

International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

K.71

(07/2007)

SERIES K: PROTECTION AGAINST INTERFERENCE

Protection of customer antenna installations

ITU-T Recommendation K.71

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Protection of customer antenna installations

Summary

ITU-T Recommendation K.71 provides information to network operators on when antennas may be installed in, or on, a customer building without performing a building-specific risk assessment. When a risk assessment is required, it provides guidance on the application of IEC 62305-2. It also provides information on the responsibilities of the network operator and the building owner.

Source

ITU-T Recommendation K.71 was approved on 29 July 2007 by ITU-T Study Group 5 (2005-2008) under the ITU-T Recommendation A.8 procedure.

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Protection of customer antenna installations

1 Scope

Telephony services delivered via an antenna installation may be subjected to lightning discharges. This Recommendation provides requirements to minimize the risk of injury to users of the service and damage to equipment. It provides requirements to achieve protection of telecommunications and video content antenna systems, including satellite antennas, against lightning discharges and mains contact including contact with aerial power service leads.

When protection against direct lightning discharges is not required, this Recommendation requires protection against mains contact to minimize the risk of injury to users of the service and to network operator personnel.

When protection against direct lightning discharges is required, this Recommendation defines protection measures distinguishing two cases:

- 1) The antenna is located on the building.
- 2) The antenna is installed on a mast near to the building at a maximum distance of about ten metres.

This Recommendation does not provide methods to protect the antenna and associated cabling against a direct strike to the antenna mast (see clause 7.2).

Damage to equipment is minimized by providing requirements to achieve protection against lightning.

This Recommendation provides requirements for:

- the resistibility of the equipment;
- how and when to protect the customer's premises from direct strikes;
- how and when to bond the mast or tower to the customer building electrical installation earthing system;
- how and when to protect the services, i.e., the power supply for the service, the telecommunication line and the antenna cable, entering the customer's building.

This Recommendation does not apply to structures where there is the risk of explosion, nor to hospitals with life-saving electrical equipment or structures where failures of internal systems immediately endanger human life.

This Recommendation covers the protection of antennas installed at private buildings ranging in size from small single-storey buildings up to multi-storey buildings. This Recommendation only applies in the case when the antenna is being installed to supply service to the building on which the antenna is being installed. For radio base station installations refer to [ITU-T K.56].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T K.21] ITU-T Recommendation K.21 (2003), *Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents.*
- [ITU-T K.47] ITU-T Recommendation K.47 (2000), *Protection of telecommunication lines using metallic conductors against direct lightning discharges.*
- [ITU-T K.56] ITU-T Recommendation K.56 (2003), *Protection of radio base stations against lightning discharges.*
- [ITU-T K.66] ITU-T Recommendation K.66 (2004), *Protection of customer premises from overvoltages.*
- [IEC 60364-5-54] IEC 60364-5-54 (2002), *Electrical installations of buildings – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements, protective conductors and protective bonding conductors.*
- [IEC 60728-11] IEC 60728-11 (2005), *Cable networks for television signals, sound signals and interactive services – Part 11: Safety.*
- [IEC 60950-1] IEC 60950-1 (2005), *Information technology equipment – Safety – Part 1: General requirements.*
- [IEC 62305-1] IEC 62305-1 (2006), *Protection against lightning – Part 1: General principles.*
- [IEC 62305-2] IEC 62305-2 (2006), *Protection against lightning – Part 2: Risk management.*
- [IEC 62305-3] IEC 62305-3 (2006), *Protection against lightning – Part 3: Physical damage to structures and life hazard.*
- [IEC 62305-4] IEC 62305-4 (2006), *Protection against lightning – Part 4: Electrical and electronic systems within structures.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 exposed structure: (See ITU-T Rec. K.25) A structure, e.g., telecommunications tower, high building, which needs to be protected against direct lightning strokes.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 antenna system: The antenna connecting cable and terminating equipment.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

BB	Bonding Bar
CDMA WLL	Code Division Multiple Access Wireless Local Loop
GDT	Gas Discharge Tube
LPL	Lightning Protection Level
LPS	Lightning Protection System
MEB	Main Earth Bar
PoE	Point of Entry

