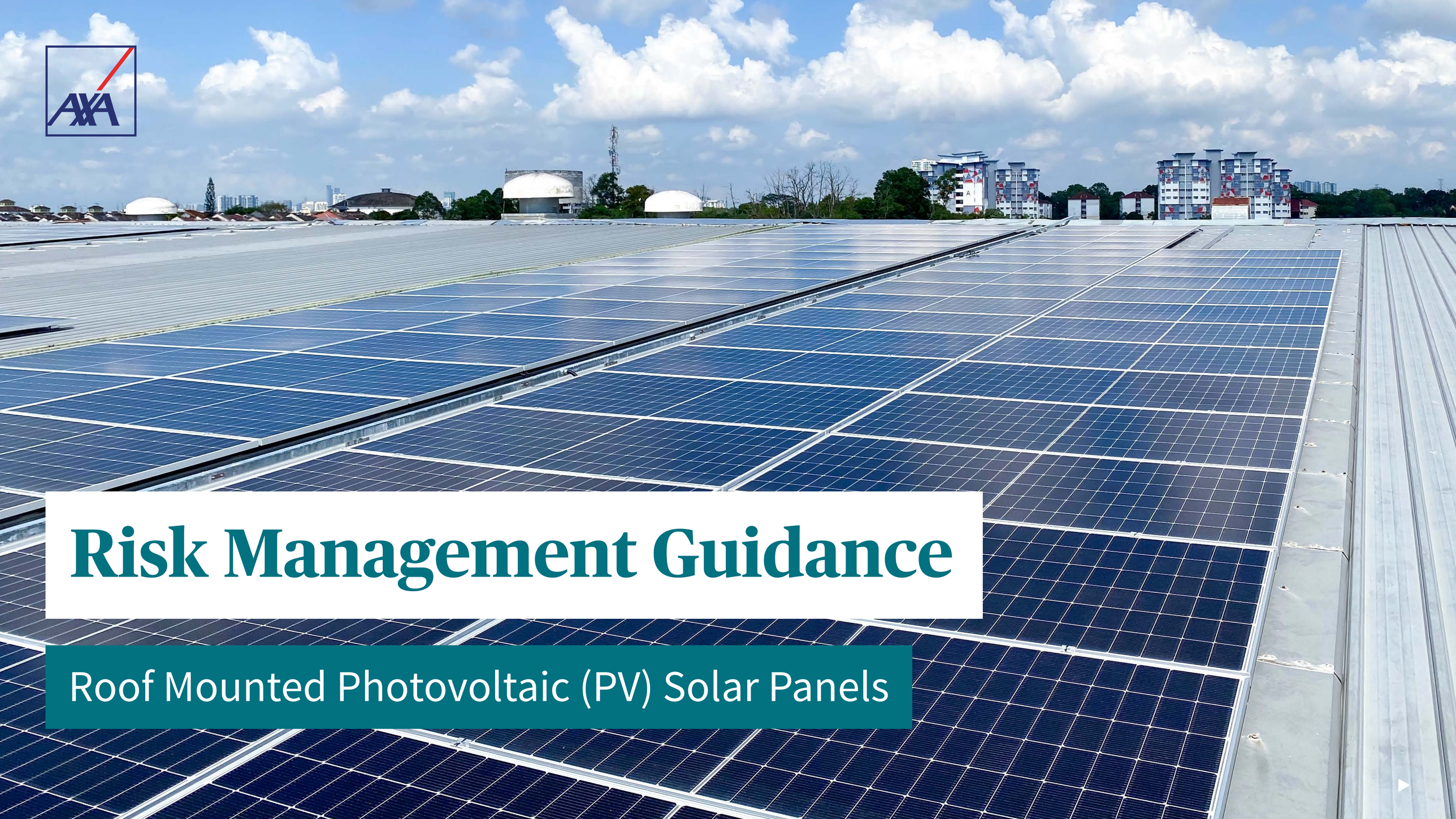


Risk Management Guidance

Roof Mounted Photovoltaic (PV) Solar Panels

Contents

Introduction

The UK government target is to reach 70GW generation capacity from solar energy by 2035 as part of the drive for clean power.

