Date: _____ Project No.: _____

Lightning protection
Risk management

Questionnaire for assessing the risk of damage to structures

Created according to international standard:
IEC 62305-2:2010-12

Considering the country-specific annexes for:
BS EN 62305-2:2012

Ground flash density Ng: _____ per km² / year

Contents

1. Customer data

Company: _____
Contact: _____
Street: _____
Postcode / place _____
Telephone: _____
Fax: _____
Mobile phone: _____
Email: _____
Internet: _____

2. Project data

Project: _____
Project No.: _____
Contact: _____
Street: _____
Postcode / place: _____
Telephone: _____
Fax: _____
Email: _____

Notes / _____
remarks: _____

3. General information on risk analysis and the questionnaire to be filled in

The risk analysis allows to calculate the risk potential for structures resulting from lightning effects. Four sources of damage are considered in the calculation:

- Direct lightning strikes to a structure
- Lightning strikes near a structure
- Direct lightning strikes to incoming and outgoing supply lines
- Lightning strikes near supply lines

Following the assessment, specific measures for reducing the risk to protect persons, systems and installation can be taken.

This leads to an economically feasible selection of protection measures suitable for the building characteristics and the use of the building. In addition to the class of LPS, the result of a risk analysis must be a complete protection concept including the necessary LEMP shielding measures.

A risk analysis is based on normative parameters. Apart from the building parameters, factors relating to incoming and outgoing supply lines are a key element of the assessment. The following supply line must be considered:

- Information technology lines
- Power supply lines

Electrically conductive pipes do not have to be considered provided that the pipes are connected with the main earthing busbar of the structure. If equipotential bonding is not established, this risk also has to be considered.

Please enter / select the known values in the following questionnaire. The relevant factors are explained. The parameters to be selected are listed according to the normative calculation basis as per BS EN 62305-2:2012.

4. Selection of the risks to be considered

The type of use of the structure must be considered at the beginning of the risk analysis. This leads to the risks that must be considered for the object to be protected. When performing a risk analysis, a distinction is made between four different risks. Please select the relevant risk:

- ☐ R1 - Risk of loss of human life
- ☐ R2 - Risk of loss of service to the public
- ☐ R3 - Risk of loss of cultural heritage
- ☐ R4 - Risk of loss of economic value

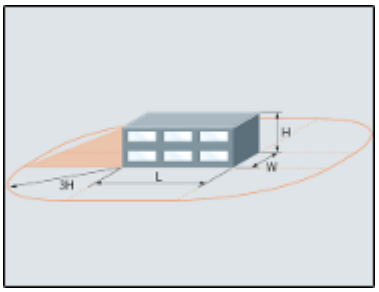
Several risks can be selected depending on the type of use of the structure (e.g. hospital R1 + R4; church R1 + R3; gas compressor station R1 + R2 + R4).

5. Type of structure

The dimensions of the building are required to calculate the collection areas for direct / indirect lightning strikes to and near a building. Please make your choice and enter the building dimensions:

5.1. Simple structure

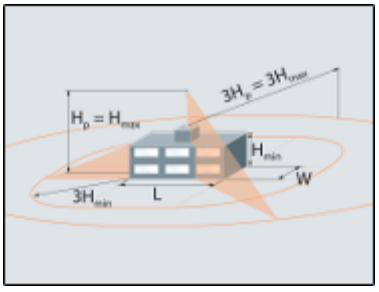
☐



Length Lb: _____ m
Width Wb: _____ m
Height Hb: _____ m

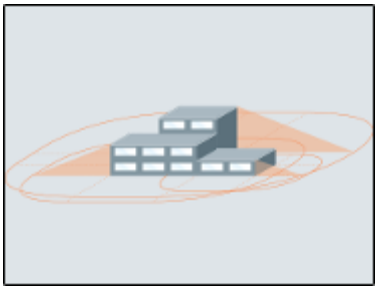
5.2. Buildings with a high point (e.g. church steeple, chimney, mobile phone antenna)

☐



Length Lb: _____ m
Width Wb: _____ m
Height Hb: _____ m
Highest point Hpb: _____ m

5.3. Complex structure

☐ 

Drawings with the relevant dimensions and heights are prepared by the builder.

