



Engineering Recommendation G78

Issue 4 2018

Recommendations for low voltage supplies to mobile phone base stations with antennae on high voltage structures

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First published, January, 2003.

Amendments since publication

Issue	Date	Amendment
Issue 1	May, 2005	New methods introduced for providing supply to the installation: a) Local generation; b) LV connection via a motor-generator set; c) HV connection from a cable network
Issue 2	April, 2006	A further connection arrangement added utilising an LV isolation transformer.
Issue 3	February, 2012	Minor revision of Issue 2. This issue includes the following principal technical changes. Section 3.2.1: Rewording of main text to align with Figure 3.2.1. Section 3.3.3: Note 1 updated regarding lightning impulse withstand capability of DNO LV connection. Sections 3.3.3.1 & 3.3.3.2: Incorrect reference to surge arrester SA2 corrected to SA5. Additional explanatory text concerning provision of MCB/RCD. Section 3.3.4.1: Added requirement for supply to MPBS to be terminated in an insulated cut-out. Section 4.1: Additional guidance provided on adverse weather conditions.
Issue 4	February, 2018	Minor revision of Issue 3. This issue includes the following principal technical changes. Foreword: Wording added to cover also the situation of an ROP due to an HV fault on the DNO HV system.

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	<p>Clause 4.1.1: Wording added to include also the situation of an ROP due to an HV fault on the DNO HV system.</p> <p>Clause 4.1.1.4: New Clause stating that the permissible step and touch voltages for typical fault clearance times in ENA TS 41-24 are to be used as the limits for assessing danger due to ROP at a MBPS site.</p> <p>Clause 4.1.3: Requirements added (i) that HV structure owner to provide information on the ROP and the voltage contours to allow the MPBS and the incoming DNO supply design to proceed and (ii) in cases, where the ROP from incoming DNO supply may exceed the permissible limits for step and touch potential in the area of the MPBS installation, the information to be provided to the owners of the MPBS.</p> <p>Clause 4.1.5: Requirement added that prior to access or work in proximity to MPBS antennae, the antenna to be isolated. Recommendation added that anyone working on or accessing structures in proximity to antennae to wear a portable personal EMF meter.</p> <p>Clause 4.1.7, Item (g): Note added that the wearing of Class 2 gloves is not reasonably practicable when climbing or accessing structures with antennae systems fitted.</p> <p>Clause 4.2.1:</p> <p>(i) 2nd Para: Requirement added that where a DNO HV supply arrangement is to be used, the owner of the HV structure is to provide information to the DNO on the actual tower footing impedance to allow the design of the incoming DNO HV supply to proceed.</p> <p>(ii) List item a): Exothermic welded added to list of acceptable connection methods. Wording added to preclude use of bolted connections below ground, unless agreed by all parties.</p> <p>(iii) List item b): Note added that at sites vulnerable to theft, the electrode may be buried at a deeper depth subject to a site-specific earthing study being carried out to confirm step and touch potentials are controlled.</p> <p>(iv) List item c): Footnote added giving guidance when proposing to use galvanized steel, for the earth mat.</p> <p>(v) New list item g): Requirement added that any communication service to the MPBS should not introduce a conducting path away from the site.</p> <p>Clause 4.2.2:</p> <p>(i) New list item c): Requirement added that any communication service to the MPBS should not introduce a conducting path away from the site.</p> <p>Clause 4.3.4.1: HV Overhead Line Arrangement</p> <p>(i) 2nd & 4th para: Reference to “650 V contour” replaced by “ROP permissible threshold contour (see Clause 4.1.1.4)”.</p> <p>(ii) 3rd para: Requirement “...stay wire insulators suitable for use on a 33 kV system” replaced by “...stay wire insulators with a 50Hz ac withstand in excess of the HV Structure ROP”. Guidance added that care required with the positioning of stay wires relative to equipment/conductive parts which are bonded either directly or indirectly to the HV Structure. The stay to be effectively separated by 2 m from such equipment.</p> <p>New Clause 6.1.3: Communication service cables. Clause added to include requirements for appropriate procedures for work on communication cables which may serve the MPBS.</p> <p>Clause A.1.2 and Clause B.1.2: Reference to “650 V contour” replaced by “ROP permissible threshold contour (see Clause 4.1.1.4)”.</p> <p>Clause B.1.4: Guidance expanded to clarify that the preferred arrangement is for the pad-mounted transformer to be installed on the</p>
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		<p>LED associated with the MPBS with an alternative arrangement allowed where the pad-mounted transformer is installed on an insulated base.</p> <p>Clause B.2.1: Guidance added that the LED design makes use of the permitted step and touch potentials in Table B2.1b and these values have been superseded by ENA TS 41-24 [N5]. This may invalidate the LED design given in this document but it is recommended that a site-specific earthing study is carried out.</p> <p>Details of all general and editorial amendments are included in the associated Document Amendment Summary for this Issue (available on request from the Operations Directorate of ENA).</p>
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Foreword

This Engineering Recommendation (EREC) is published by the Energy Networks Association (ENA) and comes into effect from the date of publication. It has been prepared under the authority of the ENA Engineering Policy and Standards Manager and has been approved for publication by the ENA Electricity Networks and Futures Group (ENFG). The approved abbreviated title of this engineering document is “EREC G78”.

