ENGINEERING DESIGN STANDARD

EDS 08-2109

LV SUPPLIES TO MOBILE PHONE BASE STATIONS MOUNTED ON TRANSMISSION TOWERS

Network(s): EPN, LPN, SPN

Summary: This standard provides guidance on the installation of LV supplies for mobile phone base stations associated with antennae mounted on 132, 275 and 400kV transmission towers.

Author: Stephen Cuddihey Date: 04/09/2017

Approver: Paul Williams Date: 09/10/2017

This document forms part of the Company’s Integrated Business System and its requirements are mandatory throughout UK Power Networks. Departure from these requirements may only be taken with the written approval of the Director of Asset Management. If you have any queries about this document please contact the author or owner of the current issue.

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☐ Procurement
☐ Strategy & Regulation
☒ Technical Training

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☒ G81 Website
☐ UK Power Networks Services
☒ Contractors
☒ ICPs/IDNOs
☐ Meter Operators
**Revision Record**

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**Reason for update:** Periodic review, review of LV document numbering and new draft of G78 to be released.

**What has changed:** Document number changed from EDS 08-0030, no changes required from G78 review.

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No major changes; compliance with ENA ER G78 confirmed and layout revised.

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1 Introduction

This standard provides guidance on the installation of LV supplies for mobile phone base stations associated with antennae mounted on 132, 275 and 400kV transmission towers. A safe system for the provision of such installations has been determined by the Energy Networks Association (ENA) and is detailed in ENA ER G78.

Mobile phone installations require a low voltage supply; however when the antennae are mounted on high voltage structures safety issues can arise. Lightning strikes and power frequency events such as power system faults can cause the conductor, earth wires and/or supporting structure to rise in potential. The mobile phone installation shall be designed, as far as is reasonably practicable, to withstand the earth potential rise for both lightning impulse and power frequency events in order to minimise any risk to personnel and the public.

The standard applies the principles of ENA ER G78 for UK Power Networks and includes:

- Arrangements for supplies fed from an overhead line.
- Arrangements for supplies fed directly from the LV network.
- Standard designs for supplies for mobile phone base stations.
- Responsibilities within UK Power Networks.

2 Scope

This standard applies to the provision of LV supplies of LV supplies for mobile phone base stations associated with antennae mounted on 132, 275 and 400kV transmission towers in EPN, LPN and SPN.

3 Abbreviation and Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>BIL</td>
<td>Breakdown Impulse Level</td>
</tr>
<tr>
<td>CDM</td>
<td>Construction Design and Management Regulations 2007</td>
</tr>
<tr>
<td>ENA TS</td>
<td>Energy Networks Association Technical Specification</td>
</tr>
<tr>
<td>EPR</td>
<td>Earth Potential Rise</td>
</tr>
<tr>
<td>HV</td>
<td>High Voltage (above 1000V)</td>
</tr>
<tr>
<td>IBD</td>
<td>Insulated Base Design</td>
</tr>
<tr>
<td>LV</td>
<td>Low Voltage (below 1000V)</td>
</tr>
<tr>
<td>MPBS</td>
<td>Mobile Phone Base Station</td>
</tr>
<tr>
<td>NGC</td>
<td>National Grid Company</td>
</tr>
<tr>
<td>OHL</td>
<td>Overhead Line</td>
</tr>
<tr>
<td>ROEP</td>
<td>Rise of Earth Potential</td>
</tr>
<tr>
<td>UK Power Networks</td>
<td>UK Power Networks (Operations) Ltd consists of three electricity distribution networks:</td>
</tr>
<tr>
<td></td>
<td>• Eastern Power Networks plc (EPN).</td>
</tr>
<tr>
<td></td>
<td>• London Power Network plc (LPN).</td>
</tr>
<tr>
<td></td>
<td>• South Eastern Power Networks plc (SPN).</td>
</tr>
</tbody>
</table>
4 Design Requirements

4.1 General

The design of the supply installation shall meet the requirements of ENA ER G78, specifically those detailed in Annex A for the Insulated Base Design (IBD).

