

Photovoltaic systems: Recommendations on loss prevention

CFPA-E Guideline No 37:2018 F





FOREWORD

The European fire protection associations (CFPA-E) have decided to produce common guidelines in order to achieve similar interpretation in European countries and to give examples of acceptable solutions, concepts and models. The Confederation of Fire Protection Associations in Europe (CFPA-E) has the aim to facilitate and support fire protection work in European countries.

The market imposes new demands for quality and safety. Today, fire protection forms an integral part of a modern strategy for survival and competitiveness.

The measures of Natural Hazards Guidelines concern not only operators, businesses, specialists and plant officers, but also the population and local administration. This is due to the fact that in contrast to fire, the impact of natural hazards as a result of drought, are often very widespread.

The proposals within this guideline have been produced by GDV, Gesamtverband der Deutschen Versicherungswirtschaft e.V., and Dr.-Ing Mingyi Wang has done the final preparation.

The Guideline has been compiled by Natural Hazards Group in the Guidelines Commission and adopted by all fire protection associations in the Confederation of Fire Protection Associations Europe.

These guidelines reflect best practice developed by the countries of CFPA Europe. Where the guidelines and national requirement conflict, national requirements must apply.

Copenhagen, February 2018
CFPA Europe

Jesper Ditlev
Chairman

Madrid, February 2018
Guidelines Commission

Miguel Vidueira
Chairman





Contents

1. Introduction	4
2. Scope	4
3. Definitions.....	4
4. Hazards and risks	6
5. Prevention measures	8
5.1 Preliminary	9
5.2 Planning and Installation	9
5.2.1 Stability	9
5.2.2 Electrical safety, lightning and surge protection	10
5.2.3 Fire protection.....	11
5.2.4 Theft protection	13
5.3 Before start of operation.....	14
5.4 Operation	14
5.5 Special information on fire fighting	15
6. Literature	16
7. Appendix: Checklists for the planning and acceptance of PV systems.....	17
8. European guidelines	22

Key words: photovoltaic systems, PV modules, inverter, stability, electrical safety, fire safety, security.



1. Introduction

Photovoltaic systems are being increasingly installed to meet solar energy demand.

For the electrical energy generation, components of photovoltaic systems, especially solar modules, are mounted on buildings in order to optimally capture the sunlight. These components are exposed to the weather, such as wind, snow, hail and temperature fluctuations, but may also benefit from existing structural elements with regards to their protective function e.g. fire protection.

This guideline should give guidance for the proper design, installation, operation and maintenance so that safe operation of photovoltaic systems can be assured.

2. Scope

The current guideline covers grid-connected photovoltaic systems installed on buildings. It provides information on loss prevention with respect to fire protection, firefighting, mechanical, electrical and security aspects. This guideline is primarily directed at

- planners,
- installers and auditors of electrical installations,
- operators of photovoltaic systems and
- building owners.

This publication is based on the current knowledge and previous experience of loss prevention and risk management. It will be reviewed regularly and updated when there are significant improvements or changes in this field.

Legal regulations are not affected.

3. Definitions

Grid-connected **photovoltaic system**: as abbreviated to PV system, it converts sunlight into electricity, which used internally or fed in the public grid. In contrast, solar thermal systems convert sunlight into heat. PV systems essentially consist of the following components:

- (1) **PV generator** may consist of one or more interconnected PV modules.
- (2) **Generator connection box** (optional) brings separate strings together and may include protective equipment, for example, surge protection devices, string fuses
- (3) **Cabling** on the DC side
- (4) **Switch disconnectors**, required for maintenance on the inverter and is often integrated in the inverter
- (5) **Inverter**, formed direct current (DC) and DC voltage to grid-compliant alternating current (AC) and AC voltage,
- (6) **Cabling** on the AC side
- (7) **Sub distribution**
- (8) **Feed meter** and / or **counters** for their own consumption

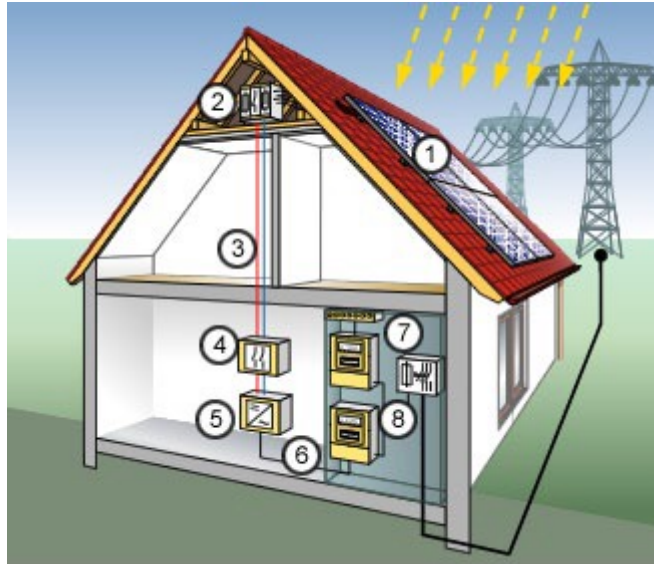


Figure 1 Basic design of a photovoltaic system (source: DGS)

Building integrated PV systems: PV systems with PV modules as part of the building envelope. They are integrated into the roof or the facade and meet in addition to the function of electricity generation at least one constructional function, such as weather protection, thermal protection, electromagnetic shielding.

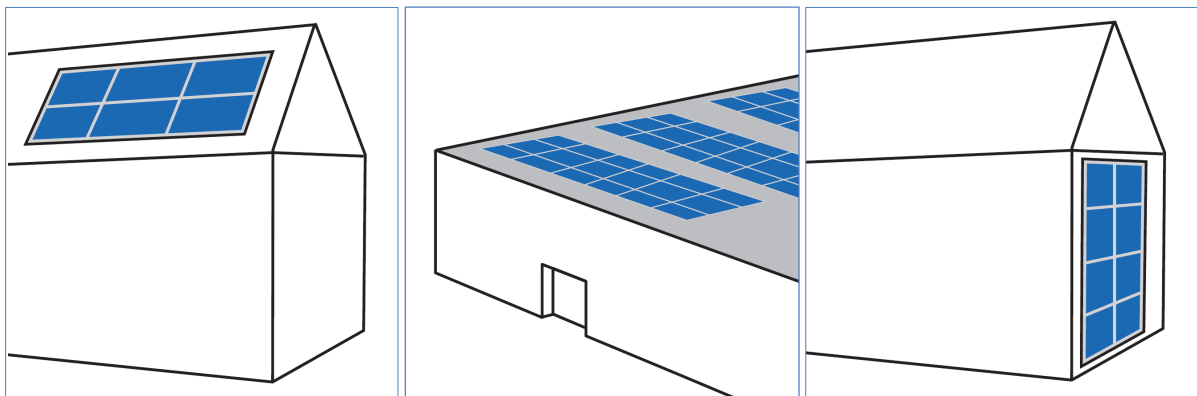


Figure 2 Examples of building integrated PV systems (source: VdS)

Additive PV systems: PV systems with PV modules in addition to or for the building envelope. They are fixed in parallel or at an angle to the adjacent roof or façade.

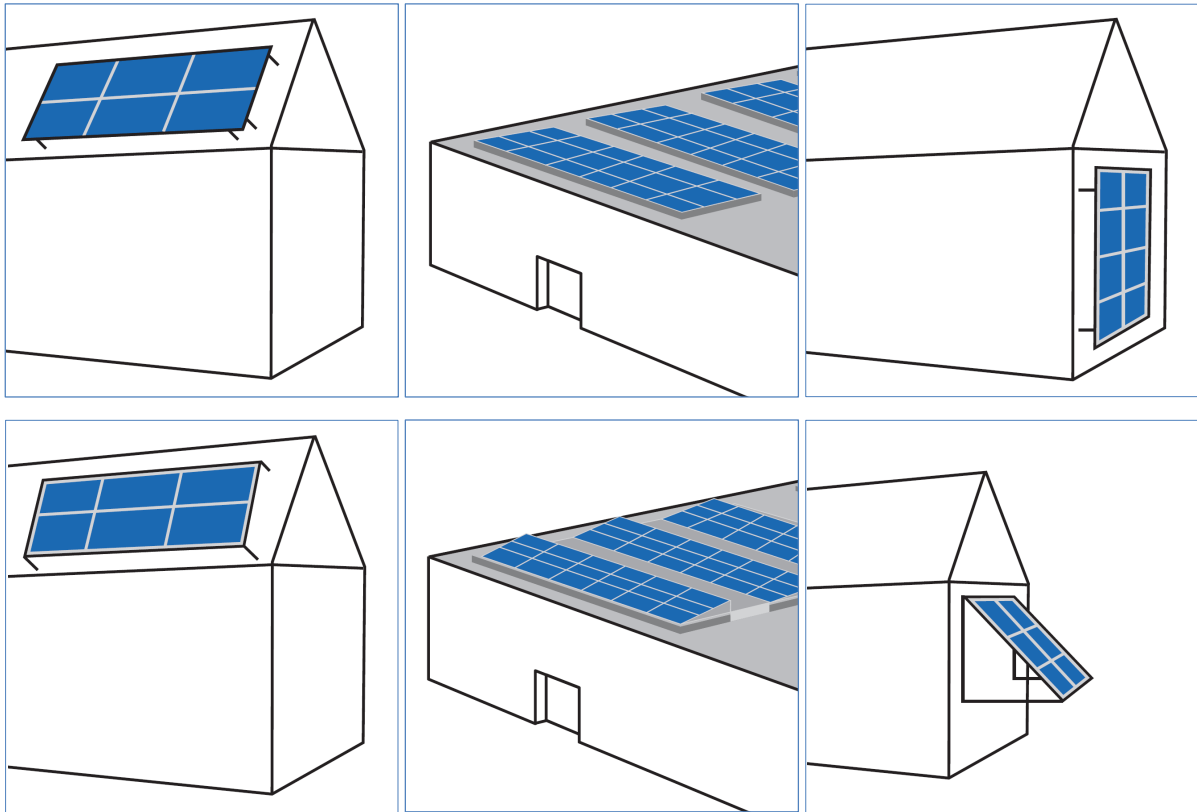


Figure 3 Examples of additive PV systems (source: VdS)

Mounting system: the means of securely fixing the PV modules to the building. It essentially consists of a supporting frame, whereby the loads on the PV modules are introduced in it, and fastening elements, so that the PV modules are anchored to the support frame and the support frame are anchored to the adjacent building components

4. Hazards and risks

In installing a PV system which is a complex technical system, hazards can be generated, for example, through planning, installation and operation errors. In addition, they are exposed to a number of external threats to both their structure and function, such as

- wind
- snow, ice
- hail
- lightning and overvoltage
- fire
- theft
- rodents

Thereby the regular energy production and the use of buildings can be negatively affected.