5.4. Location factor of the structure, Cd

The location factor describes the possibility that a direct lightning strike hits the building. The rolling sphere is used as assessment criterion. Only the probability of a direct lightning strike in the surroundings is assessed (e.g. residential building surrounded by high-rise buildings -> Possibility is very low; summit station of a high mountain -> Possibility is very high). If there is no other object within the radius (r=3x height of the building), the object is isolated. Please make your choice:

- ☐ Object is surrounded by higher objects
- ☐ Object is surrounded by objects of the same height or smaller
- ☐ Isolated object: no further objects in the vicinity
- ☐ Isolated object on a hilltop or knoll

5.5. Zone properties

5.5.1. Human life L1

Time during which persons are present in the zone. _____ hours/year

5.5.2. Economic value L4

Economic considerations can be made in conjunction with the costs of the object. To this end, the following information is required:

5.5.2.1. Value of animals in the zone, L4ca

Costs of animals inside the structure

Value of animals in the zone _____ £

5.5.2.2. Value of the zone, L4cb

Costs of the structure (building shell without installations / equipment)

Value of the zone _____ £

5.5.2.3. Value of content in the zone, L4cc

(equipment)

Value of content in the zone _____ £

5.5.2.4. Value of systems in the zone (including their activities), L4cs

Costs of the systems in the structure (all installations, etc. which may be damaged or destroyed by lightning strikes and surges).

Value of systems in the zone (including their activities) _____ £

If you are not able to provide information on the building values, please tick the following:

☐ Not specified

5.6. Economic consideration version 2

BS EN 62305-2:2012 allows to roughly determine the building values based on the height of the building with the help of tables. To this end, the following information is required:

Which type of structure is installed and how high are the replacement costs? Please make your choice:

☐ Industrial structure

☐ With animals

Reference value for the costs:

☐ Low
☐ Ordinary
☐ High

What is the volume in the zones?

Volume of the zone _____ m³

How many employees are in the zones?

Employees in the zone _____ persons

6. Supply line

When performing a risk analysis, all incoming and outgoing supply lines of the structure to be considered have to be assessed. Electrically conductive pipes do not have to be considered if they are connected to the main earthing busbar of the structure. If this is not the case, the risk of electrically conductive pipes also has to be considered in the risk analysis. For every defined supply line, the normative parameters such as

- Type of line (overhead line / buried)

- Length of line (outside the building)
- Surroundings
- Connected structure
- Type of internal cabling
- Minimum rated impulse withstand voltage

have to be defined and are integrated in the line-related risks for the structure. If these parameters are not known when defining the line length, the standard recommends to use a maximum line length of 1,000 meters for the calculation. The line length is defined from the point where it enters the object to be protected up to the connected structure or node. A node is, for instance, a distribution point of a power line on a HV / LV transformer or a transformer substation and on a telecommunication switch.

6.1. Supply lines

Conductor designation 1: _____

6.2. Line type, Xtyp

Xtyp	VL 1
Power supply line	☐
Telecommunication line	☐

6.3. Conductor length, LL

LL	Conductor length (m)
VL 1	

6.4. Installation factor, Ci

Types and characteristics of supply lines:

Ci	VL 1
Aerial	☐
Buried	☐
Buried cable running entirely within a meshed earth termination	☐

6.5. Environment, Ce

The factor allows to assess the surroundings of the relevant supply line with regard to its shielding performance. A city with many high buildings provides an excellent electromagnetic shield.

Ce	VL 1
Urban with tall buildings higher than 20 m	☐
Urban	☐
Suburban	☐
Rural	☐

6.6. Transformer, Ct

If a transformer is installed directly next to the point where the conductor enters the building (transition from LPZ0 to LPZ1), it can be used for protection.

Ct	VL 1
HV power supply line (with HV/LV transformer)	☐
LV power supply, telecommunication or data line	☐

6.7. Conductor shielding, Xshd

X_{shd}: An external line of the structure is exposed to a direct / indirect lightning strike. To reduce the risk of failure of an internal system resulting from lightning effects, shielded lines can be installed outside the structure. However, it must be observed that the shield has to be capable of carrying lightning currents. It must be connected to the lightning protection equipotential bonding at the point of entry into the building. If these points cannot be observed, an unshielded line is assumed. The following criteria are available:

Xshd	VL 1
External: Aerial or unshielded buried cable	☐
External: Shielded: 5 ohms/km < shield resistance (RS) <= 20 ohms/km	☐
External: Shielded: 1 ohm/km < shield resistance (RS) <= 5 ohms/km	☐
External: Shielded: shield resistance (RS) <= 1 ohm/km	☐