To prevent the danger that may occur from a rise of earth potential, the installation shall be protected in line with Section 4.1 ‘Identification and Control of Hazards’ in ENA ER G78. Specific attention shall be given to the assessment of step, touch and transfer potentials and where required the appropriate measures detailed in Section 5 ‘Construction’ of ENA ER G78 shall be applied.

The construction of each site shall be subject to CDM Regulations. When sites are decommissioned, the CDM regulations shall again apply, with particular attention to the removal of earth conductors or cables, and to the decommissioning of the cables. See Section 8 ‘Decommissioning’ of ENA ER G78 for further details.

The design shall be approved by Connections.

4.2 Load

The equipment shall supply a maximum load of 100kVA via three independent three-phase 100A services.

4.3 Site Assessment

When approached by a mobile phone operator for the provision of supplies to a base station, UK Power Networks shall:

- Obtain the ROEP value and a plot of the HOT zone from NGC.
- Perform a site risk assessment.

The site shall be assessed against ENA ER G78 and the requirement of this standard to determine if the proposed connection can be provided, and is practicable for installation and future maintenance. The site risk assessment shall be completed in accordance with HSS 01 062 and the appropriate generic design identified.

The assessment shall take into account:

- Access for maintenance.
- Local conditions and risk of third party interference.
- Clearances from associated exposed conductors.
- Existing network availability and current load levels.

The mounting of MPBS antennae introduces a number of hazards

- ROEP caused by lightning strikes and power system faults.
- Proximity of live conductors.
- Proximity of the mobile phone antennae.

The design of the installation shall minimise the hazards as far as is reasonably practicable, and/or additional measures shall be put in place to control such hazards (e.g. fencing around the MPBS).
4.4 Supply Options

The UK Power Networks standard supply solution shown in Figure 4-1 should be used for all MPBS mounted on transmission towers.

UK Power Networks preferred option is to provide an LV supply via a pole-mounted transformer supplied from either an HV overhead line or HV underground cable. In both cases the final connection between the transformer and the 11kV network shall be via at least one span of overhead line. The underground cable option is shown in Figure 4-2 and Figure 4-3. The overhead line option is shown in Figure 4-4 and Figure 4-5.

ENA ER G78 also allows supplies to be derived from the local LV network feeding a motor-alternator set mounted on the MPBS. The supplier shall provide proof that the motor-alternator complies with the technical requirements of ENA ER G78.

Most services will be in rural locations and wherever possible the use of overhead lines throughout the system shall be preferred to reduce costs of installation. Where it is not possible to obtain wayleaves, the use of long LV cable within the constraints of voltage drop shall be used to connect the LV supply from the transformer to the services.

The LV connection shall only supply the MPBSs associated with the specific tower. No other supplies shall be connected to the transformer or to the HV overhead line on the span or spans between the SA3 surge arrester and the pole-mounted transformer.

Figure 4-1 - UK Power Networks Standard Supply Solution
The installation above provides guidance for the connection of the HV supply to the existing network.

The energisation of surge arresters from the pole where they are installed is not allowed due to the risk of failure of the unit.

Due to the size of the area affected by ROEP, intermediate poles may be required between the pole mounted transformer and the SA3 surge arrester.

Figure 4-3 – Guidance on Installing Equipment Supplies from Underground Networks
LV Supplies to Mobile Phone Base Stations Mounted on Transmission Towers

The installation above provides guidance for the connection of the HV supply to the existing network.

The energisation of surge arresters from the pole where they are installed is not allowed due to the risk of failure of the unit.

Due to the size of the area affected by the ROEP, intermediate poles may be required between the pole mounted transformer and the SA3 surge arrester.

Figure 4-4 – Insulated Base Design Supplied from an HV Overhead line

Figure 4-5 – Guidance on Installing Equipment Supplies from Existing Overhead Line Networks
4.5 Wayleave and Planning Consent

The standard procedure shall be used to obtain the necessary landowner and statutory consents in order to satisfy property and planning legislation.

However, if the tower is owned by UK Power Networks, use of the structure by a Mobile Phone Operator shall be by formal completion of an asset usage agreement arranged by UK Power Networks.

