



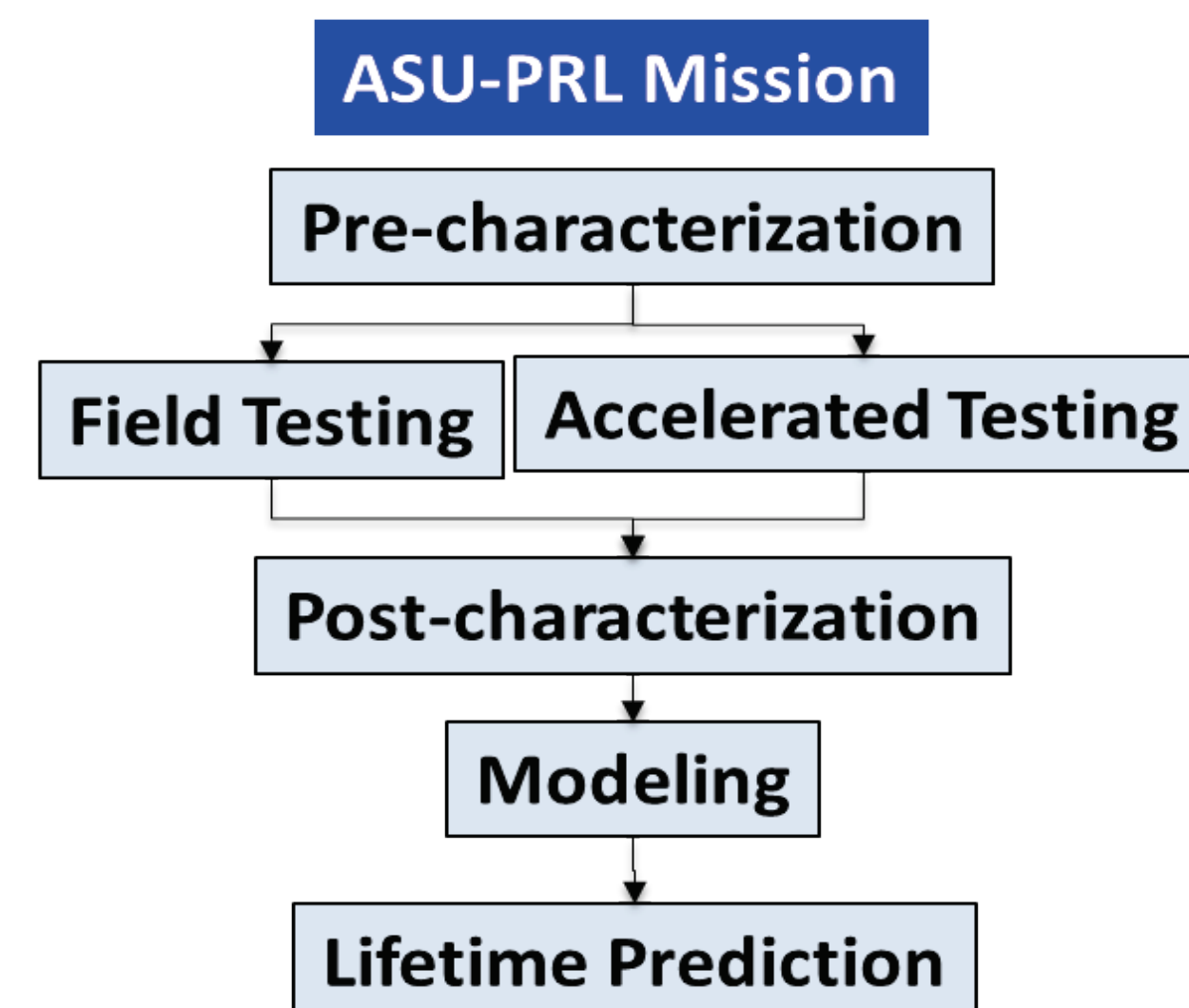
ASU-Photovoltaic Reliability Laboratory (ASU-PRL) Capabilities, Expertise and Durability Publications



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1. Introduction

ASU-PRL has more than 20 years of track record to secure and successfully execute durability and reliability projects funded by DOE, NREL, Sandia, EPRI, electric utility companies and private companies. ASU-PRL has over 20 years of reliability testing expertise and capabilities to perform accelerated tests, to perform outdoor field tests, to characterize modules, cells and materials, and to develop stress and statistical models predicting lifetime of PV modules.