This will include installation of roof mounted solar Photovoltaic (PV) systems which continues to grow at a steady pace ranging from small scale domestic systems on homes to larger scale systems on commercial and industrial premises.

Roof mounted solar PV panels are a renewable energy source that generate direct current (DC) electrical energy from sunlight. The DC electrical energy produced is converted to alternating current (AC) by an inverter for use at the premises or fed back into the power supply grid. The DC energy generated can also be stored on site in optional Battery Energy Storage Systems for later conversion to AC and use on site outside daylight hours.

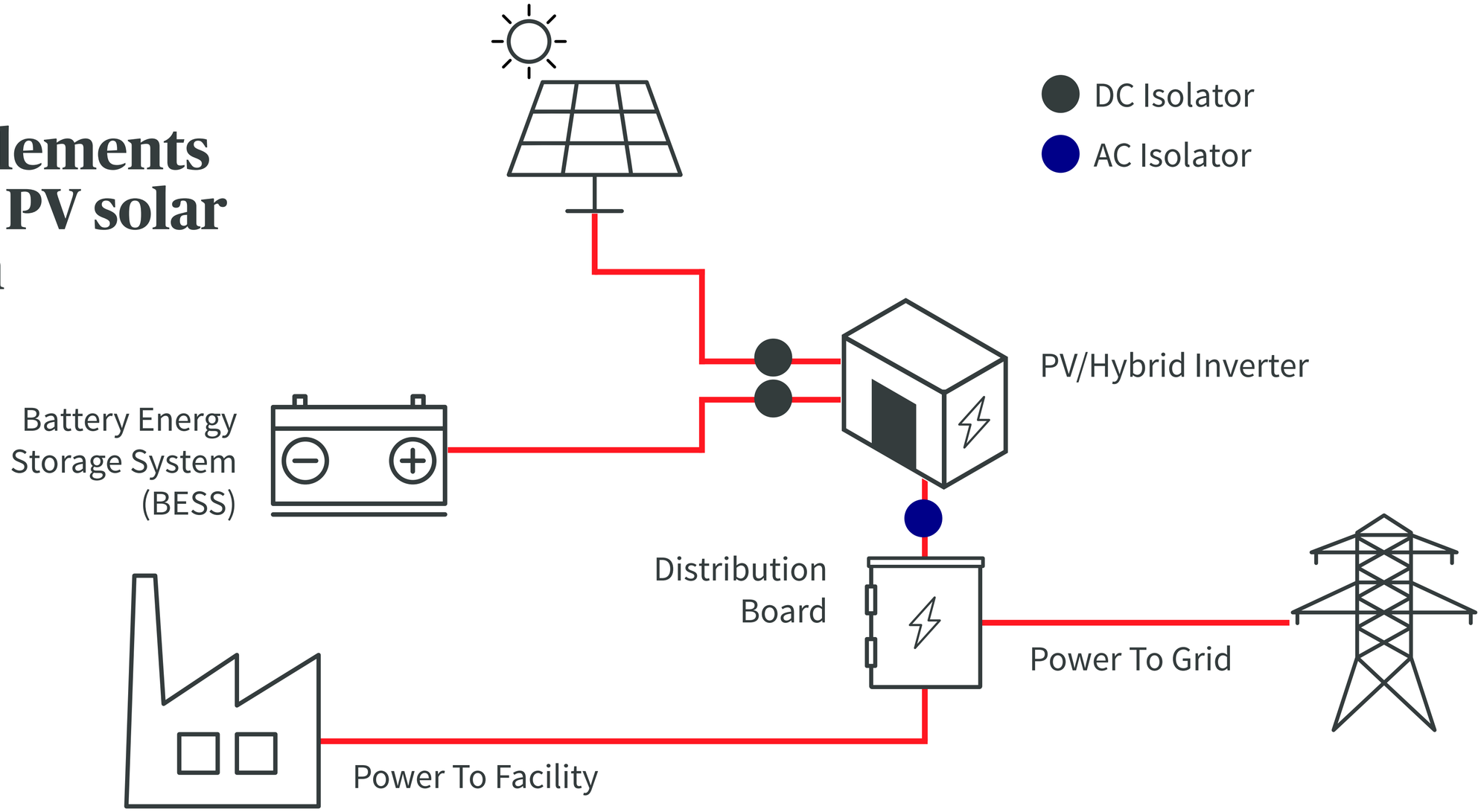
PV panels are most commonly building applied (BAPV) attached to a roof, but can also be building integrated (BIPV) where they are built into the roof structure, or ground mounted as stand-alone units for example in a solar farm. Each will have their own unique issues, and this document is intended to cover building applied PV systems.

