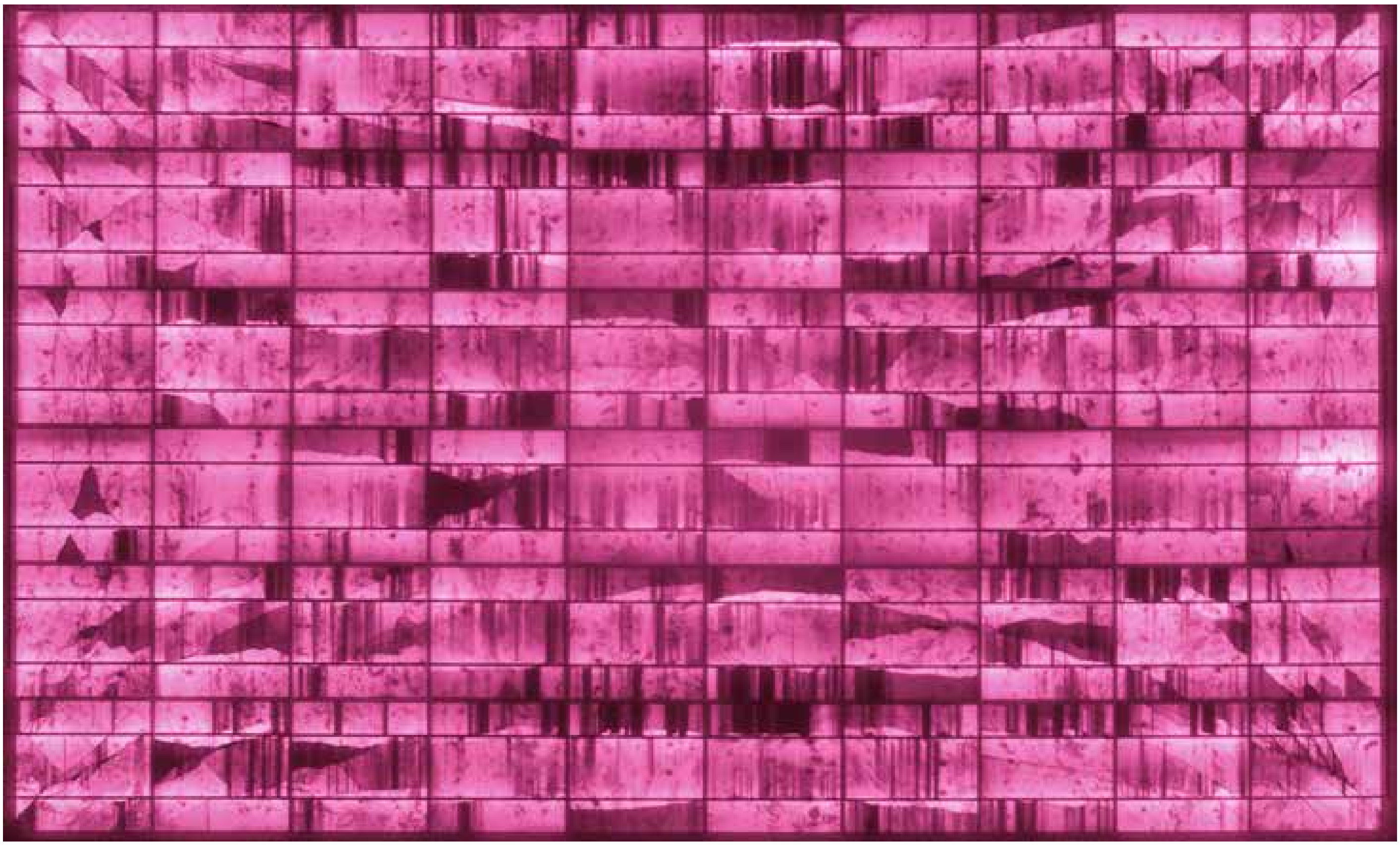
Negotiating the pitfalls of PV warranties



Credit: PI Berlin

Module performance | The value of warranties attached to PV modules is coming under increasing scrutiny as plants age and more is understood about the degradation of modules in the field. Gustaf Schuler discusses the ins and outs of PV warranties and the best methods for mitigating risks

There has been much discussion in the solar industry about PV module warranties and their worth; certainly it is not simple to make a claim. Firstly it must be proved that the modules are not performing to their detailed specification, which involves myriad tests all with varying levels of accuracy. Armed with that information, the next hurdle is to decide against which company to make the claim: the manufacturer themselves, assuming that they are still in business, a third-part insurer or even the engineering, procurement and construction (EPC) contractor.

The basics of warranties

The modules themselves are certified, as are the inverters. The modules have quality standards and certificates that are supplied by the manufacturer, with every supplier having their own warranties consisting of two parts. One part is the material or product warranty pertaining to the module itself, typically valid for 10 years. This states that the module will be generally free from any material defect that might impact on its functionality. Then there is the performance warranty, which defines the maximum foreseen rate at which the module performance will degrade over time.

This performance warranty is in effect the supplier defining the potential maximum loss of power; it is usually not higher than 0.7% of nameplate power per year, plus up to 3.0% initial degradation over the first year. This would equate to a value of approximately 80% after 25 years, with a linear degradation from the end of year one up to that point. If a client were to approach RINA after 10 years in the belief that any given modules were not performing to the expected levels, these parameters would be used to calculate the minimum expected power, taking into account the initial degradation and subsequent year-to-year linear degradation. If the results were to support the client's belief of underperformance, then a warranty claim could be valid.

Identifying faulty or underperforming modules and seeking suitable recourse is a complex process

Aside from the manufacturer's warranty, there will also be a warranty from the EPC contractor, who is responsible for the design, purchasing, installation and commissioning of the facility. The EPC warranty covers the entire system for the first two years of operation, and during this time the EPC contractor should be the first point of contact for any warranty claims to be processed.

Maintenance

Although important to overall performance, regular maintenance is not a typical warranty requirement. From a purely technical perspective, modules should operate normally and achieve the expected levels of performance without the need for further maintenance. Most operators do, however, perform a certain degree of maintenance as the warranty would be invalidated in the case of improper handling and/or operation. For example, modules can develop hot spots as a direct cause of bird droppings, which could make it difficult to claim against the warranty.

Disappearing manufacturers

In terms of assessing a PV plant and its modules, it is very important to audit the module manufacturer and its level of market acceptance. Every three months Bloomberg release a list of 'Tier 1' module manufacturers based on module sales and financial stability. Whilst not taking technical parameters into consideration, modules on this list are being used for large, bank-financed PV projects, and should therefore offer some degree of reassurance. On the other hand, should a module not be included within this list, it may be an indication that further investigation and testing are required.

A major consideration is often the 'status' of the manufacturer. In recent years many suppliers have ceased operations, and this must be a concern. The market has consolidated, mainly due to tough competition from China, where the entire PV industry is heavily supported by the Chinese government, and such competition has forced other manufacturers from Europe and the United States out of the market.

Another common reason why some manufacturers have closed their doors is the decline in the price of the modules, which has led to them being unable to compete on the market. This industry-wide issue is not unusual and RINA does sometimes become involved in PV projects where the module supplier has exited the market.

As an operator or any other company looking to purchase an existing PV farm, there are several options to consider. Some, but not all manufacturers have a backup warranty meaning a third-party

Flash and EL testing can be used to identify damaged or underperforming modules

Credit: Suncycle

insurer may be willing to take on this risk, although claiming against third-party insurance is often an arduous task. It is therefore necessary to study each individual policy in detail, remembering that it has been specifically tailored to the client or project. In the event of a claim, the insurance company will consider the condition of the modules and make a decision based on this assessment. Even in the event of a successful claim, one issue often cited is the limited liability against a manufacturer. If a client is one of several claiming against the manufacturer, it is possible that the policy limit (for example US$10 million out of US$100 million) may have already been reached and the claim, whilst valid, will not be satisfied.

Testing

To help mitigate this risk, RINA recommends undertaking a range of tests on a sample of modules from the farm. The first is a simple visual and thermal inspection of the modules in order to determine their condition. Although not definitive, such inspections can confirm the presence or otherwise of 'snail trails', eventual delamination of the layers and any discoloration or hot spots. Following this initial inspection there are various other tests that can usually be undertaken on site with a mobile testing laboratory. Flash testing and electroluminescence (EL) tests are the most common and, together with the visual and thermal inspection, will give a reasonably clear indication of the modules' condition.

For more sophisticated tests, or in areas where on site testing is not possible, a sample of modules can be sent to specialist testing facilities such as TÜV Rheinland, TÜV Sud or PI Berlin, able to perform further tests to simulate the ageing process of the modules. Test results can be compared to the modules' expected performance, and from that comparison a profile can be developed which will help assess the level of risk.

Flash tests

A flash tester is used to measure the output performance of a solar PV module, with results compared to the power output specifications of the module. During a flash test, the module is exposed to a short, bright flash of light from a solar simulator – a xenon-filled arc lamp with an irradiation of 1,000 W/m^2, as close as possible to the spectrum of the sun – at a temperature of 25°C and an air mass of 1.5. These parameters are referred to as Standard Test Conditions (STC). The testing parameters of the module are voltage and current at maximum power point (VMPP, IMPP), open circuit voltage (VOC), short circuit current (ISC) and the module maximum power output (PMAX).

Electroluminescence analysis

Electroluminescence testing will determine whether a module has microcracks or other defects which can lead to increased rates of degradation and are undetectable through a simple visual inspection. To carry out an EL analysis, current is fed into the solar cells and an electroluminescence image is captured by an infrared camera. In a fully functioning cell, current, and therefore light distribution, will be homogenous, so defects captured by the EL test show up as dark areas on the cells. The main advantage of this method is that it is quick and non-invasive, giving prominence to defects that would otherwise have gone unnoticed.