This document replaces and supersedes ENA EREC G78 Issue 3 2012.

The expansion of the mobile phone network within the UK has led to an increase in the number of Mobile Phone Base Stations (MPBSs). HV Structures used by Transmission and Distribution Network Operators for supporting overhead lines can, in some cases, provide a suitable platform for mounting mobile phone antennae.

Power lines are occasionally affected by lightning strikes, causing conductors, earth wires and/or supporting structures and the surrounding ground to rise in potential. Lightning strikes and other adverse weather conditions can in some cases cause insulators to flash over. If this occurs, power frequency fault current will flow through the earthed metalwork to ground, again causing the local ground to rise in potential. The fault may either be located on the line the HV Structure is supporting or on a DNO HV supply to the MPBS. The result of the fault current is a Rise of Potential (ROP) between the general mass of earth and locally earthed equipment and/or the local ground/soil.

The MPBS installation and its electricity supply shall be designed, as far as reasonably practicable, to withstand ROP due to lightning strikes and power system faults and to minimise any risk to Personnel and the public.

The purpose of this document is to provide recommendations for the design of LV connections to MPBSs, whose antennae are supported by HV Structures. These recommendations mitigate, as far as reasonably practicable, the risks caused by ROP. Some mitigation is necessary within the MPBS itself and so the recommendations also apply to some aspects of the MPBS design.

Where the term “shall” or “must” is used in this document it means the requirement is mandatory. The term “should” is used to express a recommendation. The term “may” is used to express permission.

NOTE: Commentary, explanation and general informative material is presented in smaller type, and does not constitute a normative element.

Introduction

This Engineering Recommendation provides guidance on the provision of LV connections to Mobile Phone Base Stations (MPBSs). A number of possible LV power supply arrangements are listed, some of which require a connection to the DNO's network. The main part of the document specifies generic requirements whilst detailed requirements for three of the possible arrangements are included in the Annexes.

The following "whole life cycle" aspects have been considered in these recommendations.

- a) Earthing requirements.
- b) Construction, access and egress of Personnel, operation, maintenance and decommissioning requirements.
- c) Safety – Personnel, public and third parties.
- d) Equipment specifications.
- e) Requirements for the DNO's electrical connection.

Following the first issue of EREC G78 in January 2003, new connection arrangements were added in Issues 1 and 2. Minor technical amendments were made in Issue 3. This latest issue brings the content up to date but the technical intent and guidance remain unchanged.

1 Scope

This Engineering Recommendation provides guidance on the provision of LV connections to MPBSs where their rigging and antennae are supported by HV Structures operating at voltages up to 400 kV.

2 Normative references

The following referenced documents, in whole or part, are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standards publications

BS EN ISO 20345, *Personal protective equipment. Safety footwear*

BS EN 60099-4, *Surge arresters. Metal-oxide surge arresters without gaps for a.c. systems*

BS EN 60903, *Specification for gloves and mitts of insulating material for live working*

BS EN 62305, *Protection against lightning*

BS 7430, *Code of practice for earthing*

BS 7671, *Requirements for electrical installations. IET Wiring Regulations*

BS 7870-4, *LV and MV polymeric insulated cables for use by distribution and generation utilities. Specification for distribution cables with extruded insulation for rated voltages of 11 kV and 33 kV*

ANSI ASTM F1117-03 (2013), *Standard Specification for Dielectric Footwear*

Other publications

[N1] ENA TS 43-8, *Overhead line clearances*

[N2] Health and Safety Executive GS6: *Avoidance of danger from overhead electric power lines*

[N3] Health and Safety Executive HS (G) 47: *Avoiding danger from underground services*

[N4] The Management of Health and Safety at Work Regulations 1999

[N5] ENA TS 41-24 Issue 2: 2017, *Guidelines for the design, installation, testing and maintenance of main earthing systems in substations*

[N6] ENA ER P28, *Planning limits for voltage fluctuations caused by industrial, commercial and domestic equipment in the United Kingdom*

[N7] ENA TS 35-1, *Distribution transformers*
Part 1, *Common clauses*
Part 2, *Ground mounted transformers – not close coupled*
Part 3, *Ground mounted transformers –close coupled*

Part 4, *Pole mounted transformers*

[N8] The Construction (Design and Management) Regulations 2015

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

Circuit Main Earth (CME)

earthing equipment of approved type applied before the issue of, and at a position recorded in, a safety document

3.2

Distribution Network Operator (DNO)

holder of a distribution licence

3.3

High Voltage (HV)

a voltage exceeding LV

3.4

HV Structure

steel lattice tower or other metal structure used for supporting an overhead line operating at HV

3.5

Insulated Base Design (IBD)

earthing design as described in Annex A of this document

3.6

Low Voltage (LV)

a voltage exceeding 50 V a.c. but not exceeding 1000 V a.c. or a voltage exceeding 120 V d.c. but not exceeding 1500 V d.c.

3.7

Mobile Phone Base Station (MPBS)

installation owned or operated by a mobile phone operating company for the purpose of transmitting and/or receiving mobile phone communication signals