6.8. Connection of the conductor, Xcon

Type of the supply line at point of entry into the building, X_{con} :

Xcon	VL 1
No special conditions	☐
Multiply earthed neutral conductor	☐
Connected to shielded buried cables	☐
Connected to shielded aerials	☐
Connected to shielded and earthed lines	☐
Lightning protection cable or duct	☐
No external connection (stand-alone systems)	☐
Connection via isolating interface	☐

6.9. Connected structure at the other end of the supply line

If a building is situated at the end of a supply line, this has to be considered in a risk analysis. In addition to the building dimensions, the surroundings must also be assessed.

	VL 1
Length	
Width	
Height	
Highest point of the building	
Complex structure: Drawings with the relevant dimensions and heights are prepared by the builder.	

6.9.1. Relative position of the connected system, CDJ

CDJ	VL 1
Object is surrounded by higher objects	☐
Object is surrounded by objects of the same height or smaller	☐
Isolated object: no further objects in the vicinity	☐
Isolated object on a hilltop or knoll	☐

6.10. Coordinated SPD system, pSPD

Coordinated SPD protection defines the protection of electronic systems by means of surge protective devices (SPDs). If surge protective devices are already installed, they must be considered according to their discharge capacity. Type 1 SPDs which have to be tested and specified according to the LPL (Lightning Protection Level) can form the basis of a coordinated surge protection.
Please make your choice:

pSPD	VL 1
No SPD	☐
SPD according to LPL III or IV	☐
SPD according to LPL II	☐
SPD according to LPL I	☐
Improved SPD protection according to LPL III or IV	☐
Improved SPD protection according to LPL II	☐
Improved SPD protection according to LPL I	☐

If no assignment is possible, please briefly describe the place of installation and the type of device.:

6.11. Type of internal wiring, KS3

KS_3: The "type of internal wiring" describes the type of cable routing inside the building based on the supply line to be considered. The following distinction is drawn:

KS3	VL 1
Unshielded cable – no routing precaution in order to avoid loops	☐
Unshielded cable – routing precaution in order to avoid large loops	☐
Unshielded cable – routing precaution in order to avoid loops	☐
Shielded cables and cables running in metal conduits	☐

6.12. Rated impulse withstand voltage of system to be protected (kV), Uw

The term "minimum rated withstand voltage" defines the dielectric strength of electric equipment in the building. A distinction is made between:

Uw	VL 1
Uw <= 1.0 kV	☐
1.0 kV < Uw <= 1.5 kV	☐
1.5 kV < Uw <= 2.5 kV	☐
2.5 kV < Uw <= 4.0 kV	☐
Uw > 4.0 kV	☐

7. Measures to reduce the risk

Protection measures allow to reduce the risk of damage to a structure and its content. In addition, these parameters describe the building characteristics. They are thus an essential part of the analysis.

7.1. External characteristics of the ground/floor, rta

- ☐ Agriculturally used area, concrete R <= 1 kOhm
- ☐ Marble, ceramics R = 1 to 10 kOhms
- ☐ Gravel, plush, carpets R = 10 to 100 kOhms
- ☐ Asphalt, linoleum, wood R >= 100 kOhms

7.2. Internal characteristics of the ground/floor, rtu

- ☐ Agriculturally used area, concrete R <= 1 kOhm
- ☐ Marble, ceramics R = 1 to 10 kOhms
- ☐ Gravel, plush, carpets R = 10 to 100 kOhms
- ☐ Asphalt, linoleum, wood R >= 100 kOhms

7.3. Protection against electric shock (lightning strike in structure), pta

- ☐ Electrical insulation of the relevant down conductor
- ☐ Effective potential control in the ground
- ☐ Warnings
- ☐ Reinforcement or framework is used as a down conductor

7.4. Protection against electric shock (lightning strike in supply line), ptu

- ☐ Electrical insulation
- ☐ Warnings
- ☐ Physical restrictions

7.5. Fire precautions, rp

- ☐ No measures
- ☐ Fire extinguishers, manual fire alarm system, hydrants, fire-proof compartments, protected escape routes
- ☐ Automatic fire extinguishing system/fire alarm system

Note to selection 2 (fire extinguishers, manually operated fire extinguishing systems, etc.): In case of risk R1 "Loss of human life", persons in the structure should be familiar with fire precautions, their place of storage and the behaviour in case of fire.