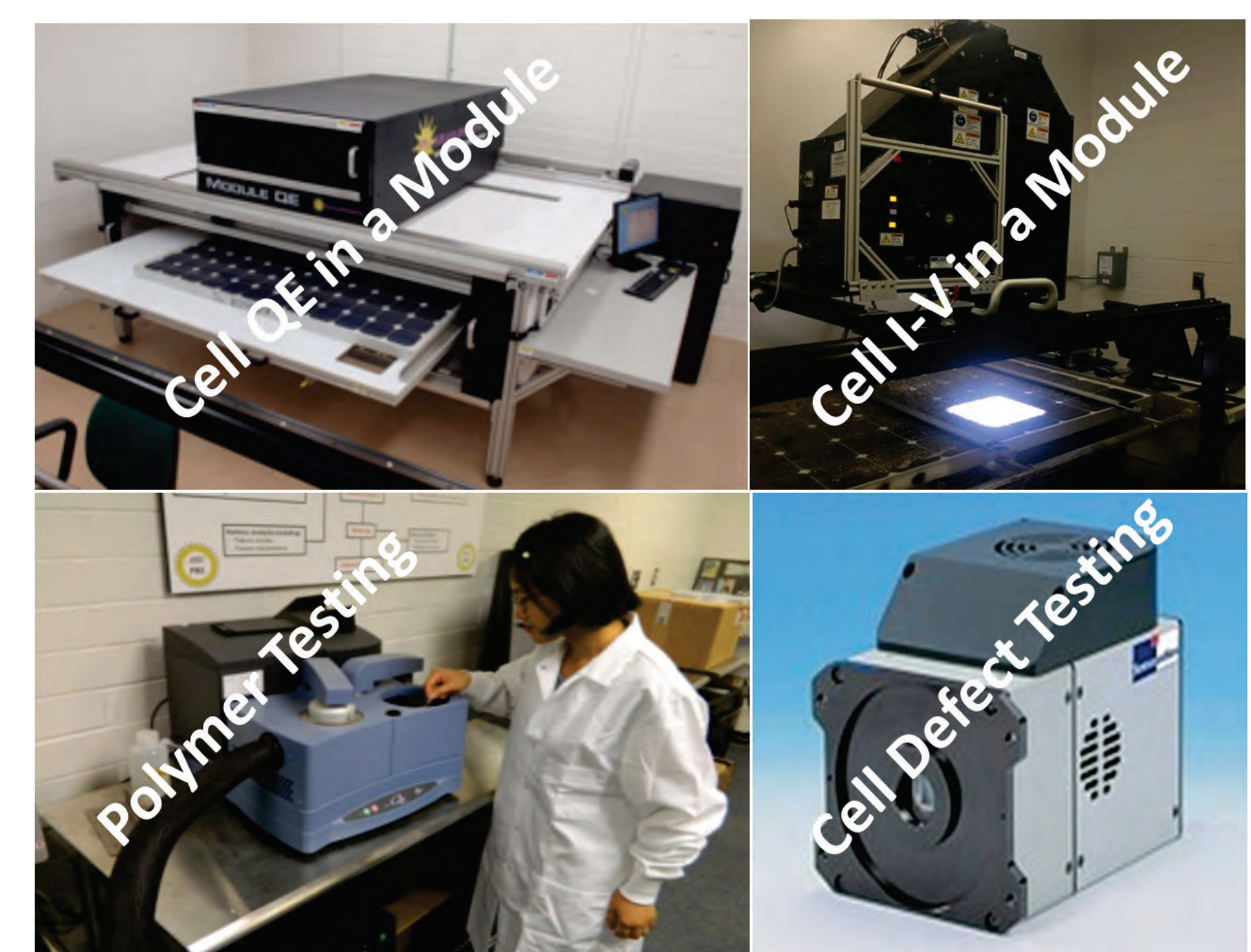
2. List of Durability and Reliability Capabilities

