Maintenance requirements for utility-scale solar

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Adequate solar system maintenance is an important factor determining the long-term success of any solar production facility. Improper or insufficient levels of maintenance can lead to increased levels of production loss. This underperformance or asset downtime is avoidable with increased levels of both predictive and preventative maintenance.

The recent increase in demand for solar PV services within the renewable industry has led to a shortage of skilled labor throughout Europe. This in turn has led to service providers placing the resources at their disposal towards reactive maintenance and other services. This is instead of the levels of predictive or preventative maintenance that are required for a solar production facility to perform at peak performance.

RFM aims to provide asset owners and operators with further insight into the maintenance requirements of their solar production facilities. It serves to aid in highlighting areas of improvement, leading to the avoidance of underperformance and asset downtime.

Identifying underperformance and issues with the capability to cause asset downtime

The most comprehensive way to ensure that your solar production facility is in peak condition is by a combination of inspection and testing on an annual basis. This can be done by utilizing a variety of different technologies to highlight issues.

Thermal imaging is possibly the most under-rated tool in the solar industry at the moment. It is the most evident indicator of component degradation or poorly terminated connections, such as incorrectly crimped MC4 connectors within a solar system. As a component breaks down over time, the resistance within a circuit increases, leading to heat being dissipated. Heat dissipation will often go unobserved, as the human eye cannot detect the release of heat radiation, leading to component degradation to the point of asset downtime. It remains an essential tool for any O&M provider.

Isolation resistance testing is very similar to insulation resistance testing, with the exception that insulation resistance refers to the mechanical properties of the protective insulation material, whereas isolation resistance (Riso) refers to the electrical isolation resistance of the system itself. This is the most essential test in determining the condition of any solar array, by identifying the level of electrical current flow to Earth, known as short circuit current.

Riso readings above 20MΩ indicate that the system is in a good condition, whereas Riso of below 20MΩ would generally indicate that insulation is degraded and a Riso reading of less than 1MΩ would indicate that the system is in a potentially dangerous condition, with a risk of fire present. It is essential that all individual DC strings across a solar array are tested annually in order to identify degradation and mitigate the risk relating to the safety of a system and underperformance.

IV-Curve testing, the power produced by a solar panel, is determined by the relationship between current (I), which is the rate of electrical charge moving through a conductor and voltage (V), which is the pressure that pushes charged electrons through a conductor. I-V Curve testing measures the correlation between current and voltage, whilst switching between open circuit and short circuit load, producing a characteristic of current vs voltage (I-V).

In simple terms, I-V Curve testing consists of inputting the amount and types of panels into a tester, which considers environmental conditions, creating a predicted value of the result that we should get on a system that is in a good condition. This then measures the actual value, indicating if the energy yield is above or below the forecasted figure. If it is below the forecasted figure, then an issue is likely present, such as a degraded panel module.

Avoiding yield losses with adequate levels of preventative maintenance

Preventative maintenance is routine maintenance, often done on either a six- or 12-month basis, depending on the requirements of the solar array, influenced by factors such as location, size and environmental conditions. Regular and routine maintenance, performed correctly, will aid in mitigating the likelihood of equipment failure leading to asset downtime.

Green space maintenance is an essential part of an effective preventative maintenance strategy. If sites are left to become overgrown, this can lead to unnecessary levels of shading, and damage to PV panels, as vegetation grows upwards creating resistance against the underside of the PV pane. Not to mention the issues that can be created relating to access and egress. It is standard practice to have green space maintenance carried out on a six-monthly basis, both in autumn and spring, ensuring the best results.

Solar panel cleaning should be carried out regularly. Build-up of dirt on the panel surface will affect the output of the system, and subsequently removal of severe soiling may damage the panels. Allowing lichen and bird feces to accumulate on solar modules may degrade the glass surface via both chemical and mechanical action. Uneven soiling may also cause localised hot spots, leading to module failure.

Generally, a solar array should be cleaned annually, but in areas with increased levels of dirt and waste it is advisable to have them cleaned every six months, as the level of production loss will likely outweigh the cost of an additional attendance for cleaning making it much more viable.

