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Best Practices

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MMA

ENTREPRISE

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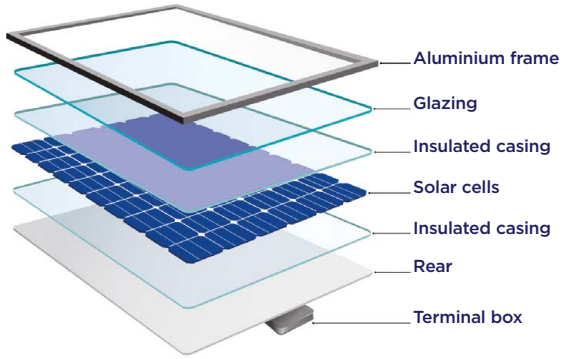
RISK DESCRIPTION

WHAT IS **PHOTOVOLTAIC ENERGY**?

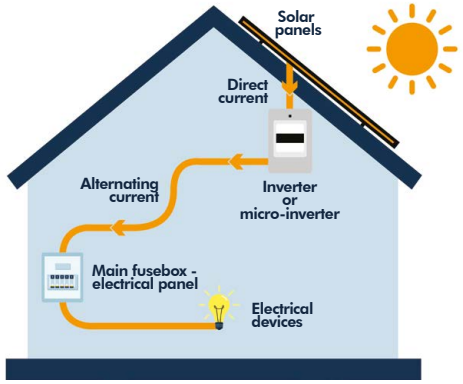
Photovoltaic panels use sunlight to produce electricity. Inverters then convert direct current from the panels into alternating current. The owner or operator of the panels (the producer) can choose one of 3 models when deciding how to sell or use the energy produced:

> Sale the entire production
> Self-consumption, with sale of surplus
> Self-consumption of entire production

Composition of a photovoltaic panel



How solar photovoltaic panels work



The number of photovoltaic panels installed has risen steeply in recent years, driven by:

enforcement of the 2020 environmental regulations, promoting self-consumption and renewable energies;

the Climate and Resilience Act of August 22,2021, as modified on March 10,2023.

> **From July 1st 2023,** new constructions, extensions and major renovations of buildings used for commercial, industrial or trade purposes, as well as storage and warehouse units larger than 500 m^2 and office buildings larger than 1000 m^2, must have a green roof or solar installation covering 30% of the roof surface.
> **From July 1st 2025,** these requirements apply to new constructions, extensions and major renovations of buildings used for administrative and educational purposes, sports, leisure and recreation facilities, as well as hospitals larger than 500 m^2.
> **From July 1st 2026,** the planted or solar surface area requirement rises to 40% of the built area, then to 50% from July 1st 2027, with these requirements extended to existing buildings from July 1st 2028.

Main types of systems

ROOF MOUNTED SYSTEMS

RISK DESCRIPTION

THE MAIN RISKS

Photovoltaic panels present two main types of risks:

Risks relating to the installation of panels:

> Watertightness fault/leak
> Detachment from the structure
> Excessive load on the building

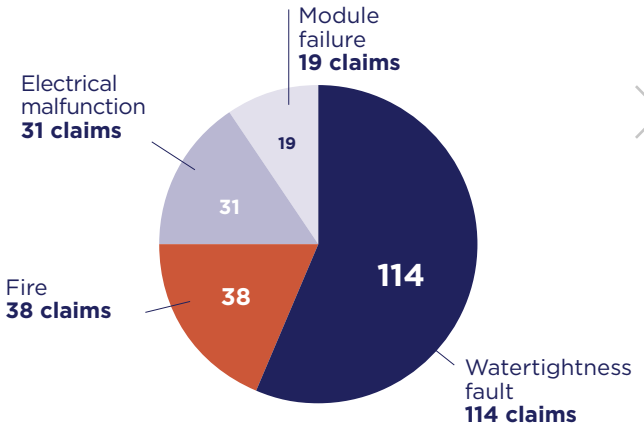
Risks relating to the installation of a live electrical system:

> Earthing fault on one or more components of the installation
> Creation of electric arcs
> Faulty connections (DC terminals)
> Defective junction boxes
> Faulty photovoltaic cells
> Damage to DC cables

A FEW FIGURES

The chart below, from France's Construction Quality Agency (AQC), identifies the underlying causes of 202 claims between 2009 and 2012.

