PROBITUMEN
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Position Paper (update 10-01-2022)

FIRE SAFETY OF PV PANELS ON FLAT ROOFS

Summary

As the number of solar panels on roofs has increased exponentially, so has the debate on fire safety. The fire risk seems to be pinned on the roofing structure. ProBitumen believes that this position is unjustified. Tests have shown that the solution does not lie in the choice of roofing material or thermal insulation.

Measures to limit the spread of fire must be included in the design of a photovoltaic (PV) system for a flat roof. ProBitumen argues for an approach to prevent fires initiated at the PV installation in the first place and to develop effective measures in parallel. This approach requires knowledge of the fire behaviour of PV installations on roofs.

Drive

The solar energy sector has seen fast paced growth in recent years. In 2020, the installed capacity of PV panels has increased by more than 40% to 10,213 MWp [1]. That represents a tenfold increase since 2014. Today, there are approximately 34 million PV panels or 3.4 million solar energy systems [2], many of which are installed on residential houses.

In most policies, the installation of PV systems is considered a relevant change to the building which must be reported to the building insurer. Movable PV installations placed on the roof are not always regarded as part of the property and therefore may not be covered by the home insurance. In order to limit the cost of damage caused by fires in PV installations on roofs, insurers and insurance brokers should adjust their policy conditions.

Furthermore, insurers are increasingly imposing fire safety requirements for roof systems that go beyond building regulations. They seem to start from the assumption that there is a real chance of fire starting in PV installations and that the fire must be prevented from spreading. As a result, certain roof systems or materials are prescribed or excluded and requirements such as: 'non-combustible' are formulated. One wonders to what extent these requirements actually

[1] Source: CBS

[2] At an average power of 300 Wp per panel; 3 kWp per system

contribute to fire safety. Moreover, the total number of fires with PV systems is very small compared to the number of PV installations.

Purpose of this position paper

This position paper examines the issue of fire safety and makes recommendations for a safe installation of PV panels on flat roofs. It aims to avoid unsuitable solutions being chosen or prescribed and/or to prevent PV projects from being unjustly excluded from insurance policies. It also intends to avoid PV systems being taken out of service which would hinder advances in using roofs for solar energy and, thus, would also slow the achievement of climate goals.

Fires on roofs with PV systems

In 2018, TNO conducted an investigation[3], commissioned by the Netherlands' Enterprise Agency (RVO), into the 23 fire incidents involving residential houses that took place in 2018. In a third of these cases, the incident involved so-called in-roof PV systems (also known as Building Integrated PV or BIPV). TNO stated that, according to the damage adjusters, this share could even be estimated at 80 to 90 percent. This applies only to pitched roofs.

The TNO report showed that, in most cases, the cause was connector related ('cross mating '). Damage adjusters estimated that problems with connectors were by far the most important cause: according to the TNO report, between 80 and 99 percent of all fires were said to be caused by connector issues.

Three of the fires initiated on PV equipped roofs in 2018, occurred on flat roofs, two of which were on residential homes.

TNO: "between 80 and 99 percent of all fires are caused by connector related issues."

Building regulations and fire behaviour

Building Decree 2012 sets requirements for the flammability of the top layer of roofs and, therefore, refers to NEN 6063[4]. This standard is based on preventing fire caused by windborne embers: when sparks and small burning material from a local fire fly through the air and end up on the roof.

The NEN 6063 standard is executed as a system test in a standard test situation, which may be extrapolated to other roofing applications. Practice has shown that this leads to a sufficient degree of fire safety, according to the preface of NEN 6063. NEN 6063 largely refers to (NPR-) CEN/TS 1187 [5].

[3] TNO 2019 P10287 EE. Gang and NJJ. Dekker - Fire incidents with photovoltaic (PV) systems in the Netherlands

[4] NEN 6063:2019 Determination of the fire hazard of roofs

[5] CEN/TS 1187:2012 and Test methods for roof fire hazards (Test methods for external fire exposure to robbery)

The requirements for the fire behaviour of materials that form the surface of construction parts aim at preventing an incipient fire from spreading quickly along the surface of construction parts. Since the implementation of the Building Decree 2012, building materials have been tested and classified in so-called Euro Classes defined in accordance with (NEN-) EN 13501-1[6]. There is no general requirement for roofs concerning the fire behaviour of materials used on the outside of a building, other than the system test based on NEN 6063. So, there are no legal requirements for the *fire class* of roofing and roof insulation materials. Moreover, there is no distinction between fire classes for the various flexible roofing systems made of different materials (bitumen, plastic and synthetic rubber): fire class E.

There is no distinction between fire classes for flexible roofing systems, namel,y fire class E.

EN 13501-5[7]also has a fire classification for construction products and construction parts. The classification is determined on the basis of a test according to CEN/TS 1187. Roof systems are generally tested according to t1: fire only. Most roofing systems consisting of roofing membrane sheets have a B_{ROOF}(t1) rating.