R	Risk value
R ₁	Risk of loss of human life
R ₂	Risk of loss of service
R _{A1}	Risk of loss of human life related to injury of living beings caused by touch and step voltages due to flashes to the structure
R _B	Risk component related to physical damage caused by dangerous sparking inside the building due to flashes to the structure
R _{B1}	Risk of loss of human life related to physical damage caused by dangerous sparking inside the building due to flashes to the structure
R _c	Risk component related to physical damage due to flashes to the building
R _M	Risk component related to physical damage due to flashes near the building
R _T	Tolerable risk value
R _{T1}	Tolerable risk of loss of human life
R _{T2}	Tolerable risk of loss of service
R _U	Risk component related to injury to living beings caused by touch voltage inside the structure due to flashes to the service
R _v	Risk component related to physical damage caused by dangerous sparking inside the building due to flashes to the service
R _w	Risk component related to physical damage due to flashes to the service
R _z	Risk component related to physical damage due to flashes near the service
SPD	Surge Protection Device

5 Reference configuration

Telephony services delivered via an antenna installation have the following two reference configurations:

- 1) the antenna is located on the building (Figure 1a);
- 2) the antenna is installed on a mast near to the building (Figure 1b).

In both configurations, the antenna is connected to the associated equipment with shielded symmetrical pair cable or with a coaxial cable. The associated equipment, powered by mains, is connected to the end user equipment, e.g., a personal computer (PC) (for example via a serial or USB cable), and to the external telecommunication line.

Further examples of the reference configurations covered by this Recommendation are shown in Figures 1c to 1e.