Figure 4 Example of storm damaged PV modules on the roof (source: VdS 3145)



Figure 5 A roof with PV modules collapsed under snow load (source: VdS 3145)



Figure 6 Fire damaged roof with destroyed PV modules (source: VKB)



Figure 7 A roof tile damaged by roof hooks for attachment of PV modules (source: VdS 3145)

In addition a fire caused by installation of PV system, e. g. PV module, can also damage the adjacent building construction, e. g. roof covering and facade

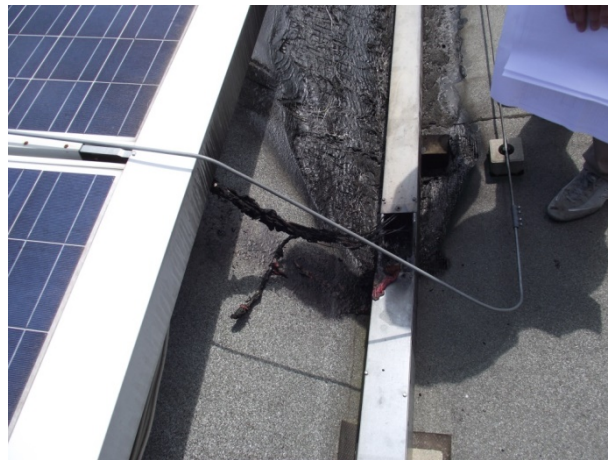


Figure 8 Damage on roof covering caused by fire of PV-installation (Source Guido G. Zaccarelli)

5. Prevention measures

In the planning, installation and operation of PV systems it is always necessary to take care that the performance of impacted building components, e. g. roofing roof cover or façade, and their use are not affected negatively.

Protective measures that are necessary due to the installation of PV systems, their operation and locally expected external threats (see section 4) should be adapted to the existing protection concept and measures for the building and its use.

All protection measures should conform to generally accepted rules and standards as necessary.



To ensure the optimal planning, installation and operation of PV systems, experience indicates that it is appropriate to consider the protection concepts and measures with all involved parties including the insurer.

5.1 Preliminary

For the effective configuration of a PV system following questions should be clarified:

- Location of the site with respect to the
 - optimal capture of sunlight (arrangement of PV modules on the roof or on the facade, parallel or at an angle to the roof or to the façade, avoid of shading) and
 - the loading capacity of the existing structure to bear additional loads
 - possible spread of fire caused by installation of PV system at roof or on façade, e. g. PV module, that must be avoid
- Which site specific environmental hazards should be expected from the surroundings (e. g. lightning, storm, hail, fire, flood, see section 4)
- What additional loads caused by the installation (e. g. static loads on the roof or façade by the own weight of PV modules, possibly modified arrangement of wind and snow load)

This comprehensive information underpins all aspects of the installation for planning, installation and maintenance.

5.2 Planning and Installation

5.2.1 Stability

When commissioning the planning and installation, the operator should check, whether the planners and contractors have the necessary expertise and experience. Otherwise suitable professionals should be engaged, such as structural engineers, electrical and roofing experts.

All aspects of the planning and installation of PV systems shall be fully documented, including any changes or adaptations necessary during installation, in order to ensure safe and trouble-free operation.

For the assessment of the stability and the sizing of relevant construction all expected load cases from its own weight, possible effects from the site specific surroundings and additional loads caused by the installation should be considered.

If the load capacity of the existing structure, such as roof construction, is not sufficient, the effected construction must be suitably upgraded to suit or the installation must be moved to an other and suitable place.

When choosing the appropriate mounting system for installation, the following aspects must be considered:

- Roof shape (flat roof or pitched roof)
- Roofing system and materials
- Possibility of load transmission by the installation of the PV modules and possibly other parts of the PV system



- Specific manufacturers requirements for the mounting of PV modules and construction components
- Permissible load of the support frame and fixings according to information provided by the respective manufacturer.

5.2.2 Electrical safety, lightning and surge protection

PV systems and its components, such as modules, cables, inverters including measures for lightning and surge protection and their installation must conform to the generally recognized rules for electrical installations and manufacturers instructions.

Note: See

EN 61215 Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval (IEC 82/684/CD)

EN 61646 Thin-film terrestrial photovoltaic (PV) modules - Design qualification and type approval (IEC 61646)

EN 62108 Concentrator photovoltaic (CPV) modules and assemblies - Design qualification and type approval (IEC 62108)

EN 61730 Photovoltaic (PV) module safety qualification

- *Part 1: Requirements for construction (IEC 61730-1:2004, modified)*
- *Part 2: Requirements for testing (IEC 82/663/CD)*

EN 62446 Grid connected PV systems - Minimum requirements for system documentation, commissioning tests and inspection (IEC 82/749/CD)

EN 50178 Electronic equipment for use in power installations

EN 60439 Low-voltage switchgear and control gear assemblies

- *Part 1: Type-tested and partially type-tested assemblies - Guide for testing under conditions of arcing due to an internal fault (IEC/TR 61641)*

EN 61439 Low-voltage switchgear and control gear assemblies

- *Part 1: General rules (IEC 61439-1)*
- *Part 2: Power switchgear and control gear assemblies (IEC 61439-2)*

PV systems should be protected against lightning and overvoltage and where appropriate, incorporated into the existing lightning protection system. Similarly the existing lightning protection must not be affected by a PV system. Therefore, the lightning protection system should be suitably interfaced and coordinated with the PV system. It is preferable that the PV modules are located completely within the protection area of the existing lightning protection system. In this case, a sufficient separation distance should be respected.

Note:

EN 62305-3 Protection against lightning

- *Part 3: Physical damage to structures and life hazard (IEC 62305-3, modified)*
- *Supplement 5: Lightning and overvoltage protection for photovoltaic power supply systems*



CFPA Europe Guideline No 4 2013 N: Lightning protection

Note: A combination of frequent shading of the panels together with inadequate heat dissipation in the junction box can lead to failure of the module bypass diodes. Failure can also result from lightning overvoltage and reversed polarity of the diodes. Care should be taken to prevent partial shading of the panels.

5.2.3 Fire protection

Components of PV systems often contain flammable materials. In order to effectively limit the spread of fire via components of PV systems, the following measures are required:

- Components of PV systems with combustible elements, e. g. cables, are not allowed to be passed over a compartment / fire wall. If this cannot be avoided, they should be installed in fire-resistant cable ducts and shafts

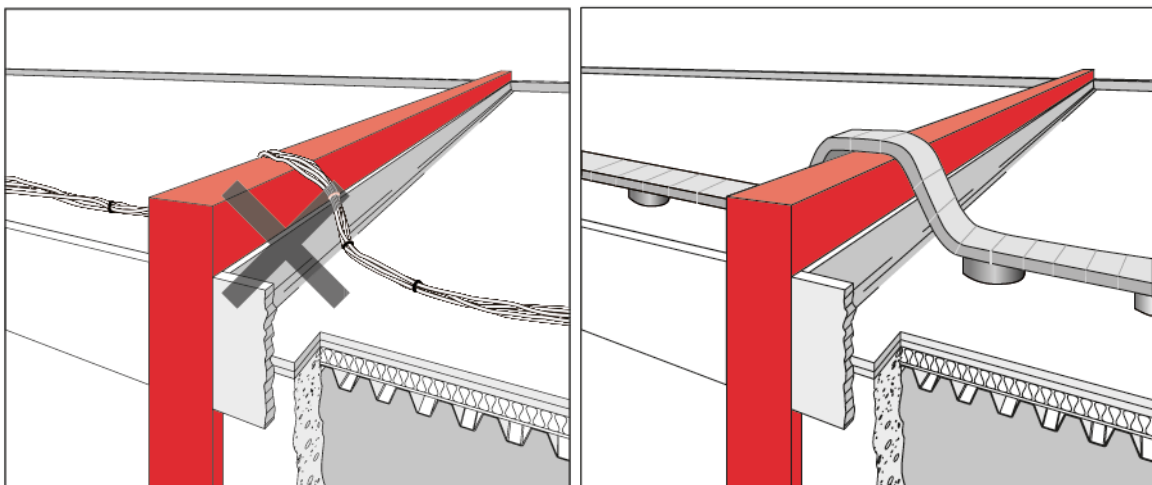


Figure 9 Conduct of cables in connection with a fire wall (source: VdS 2234)

- On roofs there should be a minimum distance of 2,5 m between the PV modules on both sides of the compartment / fire walls ; a reduced distance is permitted if the potential for a fire to spread across a compartment boundary is considered.

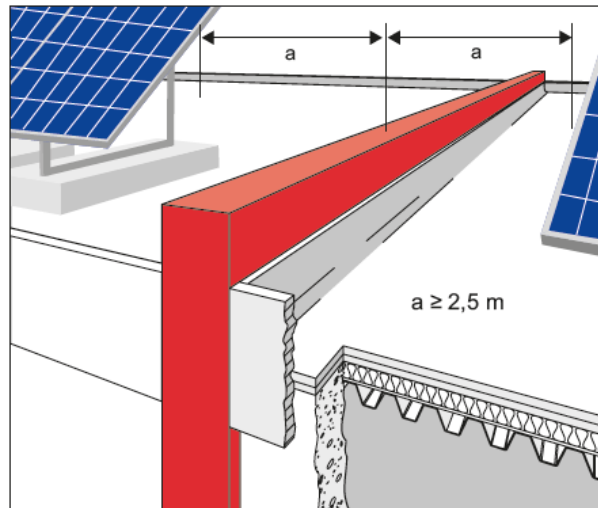


Figure 10 Arrangement of PV modules on the roof and in connection with a fire wall (source: VdS 2234)

- Continuous installation areas and rows of PV modules are to be subdivided by areas of sufficient width in order to provide access for fire-fighting and maintenance of the roof and PV modules.

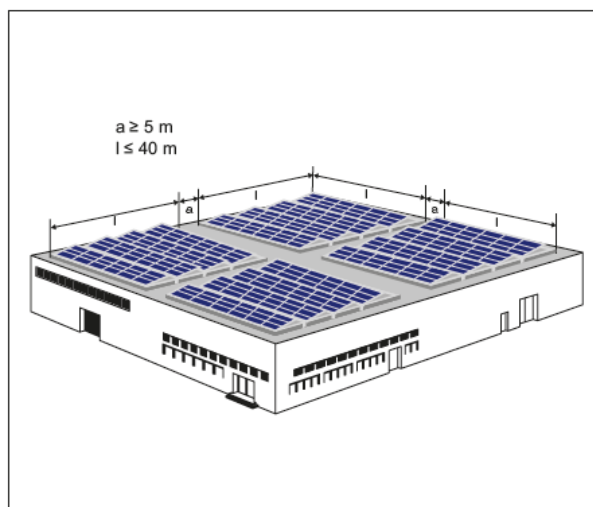


Figure 11 Required subdivision continuous installation areas and rows of PV modules (source: VdS 3145)

- If smoke and heat exhaust ventilation systems are installed in the roof, the PV modules must keep a sufficient distance¹ from these. This is to avoid any restriction on equipment operating and ensure the effective discharge of smoke and heat will not be negatively impacted in the event of a fire in the premises (see figure 10).

¹ There are requirements by manufacturing industry according to wind tunnel tests, see e. g. www.fvlr.de

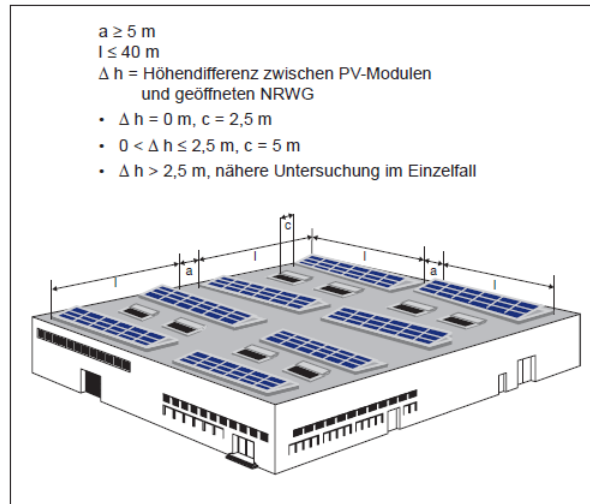


Figure 12 Example of required distances to openings of smoke and heat vent (source: VdS 3145)

- If PV modules installed on the façade, they must meet the requirements of the local and appropriate building regulations in terms of limiting the fire spread along the façade. PV modules on the façade have to meet the same requirements as the rest of the façade.

5.2.4 Theft protection

PV systems are particularly vulnerable to theft, particularly those on uninhabited or remote buildings, such as agricultural buildings, schools, office buildings, warehouses and stored system components outdoors.

PV modules and inverters can be secured mechanically, for example with:

- metal balls that are wrapped in Allen screws,
- screws with a two-screw head and the predetermined breaking point or
- Bonded joints.

In addition, steps should be taken to minimize the potential for ladders, trash cans, or unguarded interim storage of plant parts in or around the building to be used to support unwanted access to PV panels.

In order to frustrate the sale of stolen PV modules and inverters, they should be provided with non-removable serial numbers. The system owner should keep a list of the serial numbers in the system documentation.

It is also recommended to agree the anti-theft measures in the planning phase with the insurer.

For PV systems installed in open areas further measures might be required, such as: -

- to surround with suitable fencing
- to protect against intrusion with an electronic alarm system with video camera connected to a central monitoring centre or permanent transmission to the police (permission required), and/or
- by regular surveillance by a security officer or by employees.



5.3 Before start of operation

The PV system once installed is to be approved prior to operation by a competent person. In the course of this approval the following checks shall be performed

- Complete visual inspection of the system including the mounting of mechanical construction, all electrical connections and cable laying and cable routing
- Function test, e. g. check the open circuit voltage and polarity before connecting the inverter, and comparing with the device data, insulation measurement with sufficient test voltage and short circuit current measurement of all strings
- Check of the complete documentation including the planning, equipment supports, all measurement protocols and necessary information for operation

In addition, a thermographic camera can be used to identify any flaws in the modules or electrical connections. These checks should be conducted by a certified thermographer. The system documentation should be handed to the operator.

5.4 Operation

The operation of the PV system should be undertaken and monitored by a qualified electrician with special training (including "working under voltage") and experience in this field.

A PV system, like any technical equipment needs to be inspected and maintained at appropriate regular intervals. Competent persons should be commissioned to undertake all inspection, maintenance and repair work.

The operator can take the following measures to ensure the system will work safely and satisfactory for many years:

- Regular visual checks,
- Event-dependent visual checks (e. g. after a storm),
- Regular cleaning, if necessary clearing snow and keeping clean of inverters.

With the regular visual checks obvious damage, e. g. damage to cable insulation, damage in distribution and inverter housings, PV generators, etc. can be detected early.

Event-dependent visual checks should be carried out after a storm or thunderstorm. Attention should be paid to whether, for example, items such as tree branches fell on the roof and have caused damage, the supporting systems/framework of the PV systems were damaged by the storm or deformed or any lightning damage is visible.

For inspection of PV systems, thermography is increasingly used as a visual technique for non-contact measurement of temperature on surfaces by imaging, amongst other things for individual components of PV systems, e. g. PV generators, electrical equipment. It is therefore possible, during the routine operation of PV systems to examine the temperature distributions of large surfaces and also small individual parts.

To ensure accurate measurements of surface temperatures at a given level of sunlight, the object and material properties of the surfaces to be measured, e. g. emission, reflection and transmission, and the environment must be taken into account. Therefore, thermographers undertaking work on for PV systems should be trained separately.



If damage is found, competent persons should be contracted to undertake the repairs. It is also advisable to document damage with pictures and inform the insurer in advance of repair.

5.5 Special information on fire fighting

PV modules continue to generate direct current in daylight as well as when subject to other light sources such as headlights, despite a separation of the system from the grid. Thereby manual fire-fighting may be more difficult.

In the event of a fire in the building, the fire brigade should be able to disconnect the power from the PV modules. A "Fireman's switch" should be located in a suitable and easily accessible location, **in order to allow fire fighters to isolate the power supply from the PV modules.** Appropriate signage should be provided to direct fire fighters to the location of the switch. The functionality of this device should be regularly confirmed through testing.

In general, the fire-fighters are trained in fighting fires involving electrical equipment and installations, to which PV systems also belong. Therefore, a fire involving a PV system or of building with PV system can be controlled, when the appropriate construction and technical conditions as well as conditions for effective fire-fighting are met (see also section 5.2).

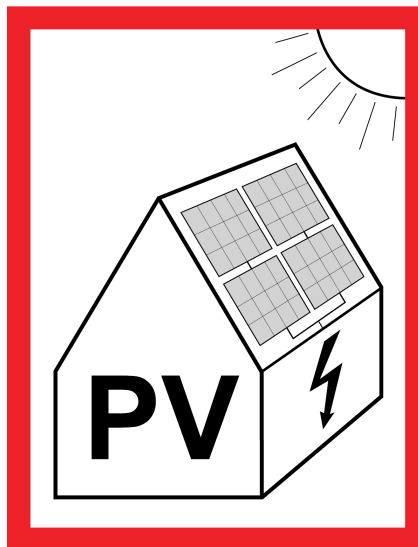


Figure 13 Example of labeling for identification (source: VdS 3145)

Buildings with PV systems should be identified by a sign in the house distribution or the house connection (See figure 12).

The signs should be situated at the

- origin of the electrical installation,
- metering position, if remote from the origin,
- consumer unit or distribution board to which the supply from the inverter is connected.



In the fire plans especially for commercial and industrial buildings, the cable routing of PV systems should be shown which will support the fire and rescue service in their tactical decision making and actions.

6. Literature

EN ISO 13943 Fire safety -- Vocabulary

EN 61215 VDE 0126-31 Bauartzulassung von kristallinen PV-Modulen

EN 61646 VDE 0126-32 Bauartzulassung von Dünnschicht PV-Modulen

EN 62108 VDE 0126-33 Bauartzulassung von Konzentrator PV-Modulen und -anordnungen

EN 61730 Photovoltaik (PV)-Module –Sicherheitsqualifikation

- *Teil 1: Anforderungen an den Aufbau*
- *Teil 2: Anforderungen an die Prüfung*

EN 62446 VDE 0126-23 Netzgekoppelte Photovoltaik-Systeme -Mindestanforderungen an Systemdokumentation, Inbetriebnahmeprüfung und wiederkehrende Prüfungen

EN 50178 VDE 0160 Ausrüstung von Starkstromanlagen mit elektronischen Betriebsmitteln

EN 60439-1 VDE 0660-500 Niederspannungs-Schaltgerätekombinationen –Typgeprüfte und partiell typgeprüfte Kombinationen

EN 61439-1 VDE 0660-600-1 Niederspannungs-Schaltgerätekombinationen

- *Teil 1: Allgemeine Festlegungen*
- *Teil 2: Energie-Schaltgerätekombinationen*

EN 62305-3 VDE 0185-305-3 Blitzschutz -Schutz von baulichen Anlagen und Personen,

EN 62305-3 VDE 0185-305-3 Beiblatt 5 Blitz-und Überspannungsschutz für Photovoltaik-Stromversorgungssysteme

The Confederation of Fire Protection Association Europe (CFPA-Europe)

CFPA Europe Guideline No 4 2013 N: Lightning protection

<http://www.cfpa-e.eu/cfpa-e-guidelines/guidelines-natural-hazards/>

Fire Protection Association on behalf of RISC Authority

RC62: Risk Control Recommendations for fire safety with photovoltaic panel installations, 2015,

Deutscher Feuerwehrverband

Einsatz an Photovoltaikanlagen; Informationen für Einsatzkräfte von Feuerwehren und technischen Hilfsdiensten

Gesamtverband der Deutschen Versicherungswirtschaft e. V.