Electrical and mechanical maintenance visits comprising standard electrical testing, functional testing, visual inspection, and torque checking of both electrical and mechanical bolts is a high priority when it comes to ensuring that your solar array is operating at peak performance. It allows issues that are either causing underperformance or will eventually develop into causes of underperformance to be identified and subsequently addressed by the O&M provider, mitigating the risk of production loss by a proportional amount. Generally, this type of maintenance will be carried out annually, with additional follow-up visits to remedy any issues that are highlighted that technicians were unable to remedy during the initial visit.

High voltage (HV) maintenance consists of mainly visual and functional checks of the HV infrastructure throughout a solar production facility. Generally, an approved high voltage senior authorised person will isolate transformers via the HV switchgear, ensuring that the switchgear operates correctly and making a high voltage area safe to fully inspect the system, carrying out necessary torque checks on HV busbars and other connections where applicable.

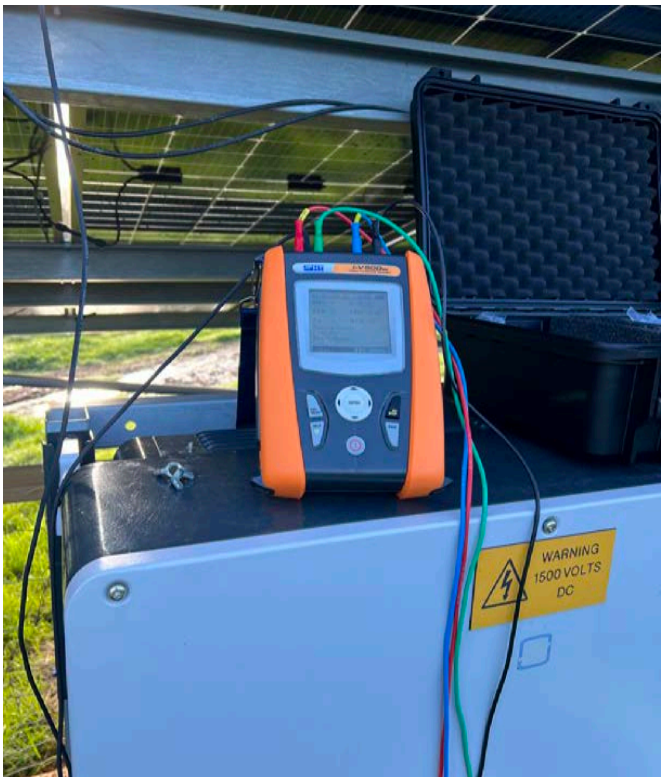
They will also check for transformer leaks and take transformer oil samples if required. This is generally done annually, with the majority of solar O&M providers bringing high voltage services in-house in recent years in order to provide a more convenient and inclusive service.