For the purpose of connecting a mobile telephone customer, it may be assumed that the supply can be treated as a single service line, unless two or more customers have made applications for supply. In the event that after the installation for a single customer, an additional request for supply from a second customer is received, then the relevant retrospective planning consents shall be obtained.
5 Installation Requirements

5.1 HV Option

The following requirements are derived from ENA ER G78 and provide additional guidance for implementing the standard supply solution from an HV underground cable or HV overhead line.

- The connection to the existing overhead line shall normally be made using live line taps.
- Surge arresters SA2 and SA3 shown in Figure 4-1 shall be installed at all sites. The surge arrester SA2 shall be specified to the ROEP declared by NGC. SA3 is a standard stock item unit.
- The pole supporting the SA3 surge arrester and the 100kVA pole mounted transformer shall be placed outside the zone of ROEP and be a minimum distance of 10m from the 100kVA pole mounted transformer. Sites where the ROEP is greater than 21kV shall use a transformer with an Impulse level of 125kV.
- The 11kV connection to the existing network shall not be energised from the pole containing the SA3 surge arrester.
- The LV supply shall be protected by a standard pole-mounted cut-out.
- The Sicame underground distribution box (which has been modified to allow four insulated service ducts to be heat fused to it) shall be installed centrally under the tower.
- A 95mm² waveform cable shall be installed in an insulated duct between the pole and underground the distribution box.
- A 35mm² three-phase cable shall be installed in an insulated duct between the distribution box and the tower. A maximum of three services may be provided from each distribution box.
- A 70mm² earth cable shall be installed in an insulated duct between the pole and the tower.
- All of the cables shall be pre-installed in the insulated duct. Standard Rigid Duct shall not be used.
- The insulated duct runs for the supply and earth cables shall be continuous and shall be terminated above the anti-climb guards on the pole.
- The insulated duct for the service cable to the base station shall be continuous and shall terminate within the cut-out enclosure.
- The insulated duct containing the earth cable shall not be connected to the tower by UK Power Networks staff or their contractors. The duct and earth cable should be left sufficiently long to allow NGC to terminate the earth cable to their nominated earth connection.

5.2 LV Option

The LV cable shall extend to the local network used to supply the MPBS and shall be installed in an insulated duct from the point of connection to the MPBS – refer to ENA ER G78 Section 4.3.3 ‘DNO LV Connection’.

5.3 Equipment and Materials

All electrical equipment shall meet the materials and equipment requirements ENA ER G78. All equipment and materials shall be approved by UK Power Networks Asset Management.

Unless otherwise stated standard overhead line and underground equipment and materials shall be used in the installation. Table 5-1 details the specific non-standard items required to comply with the requirements of ENA ER G78.
Table 5-1 – Equipment and Materials

<table>
<thead>
<tr>
<th>Description</th>
<th>ROEP &lt; 10kV Equipment</th>
<th>ROEP &lt; 21kV Equipment</th>
<th>ROEP &lt; 29kV Equipment</th>
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<tbody>
<tr>
<td>Surge Arresters SA2</td>
<td>Standard</td>
<td>Raychem HAD - 20N</td>
<td>Raychem HDA - 26N</td>
</tr>
<tr>
<td>Surge Arresters SA3</td>
<td>Standard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Cable for SA2/SA3</td>
<td>70mm² PVC Covered Copper Cable (Material Code: 05865J)</td>
<td></td>
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</tr>
<tr>
<td>Pole Transformer</td>
<td>Standard 95kV BIL</td>
<td>Standard 95kV BIL</td>
<td>Special order 125kV BIL</td>
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<tr>
<td>Underground Distribution Box</td>
<td>Sicame G78-1 Phone Mast 12 way Unit (LVD12S-F) (Material code: 02503B)</td>
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<tr>
<td>CNE Cable Duct</td>
<td>Emtelle 95mm² CNE Waveform Cable in 63/50mm² Duct (Material code: 25441A)</td>
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<tr>
<td>Service Cable Duct</td>
<td>Emtelle 35mm² CNE Service Cable in 50/40mm² Duct (Material code: 25440Q)</td>
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<tr>
<td>Earth Cable in Duct</td>
<td>Emtelle 70mm² Earth Cable in 50/40mm² Duct (Material code: 25442K)</td>
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5.4 Warning Labels

The warning labels detailed in Table 5-2 shall be applied to the installation where applicable. All warning labels shall have black writing on a yellow background and comply with EDS 07-0009.