- "Brandwände und Komplextrennwände; Merkblatt für die Anordnung und Ausführung (VdS 2234)
- "Photovoltaikanlagen; Technischer Leitfaden" (VdS 3541)

<http://vds.de/de/bildungszentrum-verlag/vds-verlag/richtlinien/>

Ministero dell Interno

Guida Per La Determinazione Die "Requisiti Di Sicurezza Antincendio Delle Facciate Negli Edifici Civili"

7. Appendix: Checklists for the planning and acceptance of PV systems

With the following sample checklists initial guidance for the planning and acceptance of PV systems should be provided. The main issues that must be clarified for the planning and inspection are listed, however, the list is not meant to be comprehensive and local conditions and environments should also be considered as necessary.

Customer	
Consultant / planner	
Location of the proposed installation (if different from address of customer)	
Date and contact of site visit	



Preliminary planning				
Issues	Assessment			Notes
	Yes	No	Not relevant	
Customer requirements - Parameter of system design				
- Max. earnings	- <input type="checkbox"/>	- <input type="checkbox"/>	- <input type="checkbox"/>	-
- Max. _____ € investment costs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Max. use of surface area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Aesthetic point (optics, architecture)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Location and size of the available area for the installation of PV modules (roof or façade)				
- Are all site-related expected impacts were taken into account?				
➢ snow (load zone) and ice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
➢ wind load zone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
➢ Others				
- Is the orientation of the adjacent components (roof or façade) suitable?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Is a sufficient installing area for the required number of modules available?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Is a possible shading, inter alia through the chimney, antenna, skylights, lightning conductors, dormer or other reason to fear	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Conditions of adjacent components (roof or façade) for the installation of PV modules				
- Is a permit for the installation required, e.g. for building conservation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Of which building material consists the adjacent component and how is its structure?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Are the building statics and structural analysis of the adjacent component present?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Is an upgrade of the existing structure for the installation of PV modules required?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Are all site-and building-related conditions taken into account in the choice of mounting system?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Others?				
- Is there a proper grounding?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Does a lightning protection system exist?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Can the PV systems be protected with the existing lightning protection system, or additional measures are needed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Is the surge protector into account?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Is the mains supply point already set?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Is a meter available?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



Acceptance of systems				
Issues	Assessment			Notes
	Yes	No	Not relevant	
Technical system data				
- Is a commissioning report or completion report from the network operator filled available?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Generator rated power: _____ kWp				
Modules (manufacturer, type, serial and identification number): <input type="checkbox"/> See Appendix				
Inverter (manufacturer, type, number, inverter rated output AC): <input type="checkbox"/> See Appendix				
The number of strings per inverter, number of modules per string: <input type="checkbox"/> See Appendix				
Potential equalization / ground (design, installation, Remarks): <input type="checkbox"/> See Appendix				
- External lightning protection available?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
String fuses, string diodes (if available) (each: manufacturer, type, voltage / current):				
Surge DC side and AC side (if available, each manufacturer, type, nominal):				
Module connection cable, DC main line (each: manufacturer, type, cross-section):				
DC circuit breaker (manufacturer, type, voltage / current):				
AC-sided residual current device (RCD switch) (if available) (manufacturer, type):				
AC-side backup (manufacturer, type, voltage / current):				
- Are functional, earnings, monitoring (remote) data available (Manufacturer, type, measurement and evaluation of sizes)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Responsible person / company that is involved in the function, earnings, data (remote) monitoring:				
- Is the grounding resistance of the earth electrode in order?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> See Appendix
- Is the Insulation resistance of the PV generator in order?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> See Appendix
- Is the Insulation resistance of the DC main line in order?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> See Appendix
Other remarks:				



Acceptance of systems				
Issues	Assessment			Notes
	Yes	No	Not relevant	
Visual inspections, match with the planning				
- There is no visible damage an installed system, buildings and adjacent components, etc.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Are the mounting system, roof penetrations and seals in order?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Is the cabling / wiring in order	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Are the inverter and their respective function in order?				
- Is the Functional testing of protective devices in order?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Is the supply control objected in the counter in order?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Are the function, earnings, data (remote) monitoring in order	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Does the installation correspond to the extent of planning and offer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other remarks:				
Plausibility check:				
- Does the installed system fully work?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Irradiation _____ W/m2 (+ / - 200 W / m ²)				
- Outside temperature _____ ° C (+ / - 5 degrees C)				
- System output DC _____ W (+ / - 10%, for example display of inverter)				
- System performance AC _____ W (+ / - 10%, for example display of inverter)				
Other remarks:				
Measurement reading				
<input type="checkbox"/> Customer-specific counter or <input type="checkbox"/> counter of the network operator				
Counter number: _____ count reading: _____ kWh				
Counter number of PV reference counter: _____ count: _____ kWh				
Inverter, type, number	Open circuit voltage U_L in V Generator / String line 1/2/3 ...		Short-circuit current I_K in A String line 1 / 2 / 3 ...	
For extended, clearer and full representation _____ additional pages have been attached <input type="checkbox"/> See Appendix. For systems with reverse current diodes the voltage drop in each string (in short circuit) is to specify via the diode. In systems with string fuses the voltage drop in each string is to specify via fuse including contacts (in short circuit).				