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In Belgium, B_{ROOF}(t1) is required. The tests according to CEN/TS 1187 are, as with NEN 6063, based on the propagation of fire as a result of windborne embers.

Occasionally, an FM Approval is advised or even prescribed. FM Approval is an American quality mark that has no legal status in the Netherlands. It is issued by FM Approvals, which is part of the insurance company FM Global. An FM Approval is based on system testing where all components must have been assessed in the approved system. An FM Approval covers several safety aspects, but there is no relationship between FM requirements and local, national safety requirements. Therefore, compliance with national requirements for wind resistance and resistance to fire cannot be demonstrated with an FM Approval. The FM classification also has no relationship with the Euro Classes: a product Euro Class E can have an FM Approval Class 1. Some insurance companies - adhere to the FM Approval.

[6] NEN -EN 13501-1:2019 Fire classification of construction products and construction parts - Part 1: Classification based on results of testing the fire behavior

[7] NEN -EN 13501-5:2016 Fire classification of construction products and construction parts - Part 5: Classification based on results of roof fire hazard tests

An FM Approval gives no certainty about the fire behaviour of a PV panel equipped roof. No tests have been carried out at that level.

Although it is not designated in the Building Decree, Dutch standard NEN 7250[8] is the standard for the architectural requirements concerning PV panels on roofs and facades. The requirement with regard to fire safety from Building Decree 2012 is repeated in standard NEN 7250.

The Dutch Quality Assurance for Building Act has a role to play in new constructions. The quality assurance officer should identify a PV installation as a risk and supervise its assembly and installation. Installations of PV systems on existing buildings are exempted, since in general, these will not require an authorisation.

PV system regulations

PV installations are electrical installations and must meet the legal (safety) requirements for electrical installations. Based on the Building Decree 2012, the installation must meet the safety-related requirements of NEN 1010. In 2015, NEN 1010 was expanded with requirements for PV installations (part 712). NEN 1010 explicitly refers to the prevention of fire as a result of short circuits and overheating in the installations. DC connectors between power lines must comply with NEN - EN- IEC 62852[9] to ensure that they fit together properly. Different brands may not be compatible and are, therefore, unsuitable to in combination. That is why plugs and sockets of different makes may only be used together if both manufacturers endorse their compatibility.

In addition, components of PV systems must bear a legally required CE marking. CE label marking is based on two European directives: the Low Voltage Directive[10] (LVD) and the EMC Directive[11]. The LVD is a directive and, as such, it is established in Dutch law via the Electrical Equipment (Commodities Act) Decree (2016). The Dutch Food and Consumer Product Safety Authority (NVWA) is the supervisory authority. The EMC directive is not relevant for this subject.

On April 27, 2019 the European Regulation Requirements for Generators (RfG) came into effect setting requirements for PV installations, however, only for supply-to the public grid.

Quality systems PV installations

There are no compulsory quality programmes for PV installations in the Benelux. In the Netherlands, Zonnekeur is a voluntary quality scheme. The regulation is aimed at system installers obliging them to supply products that meet the aforementioned standards; it also sets requirements for professional competence. At the moment, some 70 installers are accredited.

There are no mandatory quality systems for PV installations in the Benelux.

[8] NEN 7250:2014/A1:2015 Solar energy systems – Integration in roofs and facades – Architectural aspects

[9] NEN-EN-IEC 62852:2015/C11:2019 Connectors for direct current in photovoltaic systems - Safety requirements and tests

[10] LVD, 2014/35/EU Low Voltage Directive

[11] Electromagnetic Compatibility

Belgium uses, among other things, the Quest quality label for system installers (SOLAR PV), which also focuses on the installer's professional competence. InstallQ is developing a new quality scheme for installers of PV installations in collaboration with Techniek Nederland and Holland Solar. SCIOS[12] has recently introduced an inspection scheme for solar power installations (scope 12). The SCIOS scheme plans the post-installation inspection, whilst the InstallQ programme focuses on the process from design to connection.

Finally, in the United Kingdom they have a more or less compulsory MCS[13] certification for both components (MCS-005) and system installers (MIS 3001). The product certification is based on EN standards 61215[14] and 61730[15]. Many European suppliers of PV panels possess these certificates for the products they supply.

The quality regulations and standards mentioned (except NEN 1010) do not seem to set any direct requirements related to the prevention of fires caused by short circuits or overheating.

Testing PV on flat roofs

In the spring of 2021, ProBitumen commissioned KIWA-BDA to carry out two series of tests combining roofing and PV panels. Initially, tests were carried out with glass-foil panels and bitumen as well as EPDM and PVC roofing. In a second round, the same roof coverings were tested in combination with glass-glass panels.

The tests were carried out according to the CLC /TR 50670[16] principles. A gas burner was placed and ignited between the PV panel and the roof covering.