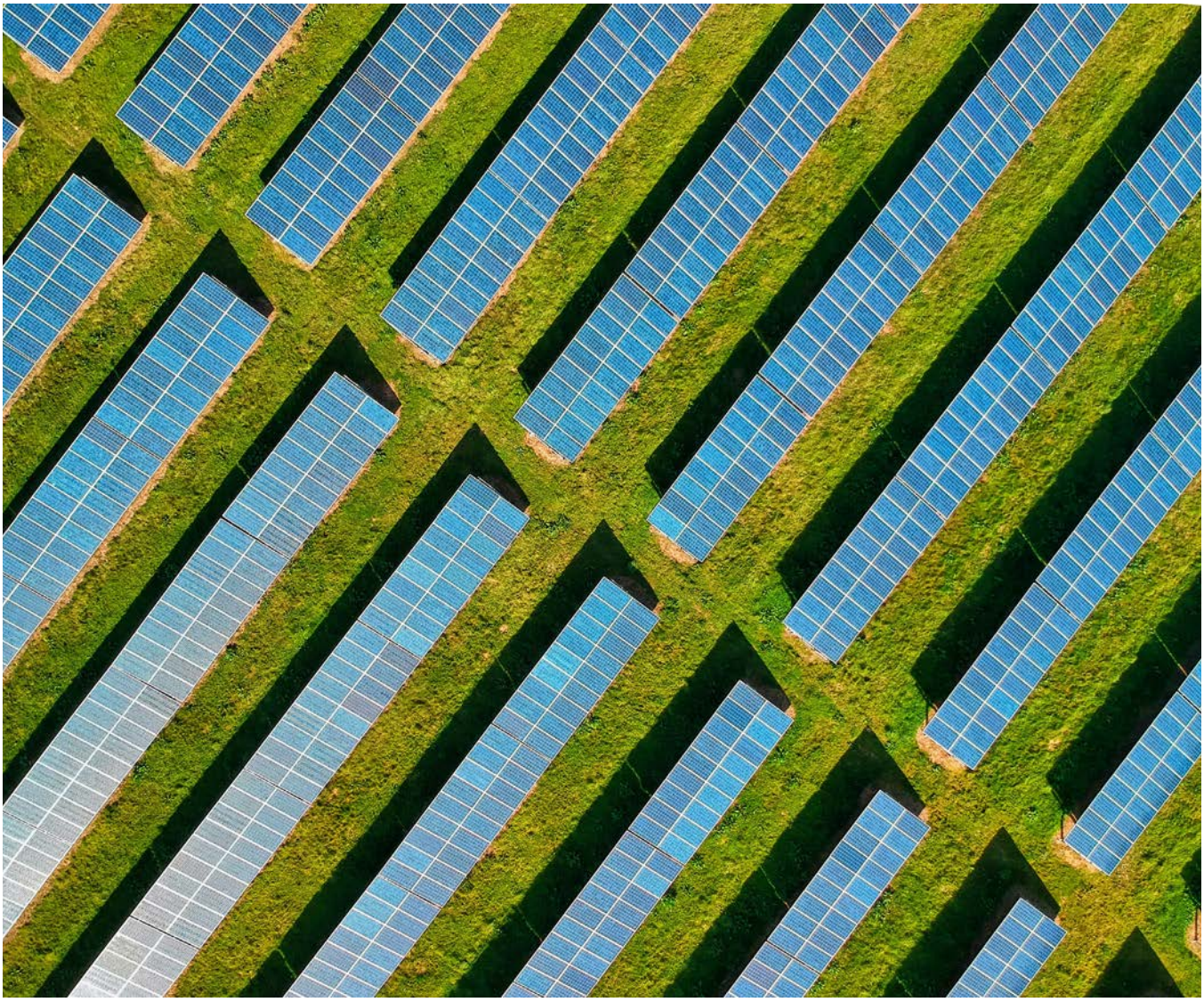
Supervisory Control and Data Acquisition (SCADA) system maintenance is often one of the most overlooked items on the maintenance checklist, yet it is responsible for allowing asset owners and operators to both acquire data from a production facility and carry out remote monitoring alerting them when asset downtime or underperformance is present. It is recommended that the SCADA system be

Jake Mason

inspected and if required updated on an annual basis in order to prevent those dreaded communication issues that are ever so apparent.

Pyranometers, weather station maintenance and calibration are pivotal factors when calculating the performance ratio (PR) of any solar plant, providing asset owners and operators with an indication of how well a solar plant is operating, highlighting issues such as module degradation, soiling and even Riso faults. Typically, visual, and functional checks should be carried out on an annual basis, with calibration carried out by an authorised body bi-annually, who will issue the relevant calibration certificates.





Ensuring the safety and conformity of a solar plant

Adequate and independent Fire Risk Assessments (FRAs) are essential when it comes to producing a quality fire safety policy on your solar plant, ensuring that it continues to operate safely and efficiently. It is essentially a scheduled investigation of your solar plant, carried out to identify all fire risks and hazards, considering the existing fire safety measures and controls in place.

The aim of a Fire Risk Assessment is to ensure you have the right fire safety equipment installed in the right places, to protect technicians and your assets. It is recommended that an FRA be carried out bi-annually or when any substantial amendments have been made to a solar plant in order to provide an accurate assessment of the site requirements.

If there is one industry where health and safety really matter, it is renewables. The potential for harm is huge, from long-term environmental impacts, major financial penalties, injury to personnel or legal action. Health and safety inspections are paramount when it comes to ensuring both the safety of technicians working on a solar plant and the identification of avoidable risk to generation. By ensuring that health and safety Inspections are carried out on a six-month basis this provides asset owners with the confidence that their production facility is in a safe condition.

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