The main components of PV systems are:

- PV panel: a framework that groups several interconnected PV cells
- PV array: several PV panels connected to provide the necessary power rating
- DC Cables and connectors to link panels
- Combiner box: for DC cables from the panels subsequently supplying the inverter
- Battery Energy Storage System: a li-ion battery pack to store generated DC energy
- Inverter: to convert the direct current (DC) output to alternating current (AC) for use

  Note, some panels are fitted with micro-inverters which convert DC to AC removing the need for a separate inverter.
- Isolators: isolation switches to both DC and AC side of equipment.

The main elements of a typical PV solar installation



Risks Associated with PV Installations

The installation of a PV system on a building introduces additional hazards that need to be considered.

These range from potential fire damage associated with electrical faults, direct damage from weather related incidents, to weight overloading of the roof structure.

Risk of Fire

A major exposure introduced by PV systems is the risk of fire and the common underlying causes identified are:

- Poor installation standards
- Use of incorrectly specified or poor-quality equipment
- Use of incompatible DC connectors
- Faulty equipment or electrical system failures
- Lack of regular inspection or maintenance

Poor installation and incompatible components can allow external influences to directly affect the safety of the installation, such as allowing moisture and water ingress into components (DC & AC isolators, connectors, combiners etc.), leading to arcing and fire potential.

Poor planning at the design stage can also impact the potential fire risk. For example, installing the PV panels directly onto a combustible roof facilitating early and rapid fire spread from an incident.

Another potential issue is installing PV panels on a roof which is not capable of carrying the increased weight loading resulting in deflection or even collapse.

Research undertaken by the BRE (2017) revealed that the bulk of losses occurred in domestic installations (46%), closely followed by commercial installations (45%) with the remainder occurring in solar farms (8%).

Faults associated with the DC components were found to be the primary cause of fires, and in most cases DC isolators and connectors were an issue, followed by inverters, cables and finally the PV modules themselves.

