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Quality of PV modules to define India's Solar Dream

Today, solar module manufacturers stand at a critical position within the industry, as they determine benchmarks and quality and eventually define the future of Indian solar projects.

Though PV manufacturing industry can now be safely termed as 'mature', the way modules are being produced have changed significantly over the past few decades and it continues to change at a phenomenally rapid pace with technology and the quality of raw materials improving every year.

The lack of Quality Standards in the industry has a negative effect on the quality of modules being installed in the country today. All manufacturers build their modules in their own way with little standardization or adherence to quality processes and methods, which are commonplace in other manufacturing industries.

Investors, financiers and lenders stand the most to gain from PV systems over the long-term, but also the most to lose if the modules fail to perform. Investors, developers, EPC, O&M must appreciate that manufacturing quality be taken more sincerely and proactively or they are bound to face untoward risks of failure all along the way. Except for some seasoned veterans,many fail to comprehensively evaluate the quality of the module.Contrary to popular belief, PV modules are not a commodity, and it must be noted that modules of the same power wattage can differ drastically in quality.

It is important to note that the majority of failures seen in the solar projects are a result of deviations in the manufacturing process that contribute to product quality issues, and are typically not caused by fundamental design flaws.

It must be clearly understood that IEC type testing and design qualification test protocols only take care of premature failures of PV modules on the field, the so called "Infant mortality zone" of the reliability curve. Prediction of lifetime of module on the field requires extended reliability testing beyond IEC type testing. In a recently published report by TUV Rheinland PTL (ASU PV Test Lab) the principal cause of failure of modules during type testing are in the period 2007 -2009 are:

- Thermal cycling 16%
- Humidity freeze 14%
- Damp heat 11%
- Hot spot 9%

A comparative failure analysis testing by TUV Rheinland PTL lab showed that the fraction of new manufacturers who failed type testing during the period 2005-2007 was 52% whereas the failure rate during the period 1997-2005 was about 30%. This can be attributed to a number of new Chinese players who set up manufacturing during 2005-07. The failure rate post 2007 reduced to 39% when these manufacturers had actually matured their manufacturing capabilities. The same analogy can now be extended to Indian manufacturing scenario as new module manufacturer are setting up capacities aggressively. The investor needs to be careful when choosing modules from their manufacturing partners.Else there will be serious generation losses affecting return on investment. Robust quality system needs to be in place for performing vigorous material level evaluation, production process and post manufacturing module level reliability evaluation.

Also, IEC / UL certifications evaluate the quality and safety of a PV Module to an extent, it is only tested on a miniscule quantity of sample modules made with care and attention and not on the daily production volumes which can actually differ in performance from the sample lot tested at the labs. Conclusion on the quality of PV modules shouldn't be drawn based on the Type Test certifications alone.For several manufacturers, cost reduction targets can unambiguously affect the quality of the PV module produced across multiple manufacturing locations. The use of new alternate low cost materials has had a significant impact on the reliability of PV modules. There is a need of a comprehensive material, processes and infrastructure norms that have to be established in order to safeguard investments.

Another process that needs to be followed is to choose modules from the random production lot and subjecting then to extended 3rd Party reliability programs will determine the desired quality and reliability of PV Module which can make them last for 25 years and beyond. Passing these tests will require excellent material evaluation techniques, comprehensive process controls for good workmanship qualities and final module level evaluation. 95% of the module manufacturers fail to pass these tests.

The modules sold will be under operation in various environmental and climatic conditions exposed to different Humidity, Different Temperatures, UV Radiations, Wind Speed, Snow Loads, Chemical Exposure, Salinity, etc. To evaluate the modules under all environmental conditions an extended reliability program will ensure that they can withstand the harsh environment conditions prevailing and one can program the degradation of the modules and subsequently calculate the performance generation vis-à-vis with the degradation of the module year on year.

Recommended best practices to be followed by manufacturers can be listed as follows:

1. Stringent IQC,IPQC ,FQC quality control with process CTQ monitoring
2. Rigorous RM evaluation process for each raw material
3. 100% EL inspection of modules
4. Regular "out-of-box" testing
5. Established process FMEA in place
6. Adherence to statistical process controls

At this critical point in India's solar mission, it is necessary for the government to instil and build investor confidence. The first step that will help in achieving this is to lay out a Quality Assurance Program by defining "official quality parameters" and issue the list of approved vendors under A,B,C category (by National Institute of Solar Energy -NISE). NISE should also issue certificates to the approved vendors for "quality products" in line with C-WET for wind manufacturers.

Implementing a Quality Assurance Program will efficiently diminish the technology risk associated with solar investment, further enabling the shift towards solarand support its quest to become a mainstream and bankable energy source. Establishing such programs has a two-pronged effect, as it enhances the reliability of successive generations of the technology while also providing usable data to aid substantiate financial investments in current project development. As the industry expands rapidly, and technology evolves, it will be important to continue to develop and deploy structured Quality Assurance Programs and to relay the data collected into the next generation of manufacturing