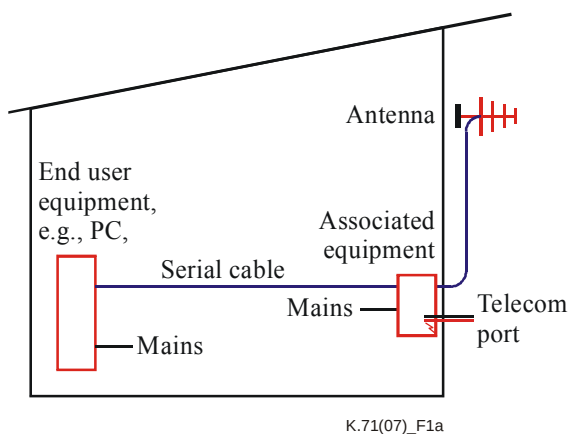


Figure 1a – Antenna attached to structure

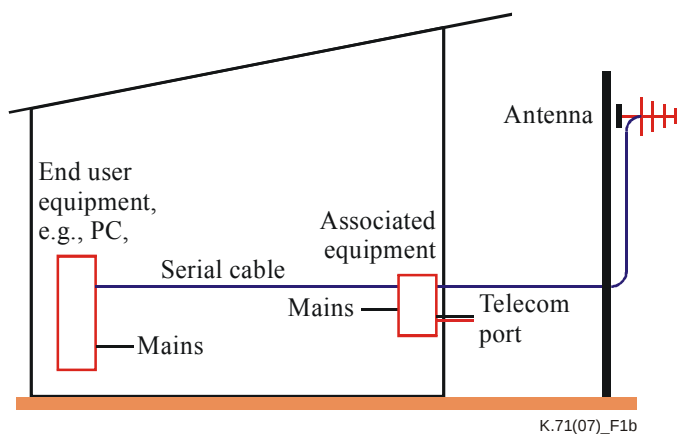


Figure 1b – Antenna installed on a mast

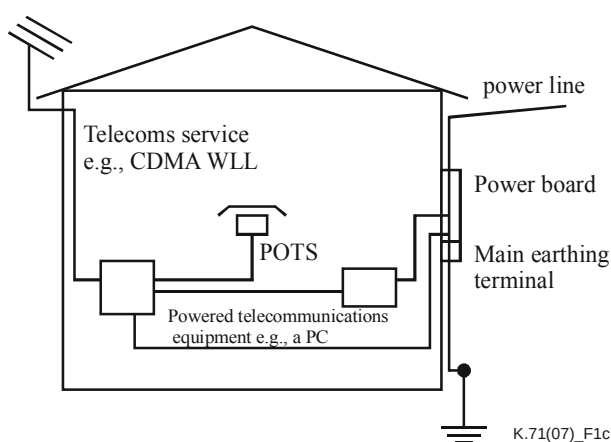


Figure 1c – Basic antenna-provided service

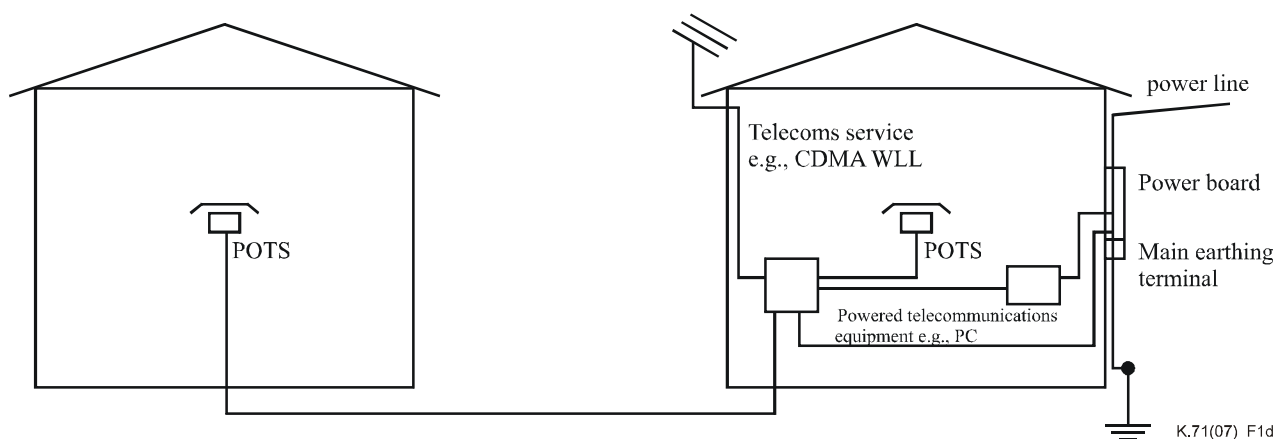


Figure 1d – Basic antenna-provided service with service extended to an out-building

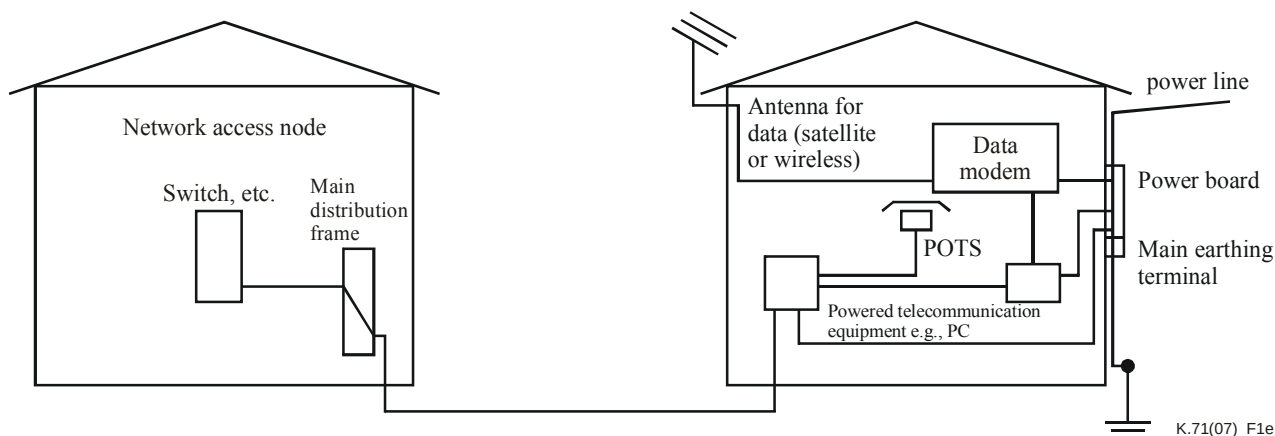


Figure 1e – Telecommunications service plus an antenna for Internet service

6 Protection need against lightning

The need for lightning protection is determined by performing a risk assessment according to [IEC 62305-2], which compares the risk value R , as the sum of all the risk components, with the tolerable risk value R_T .

To minimize the risk of injury to users, the risk of loss of human life (R_1) related to the building shall be evaluated by the building owner and compared with the tolerable risk value (R_{T1}). A maximum value of the tolerable risk of loss of human life equal to 10^{-5} is assumed by this Recommendation.

When the risk R_1 of the building, with the antenna installation, is less than the tolerable risk R_{T1} , the site is considered inherently protected against direct lightning. In this case, the antenna need only be protected against mains contact (clause 8.2).

