# Pilot Study on Quality Aspects of PV Power Plants in India

This study shows the results of a pioneer analysis conducted by PI Photovoltaik Institut Berlin AG (PI Berlin) on the status of operating grid connected solar photovoltaic plants installed across India in the recent years. The study was realized as part of a project funded by the German Ministry for Economic Cooperation and Development and executed by the Physikalisch-Technische Bundesanstalt (PTB), with the aim to strengthen the quality infrastructure in the Indian photovoltaic sector.

## First study of its kind in India

Six representative plants were selected and inspected by PI Berlin between the 3rd and 14th July 2017 thanks to the support of the Solar Energy Corporation of India (SECI) and the Kreditanstalt für Wiederaufbau (KfW), in cooperation with the Ministry for New and Renewable Energy (MNRE) and the National Institute for Solar Energy of India (NISE). The shortlisted plants were selected considering Indian specific environmental stress factors present in different climates, representative module and mounting structure technologies typically used in India and statewise accumulated solar capacity.

PI Berlin applied an auditing system focused on 7 key topics.

## Evaluation methodology

The selected plants were evaluated by PI Berlin using a Technical Due Diligence product developed specifically for operating assets. The inspection methodology is based on the assessment of 7 main topics: contracts, technical design, installation quality, commissioning completeness, module quality, system performance and operation and maintenance.

The purpose of this study was to document the status quo of the six plants in terms of safety, performance and commercial touching points, and to identify failures, risks and mitigation measures that can help increase awareness among solar project developers (SPD) and financing institutions in regards to Quality Assurance of Solar PV projects.

Note: The results and interpretations shown and illustrated in this document are only applicable to the inspected sites and are not representative for the entirety of the Indian solar PV market, due to the reduced sample covered in the study.

## Results

The results and outcomes of the survey show that (i) strict technical requirements in regards to accurate component selection (ii) failure free installation, (iii) commissioning aligned with the international norms, and (iv) a comprehensive O&M program, are four key aspects that need to be addressed properly in the EPC and O&M contracts along with the necessary performance warranties.

Missing or poorly expressed warranties in the EPC and O&M contracts are a risk for the owner since the quality can't be properly ensured along the various project stages.

*Figure 1: Ground electrode affected by salt corrosion*

During the electro-mechanical evaluation of the PV plants three types of failures were detected: (i) sporadic failures with clear impact on the performance, (ii) area-wide failures with clear impact on the performance, and (iii) failures without impact on the system performance but threatening the PV plant´s safety.

The analysis of the PV plant´s safety is a key aspect and is often disregarded as it is not always coupled to a visible performance drop.

> The quality of a PV plant should not be determined only based on its performance indicators. Safety issues are key, even though they do not influence primarily the plant´s performance.

A special focus should be put on the PV module as it is the most sensitive component of the PV system, and its stability during the full operational lifecycle is strongly affected by the manufacturing quality, the environmental factors and the damages caused by improper handling.

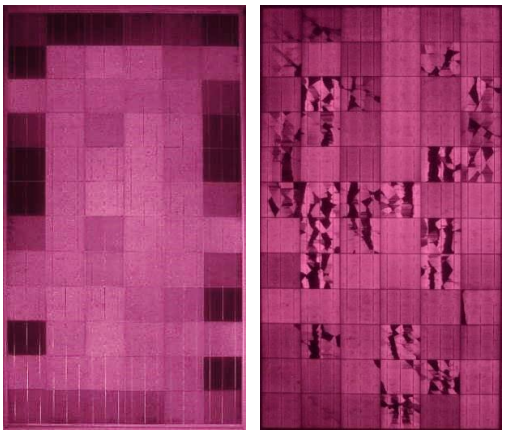

*Figure 2: Left: PID affected module; Right: Module showing cracked cells due to improper handling*

The lack of trained installers and operators, the use of nondurable and cheap system components, and the lack of supervision of owner's engineers (OE) and lender's technical advisors (LTA) representing the interests of SPD and financing institutions respectively, are some of the ingredients that increase significantly the investment risk of the project.

