. Dross**, T. Krajewski, L. Crowe
- 072.** *Reliable Module Design Cost Reductions for Vertical Bifacial PV*, **J. McCabe**
- 075.** *Assessing risk of glass failure during due diligence*, **B. Weinschenker**
- 078.** *Climate Resilience for Inverter of Utility Scale PV Plant: Strategies and Risk Assessment*, **R. Dhakal**

- 081.** *Watts the Hype? AI's Role in Powering Solar Reliability,* **M. Mousou**
- 084.** *Investigating oxygen barrier properties of desiccated edge sealants for protection of perovskite solar modules,* **L. Postak**
- 087.** *Edge sealed modules for improved perovskite stability in 1000 hours of damp heat testing,* **R. Ruhle**, D. Durney, D. McDougall, L. Laxmi, V. Chityala, D. Kabra, W. Sampath
- 090.** *Edge sealed photovoltaic modules: matching thermal and optical properties of traditional encapsulation,* **D. Durney**, R. Ruhle, L. Maple, S. Johnston, D. Kern, W. Sampath
- 093.** *Data-driven insights into solar production performance,* **P. Hwang**
- 096.** *A review of modeled performance of PAN files in PVsyst[®],* **E. Westphal**
- 099.** *Recommendations for research-scale min-module vacuum laminations,* **M. Owen-Bellini**
- 102.** *Diffuse Stow: Maximizing Potential in Photovoltaic Tracking,* **R.A. Borea**, S. Ovatt, V. Cirimele, F. Melino, G. Maugeri, T. Ford
- 105.** *Observation of High PV Durability Under Harsh Sequential Stress,* **D. Kern**

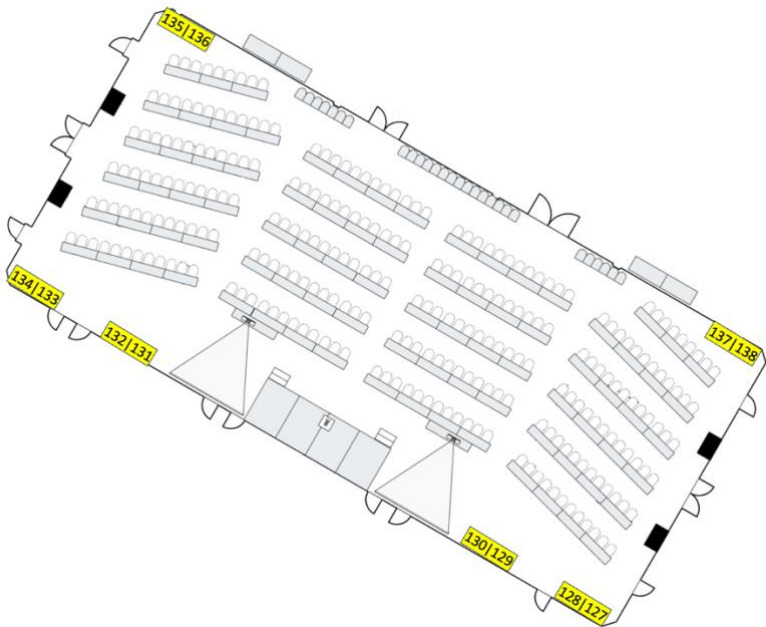
- 108.** *Sustainable Solar Photovoltaics: Utilising operational characteristics for end-of-life management*, **A.P. Joshi**
- 111.** *Heat and light: reliability testing of perovskite modules*, P. Pasmans, S. Roest, **J. Veloza**
- 114.** *Enhancing performance of solar trackers through wind nowcasting and aerodynamic mitigations*, P. Fatehi, M. Elnahla, Y. Guo, T. Wu, **J. Elsworth**, S. Dana
- 117.** *Photovoltaic module backsheet burns attributed to misaligned busbar wires*, **S. Johnston**
- 120.** *Assessment of frame sealant property to module glass breakage via beam mechanics theory*, **Y. Lai**, G. Beaucarne, V. Hayez
- 123.** *The Transferability of Silicon Photovoltaic Multiscale Diagnostics to Cadmium Telluride Technologies*, **M. Liggett**, D.J. Colvin, S.N. Venkat, G. Horner, M. Bolen, S. Johnston, D. Kern, K.O. Davis
- 126.** *Off track: performance impacts of PV tracker mishaps*, **S. MacAlpine**

Map of Presentation Rooms



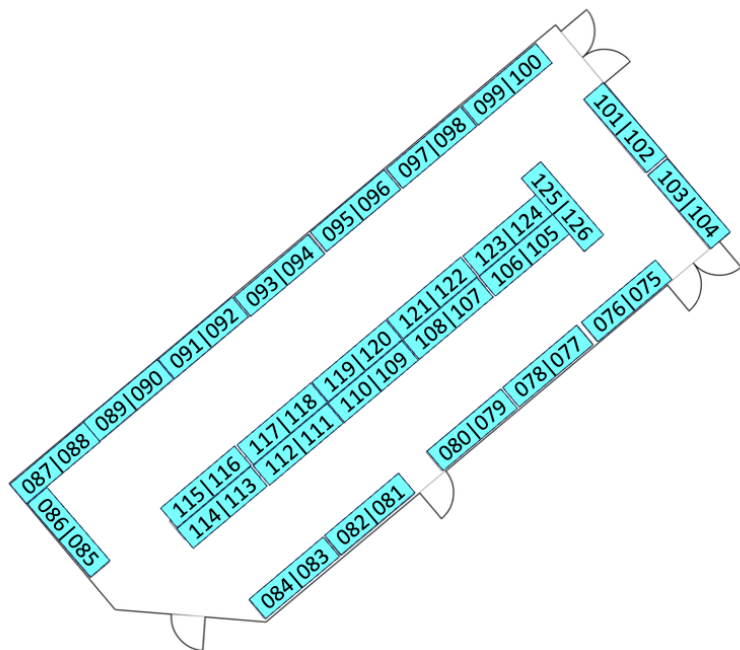
Map of Presentation Rooms

Grand Ballroom Layout
(with poster numbers in yellow)



Poster Room Layouts

Telluride-Keystone Room



Poster Room Layouts

Monarch Room