Testing in action

RINA was recently approached by a client interested in acquiring a solar plant within the UK. As some modules were showing significant levels of delamination and discolouration, the EPC contractor had approached TÜV to carry out an independent assessment of the modules' present operating performance and predict future degradation.

Considering the visual evidence of delamination and discoloration, test results were expected to confirm a drop in performance and/or increased degradation, but in fact showed performance levels to be in line with the module performance warranty.

The industry recognises the difficulties in measuring degradation, but small errors create doubt. A figure of 0.7% per year represents standard degradation, but flash tests allow for tolerances of ±3.0%. If testing measures the level of degradation at 0.8%, or even 1.0%, it will be difficult to make a claim for underperformance due to the accepted tolerances of the tests. In reality therefore, a significant level of underperformance is necessary before a claim on the warranty is considered, and such claims are rarely straightforward.

Ultimately the individual operator must take a view balancing the complexity and uncertainty of the warranties against the risk of module underperformance. In this case, RINA was not given a mandate to carry out further due diligence and testing to support the client with a potential claim either against the EPC contractor (as module supplier), or directly against the module manufacturer.

Snail trails and microcracks

The snail trail phenomenon drew the considerable attention of the industry, and scientists and researchers considered it a potential topic for research. A series of experiments including EL analysis and infrared measurements were conducted using EL cameras, optical and field-emission scanning electron microscopy and various other instruments. They compared the performance of defective PV modules with those performing according to expectations, and presented a completely new picture to the market. According to the results, snail trails were in fact a symptom rather than the disease itself, and do not directly affect the performance of the plant, but rather are evidence of underlying microcracks.

Microcracks can lead to higher degradation and a consequent reduction in performance. Such microcracks cannot be detected with the naked eye, however at times they do lead to snail trails which appear when moisture and other compounds gain access to the front of the module through cracks and cell edges, passing through the de-bonded areas between the encapsulation layer and the Si substrates to interact with the silver gridlines.

For this reason snail trails are usually not covered by the manufacturer's warranty. It is, however, recommended that their presence be reported to the module manufacturer and written confirmation be obtained ensuring that any microcracks the trails reveal will not have a negative impact on the module performance, and that all warranties will remain valid.

The value of warranties

Warranties may be significant when it comes to the perspective of a bank or financial institution, which require a reasonable amount of certainty and securities in place before it can grant the necessary funds to invest in a project, but from a technical perspective they hold little value. Of far greater importance would be a thorough plant or module inspection with comprehensive tests carried out on a representative sample of modules as defined by the ISO 2859-1 standard.

When our clients obtain a warranty RINA always recommends that it is site-specific, to ensure that the warranty is valid. Site-specific conditions such as proximity to the sea and the subsequent risk of salt corrosion, or the particular risks of floating PV installations, should be clearly covered to avoid unwanted surprises in case of warranty claims. It is also important that the warranty is properly transferred from the EPC contractor (who in most cases is procuring the modules for the project) to the owner or special purpose vehicle (SPV – a company specifically created to manage and build a given project).

In the example mentioned previously, the testing process was driven by the EPC contractor who, as the supplier of the modules, has the overall responsibility for the works until Final Acceptance, i.e. two years after Provisional Acceptance, and as such has every interest in demonstrating that the farm is fully operational. It is always advisable to engage an independent consultancy to lead this process, select the modules for testing (ensuring this is not limited to a specific batch), interpret results and write an unbiased assessment with further recommendations on how to proceed. In case of any warranty disputes, they can check on a claim, support setting it up and make sure the right documentation is in place.

Where to claim

In the case of microcracks, it is believed that the majority develop in cells due to poor handling, but they can be caused by a number of different factors and occur during production, transportation, or installation. It is important to know where the problems lie as these phases are covered by different entities. If the fault is found to originate during production or transportation, it will be the responsibility of the manufacturer, whereas a fault caused by the installation process is the responsibility of the EPC contractor.

Sometimes installers or plant operators walk on the modules and, whilst not causing any immediate visible damage to the glass (the modules are stable, and can support a person's weight), this can crack the underlying cells which are very thin and very fragile. If over time the modules develop cracks or snail trails, the operator would need to decide whether the claim should be made against the manufacturer or the EPC contractor, and it can often be difficult to prove that defects are attributable to one or the other.

Trying to ascertain the best approach to PV warranties can be a problematic process, but what is important is to fully understand the benefits and limitations of each individual policy while having a firm grasp on the physical condition of the PV plant itself. Armed with that information it is possible to define a strategy to fit any specific requirements. ■

Author

Gustaf Schuler is a senior consultant at RINA with 10 years' experience in project management and consultancy for energy projects. Over the last five years he has specialised in technical due diligence services for multi-MW solar PV projects, advising developers, EPC contractors and financing entities during development, construction and operation of projects in Europe, Australia and Africa. He has a German diploma in electrical engineering and a masters in renewable energy systems technology.