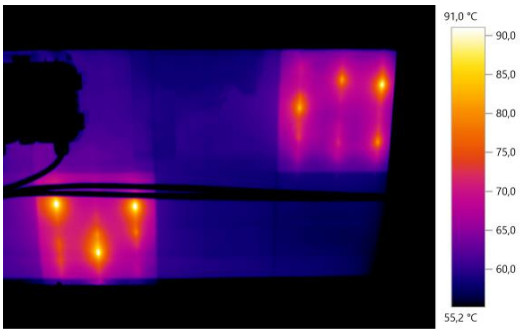


*Figure 3: Faulty ribbon soldering*

> Poor module quality, installation failures and lenient EPC and O&M contract requirements are the top 3 failure areas responsible for the performance drops.

Many failures both in the PV modules and the BOS, are easily avoidable with an appropriate quality control program starting in the PV module factory, continuing during the design and construction phase and finishing at the PV plant commissioning stage.

## Reasons for poor Quality

Some of the reasons leading to the described quality lacks are: (i) strong price pressure in the Indian market, (ii) inexperience of stakeholders, (iii) lack of awareness of some key stakeholders in regards to project risks, (iv) aggressive climatic conditions, (v) Owner´s Engineers and Lender´s Technical Advisors not fully established in the Indian PV sector (vi) lax tender requirements offering high comfort to module suppliers and installation companies.

*Figure 4: Statics did not consider maximum wind loads*

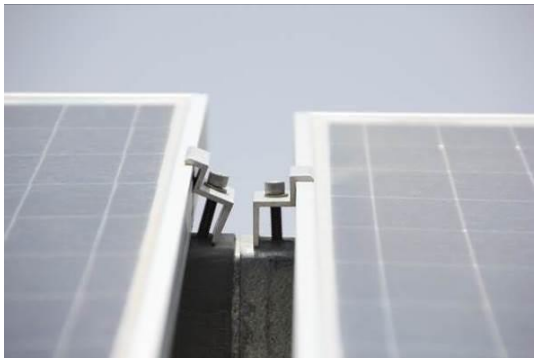

*Figure 5: Bad module fixation to the mounting structure*

PV projects developed, built and operated by the same company with no independent party involved in the QC process, are less bankable.

## Usability of this study

Competitive reverse auctions that push down bid prices to extremely low levels, is a scenario where cutting corners in regards to quality may become a common practice.

The present study helps to counteract and prevent the negative effects of poor quality during the deployment of PV projects, by detecting risks and translating them into clear statements and recommendations containing mitigation actions and risk prevention measures for developers, system integrators and financing institutions.

These statements were summarized in 25 take-away messages in a detailed report that will contribute to the sustainable achievement of the Jawaharlal Nehru Solar Missions' political goals, aiming at installing 100 GW of solar generating capacity by 2022.

*If you are interested in the full report, please reach out to Asier or Venkat at email below*

About the Author:

**Asier Ukar** is Senior Consultant at PI Photovoltaik Institut Berlin AG based in Berlin, Germany. He has 10 years of experience in deployment of multi-MW grid-connected PV systems with physical presence in Europe, Asia, the Americas and Afrika, being active in the Indian solar market since 2010. Asier Ukar has years of experience in the creation of feasibility studies, design of multi-MW PV plants, installation and commissioning supervision, creation of energy yield assessments, tender process support, contract assessment and comprehensive quality assurance of large-scale grid-connected PV plants.

He is in charge of developing tailor-made design and inspection packages, site-specific inspection concepts acting as on-site specialized supervisor with presence at key phases of projects. He has been actively involved in the design, supervision, operation and refinancing of approximately 2.5 GWp of installed capacity since 2008 at international level.

Asier Ukar acts as expert witness in arbitration processes and as consultant for banks, lenders, governmental authorities, EPCs and module manufacturers. He is listed as an international expert in various organizations, including "Asian Development Bank" (ADB), the German "Physikalisch-Technische Bundesanstalt" (PTB), and the German "Deutsche Gesellschaft für Internationale Zusammenarbeit" (GIZ). Asier Ukar holds a diploma in mechanical engineering from the Technical University Karlsruhe (GE) and speaks five languages.

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