> Watertightness fault
> Fire
> Electrical malfunction
> Module failure



Extent of damage

Action by the fire service limited the spread of the fire.

However, the flames destroyed part of the building's roof, rendering it unusable by schoolchildren. Pupils had to be sent to other schools for 2 years while the building was rebuilt.

Regarding the solar installation, 60 of the 320 photovoltaic panels were damaged. Electrical production was disrupted for 4 years following the fire.

FIRE LOSS EXAMPLE

The company

> Business activity
Operator of a photovoltaic installation to produce and sell electricity to the EDF grid, located on a council-owned sports facility.

> Status of the operator
Tenant of the roof fitted with the photovoltaic installation.

Amount of damage

Property damages €885,000
Business interruption €30,000
TOTAL..... €915,000

Loss circumstances

For 6 years, our client operated a 500 m^2 photovoltaic power plant located on the roof of a wood-framed publically owned school complex.

In the late afternoon, when the building was being used as a polling station during elections, local people coming to vote saw smoke coming from the roof. Council staff quickly alerted the fire service, shut off the power supply to the building and ordered its evacuation.

The emergency services arrived 10 minutes later. Their work was made more complex by the presence of photovoltaic panels on the roof and suspended ceilings in the building, making it difficult to target the flames directly with water. They brought the fire under control later in the evening.

A lengthy investigation determined the fire was caused by faulty manufacture or installation of the photovoltaic panels.

Extent of damage

Damage was present across the entire roof area, with approximately 1460 points of water ingress identified.

The solar installation had to be dismantled and reinstalled. All water-damaged roof components (joists and covering) also required replacement.

The building was out of use for 15 months, the time needed to make safe and repair the installation. This situation resulted in a loss of revenue for the farmer who owned the building.

WATER DAMAGE EXAMPLE

The company

> Business activity
Installer of heating and air conditioning equipment and photovoltaic panels.

> Status of the operator
Tradesperson.

> Risk insured
Construction company with 6 employees.

Amount of damage

Repair costs	€22,500
Business interruption	€75,200
TOTAL	**€97,700**

Loss circumstances

A farmer decided to fit a 650 m² integrated in-roof photovoltaic system to a farm building. The panels were installed onto a waterproof membrane to ensure the roof was watertight.

However, 5 years later the farmer noticed widespread signs of water damage to the wooden roof beneath the PV installation.

The water damage was caused by the use of an unsuitable membrane that had also been pierced by the installer when fitting mounting hardware for the photovoltaic panels.

RECOMMENDATIONS FROM OUR LOSS PREVENTION SPECIALIST

5 key criteria must be considered to make sure a photovoltaic installation is reliable and safe:

1. Type of activity beneath the panels
2. Type of installation
3. Choice of installer
4. Electrical installation
5. Installation maintenance and upkeep

1) Type of activity beneath the panels

You are advised not to install photovoltaic panels over for the following activities:

- Activities that can create an explosive atmosphere.

- Activities that can create a corrosive atmosphere that may negatively impact the quality of cables or electrical connections located at roof level.

- Storage or distribution of flammable gases or liquids.

- Building used for livestock, a sawmill, carpentry, waste sorting or processing, fuel service station, surface treatments,...

- Storage of fodder, cereals, fertilizer.

2) Type of installation

Whenever possible, **ground-mounted** photovoltaic systems, at distance from premises, are preferred **over roof-mounted** installations.

Whatever the type of installation, only photovoltaic modules complying with international standards for electrical performance and safety shall be used (such as IEC 61730/61215 and ANSI/UL 1703).

The combination of insulation, watertightness system, mounting hardware and panels must have a valid technical approval - ATEC.

Systems with French “Étude Technique Nouvelle – ETN” - status are accepted in accordance with a regularly updated list.

Internationally approval / listing of a recognized testing laboratory, such as TÜV Rheinland, Underwriters Laboratories (UL), FM Approvals, shall be available.

> Ground-mounted photovoltaic systems:

- Distance from the premises is advised at 10 meters in order to ensure any impact on the main activity.

> Roof mounted photovoltaic systems:

- Integrated in-roof installations should be avoided, roof-mounted is preferred.

- A structural load analysis must be made to check that the building can accept the extra loading associated with photovoltaic installation.

- Flexible panels are prohibited.

