



### **Company Information**

<b>Company Name</b>	<i>Electric Power Research Institute</i>	<b>Date Submitted</b>	<i>11/08/2024</i>
<b>Project Title</b>	<i>Flash Tester Learning and Correlation Analysis for Solar PV Modules: Bridging Field and Lab Testing (EPRI_FLASH)</i>	<b>Planned Starting Semester</b>	<i>Spring 2025</i>

### **Senior Design Project Description**

#### **Personnel**

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

<b>Discipline</b>	<b>Number</b>	<b>Discipline</b>	<b>Number</b>
Mechanical	3	Electrical	2 or 3
Computer		Systems	0-1

#### **Company and Project Overview:**

EPRI is an independent non-profit energy research, development, and deployment organization, with three specialized labs. EPRI collaborates with scientists, engineers, government, and experts from academia and industry to shape and drive technology advancement by pushing the frontier of innovation from concept, pilot, operation to end-of-life.

The institute's work is funded by hundreds of organizations around the world, including the energy sector, academia, and government. Organizations who engage in EPRI research, development, and demonstration programs have unique opportunities to:

- Identify and solve critical and emerging industry issues.
- Stay at the forefront of technology innovation.
- Gain access to a comprehensive, timely RD&D portfolio.
- Collaborate and network with industry peers through advisory councils and committees.
- Implement technology through the support of our researchers and technical advisors.
- Reduce future investment risks.
- Inform policies with objective, science-based findings, and facts.

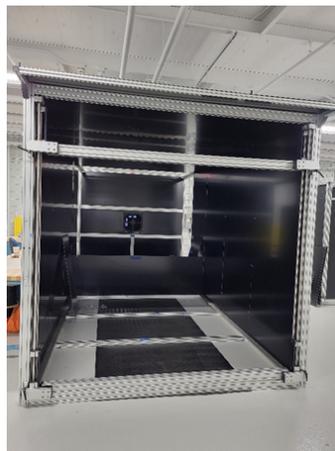


EPRI members help inform the development of EPRI's annual research portfolio, identify critical and emerging electricity industry issues, and support the application and technology transfer of EPRI's research and development.

With the growing demand for reliable solar energy, PV utilities are prioritizing quality assurance to ensure long-term performance of their modules. Flash testing, used to assess module efficiency under lab conditions, often shows discrepancies when compared to real-world results due to environmental variations. During a flash test the PV module is exposed to a short (1ms to 30 ms), bright (100 mW per sq. cm) flash of light from a xenon filled arc lamp. The output spectrum of this lamp is as close to the spectrum of the sun as possible. The output is collected by a computer and the data is compared to an exactly calibrated reference solar module. The reference data is geared to the power output calibrated to standard solar irradiation. The results of the flash test are compared to the data specifications of the PV module type which - in abbreviated form - are printed on the label on the module's back. EPRI has a flash tester from PASAN, a Swiss based PV modules and cells testing equipment company as shown in figure:



Flash Tester Assembly



Dark Room for Flash Testing

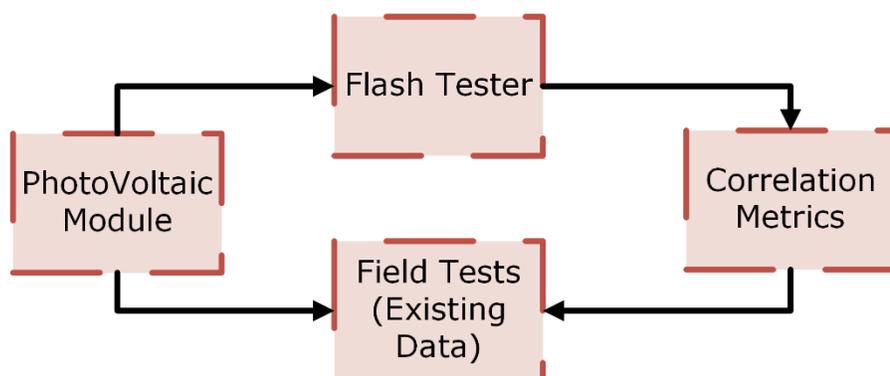


Control Unit

This project aims to bridge this gap (Specified performance compared to actual calibrated performance) by implementing a flash tester for PV modules, initially evaluating its capabilities and then correlating lab results with field data. By improving the predictive accuracy of flash testing, this study provides utilities with valuable insights to optimize performance, reduce maintenance costs, and enhance the reliability of solar installations. This Solar Flash Tester Demo Project provides an excellent opportunity for UNCC senior design students to work on an industry-relevant problem that aligns with ongoing research and development efforts at EPRI. The project will allow students to gain hands-on experience in engineering design, system integration, and testing, while contributing to the advancement of solar technology.

**Project Requirements:**

- **Project Focus:** Installation and evaluation of a flash tester specifically for solar PV modules, focusing on understanding initial capabilities and applications.
- **Phase 1 – Initial Learning:** Installation, calibration, and foundational insights on using the flash tester effectively in PV module testing.
  - Familiarize with the individual components of the flash tester, including the optical system, and electrical measurement devices.
  - Learn how to assemble the flash tester, ensuring proper integration of components for safe and effective operation.
  - Understand the physical setup and alignment of the system to simulate sunlight accurately.
  - Learn how to interface the hardware with the data acquisition system and ensure data is properly collected and recorded during testing.
  - At the end of the phase 1 – team will install flash tester in UNCC laboratory if practical or possible continue the work in EPRI labs.
- **Phase 2 – Correlation Analysis:** Comparative analysis between laboratory flash test data and field performance data of PV modules.
  - This phase aims to address the variability between controlled laboratory environments and real-world outdoor conditions, which can significantly impact the IV-traces obtained from the lab environment and field environment.
  - Some PV modules will be tested under the lab’s-controlled environment and the data from the same module will be compared against the field data to check the variance of the lab-based results and field-based results.
  - **Correlation Metrics:** Key metrics—such as power output, efficiency, and degradation rates—will be used to quantify the alignment (or misalignment) between lab and field results.
  - This quantification of field and laboratory data provides insights into how lab-based analyses—primarily conducted by manufacturers—can be interpreted in the context of field data, improving PV plant characterization.



1. How does the Lab tests differs from the field?
2. Can we relate them using quantifiable matrices?



### **Expected Deliverables/Results:**

- **Solar Flash Tester System:**
  - Fully assembled flash tester with integrated components.
  - Test and calibration documentation for the flash tester.
- **Test Data and Analysis:**
  - Complete data sets for each tested PV module, showing performance (IV curve) under standard test conditions.
  - A comparison of test results against the module manufacturer's specifications.
  - Correlation Metrics which may be formed using the manufacturer specific data.
- **Final Presentation and Report:**
  - A comprehensive presentation that demonstrates the design, operation, and results of the project.
  - A detailed project report that includes design rationale, test results, and potential improvements for future versions of the tester.
- Weekly updates provided to project sponsor with virtual or in-person meetings supported as desired by the sponsor.

### **Disposition of Deliverables at the End of the Project:**

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

### **List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):**

- Eagerness and motivation to continuously learn and improve throughout the project.
- Transparent, honest, and consistent communication and collaboration with the project team
- **Mechanical Engineering:** Knowledge of system design, integration of components, engineering drawings and basic mechanical assembly.
- **Electrical Engineering:** Experience with electrical testing, power measurement, and data acquisition.
- **Systems Engineering:** Experience with integrating hardware and software, system testing,



and troubleshooting. SEGR 4141

- Ability to travel to EPRI's Charlotte campus for frequent testing in their labs