Note to selection 3 (automatic fire extinguishing systems, etc.): Measure may only be taken into account in the risk analysis if it is protected against surges or other types of damage and if firemen can arrive in less than 10 minutes.

7.6. Reduction factor of risk of fire or explosion, rf

The risk of fire is one of the most important criteria for determining the importance of the LPS (Lightning Protection System). The risk of fire is classified according to the specific fire load. The fire load should be determined by a fire safety expert or defined after consultation with the proprietor of the building and his/her insurance company.

Risk of fire	Specific fire load
Low	< 400 MJ/m²
Normal	400 - 800 MJ/m²
High	> 800 MJ/m²

A distinction is made according to the following criteria:

- ☐ No risk of fire or explosion
- ☐ Low risk of fire
- ☐ Normal risk of fire
- ☐ High risk of fire
- ☐ Explosion - Ex zone 2, 22
- ☐ Explosion - Ex zone 1, 21
- ☐ Explosion - Ex zone 0, 20 and solid explosive

7.7. Lightning protection system (LPS), pB

- ☐ No protection by LPS
- ☐ Class of LPS IV
- ☐ Class of LPS III
- ☐ Class of LPS II
- ☐ Class of LPS I
- ☐ Better LPS I (metal building structure with air-termination system according to LPS I)
- ☐ Better LPS I (continuous metal building structure)

7.8. Lightning equipotential bonding, pEB

For electric and telecommunication lines, lightning protection equipotential bonding must be established as close as possible to the entry point of the structure to be protected. All live conductors of every line must be connected with the equipotential bonding directly or indirectly by means of an SPD (SPD = Surge Protective Devices).
A surge protective device with a minimum discharge capacity according to the LPL (Lightning Protection Level) must be used. Thus, this surge protective device must be tested according to the normative requirements.
If surge protective devices are already installed in the structure, make your choice:

- ☐ No equipotential bonding
- ☐ Equipotential bonding for LPL III or IV
- ☐ Equipotential bonding for LPL II
- ☐ Equipotential bonding for LPL I
- ☐ Improved equipotential bonding for LPL III or IV
- ☐ Improved equipotential bonding for LPL II
- ☐ Improved equipotential bonding for LPL I

If no assignment is possible, please briefly describe the place of installation and the type of device.:

7.9. Spatial shielding

Spatial shielding attenuates the magnetic field within a structure, which is caused by lightning strikes into or near the object, and reduces internal surges.
This can be achieved by a meshed equipotential bonding network in which all conductive parts of the structure and the internal system are integrated. Consequently, the external / internal spatial shield is only a part of a shielded building structure. It must be observed that metal coverings and claddings are connected to one another and conductively to the equipotential bonding of the building. In this context, the relevant normative requirements must be observed.

7.9.1. External spatial shielding (all zones), KS1

- ☐ No shielding
- ☐ continuous metal shield with a thickness not lower than 0.1 mm
- ☐ Mesh-like shield

Mesh size _____ m

7.9.2. Internal spatial shielding, KS2

- ☐ No shielding
- ☐ Continuous metal shield with a thickness not lower than 0.1 mm
- ☐ Mesh-like shield

Mesh size _____ m

8. Assessment of possible loss

If a building is divided into several zones (areas), possible loss must be defined for every zone. According to the risks, loss is sub-divided into:

- L1: Loss of human life or permanent injury
- L2: Loss of service to the public
- L3: Loss of cultural heritage
- L4: Loss of economic value

Please enter the loss values according to the selected risks and zones.

8.1. Loss of a human life or permanent injury

8.1.1. Factor for external touch and step voltage, L1La

Is there a risk of injury resulting from touch and step voltage outside the structure?

- ☐ No loss
- ☐ Typical value

8.1.2. Factor for internal touch and step voltage, L1Lu

Is there a risk of injury resulting from touch voltage inside the structure?

- ☐ No loss
- ☐ Typical value

8.1.3. Factor for fire, L1Lf

Is there a risk that persons may be injured in case of a fire caused by lightning effects? If so, please assign it to the types of use listed below according to the number of persons and the time of presence in the structure.