Table 5-2 – Warning Labels

<table>
<thead>
<tr>
<th>Label Location</th>
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<th>ROEP &lt; 21kV Equipment</th>
<th>ROEP &lt; 29kV Equipment</th>
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<tbody>
<tr>
<td>On pole adjacent to transformer</td>
<td>n/a</td>
<td>n/a</td>
<td>125kV high impulse transformer - do not replace with standard unit</td>
</tr>
<tr>
<td>On pole</td>
<td>n/a</td>
<td>Non-standard surge arrester replace with Raychem HAD - 20N</td>
<td>Non-standard surge arrester replace with Raychem HDA - 26N</td>
</tr>
<tr>
<td>Underground distribution box</td>
<td><strong>Internal components subject to rise in potential. Contact Network Control before opening</strong></td>
<td><strong>Internal components subject to rise in potential. Contact Network Control before opening</strong></td>
<td><strong>Internal components subject to rise in potential. Contact Network Control before opening</strong></td>
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5.5 Testing and Commissioning

The standard test regime for the installation of overhead lines, HV and LV cables and HV and LV equipment shall be applied in accordance with the UK Power Networks commissioning standards. As a minimum the tests shall include:

- 5000V insulation resistance tests for HV equipment.
- HV pressure tests for HV cables.
- 500V insulation resistance tests for LV cable and equipment.
- Earth resistance test for local earth pins.
- Any other special test requirements recommended by ENA ER G78 or the equipment manufacturer.

6 Commercial Requirements

6.1 Connection Agreement

The supply shall be subject to specific connection agreement.

The connection agreement shall include a site responsibility schedule that defines the ownership, maintenance, operation and control responsibilities.

Inspection and maintenance of the MPBS equipment and associated earthing connections and other cabling shall be the responsibility of the Mobile Phone Operator unless otherwise agreed and detailed in the connection agreement.

Inspection and maintenance of the overhead line equipment shall be the responsibility of the UK Power Networks.

The responsibility for security and control of access to the MPBS and compound shall normally rest with the Mobile Phone Operator and/or the site owner. However, shared locking arrangements shall be provided to allow access to the UK Power Networks, Supplier and Meter Operator as required. Details of the shared access arrangements and the responsibility to control access shall be detailed in the connection agreement. Such arrangements shall also detail contact names, telephone numbers and the reporting requirements before entering a MPBS site.

6.2 Installer Responsibilities

The installer is responsible for the provision of competent staff to complete both the HV and LV installation from the HV supply up to and including the mounting of the cut-out on the insulated base.

The Installer shall:

- Liaise with the mobile phone operator owning the insulated base to co-ordinate the installation of the LV supply to the insulated base.
- Liaise with tower owner to co-ordinate the installation of the earth connection to the tower.
- Ensure that only approved materials and subcontractors are used.
7 Operational Requirements

7.1 Training

All UK Power Networks staff entering the MPBS enclosure shall be competent for this purpose and have received appropriate training. Staff shall be made aware of the requirements of ENA ER G78 Section 6 ‘Operational Requirements’ and Section 7 ‘Maintenance and Inspection’, the Distribution Safety Rules and codes of practice applicable to work on the insulated platform.

7.2 Site Access

Before any MPBS site may be entered to operate the equipment or to undertake inspection and maintenance work, the following criteria shall be satisfied:

1. Confirm acceptable weather conditions are prevailing.
2. Obtain any necessary authorisations to access site.
3. Ensure that staff are familiar with site safety rules and working procedures and have the appropriate competency level.
4. Ensure that staff have received adequate training has been received.
5. Where work exceeds the day-to-day operation and maintenance requirements complete a risk assessment.
6. Ensure that the insulated platform has been correctly maintained (undertake a visual inspection and refer to the platform owner’s maintenance records).

8 References

EDS 07-0021  Signs and Labels for Operational Sites.doc
HSS 01 062   Undertaking On-site (Point of Work) Assessment
ENA ER G78   Energy Network Association Engineering Recommendations for Low Voltage Connections to Mobile Telephone Base Stations with Antennae on High Voltage Structures