SOMPO INTERNATIONAL
INSURANCE

Sompo International Risk Control
Rooftop Photovoltaic Panels

Rooftop mounted photovoltaic (PV) panels are widely available and their installation can be economically favourable thanks to grants, feed in tariffs and energy efficiencies. At the same time, however, careful consideration should be given to their installation and ongoing maintenance to reduce the potential for fire or building damage.

There have been several incidents in recent years where PV panels have been the ignition source for fires which have then spread to the building on which they are installed, causing large scale damage and business interruption. Furthermore, the presence of rooftop PV panels can hamper fire-fighting efforts: manual venting of fires may not be possible, elevated hose streams could be obstructed, and there may be reluctance to apply water to the fire for fear of electrocution.

This document provides some key measures for building owners and occupiers where PV panels are present in order to mitigate the hazard they may present. However, please note that this document is not intended to provide a detailed review of all applicable codes and standards, nor is it intended for operators of large solar farms. If further details or support is needed please consult you Sompo International Risk Control Professional.

Physical Arrangement:

Loading:

Panels can vary in size and weight with various fixing methods. The installation also requires provision of electrical cabling and control systems. The presence of PV panels on building roofs can represent a significant increase in weight loading. Furthermore, the arrangement of the PV

panels may lead to drifting of snow and increase environmental loading above the original roof design. This must be reviewed by suitably qualified structural engineers to ensure the roof is sufficiently strong and the building codes are not compromised.

Additional caution should be taken when buildings are located on high ground, coastal areas or other regions exposed to high winds since the panels can be susceptible to wind damage. Wind forces can create uplift, lateral forces and additional downwards pressure on the panels that may cause significant damage or loss to the panels or the roof.

Fixing and Location:

Do not locate PV panels on combustible roofs or roofs with combustible insulation. If this is unavoidable, any combustible layer directly beneath and around the panels should be replaced or covered with non-combustible materials, extending 2-m (6-ft) beyond the outer edge of the panels.

Care should be taken to ensure that arrangement of any components such as cables, fixings, etc., do not breach compartmentation or fire walls and parapets, either going through *or* over. If this cannot be avoided, they should be installed in fire resistant cable ducts and shafts. Cable penetrations into the building should be provided with a non-combustible sleeve fitted to the full thickness of the wall/roof and provided with non-combustible packing around the cable within the sleeve.

The PV panels should be fully mechanically secured to the rooftop, however, ballast or any other weighting down methods without fixings should not be used. Care should be taken to ensure that the fixings do not compromise the waterproof membrane or roof insulation. The roof should be checked in detail for damage from fixings.

Provide walkways between panels to allow access for maintenance to the panels, electrical connections, fixings and drains. Do not install PV panels over drains.

Inverters should be located at ground level in fire rated enclosures (minimum 1-hr), kept clear of combustibles and provided with fire detection. Isolation switches need to be located in readily accessible and clearly signed areas to allow safe access by fire and rescue services, etc. Operation of the switch should, as a minimum, make the DC side of the wiring inside the building de-energized. The switch should be tested during routine maintenance visits, with the results being recorded.

Management and Maintenance:

Emergency Response:

Ensure the premises' fire and health & safety risk assessments are reviewed and updated to take into consideration the PV solar panel system.

In the event of a fire the emergency response plan should take the presence of the PV panels into account. This should include isolating the panels on discovery of a fire. The location of panels, associated equipment, and energy isolation switches should be clearly identified as well as being clearly marked on building layouts kept in onsite emergency packs.

PV installations should be provided with remote load monitoring and alarm management to include the panels and the inverters. The alarms should signal to a permanently manned station or to a cascade of contact phone numbers where site staff have the option to remotely check the plant condition.

Shading and Cleaning:

Panels are sensitive to shading from trees, other buildings, debris on the panels. Partial shading can lead to hot spots which can cause the panel to deteriorate leading to faults that cause fires. This is especially important if modules are not provided with by-pass diodes. Panel placement

should take into account shading and periodic inspection. The pruning of nearby vegetation should be included as part of the planned maintenance routine.

Maintenance routines should also include cleaning panels with water and suitable detergent to remove dust, bird droppings etc. Frequency of cleaning will depend on local conditions but should be formally recorded.

Physical Inspection:

The roof should be inspected at least every 3 months and before any expected heavy wind or rainstorms. During these inspections: Remove loose objects. Check the roof material for deterioration and peeling. Check that gutters and drains are clear of debris. Check that safety barriers are in good condition and firmly fixed in place. Roof construction such as chimneys should have no loose construction elements. The panel support structures should be firmly fixed in place and in good condition, with no signs of corrosion.

Electrical Maintenance:

Ensure all servicing and maintenance is completed in accordance with the manufacturer's instructions and by competent, qualified engineers.

An electrical inspection should include:

- Verifying the polarity of each string.
- Measuring and recording the open circuit current of each string.
- Measuring and recording the short-circuit current for each string.
- Testing and recording the insulation for each circuit.
- A Thermographic inspection of the entire system, whilst under load, on an annual basis or twice per year for combustible roofs.
- Ground fault and arc fault triggering, and monitoring should be verified.

Detailed records of maintenance should be kept and made available to building occupiers. It is important to acknowledge all contract conditions between the various parties, for example the system owner, the operator, the maintainer, the electrical company and the owner of the building or land.

Further Information:

A proactive approach to addressing hazards is critical to keeping your property and employees safe. Please reach out to your Risk Control Specialist or contact Sompo International's Risk Control Department at riskcontrolquestions@sompo-intl.com.

Standards:

The PV generating system should be designed according to internationally recognized standards. The International Electrotechnical Commission (IEC) standards that apply are:

- IEC (EN) 61215 PV modules – Design qualification and type approval

- IEC (EN) 61730 PV modules – Safety qualification
- IEC (EN) 61701 PV modules – Salt mist corrosion testing

These standards reflect the latest developments and safety experience on PV modules, therefore a detailed study of the installation shall be carried out if they are not fulfilled.

The followings IEC standards apply to other equipment:

- IEC (EN) 62093 Balance-of-system components for PV systems (batteries, inverters, diodes...)
- IEC (EN) 62109 Safety of power converters for use in PV power systems

The Underwriters Laboratory standards for PV panels are:

- UL 1703 Standard for Flat-Plate Photovoltaic Modules and Panels
- UL 2703 Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels

The latter is the only international standard for mounting systems. Other local standards may be applied by location.

Guidance Documents:

- CFPA-E Guideline No 37:2018 F - Photovoltaic systems: Recommendations on loss prevention
- RISCAuthority RC62: Recommendations for fire safety with photovoltaic panel installations.
- NFPA Commercial Roof-Mounted Photovoltaic System Installation Best Practices Review and All Hazard Assessment
- SFPE Fires in Photovoltaic Systems: Lessons Learned from Fire Investigations in Italy
  https://sfpe.connectedcommunity.org/publications/magazine/fpeextra/etarchives3/fpeetissue99