AXTER GENERAL SOLAR PV

Inspection and Routine Maintenance Guide

PV LAMINATES ON MEMBRANE ROOFING

The following inspection and routine maintenance instructions are in addition to and must be read in conjunction with Axter's standard maintenance instructions for waterproof membranes.

A grid connected General Solar PV system is a potentially dangerous, high voltage electrical generator and should be inspected at least every six months to ensure that all system components are working correctly.

Appropriate maintenance should occur at least before the onset of both summer and winter. Axter recommend that all General Solar PV systems are fitted with monitoring software as this can give advance warning of potential problems and can provide the opportunity to perform corrective action before a problem becomes serious.

CAUTION

General Solar PV photovoltaic modules produce electrical energy when exposed to the sun, including under cloud, or other light sources. The power of an individual module is not considered dangerous but when connected in series and / or parallel the danger of an electric shock will increase.

The DC voltage produced by General Solar PV modules can reach up to 1000V during the day even if the inverter is not switched on. The module surface can become slippery when wet and operatives must follow appropriate safe working practices when accessing General Solar PV systems.

GENERAL ADVICE

- Ensure that appropriate safety signs are in place at each access point to the installation.
- When working on a roof, ensure you are properly tethered and that your safety equipment is in safe operating condition.
- Avoid walking on photovoltaic modules and utilise access routes where provided.
- Do not cut or fold the photovoltaic modules for any reason.
- Do not apply screws, nails etc and avoid letting pointed or heavy objects fall onto any part of the module. Such action could cause shock, generate flame, and invalidate any warranty.
- Do not place any device on top of the photovoltaic modules.
- Do not work on a Solar PV array when it is under standing water.

INSPECTION & MAINTENANCE GUIDANCE

The following procedures should be completed during each operation and maintenance visit:

- Visually check that each laminate is bonded perfectly to the waterproof membrane. If any areas of the laminate are NOT perfectly bonded, mark the product with a permanent marker or crayon. If this de-bonding gets worse over subsequent maintenance visits, carry out the following repair advice:

  Re-establish the adhesion by a combination of hot air and pressure from a Teflon coated roller or by applying Axter Solar fill glue and pressing the two elements together until they adhere.

- Check the top surface of each laminate for any scratches or surface damage. Patch any surface damage in accordance with module manufacturer repair guidelines (contact your Axter representative) without delay. If the PTFE top surface becomes damaged and is not repaired quickly, system performance can be degraded and the laminate could fail.

- Visually inspect cables and cable ducting, verifying that adequate strain relief is provided and the connections are tight, secure and free from corrosion. Ponding water on laminate surface should be avoided, laminates should not be subjected to ponding water and cables should be housed off the membrane surface in an appropriate free-draining cable tray. The most appropriate time to carry out this inspection is just before and/or just after the winter (or rainy) season.

- Cable trays should be secured to the roof membrane with the Axter BandFix® and AluFix® attachment system. Security of attachment should be visually checked.

- Clean laminates which are particularly dirty or have localised shading (bird droppings, leaves, etc.).

- During the pre-summer visit, check the extent of dirt on the module surface and perform cleaning if this is warranted (refer to the Cleaning Procedure for cleaning instructions).

- Verify that all laminates are located in areas that have no shading, and remove temporary objects that may be shading the array and reducing system performance. For example, prune trees that may be shading the array during the summer months.

- Ensure that the drainage system is not blocked and that there is no potential for water pooling on the laminates.

SYSTEM COMMISSIONING & TROUBLESHOOTING FOR ELECTRICIANS AND MAINTENANCE STAFF

The following tests should only be performed by trained and qualified personnel. The best weather conditions that will provide the most accurate system tests are cloudless days with strong sun conditions.

- Before starting PV system maintenance, check that metal parts (array frames, junction box enclosures, DC disconnect switch enclosures, inverter enclosures) are earthed properly.

- When working on the PV Laminates, always wear electrical gloves and shoes and use only insulated tools rated for the maximum rated system voltage (i.e. 600 VDC), disconnect all energy source (i.e. battery and/or utility) and short-circuit the output of the PV Laminates.

- If more than one ground rod is being used, verify that all ground rods are bonded together with appropriately sized conductors.

- Measure and record the open circuit voltage of each series string, verifying that all strings that are feeding the same inverter have the same polarity and a similar open circuit voltage (within ± 5V of each other). If the variation in string voltages is greater than 5V, check the individual connections to that string of laminates.