When $R_1 > R_{T1}$ lightning protection, against the loss of human life in the building, is required. This Recommendation defines the methods of protection (clause 8) and the protection requirements (clause 9).

To minimize the risk of damage to equipment inside the building, the risk of loss of service (R_2) should be evaluated and compared with the tolerable risk of loss of service value $R_{T2} = 10^{-3}$ or a lower value according to the customer's decision. Even when $R_1 < R_{T1}$, the customer should evaluate the risk of loss of service R_2 in accordance with [IEC 62305-2]. When $R_2 > R_{T2}$, protection is recommended and the knowledge of the risk component values guides the protection designer in selecting the most adequate protective measures in order to protect the equipment inside the building. This evaluation and the relevant protective measures are outside the scope of this Recommendation.

The risk assessment of loss of service R'_2 related to the antenna system when the antenna is installed near the building is not necessary because this risk is very low due to both the short length (in general less than 50 m) of the cabling and the presence of the shield (coaxial pair or shielded line).

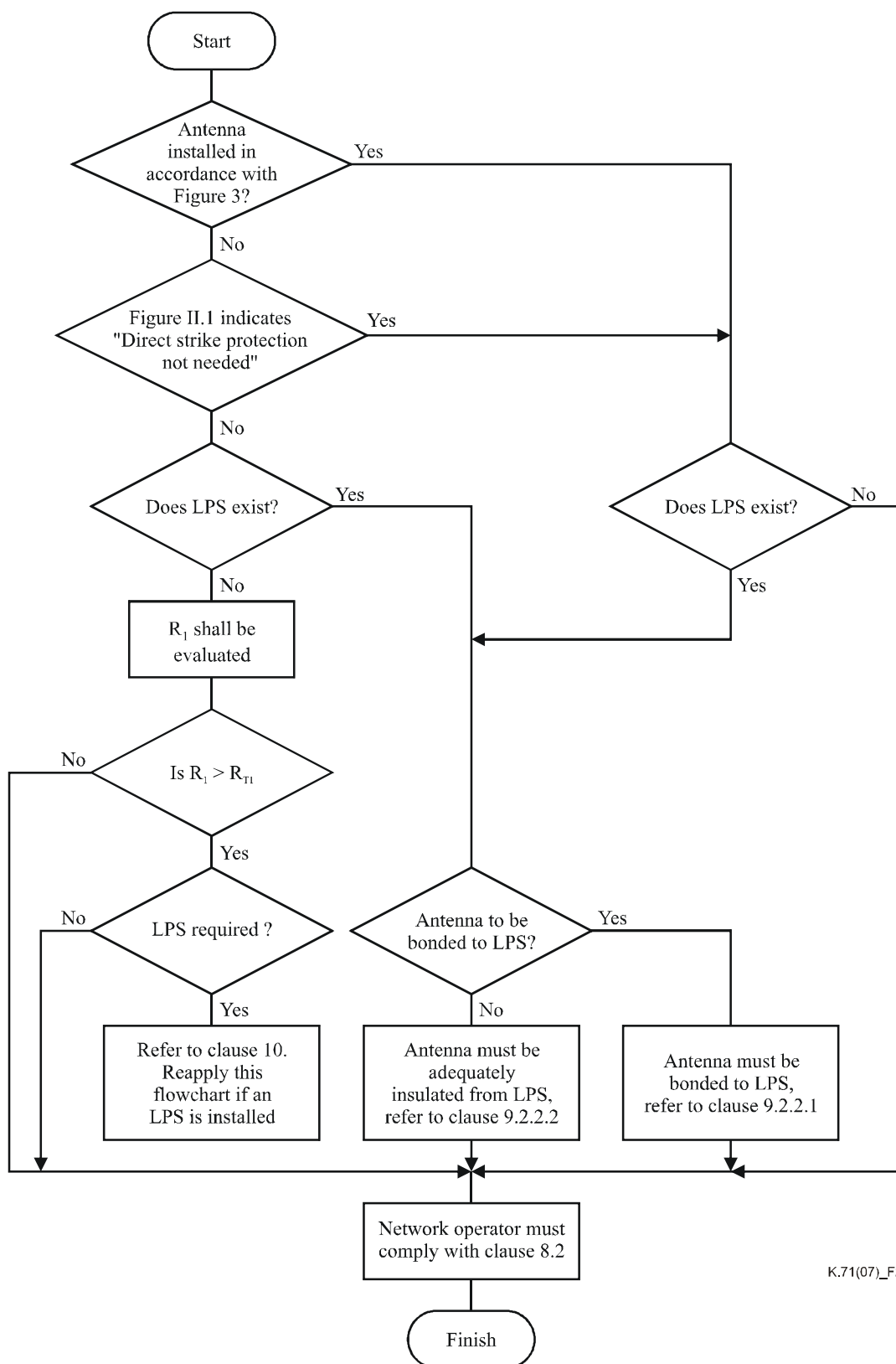
The protection needs of the antenna cable against physical damage due to a direct lightning to the building is considered in the risk assessment against the loss of human life (see clause 9.5 and Appendix III).