PV solar installation component faults causing fires – BRE 2017

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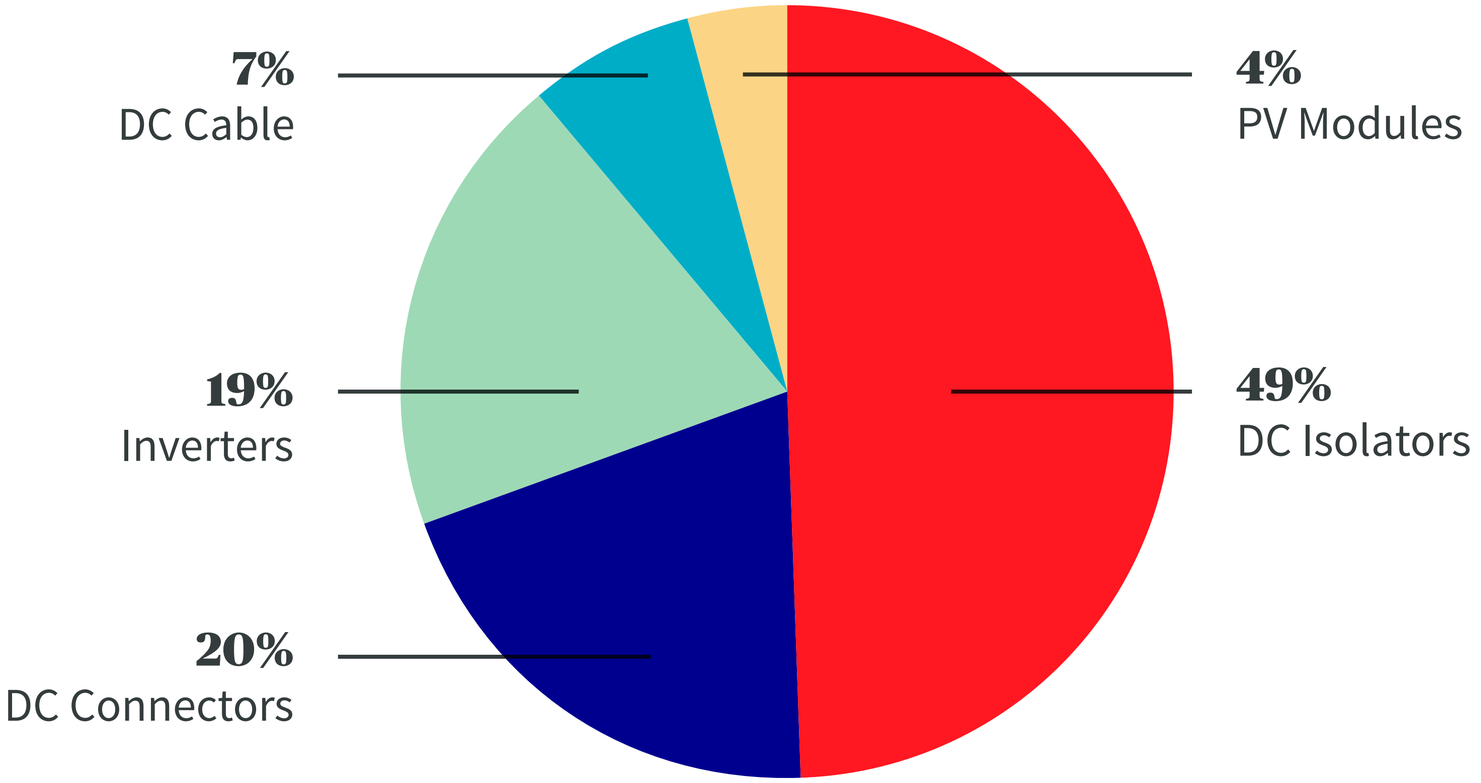


Neglected Maintenance Risks PV System Failure

Lack of regular inspection and maintenance can allow deterioration of the PV system leading to failure and potential fire.

A summary of common causes of fire are as follows:

- Ingress of moisture or water into components such as connectors, junctions, damaged cables and DC/AC isolators leading to short-circuits.
- A build-up of dirt, vegetation or bird-droppings on PV panels, causing partial shading leading to hot spots developing into faults.
- Failure of poor quality or incompatible components fitted either during initial installation or subsequently as replacement spare parts.
- Mechanical damage to cables / connectors and panels caused by maintenance personnel walking on roof (over cables / connectors), or damage caused by wildlife.
- Movement of roof / components which may result in loosening of cable connections / junctions resulting in short circuit.

