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Level 2

Radio Mast Lightning Protection and Earthing System

Endorsement and Authorisation

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Issue record

Issue	Date	Comments
Issue 1	June 2003	
Issue 2	April 2005	This standard has been updated to include for the use of rebar, screw piles, earth nails and other structural metalwork to be used as part of the earth system. The other change has been to allow for a risk assessment to be undertaken for inclusion of a lightning finial.
Issue 3	August 2008	Standard significantly rewritten and installation
Issue 4	March 2010	Updated to reflect Engineering reorganisation diagrams added

Reference documentation

NR/L2/TEL/30066, *Signalling and Telecommunications technical clearance for antennae systems*

NR/L3/TEL/31103, *Energisation of commercial and operational radio antenna systems*

NR/SP/ELP/21085, *Specification for design of earthing & bonding systems for 25Kv AC electrical lines*

BS 6651, *Code of practice for protection of structures against lightning*

BS 7430, *Code of practice for earthing*

BS EN 50164, *Lightning protection components (LPC)*

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors if applicable from 6 March 2010.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 4 to continue to comply with the Issue of any relevant Network Rail Standards current when GRIP Stage 4 was reached and not to comply with requirements contained herein, unless the designated Standard Owner has stipulated otherwise in the accompanying Briefing Note.

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1 Purpose

This standard details the design requirements for a lightning protection and earthing system (LP&ES) for permanent radio mast or tower structures located on Network Rail land, property or TOC leased land to minimise the risk to personnel and equipment.

2 Scope

This standard shall be used by project managers, system designers (both tower and earth designers), implementation engineers and others involved in the design and implementation of radio tower lightning protection and earthing systems.

This standard does not cover installation, testing or maintenance requirements.

3 Roles and Responsibilities

Responsibilities for meeting the requirements of this standard shall be clearly defined at the commencement of any project. As a minimum, the responsibilities for the following activities shall be defined:

- Network Rail point of contact with authority to approve designs, documents and completed infrastructure
- Site survey
- Design
- Construction
- Verification

4 Definitions

AC

Alternating current

Bond

A conductor intended to provide equipotential bonding between the lightning protection system and other metalwork and between other earth systems.

DC

Direct current

Down conductor

A conductor that connects a finial with an earth electrode.

DNO

Distribution network operator

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Earth electrode

Conductor or group of conductors in intimate contact with, and providing an electrical connection to Earth.

Earth mesh

A mesh installed beneath the blinding layer or concrete (of the radio tower or associated base) connected to the earth electrodes and to the tower legs.

Earth system

A part of the lightning protection system which is intended to discharge lightning currents into the general mass of earth.

Equipotential bonding

Electrical connection maintaining various conductors at substantially the same potential.

Finial

A part of a lightning protection system that is intended to intercept the lightning discharge. This is also known as an air termination.

LP&ES

Lightning protection and earthing system

Lightning protection system

Whole system of conductors used to protect a structure from the effects of lightning.

Lightning Strike

A stroke of a lightning flash attaching to a structure/earth mass.

Mast

Structure supported with guys used to support radio antennas. In this standard, "tower" is used as a generic term to cover both towers and masts.

REB

Relocatable equipment building

Rebar

Reinforcing metal bars cast within concrete to provide strength to foundations.

Ring earth electrode

An uninsulated earth electrode forming a closed loop around the structure installed below the surface of the earth, or within or under the foundations, connected to the tower legs.

SFARP

So far as reasonably practical

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Tower

Self-supporting structure for supporting radio antennas. In this standard, “tower” is used as a generic term to cover both towers and masts.

Zone of Protection

Volume within which a lightning conductor gives protection against a direct lightning strike by directing the strike to itself.

5 Risk Assessment of Lightning Attachment

According to the risk assessment method of lightning attachment provided in **10.2** of BS 6651, a 30 m tower in the UK has a collection area, A_c , of

$$A_c = LW + 2LH + 2WH + \pi H^2$$

Eqn 1

As the length, L , and width, W , of a tower are significantly smaller than the height, H , this reduces to:

$$A_c \approx \pi H^2$$

Eqn 2

For a 30 m tower, the collection area is about 2800 m².

The probable number of strikes to the structure per year, p , is

$$p = A_c N_g \times 10^{-6}$$

Eqn 3

where N_g is the number of lightning strikes to ground per square kilometre per year. In the UK, N_g is a maximum of 1 strike per km per year, hence p is approximately 2.8×10^{-3} or once every 350 years.

In some cases the towers may be completely isolated and an additional weighting factor of 2 is applicable, increasing the frequency of direct strikes to once in 175 years. Although direct lightning attachments are rare, there is a requirement to reduce such risks so far as is reasonably practical (SFARP). Furthermore, protecting the tower from a direct strike also protects it from coupled lightning effects, such as radiated transients and ground potential rises due to lightning strikes nearby.

Through a careful approach to the design, it is possible to provide a high level of protection without significantly increasing the cost of the installation.

6 Fundamental Requirements

Radio towers and ancillary systems shall be protected from direct lightning strikes up to 100 kA. The fundamental requirements for the design of the lightning and earthing protection systems are: