Sandia National Laboratories

Energy, Climate & Infrastructure Security

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# PHOTOVOLTAIC RELIABILITY PERFORMANCE MODEL (PV-RPM)

**Sandia recognizes a need to design more reliable and efficient PV systems and has developed a PV Reliability Performance Model (PV-RPM) to test strengths and weaknesses of different PV plant configurations and operations and maintenance procedures.**

**Sandia is delivering a valuable scenario-based predictive tool that helps owners, operators, risk managers, and financiers simulate planned PV projects prior to development to avoid costly system weaknesses.**

## Reliability Performance Model

As new technology helps bring photovoltaic (PV) output costs closer to those of traditional power generation sources, plant operators are looking for ways to increase operations and maintenance (O&M) efficiencies to increase PV's profitability. Decreased O&M costs translate to increased production efficiency resulting in higher returns for investors.

To date, PV reliability studies have focused on components much more than entire systems. As the size of PV installations continues to grow and profit margins continue to shrink, the PV industry recognizes the need to better understand how component reliability affects overall system performance. Sandia's PV-RPM provides risk management experts with a rich visualization tool to simulate detailed PV plant operational scenarios using a hypothetical lifespan typically set at 30 years.

PV-RPM calculates hourly simulated plant life cycle data including energy production and component availability. For each simulation month PV-RPM calculates estimated positive and negative cash flow based on theoretical sale of produced energy and energy loss due to component failure respectively. The predictive tool also estimates O&M costs in the final cash flow calculation, as well as the value of string-level monitoring, which increases installation costs but allows integrators to identify and fix string-level failures shortly after they occur.

PV-RPM functional highlights include:

- Component based reliability based on Failure Modes and Effects Analysis (FMEA) coupled with Sandia's PV Array Performance Model
- Simple financial cash flow model including dynamic (failure event driven) O&M costs

- Evaluation of performance uncertainty, levelized cost of energy (LCOE) for reliability, and trade-offs
- Correlation between operational reliability and weather conditions

Sandia conducts PV-RPM as part of the lab's research to integrate emerging PV and other renewable technologies into new and existing electricity infrastructures. PV-RPM allows stakeholders to assess different system configurations and O&M strategies for operational effects and value. To improve its effectiveness, Sandia utilizes site performance data from its own Reliability Accelerated Testing program and from industry and government partners including Arizona Public Service and General Services Administration.

## Commercialization Path

Sandia looks forward to contracting with companies and research institutions to assist them with testing their ideas for new novel technologies. In addition, Sandia seeks partnerships to jointly explore new technologies by making proposals to DOE or other funding agencies.

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