2.1 ASU-PRL Outdoor Characterization & Testing



- I-V curves
- Soiling loss and cleaning tests
- Handheld reflectance/transmittance
- EL & IR imaging
- Megger, diode and circuit tests
- 2-axis; 1-axis; mock rooftop
- Module level power electronics
- Handheld FTIR
- Angle of incidence
- Power quality analysis
- Weather station etc.

2.2 ASU-PRL Indoor Characterization & Testing



- Cell QE at the module cables
- Cell IV in a module
- Indoor soiling stations
- DSC, TGA, FTIR, WVTR
- Dark I-V (cell and module)
- Module laminator and taber/stringer
- Dry hipot and wet-resistance testers
- Four-probe resistance tester
- Module component extraction
- Universal mechanical/peel tester
- Thermal conductivity tester
- Electroluminescence

2.3 ASU-PRL Accelerated Testing and Modeling



- Walk-in environmental chambers
- Walk-in UV chamber
- UV weathering chamber
- Module PID test station
- Cell PID test station
- Static temperature ovens
- Physical modeling
- Statistical modeling: Full suite of ReliaSoft software, Pvsyst, Minitab, Tableau, SAS, JMP, MATLAB and OriginPro.

3. Durability and Reliability Expertise

- Over 30 years of experience in solar PV cell and module research
- Over 20 years of experience in PV module accelerated test research
- Over 7 years of experience in statistical and physical modeling of PV module durability
- Extensive experience in certification testing of PV modules per national and international standards for performance, qualification and safety
- Participation in national and international standards development activities and committees
- Extensive experience in training the testing and research personnel
- In the past four years alone, ASU-PRL has published more than 40 papers in the peer-reviewed photovoltaic conferences and journals, and most of these papers are related to PV reliability and durability
- Development of risk priority number (RPN) for each defect observed in the PV plants through a streamlined statistical approach
- Degradation rate determination using metered kWh data and weather data through the use of statistical approaches and statistical tools
- Degradation rate determination using accelerated test data and weather data
- Designing and building different types of outdoor soiling loss monitoring stations depending on the goals of the individual projects
- Development of different types of indoor soil deposition stations
- Extensive experience in PID research
- Calibration and troubleshooting of weather stations
- Thermal performance evaluation of PV modules on open-racks, rooftops and power plants
- Encapsulant degradation level determination using image processing techniques
- Durability and reliability evaluation of module level power electronics (MLPE)
- Recycling of PV modules: Toxicity characteristic leaching procedure (TCLP) development for PV modules
- Fabrication of PV coupons and modules

4. Near-term and Long-term Usefulness of ASU-PRL

Near term usefulness of ASU-PRL:

- Field evaluation using statistical approaches for bankability and financial risk evaluation of PV power plants
- Degradation rate determination using accelerated test data and weather data
- Degradation rate determination using metered kWh data and weather data
- Key accelerated testing of newly packaged PV modules before the modules are submitted to certification testing with certification labs;
- Key accelerated testing of new packaging materials to be included in the new or existing design of PV modules;
- Characterization of new PV modules and module materials for various issues including LID, PID, encapsulant browning, QE loss, soiling loss, AOI loss;

Long term usefulness of ASU-PRL:

- Lifetime prediction of packaging materials and PV modules;
- Reducing warranty claims;
- Passively lowering the operating temperatures of the modules using innovative encapsulant and backsheet materials.

Contact

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