- ☐ No loss
- ☐ Hospital
- ☐ Hotel
- ☐ Large House
- ☐ Block of flats
- ☐ Oil refinery/chemical plant
- ☐ Halls of residence
- ☐ Prison
- ☐ Police/fire brigade/ambulance station
- ☐ Farm building
- ☐ Nursing/children´s home
- ☐ Factory
- ☐ Railway station
- ☐ Airport building
- ☐ Fuel/service station
- ☐ Leisure centre
- ☐ Shop/shopping centre
- ☐ Cathedral
- ☐ University
- ☐ Museum
- ☐ Commercial building/office block
- ☐ Department store
- ☐ Industrial warehouse
- ☐ Civic building
- ☐ Commercial centre
- ☐ Medical centre
- ☐ Telephone exchange
- ☐ Water treatment works
- ☐ Power plants
- ☐ Power staion/substation
- ☐ School
- ☐ Gas Compound
- ☐ Theatre
- ☐ Church
- ☐ Sports stadium
- ☐ Base station
- ☐ Wind farm
- ☐ Ruins
- ☐ Others

8.1.4. Kind of special hazard, L1hz

Is there a risk that panic is caused in the object resulting as a result of damage, h_z?

- ☐ No special hazard
- ☐ Low level of panic (e.g. a structure limited to two floors and the number of persons not greater than 100)
- ☐ Average level of panic (e.g. structures designed for cultural or sport events with a number of participants between 100 and 1 000 persons)
- ☐ Difficulty of evacuation (e.g. structures with immobile persons, hospitals)
- ☐ High level of panic (e.g. structures designed for cultural or sport events with a number of participants – greater than 1 000 persons)

8.1.5. Damage factor for overvoltage, L1Lo

Is there a risk of failure of internal systems and thus loss of human life in case of surges (e.g. hospital / intensive care unit / failure of vital measures)?

- ☐ No loss
- ☐ Risk of explosion
- ☐ Intensiv care unit and operation block of hospital
- ☐ Other parts of hospital

8.1.6. Additional loss - Human life L1

If damage to a structure caused by a lightning strike can also affect nearby structures or the surroundings (e.g. chemical or radioactive emissions), additional loss (LBE and LVE) should be considered when assessing the total loss (LBT and LVT):

Time during which persons stay outside the structure _____ hours/year

- ☐ Calculate additional loss

Persons injured outside the structure _____ %

8.2. Loss of economic value

8.2.1. Factor for external touch and step voltage, L4La

Is there a risk of injury for animals resulting from touch and step voltage outside the structure?

- ☐ No loss
- ☐ Typical value if only animals are present

8.2.2. Factor for internal touch and step voltage, L4Lu

Is there a risk of injury for animals resulting from touch and step voltage inside the structure?

☐ No loss
☐ Typical value if only animals are present

8.2.3. Factor for fire, L4Lf

Is there a risk of economic loss resulting from fire caused by lightning effects? Please assign the possible loss according to the importance of the types of use.

☐ No loss
☐ Risk of explosion
☐ Hospital, industrial, museum, agricultural
☐ Hotel, school, office, church, entertainment, commercial
☐ Others

8.2.4. Damage factor for overvoltage, L4Lo

Is there a risk of failure of internal systems and thus economic loss resulting from surges (e.g. failure of production facilities)? Please assign the possible loss to the type of use according to their importance.

☐ No loss
☐ Risk of explosion
☐ Hospital, industry, office, hotel, economy
☐ Museum, agriculture, schools, churches, entertainment
☐ Others

8.2.5. Additional loss - Economic value L4

If damage to a structure caused by a lightning strike can also affect nearby structures or the surroundings (e.g. chemical or radioactive emissions), additional loss (LBE and LVE) should be considered when assessing the total loss (LBT and LVT):

Total value of goods in a dangerous place outside the structure. _____ £

☐ Calculate additional loss

Value of all goods damaged outside the structure _____ %

9. Economic consideration

Economic considerations can be made in conjunction with the costs of the object. To this end, the following information is required:

Details for cost estimation

Interest rates _____ %

Maintenance rates _____ %

Amortisation rates _____ %

10. Confirm details

The questionnaire was filled in by: _____

_____	_____
Place, date	Stamp, signature

11. Zone and conductor key

Lightning protection zone	Zone	Zone designation
LPZ 0B		Structure protected against direct lightning strikes
	Z1	
LPZ 1		Inner zone of the protected structure
	Z1	
LPZ 2		Room/device in LPZ 1 with shielding properties
	Z1	

Conductor designation 1: _____