To assist in the risk assessments, this Recommendation has defined a site classification (clause 7).

7 Site classification

7.1 Antenna installed within, or attached to, the building

The flowchart in Figure 2 determines the need for a risk assessment.



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Figure 2 – Process for antennas on or in the structure

7.1.1 Sites inherently protected against direct flashes due to antenna placement

If the antenna is installed within the shaded area of Figure 3, it is considered to be inherently protected from direct lightning strikes. There are two cases to consider, (see Figure 2), and these are:

- 1) No LPS exists. In this case refer to clause 9.2.1.
- 2) An LPS exists. In this case refer to clause 9.2.2.

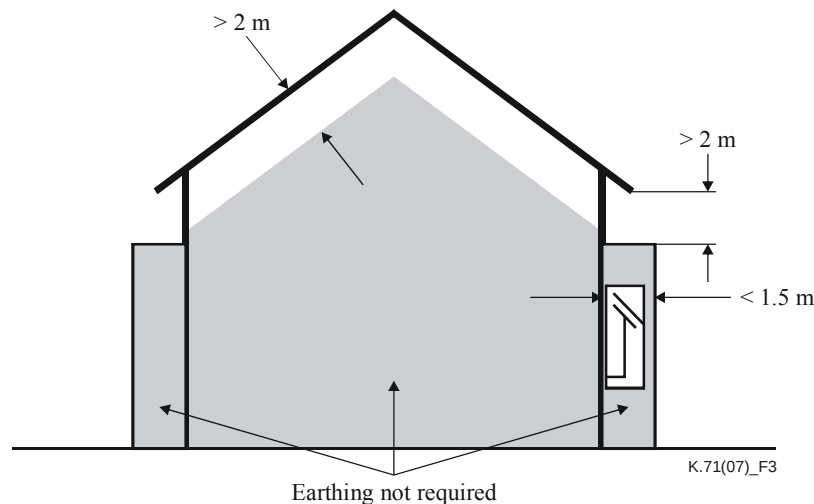


Figure 3 – Example of outdoor antenna mounting on buildings where earthing is not required but is recommended (Figure 9 of [IEC 60728-11])

7.1.2 Sites determined to have a low risk of loss of human life from strikes to the structure

To eliminate the need for the network operator to have to perform a risk assessment for every installation not covered by clause 7.1.1, a range of installations have been considered to determine cases where the risk of a direct lightning strike is less than the tolerable risk using the software provided with [IEC 62305-2], see Appendix II. If the Flowchart in Figure II.1 indicates "Specific risk assessment required", refer to clauses 6 and 7.1.3.

NOTE – This risk assessment assumes no external services are connected to the building. This risk assessment is only to determine if an LPS is required on the building when the network operator installs the antenna.

There are two cases to consider and these are:

- 1) No LPS exists. In this case refer to clause 9.2.1.
- 2) An LPS exists. In this case refer to clause 9.2.2.

7.1.3 Sites requiring individual risk assessment

A risk assessment is not required if an LPS already exists. Where an LPS exists, refer to clause 9.2.2.

If the installation is not covered in clause 7.1.1 or the structure is not covered by the generic risk assessments of clause 7.1.2, the risk of loss of life (R_1) should be calculated in accordance with [IEC 62305-2].

When $R_1 \leq R_{T1}$, lightning protection against loss of life is not required. In this case, protection is only required against mains contact, see clause 8.2.

When $R_1 > R_{T1}$ the methods of protection should be as determined in clauses 8 and 9.

These situations are also shown in Figure 2.