- Measure and record the operating current of each series string and verify that all strings with the same number of laminates have a similar operating current (within ± 1A of each other). A variation in operating current can indicate areas of the array which are shaded or are particularly dirty and should be investigated further.

- Check the alarm status of each inverter and also the historical alarm log if this is available (refer to inverter manufacturer's manual). Any alarm which indicates either a low resistance or an earth leakage fault should be investigated as soon as weather conditions permit, by suitably qualified personnel.

- Record DC and AC power (at the input and output of the inverter) and determine inverter operating efficiency.

- Perform and record insulation resistance (R_{iso}) on the input to each inverter.

- Check that system fuses and DC disconnect switches are operational.

- Check for loose wires or connections at all solar system array controller (voltage regulator), Combiner Boxes, and/or other Junction Boxes within the system.

- Perform maintenance on the inverter(s) as stipulated by the manufacturer (clean filters, etc.).

- Confirm that no new loads have been added to the system and that loads are operating for the specified number of hours per day.

CLEANING PV LAMINATES

Generally, a good rain is sufficient to clean the PV Laminates. However, in dusty arid locations the PV Laminates can be cleaned with water or mild soap and water in accordance with the following procedure. However avoid cleaning the panels in the middle of the day and do not use abrasive soaps or solvents.

GENERAL RECOMMENDATIONS

- Wear rubber soled boots and cut resistant gloves when cleaning laminates.

- Survey the roof for any loose wires, damaged modules and tough stains that will require special attention.

- While surveying, remove all large debris from the roof surface.

- Use a leaf blower to remove all small sized debris from the roof surface.

- Use a garden hose to get the entire PV laminate wet, making sure not to spray water on electrical wires.

WHEN TO CLEAN

The amount of electricity generated by a solar cell is proportional to the amount of light falling on it. A shaded cell will produce less energy. The non-stick PTFE top surface of Axter General Solar PV modules promotes automatic self-cleaning. It is normally NOT necessary to perform an all-encompassing cleaning of dirt from the solar array, provided that the array is installed on more than a 5% slope.

Cleaning should be performed on any modules that are excessively affected by a collection of bird droppings, dirt, or miscellaneous debris, such as fallen leaves. This cleaning should be performed at each maintenance visit. The monetary value of cleaning dirt and debris from the array is a trade-off between the cost of the cleaning, increased energy production as a result of the cleaning, and the inevitable re-soiling of the laminates over time once they have been cleaned.

To help determine the performance benefit of cleaning, perform the following steps to measure the short circuit current of individual laminates before and after cleaning: Measure and record the operating voltage of each series string and verify that all strings feeding the same inverter have a similar operating voltage (within ± 5V of each other). Any difference greater than 5V between strings requires investigation.

- Isolate a single string, making sure all the DC isolation switches are open (OFF) and all the string fuses have been removed.

- Disconnect the laminates that will be used for the test by opening connections via an MC4 disconnect tool.

- Verify that the current sunlight is effectively constant (clear sky, strong sunshine, no clouds)
- Connect a DC multimeter across the terminals (10A or greater) to measure and record short circuit current.
- Clean the laminate as described in the Cleaning Procedure below.
- Measure and record the current and verify the percentage difference between the two readings. This percentage difference is the potential gain that will be derived from cleaning the product.

CLEANING PROCEDURE

Clothing - Anti-slip rubber shoes and gloves.

Tools
- Soft brush, dry cotton mop or clean broom.
- Low pressure water or portable pressurised water tank.
- Biodegradable, non-abrasive mild detergent.
- Clean water source.

- Check earth connection of PV modules and inverter.
- Examine the roof for damaged modules or persistent staining.
- Remove all waste matter lying on the modules.
- Wet the area avoiding the electrical cables.
- Using a soft brush remove excess dirt.
- Pressurized power washers should NOT be used directly on the laminates. If these devices are being used to clean the roof around a solar array, ensure that the nozzle of the power washer remains at least two feet away from the surface of the laminates at all times while cleaning.
- When spraying a module, do NOT spray water directly on the electrical connections or at the leading edge of the PV laminate.
- Use caution when cleaning PV modules, as the combination of water and electricity may present a shock hazard.
- Use a soft brush to scrub stubborn stains, be careful not to scratch the surface.
- Rinse with water to remove all traces of detergent.
- Dry any puddles left on the roof post cleaning.

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