Other potential risks include:

- Impact damage due to weather events (e.g., hail or wind-borne debris).
- Deliberate malicious damage.
- Falling objects (tree branches) and damage from birds.
- Overloading of the roof structure causing deflection with pooling or ingress of rainwater.
- Roof collapse from weight overload especially if there is additional build-up of snow.
- High wind and storms not considered in the original design.
- Theft of copper cables associated with the installation and the panels particularly during the construction phase prior to installation.

Case Study

Solar PV Fire at an Industrial Building

A fire occurred at an industrial building in the West Midlands, the cause of which was established as an incendive electrical fault on the cables and/or connections associated with the PV system, located on the roof.

Employees working within the building did not see any indications to suggest that a fire was in progress on the roof.

The fire quickly spread laterally across the roof space (an area over 20,000 sqm), assisted by prevailing winds with the heat causing collapse into the areas below.

26 fire appliances were dispatched to the scene, manned by around 100 firefighters. Partial demolition of buildings was required to prevent fire spread and fire crews remained on site for four days until the fire was considered fully extinguished.

The Solar PV panels and associated equipment were installed approximately 12 years ago, and the installer is unknown.

Risk Management Considerations

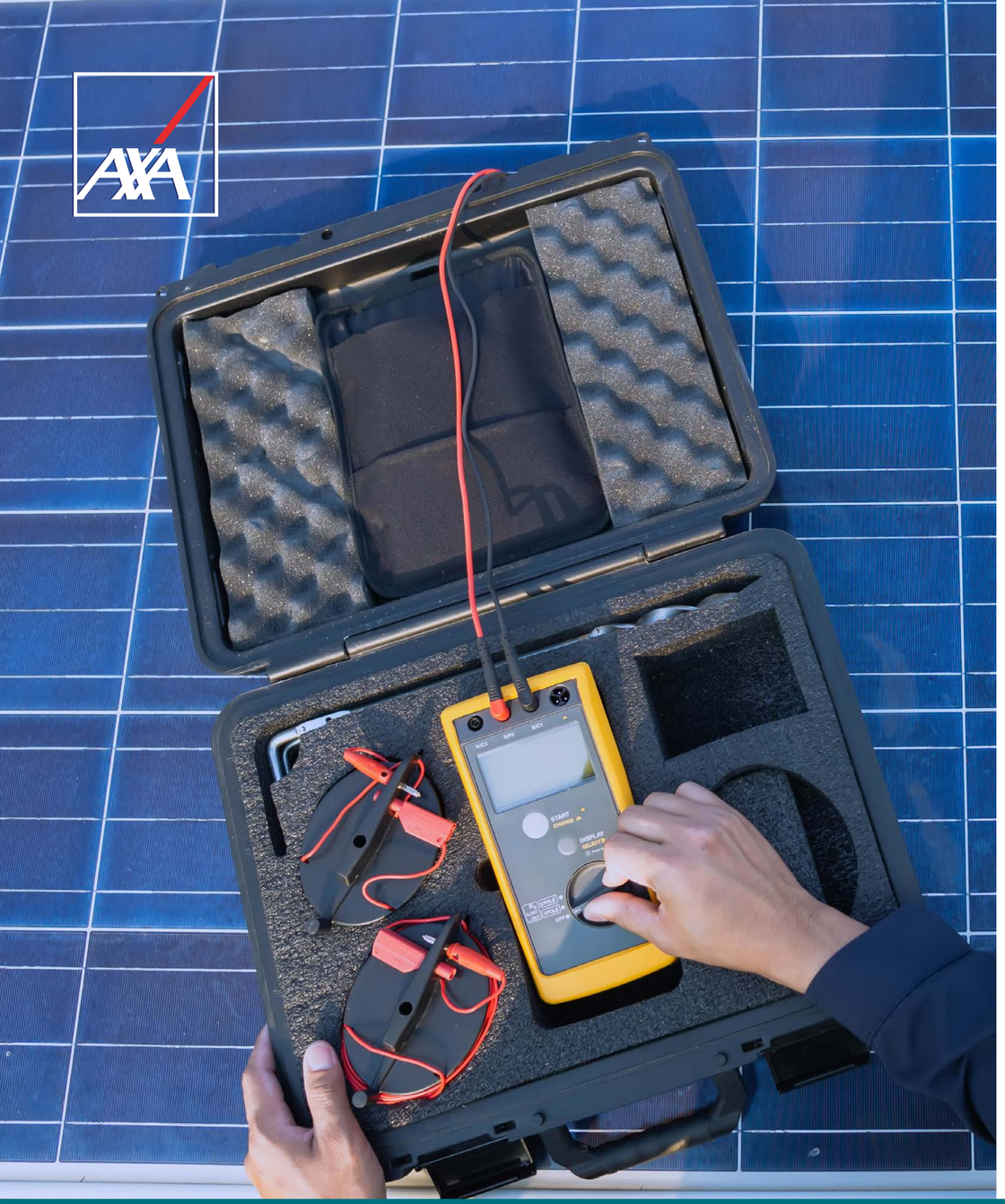
The presence of PV systems introduces potential hazards including fire, although correctly planned, installed, and maintained the risk can be substantially reduced protecting both the installation and the building to which it is attached.