7.2 Antenna installed near the building

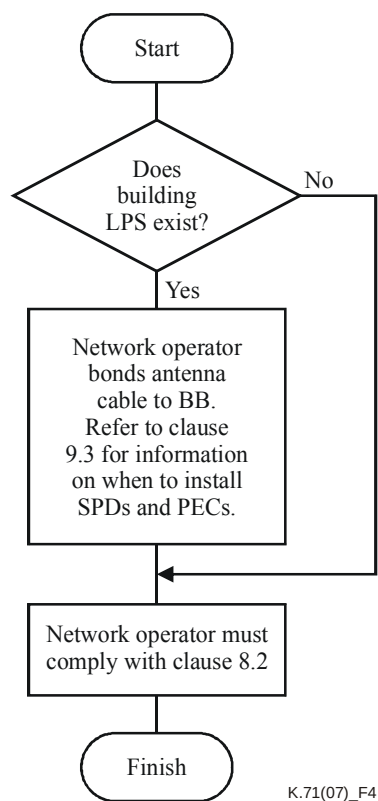


Figure 4 – Process for an antenna on a separate tower

If the structure is not covered by the generic risk assessments of clause 7.1.2, the risk of loss of life (R_1) should be calculated in accordance with [IEC 62305-2]. The individual risk assessment should be evaluated referring to the building, because the antenna mast is considered separate from the building installation.

When $R_1 \leq R_{T1}$, lightning protection against loss of life is not required and only protection against contact with the mains is required, see clause 8.2.

When $R_1 > R_{T1}$, an LPS on the building could be required to achieve the required protection level ($R_1 \leq R_{T1}$), see clause 8. In this case, the method of protection is given in clauses 8 and 9. An example of this risk evaluation is reported in Appendix III.

To determine the need for protection against direct strikes to the antenna mast, refer to [ITU-T K.56] where some protection measures are also given.

8 Methods of protection

8.1 General

The type of the protection measure depends on which risk components need to be reduced.

If the risk component R_B (related to physical damage caused by dangerous sparking inside the building due to flashes to the structure) is the major contributor, an LPS on the building could be required to achieve the required protection level ($R_1 \leq R_{T1}$).

If the risk components R_U (related to injury to living beings caused by touch voltage inside the structure due to flashes to the service) and R_V (related to physical damage caused by dangerous

sparkling inside the building due to flashes to the service) are the major contributors, SPDs and equipotential bonding could be enough to achieve the required protection level.

8.2 Contact with the mains

Contact with an aerial power service lead can cause serious problems, e.g., a fire due to overheating or electric shock. Protection can be provided by earthing or by providing adequate isolation.

8.2.1 Earthing

A 4.0 mm², or greater, bonding conductor from the antenna, or from the coaxial cable outer, to the building earthing system shall be installed to protect against contact with mains power (to activate protection fuses and remove the mains power).

8.2.2 Isolation

Measures may include:

- Maintaining suitable clearance distances of the antenna installation (and lead-in cable) from overhead service lines. A >3 m horizontal clearance would be considered conservative. Additional spacing may be required to ensure safety of personnel during the installation or if the antenna is attached to a long arm. The antenna lead in-cable should not cross over or under overhead mains power service lines.
- Ensuring that there are no live conductors associated with the electrical installation within the vicinity of the proposed antenna location (e.g., within 3 m). This may need to involve suitable inspection and testing as part of the installation procedure.

Where it is not possible to maintain adequate isolation, the installation should be earthed, see clause 8.2.1.

8.3 Direct lightning strike protection

The installation of the lightning protection system (LPS) against direct lightning strike is a complex subject and reference should be made to [IEC 62305-3] or to a national standard. Some information taken from this IEC standard is reported in Appendix I.

The requirements for bonding of the antenna system to, or insulating from, an LPS are described in clause 9.2.2.

9 Protection requirements

9.1 General

All parts of the outer antenna system shall be so designed that they will withstand a lightning discharge without danger of fire or separation of the components of the antenna system.

Antennas shall not be installed on buildings having roofs covered with highly flammable materials (for example, thatch, reed-like material, etc.).

Antenna cables and earthing conductors shall not be laid in areas used for the storage of easily ignitable materials, such as hay, straw and similar substances, or in areas in which explosive gases can develop or collect.

An antenna installation may need to be protected against mains contact and lightning discharges. As a minimum, the following applies to all sites:

- The associated equipment shall comply with the safety requirements of [IEC 60950-1].