Acceptance of systems				
Issues	Assessment			Notes
	Yes	No	Not relevant	
Other remarks:				
Defects, rework and other remarks				
Shortcomings and possible improvements are marked and listed below as such and provided with execution deadlines				
Documentation				
- The system documentation is completely available?	<input type="checkbox"/>	<input type="checkbox"/>		
The system documentation shall include in particular the following <ul style="list-style-type: none"> - Declarations of conformity - Certificates and warranty certificates - Technical documentation and data sheets of the essential system components - Serial numbers of the installed modules with assignment to the interconnection - Wiring plan with module wiring and inverter assignment - Measurement protocols (if any) - Commissioning protocol of the network operator - Operating instructions especially for inverter and for the function, earnings, data (remote) monitoring (if available) - Installation instructions of the essential components - Service or emergency phone numbers - Conformation of instructions to customers - Form for independent detection of the yield data by the system operator (e. g, a monthly meter reading). The documents should be dated and stamped or initialled.				
Other remarks:				
Instructions to customers				
- Has the instruction to the customer been done?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other remarks:				
Signatures				
With the signing of this protocol the PV system is, apart from the listed shortcomings, improvements and other remarks accepted without further defects.				
_____	_____	_____	_____	_____
Place, Date	Signature Customer	Signature Company / Contact		
Appendix				



8. European guidelines

Fire

- Guideline No. 1:2015 F - Fire protection management system
- Guideline No. 2:2013 F - Panic & emergency exit devices
- Guideline No. 3:2011 F - Certification of thermographers
- Guideline No. 4:2010 F - Introduction to qualitative fire risk assessment
- Guideline No. 5:2016 F - Guidance signs, emergency lighting and general lighting
- Guideline No. 6:2011 F - Fire safety in care homes for the elderly
- Guideline No. 7:2011 F - Safety distance between waste containers and buildings
- Guideline No. 8:2004 F - Preventing arson – information to young people
- Guideline No. 9:2012 F - Fire safety in restaurants
- Guideline No. 10:2008 F - Smoke alarms in the home
- Guideline No. 11:2015 F - Recommended numbers of fire protection trained staff
- Guideline No. 12:2012 F - Fire safety basics for hot work operatives
- Guideline No. 13:2015 F - Fire protection documentation
- Guideline No. 14:2007 F - Fire protection in information technology facilities
- Guideline No. 15:2012 F - Fire safety in guest harbours and marinas
- Guideline No. 16:2016 F - Fire protection in offices
- Guideline No. 17:2015 F - Fire safety in farm buildings
- Guideline No. 18:2013 F - Fire protection on chemical manufacturing sites
- Guideline No. 19:2009 F - Fire safety engineering concerning evacuation from buildings
- Guideline No. 20:2012 F - Fire safety in camping sites
- Guideline No. 21:2012 F - Fire prevention on construction sites
- Guideline No. 22:2012 F - Wind turbines – Fire protection guideline
- Guideline No. 23:2010 F - Securing the operational readiness of fire control system
- Guideline No. 24:2016 F - Fire safe homes
- Guideline No. 25:2010 F - Emergency plan
- Guideline No. 26:2010 F - Fire protection of temporary buildings on construction sites
- Guideline No. 27:2011 F - Fire safety in apartment buildings
- Guideline No. 28:2012 F - Fire Safety in laboratories
- Guideline No. 29:2013 F - Protection of paintings: Transport, exhibition and storage
- Guideline No. 30:2013 F - Managing fire safety in historical buildings
- Guideline No. 31:2013 F - Protection against self-ignition and explosions in handling and storage of silage and fodder in farms
- Guideline No. 32:2014 F - Treatment and storage of waste and combustible secondary raw materials
- Guideline No. 33:2015 F - Evacuation of people with disabilities
- Guideline No. 34:2015 F - Fire safety measures with emergency power supplies
- Guideline No. 35:2017 F - Fire safety in warehouses
- Guideline No. 36:2017 F - Fire prevention in large tents
- Guideline No. 37:2018 F - Photovoltaic Systems: Recommendations on loss prevention

*Natural hazards*

- Guideline No. 1:2012 N - Protection against flood
- Guideline No. 2:2013 N - Business Resilience – An introduction to protecting your business
- Guideline No. 3:2013 N - Protection of buildings against wind damage
- Guideline No. 4:2013 N - Lightning protection
- Guideline No. 5:2014 N - Managing heavy snow loads on roofs
- Guideline No. 6:2015 N - Forest fires
- Guideline No. 7:2018 N - Demountable / Mobile flood protection systems: Recommendations on planning, selection, providing and using.

Security

- Guideline No. 1:2010 S - Arson document
- Guideline No. 2:2010 S - Protection of empty buildings
- Guideline No. 3:2010 S - Security system for empty buildings
- Guideline No. 4:2010 S - Guidance on key holder selections and duties
- Guideline No. 5:2012 S - Security guidelines for museums and showrooms
- Guideline No. 6:2014 S - Emergency exit doors in non-residential premises
- Guideline No. 7:2016 S - Developing evacuation and salvage plans for works of art and Heritage buildings
- Guideline No. 8:2016 S - Security in schools
- Guideline No. 9:2016 S - Recommendation for the control of metal theft
- Guideline No. 10:2016 S - Protection of business intelligence