RECOMMENDATIONS FROM OUR LOSS PREVENTION SPECIALIST

- Photovoltaic panels must not be installed nearer than:
• 1m from the building edge, any technical equipment, gullies and rainwater collection systems;
• 2m from smoke extraction vents and skylights;
• 5m from either side of separating fire walls.

- The roof assembly must comply with Broof T3*.

- For new constructions, bituminous coatings with mineral additives are preferred, where possible.

- When fitting above a bituminous or PVC coating, anchoring of the panels chassis shall be carefully performed by sealing specialist contractors only.

3) Choice of installer

The choice of installer is **critical** to the ultimate quality of an installation. The installer must provide a civil insurance certificate naming the specific worksite.

To prevent problems with completing and delivering the system, you should check that, as a minimum, the installer holds sufficient qualifications to recognized local standard. For example, in France:

- QualiPV module Elec.

- Qualifelec SPV1 (for power ≤ 36 kWp) / SPV2 (P ≤ 250 kWp) / SPV3 (P > 250 kWp).

4) Electrical installation

The installation should be in accordance with relevant national electrical codes/rules, or equivalent international codes or standards, including proper ground fault protection. Examples listed below:
- UTE 15-712-1
- NF C 15-100
- NF C 13-100 (if HTA)
- APSAD D20
- NFPA 70E

- The ratio between the panel power and admissible inverter power must be within the range specified by the manufacturer.

- Module-Level Power Electronics (MLPE) should be used. These act to lower the current at panel level, keeping current below the 120-volt DC extra-low voltage threshold.

- Inverters must be fitted with series and parallel arc-fault circuit interrupters (AFCI).

- String inverters must be fitted as close as possible to panels, at the top of solar canopy support columns and, ideally, on the roof for roof-mounted installations on flat roofs.

- Roof-mounted inverters must be securely attached to a non-combustible mounting. In cases where inverters are installed at ground level, it is advisable to fit EI60 or EI90 fire resistant insulation between the inverter and the roof coating, and to ensure a secure mounting to prevent the inverter moving in strong winds.

*Broof (t3): fire resistance classification for roofs (as defined in the decree dated 14 February 2003), requiring a delay of not less than 30 minutes before fire penetrates a roof and flame spreads to its upper surface.

RECOMMENDATIONS FROM OUR LOSS PREVENTION SPECIALIST

- Inside the building, inverters must be located in a dedicated room with 2-hour fire resistance (REI 120), accessible from outside.

- Outside the building, inverters must be located in a dedicated room with 2-hour fire resistance rating (REI 120), not less than the wall facing the building and the two return walls, the last non facing side may be protected by a grating providing IPXX protection. This technical room must be fitted with:

• 1-hour fire door (EI60) as a minimum;
• High-level and low-level ventilation;
• Automatic fire and intrusion detection, with 24/7 alarm monitoring (remote surveillance or supervision).

- Particular care must be made to ensure all equipment are earthed correctly.

- Direct Current (DC) cable runs must:

• Be routed outside the main building, no penetration within the building envelope is allowed;
• Enter the inverter room directly;
• Be separated from the building's walls and roof by a partition providing at least an EI60 fire resistance, or kept at a distance of 5 cm as a minimum in situations where the partition is not resistant to at least EI60;
• Be protected against mechanical impacts.

- When first commissioning a photovoltaic installation, infrared thermography must be performed to inspect all AC and DC installations (inverter and panel connector boxes).

5) Installation maintenance and upkeep

A well-maintained installation will last well. Maintenance is key to monitoring a photovoltaic installation and keeping it safe.

It is advisable to set up a maintenance contract with a professional, including at least 1 annual visit and covering the following points:

- visual inspection of photovoltaic panels, cables and connections;

- cleaning photovoltaic panels;

- infrared thermography inspection with the issue of a report and certificate, via a drone for PV panel fields;

- string measurement readings: open circuit voltage (Vco), current at maximum output (Impp), Riso (insulation resistance);

- visual inspection of inverters and ventilation filters;

- inspection of AC and DC cable connections and their tightness, as described in safety instructions from the supplier;

- Inspection of all safety equipment (fire protection, back-up emergency lighting, emergency torches,...);

- cleaning technical room air vents;

- removing dust from technical room;

- repair or replace of any defective items (cable, terminal, fuse,...);

- verification of conformity of the immediate environment of the installation.

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Discover all our risk prevention guides: **http://entreprise.mma.fr/connexionpro/univers/prevention**

Contact us: **prevention@groupe-mma.fr**

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