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# FIRST ANNUAL SANDIA-EPRI CONNECTOR RELIABILITY WORKSHOP

Laurie Burnham,  
Workshop Chair

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# WORKSHOP AGENDA

- Session 1. View from the Trenches
- Session 2. Failure Mechanisms: Field and Lab Findings
- Session 3. Economic Impacts
- Session 4. Looking Forward



# ACKNOWLEDGMENTS



- US DOE Solar Energy Technologies Office
  - This work is supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Solar Energy Technologies Office Award #s 38531 and 39035.
- ELECTRIC POWER RESEARCH INSTITUTE
  - Wayne Li, Robert Flottemesch, Virah Pirakh
  - Julie Bost

# A LITTLE HISTORY: SANDIA'S RESEARCH ON CONNECTORS



*Connector Reliability Across the US Solar Sector (FY22-24)*

US DOE Solar Energy Technologies Office (SETO) funded investigation; led by Sandia; NREL and EPRI are partners.

## Four-Part Study

**Field Inspections**

Determine the extent of the problem and correlate field failures with site metadata, installation practices, connector design

**Materials Characterization  
and Forensics**

Conduct forensics analysis on fielded and COTS connectors to determine root causes of failure

**Techno-economic Analysis**

Calculate forensics analysis on fielded and COTS connectors to determine root causes of failure

**Best Practices & Knowledge  
Transfer**

Inform best practices; new designs; codes and standards

NREL HAS A PARALLER EFFORT FOCUSED ON ACCELERATED TESTING (Dave Miller, PI)





# INDUSTRY OUTREACH



**Primary objective:**

Solicit data on situational awareness and known failures.

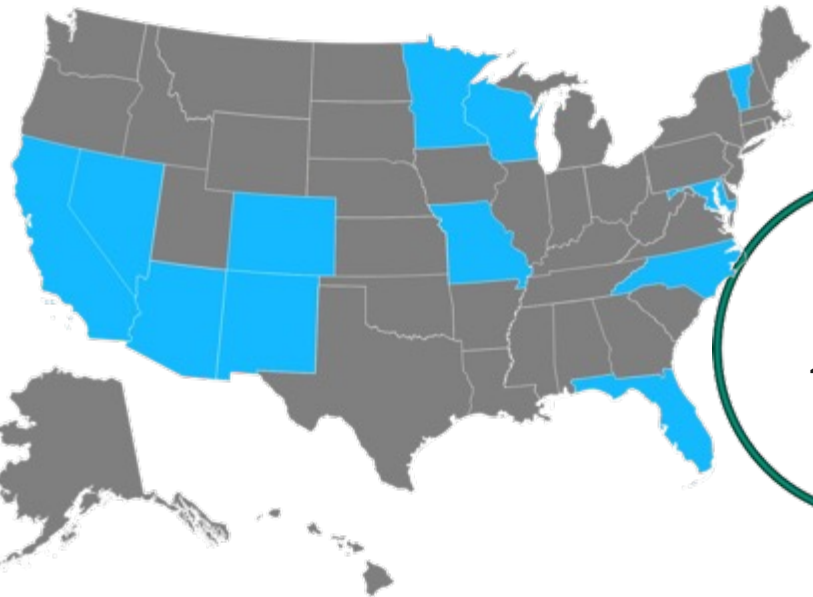
**Secondary objective:**

Facilitate site access for *in situ* inspections and forensics analyses.

**Distribution:**

Asset owners, EPCs, O&M cos, insurers, risk management cos, SMEs

**Terms & Conditions:** Data confidentiality



High rate of return = 60%/88%

50% of top ten EPCs

90% agreed to site inspections

Sandia National Laboratories

## Sandia PV Connector Questionnaire

**Purpose**  
This questionnaire will gather information to support a research study on fielded photovoltaic (PV) connectors across the United States. The study is led by Sandia National Laboratories (Sandia) and is funded in part or in whole by the US Department of Energy Solar Energy Technology Office, under Award #38531.

This study aims to determine:

- 1) the extent of connector degradation across representative commercial- and utility-scale installations
- 2) the diversity of failure mechanisms
- 3) the root causes of those failures

The overall objective is to collect data that can help improve the performance and reliability of connectors, reduce their operational risk to PV plants, lower Operation & Maintenance costs, and help build a more robust solar infrastructure in the US. More information about the study can be found at <https://energy.sandia.gov/programs/renewable-energy/photovoltaics/>.

**Your Contributions**  
We are reaching out because industry input is critical to ensuring an impactful study. Your firsthand experiences and observations are extremely valuable to understanding this topic in more depth, and your willingness to complete this survey is much appreciated.

**Data Management**  
All responses will be treated as confidential. Data that appears in reports or publications of any kind will be aggregated, anonymized, and scrubbed of all ownership or site-specific identifying information.





# LESSONS LEARNED TO DATE



PV connectors are:

- Critical to PV plant efficiency and a leading cause of plant under-performance
- Numerically the largest BoS component at PV power plants (many points of failure)
- Easy to get wrong
- Of unknown lifetime
- Responsible for significant economic losses



# SANDIA'S RESEARCH ON CONNECTORS, CON'T.



## National Lab Center for Power-Transfer-Chain Reliability (FY25-27)

- Identify and quantify degradation and failure occurrences in the field
- Conduct experiments at Sandia's outside research facility and at NREL's accelerated-test lab
- Expand our economic analysis and risk assessment studies
- Create a National Lab Center for information sharing, including early failure warnings, best practices, etc.

# WORKSHOP OBJECTIVES

- Break down barriers to information-sharing
- Build a stakeholder community with diverse opinions and perspectives
- Solicit feedback to inform Sandia's research efforts
- Increase awareness (e.g., capture highlights in a proceedings paper)
- Propose ideas for next year's workshop





# RULES OF ENGAGEMENT

## DO:

- Ask questions
- Contribute commentary
- Provide good feedback

## DON'T:

- Take photos
- Market your business or product
- Dominate the discussion

## LOOK FOR:

- Presentations on our project website:  
[energy.sandia.gov/pvconnectors](http://energy.sandia.gov/pvconnectors)



QUESTIONS?

[lburnha@sandia.gov](mailto:lburnha@sandia.gov)