Installation

- The planning, design and installation of Photovoltaic systems should be undertaken by a Microgeneration Certification Scheme (MCS) certified contractor. Following the completion of the installation, certification and handover documents need to be provided.
- Panels and other system components need to be fully compatible, with particular attention and consideration given to DC connectors (avoid cross fitting of components from different manufacturers).
- Penetrations where power cables enter the building should be provided with non-combustible sleeves to prevent transmission of fire, in either direction.
- Inverters and Battery Energy Storage Systems should ideally be in a separate fire rated compartment, free of storage and provided with automatic fire detection.
- Photovoltaic (PV) panels located on buildings (applied or integrated) should not be installed on combustible roof structures.
- If PV panels are located on a combustible roof structure, the existing roof structure needs to be fire protected with a fire-resistant covering.
- Where there are pre-existing compartment firewalls, PV equipment and cables should pass over the wall. If any cabling must pass over a compartment firewall, it needs to be enclosed in fire resistant cable ducts.
- PV panel arrays will increase the weight loading on a roof, increasing potential for collapse under normal conditions, and more notably in extreme weather conditions (e.g., snow loading). A structural assessment will need to be conducted.

Maintenance

- PV panels require regular inspections (both end user and by a suitable contractor) to ensure panels are clean, securely fixed, free of damage and build-up of vegetation of wind-blown debris.
- PV panels, associated equipment, cables / connectors, and fittings will need to be inspected, serviced, and maintained in accordance with the Original Equipment Manufacturers (OEM) instructions.
- Inverters and Battery Energy Storage Systems need to be checked to ensure fully operational, particularly fans and ventilation.
- Maintenance needs to be conducted by a competent contractor who is Microgeneration Certification Scheme (MCS) certified. Records of the maintenance activities need to be retained.
- Thermographic surveys should be considered for the PV panels and the associated electrical equipment including inverters and Battery Energy Storage Systems.
- Maintenance should not be restricted to electrical testing (e.g., resistance checks, etc.) but should also include physical inspections of fittings, cable connectors, cable supports, DC and AC isolators, etc. (Refer **MCS MIS 3002 Appendix F**).
- Safe, clear access to the roof and between rows of PV panels must be maintained to permit servicing, maintenance, cleaning and to allow fire-fighting operations.



Reference documents

Guidance on the installation, operation and maintenance of PV solar panels is provided in the following documents:

RC62: Recommendations for fire safety with PV panel installations

RE3: Need to Know Guide Rooftop mounted PV Solar Systems

MCS 005 Product Certification Scheme Requirements: Solar PV modules

Get in touch.

If you have any questions about this document, please get in touch with your usual AXA contact or your insurance broker.

Risk Management Guidance

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