Want to improve the ROI on your next PV project?

Solar photovoltaic (PV) plants provide low-cost electricity generation with minimal carbon and water footprints, but the performance may not always live up to pre-construction expectations.

Under-performance of a solar PV plant can have a negative impact on the financial returns for investors, owners, and insurers. The factors contributing to under-performance fall into four categories: overly optimistic prediction models, component degradation, operations and maintenance, and factors beyond the control of the plant owner such as environmental disaster and grid availability. To ensure optimal returns, the PV plant developer must select certified, reliable components and follow the relevant standards for installation and operation.

The technical challenges

At the Council for Scientific and Industrial Research (CSIR) Pretoria campus, despite following best practices, two out of three PV systems ranging from 203kW to 558kW DC capacity do not meet the performance guarantees after the first three years of operation. PV module degradation, system design, and overly optimistic expectations largely explain the under-performance. In another case, the CSIR PV module testing lab assisted in proactively identifying a latent defect in its most recent PV plant averting what could have otherwise resulted in a future safety issue, thereby assisting both the CSIR and panel supplier in avoiding future claims and production loss.

In the *Solar Risk Assessment: 2019, Quantitative Insights from Industry Experts* report, DNV GL states that 50% of PV plants underperform relative to the pre-construction estimates by 3.1% or more, based on a sample of 39 PV plants with a total installed capacity of 1.2GW. While the PV industry continues to expand and provide low-cost electricity across the globe, focus on quality and reliability remains a high priority to ensure that every local PV plant meets or exceeds pre-construction performance estimates.

PV module quality and reliability is one factor impacting the performance of PV plants. Module certification from an accredited body indicates that the safety and performance of the PV module meets the minimum requirements for type approval.

▲ *Figure 1: A+A+A+ solar simulator with integrated thermal chamber*

However, the materials and process that were used to produce the certification samples change over time as manufacturers optimise processes and suppliers for cost and efficiency.

The substitutions and optimisations are supposed to be monitored and approved by the certification body, but not all changes are fully tested. As a result, modules of the same make and model are not all identical to the original certification samples. Some variants can have excellent performance over time while others manifest higher degradation rates and other defects over time. While PV module certification reduces infant mortality issues for type approval, extended reliability testing can further de-risk the PV plant by ensuring that the specific PV module bill of materials purchased for a given project performs well in to the 25 year lifetime of a PV plant.

The technical solution

The CSIR is launching a PV module quality and reliability testing lab to service and support the solar PV industry in Southern Africa in providing reliable, renewable electricity to the grid. The research and testing lab complements the PV module quality testing services already in the region with state-of-the-art accelerated stress testing, which provides quantitative results regarding the reliability of PV modules that would normally take years to collect naturally in the field. These results are used regularly in the global PV industry to inform contractual agreements among module manufacturers, plant developers, owners, and financial backers such as lenders and insurers.

The PV module quality and reliability test lab includes a number of capabilities new to South Africa. The state-of-the-art solar simulator is used to verify performance measurements at standard test conditions and across a broad range of temperatures (15-75°C) and irradiance (100 W/m2 to 1100 W/m2) (Figure 1). Temperature coefficients can also be directly measured to verify expected losses associated with operation at elevated temperatures. The new environmental chambers apply accelerated stresses across a range of temperatures (-40°C to 85°C) and humidity levels (up to 85% relative humidity) so that defects that may take several years to manifest in the field can be detected in a few months in the laboratory.

The mechanical load tester simulates wind and transportation stresses that can lead to cracked cells and weakened solder bonds. The wet leakage station applies a high voltage potential across the module circuit while the module is submerged in water to check for insulation resistance of the module for safety. The PV module quality and reliability testing facility is the first in sub-Saharan Africa to conduct indoor accelerated stress testing and energy rating measurements of PV modules across a broad range of temperature and irradiance levels.

In *Boosting Solar PV Markets: The Role of Quality Infrastructure*, the IRENA reports on several cost benefits of additional quality and reliability testing for a specific project. For instance, plant performance can increase by 2-3% when batch testing is announced because manufacturers tend to deliver the best product to customers that conduct independent tests. In another example, higher quality modules exhibit lower degradation rates, which will pay large dividends through increased production over the PV plant life.

The research and testing facility at the CSIR is designed to support the local PV industry by quantifying the distribution of PV module quality and reliability performance over the expected lifetime. Let our team of experts help you make the right choice for PV modules to reduce risk and increase the profitability of your next solar PV plant. ESI

About the author

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