In the tests with glass-foil panels, we observed that the fire started in the panels and shortly afterwards in the roofing. Within 4 to 5 minutes the fire had developed to such an extent that it had to be extinguished. We saw a similar pattern with the glass-glass panels. The panels and roofing ignited and the fire had to be extinguished after 5 to 8 minutes.

[12] SCIOS foundation owns, manages and develops the quality system for the benefit of installation owners and inspection and installation companies for the inspection and maintenance of technical installations.

[13] MCS is a scheme manager of schemes in the field of sustainability and energy efficiency

[14] NEN -EN- IEC 61215 Photovoltaic (PV) modules for terrestrial applications - Design classification and type approval

[15] NEN -EN- IEC 61730 Safety qualification of photovoltaic (PV) modules

[16] CLC/TR 50670:2016 – External fire exposure to roofs in combination with photovoltaic (PV) arrays – Test method(s).

The testing method, the power of the gas burner and the test configuration may be debated, but one thing is clear: sooner or later, regardless of roofing material, the roof will burn. The presence of PV panels influences the propagation of the fire.

Industry associations NVPU and Stybenex have performed the same type of tests with comparable results. This leads to the conclusion that the construction of roofing systems cannot solve the fire risk of PV panels on roofs. Instead, the solution tackling fire ignition on roofs, lies in measures that will limit the spread of fire, e.g., maximum size of a cluster of panels, orientation, compartmentalisation and shielding between panels and roofing.

ProBitumen Position

ProBitumen is in favour of a multifunctional use of roofs, provided that it is done in a responsible manner. This also applies to the installation of solar energy systems on roofs. In fact, bitumen is ideally suited for this type of application because of its durable watertightness and that is why various suppliers of PV installations recommend bituminous roofing as a suitable substrate.

Flat roofs are ideal for all manner of installations such as ventilation, cooling, solar heat, solar power and possibly battery packs in the future. Fire safety is a topic that has the full attention of the (bitumen) roofing industry. Many products are KOMO-certified and have demonstrated that they meet the strict requirements of fire resistance according to NEN 6063 of the Building Decree 2012. The BUtgb - certified products have a technical approval (ATG) for the B_{ROOF} (t1) that is mandatory in Belgium.

CE marks, standards, quality regulations and legislation currently seem insufficient to prevent fires in PV installations. At the same time, we must note that the small number of fires is concentrated in integrated PV panels in pitched roofs. According to experts, the cause resides in the electrical installation itself, precisely in the connectors.

Therefore, it would seem indefensible to impose requirements on roofing and roof insulation without tackling the source of the problem. Current roofing systems are the result of continuous development. Higher insulation values lead to thicker insulation packages with a higher compressive strength to guarantee the quality of roofing in the longer run. We must not be dragged backwards by unfounded demands that place the quality of the roofing systems under pressure, and which cause damage to the roofing, potentially leading to significant (water) damage.

ProBitumen is calling for a stricter regulation and enforcement of the supply, assembly and installation of PV systems. Techniek Nederland points out that fire due to PV installations can easily be limited by installing in compliance with the regulations. In that case, a legal system for mounting and installing PV installations - also advocated by Holland Solar -, as well as legal quality requirements for PV installations or a mandatory permit for installing PV installations are options that may significantly limit the risks.

ProBitumen pleads for a stricter regulation and enforcement of the supply, assembly and installation of PV-systems.

We do not expect a government quality system to be prescribed, but it is possible to include such a requirement in insurance conditions. Another option is to include an inspection of the installation as intended by the SCIOS inspection scheme scope 12 or the InstallQ accreditation, as a condition of insurance.

In addition, we should not ignore what happens when a fire ignites. The different tests show that the choice of roofing and/or thermal insulation does not offer the solution that has been suggested. In our view, the vastly more logical solution to limit damages, is to consider measures that would limit the propagation of a potential fire.

In that light, it makes no sense to carry out expensive, large-scale product tests in order to determine that the solution does not lie in the choice of the roofing construction. However, it is necessary to investigate how a fire in and around a PV installation develops in order to conceive and test measures. These measures and the choice of PV installation on a roof must be linked and incorporated in the design of a PV installation. This puts the responsibility where it belongs. The same applies to all (future) developments related to roofs, such as cooling installations, heat pumps, battery packs, and the like.

ProBitumen is ready to engage with sector representations, such as Techniek Nederland, Holland Solar, the Dutch Association of Insurers and the legislator in order to arrive at responsible solutions. ProBitumen is willing to contribute and work on suitable solutions that do justice to the quality of roofing systems.

Tips

Many insurance issues can be avoided by discussing a plan for installing PV systems with the building's insurer prior to implementation. In many cases, the installation of PV systems is considered a change to the building and must be reported according to the policy conditions. This is primarily a task of the building owner as policyholder, but there is also a role for the installer or roofer to point this out to the building owner.

Complementary information (update 10-01-2022)

The present position paper has been compiled with the utmost care, based on the best available knowledge and information from ProBitumen members, from surveys conducted and from public sources. ProBitumen accepts no liability for (any missing) information in this position paper.